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A Functional Analysis of Yadkin Bifaces in the Middle Savannah River Valley

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A FUNCTIONAL ANALYSIS OF YADKIN BIFACES IN THE MIDDLE SAVANNAH RIVER VALLEY

by

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DEDICATION

For Gabriel, without your endless optimism and encouragement this would not have been possible.

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ABSTRACT

The Woodland period was a time of changing settlement patterns, social structure, and technology. Increasing sedentism and social complexity begin during this period in the Savannah River valley and triangular bifaces enter the technological repertoire for the first time in the form of Yadkin bifaces. Yadkins are found exclusively in Middle Woodland contexts suggesting they played an important role in the changes occurring during this time. This thesis establishes the presence of the bow and arrow during the Middle Woodland period through a functional analysis of Yadkin and Eared Yadkin bifaces from South Carolina. This analysis shows that the evolutionary approaches used to explain the relationship between social complexity and the bow and arrow are inadequate for the Savannah River valley and other perspectives must be employed.

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CHAPTER ONE

INTRODUCTION

The Woodland Period (2450-1450 B.P.) in the Eastern United States is a time of enormous social, political, and economic change reflected in shifts toward larger, more sedentary occupations, long distance trade and interaction, and new technologies. The arrival and increasing importance of the bow and arrow is thought to be an integral part of this suite of changes, bringing about a more efficient projectile technology that likely enhanced subsistence strategies while also intensifying warfare and the consequent rearrangement of social and political structures. Although the presence of the bow and arrow is often implied by a reduction in the size of projectiles and the appearance of triangular, stemless projectile points, this pattern on its own is not sufficient evidence for the presence of bow and arrow technology. The primary goal of this thesis is to establish the presence of the bow and arrow during a time of increasing sedentism and social complexity in the Middle Woodland period (2450 B.P.-1450 B.P.) through a functional analysis of Yadkin and Eared Yadkin bifaces from the Middle Savannah River valley in Coastal Plain South Carolina.

Because the Woodland period was a time of transition from mobile hunter-gatherers to more sedentary villages, I begin this chapter with a discussion of hunter-gather sedentism and social complexity. Next I discuss the archaeological, ethnohistoric, and ethnographic background of the bow and arrow. Finally, the data and analytical methods that are used to determine the timing of the arrival of the bow and arrow are introduced.

Intensification, Sedentism, and Social Complexity

During the Woodland period, a shift in settlement patterns from mobile hunter-gatherer camps to relatively permanent or semi permanent villages is well documented in the archaeological record (Anderson and Mainfort 2002; Parry and Kelly 1987). Correlated with the rise in sedentism is a rise in social complexity among hunter-gatherers (Kelly 1992; Price and Brown 1985). Hunter-gatherer social complexity is defined by archaeologists in various ways (Arnold 1996; Barnard 1983; Price and Brown 1985; Sassaman 2004; Woodburn 1988; Morgan 2015). According to Arnold (1996), a distinguishing feature of complexity is the need for a leader to have control over social and labor relationships and includes hereditary social hierarchy. However, Price and Brown (1985:8) define social complexity as "increases in societal size, scale, and organization" and list three aspects of complexity: *causes, conditions,* and *consequences*.

The *causes* of social complexity among hunter gatherers is the subject of much debate among archaeologists. Some explanations include environmental causes and increasing population (Price and Brown 1985). The "settling down" process that is a result of population growth and involves increasing resource specialization is also offered as an explanation (Price and Brown 1985). Internal pressures to maintain alliances and meet social obligations may dictate the path of hunter-gatherer complexity. The cause of hunter-gatherer social complexity cannot be resolved by pointing to one factor and arguing that all things branch out from it; complexity is complex and it requires a multitude of conditions in order to form.

Price and Brown (1985) identify three common conditions that facilitate increased social complexity; territorial circumscription, abundant resources, and population growth. Abundant resources attract people to the area and make it possible for them to live well and increase the population. Population pressure puts stress on resources, which can reach a crisis if the area is territorially circumscribed and people have no way to expand. Under these circumstances authority figures who can make decisions on behalf of the whole community, allocate and manage resources, and mediate disputes become essential, as does a hierarchy of other people to support the decisions and carry out necessary protocols. Complex hunter-gatherers and small scale farmers rarely have centralized leadership that govern large populations. Rather, these small polities organize lineages that can lay claim to particular resources or geographical loci. The technological correlate of this process is intensification.

In its broadest sense, intensification is defined by increasing productivity (Price and Brown 1985; Morgan 2015). The consequences of intensification are shifts in productivity, settlement, and decision making. Changes in productivity are best observed archaeologically as changes in technology such as plant cultivation and food storage (Price and Brown 1985; Morgan 2015). Sedentism is also a consequential strategy of intensification and can be seen in the archaeological record as larger sites that are occupied for longer periods of time (Price and Brown 1985).

Plant cultivation, food storage, and intensified foraging activities are characteristics of a delayed rather than an immediate return system. In an immediate-return system, hunter-gathers reap the benefits of their subsistence activities soon after completing collection or foraging tasks (Barnard 1983). In a delayed-return system, hunter-gathers allows surplus resources to amass because tasks are specialized and are usually attributed to sedentary and semi sedentary populations (Barnard 1983). The building of fishing weirs and nets requires the manipulation and management of land and resources in order to obtain a surplus. Arnold (1996) argues that delayed-return systems lead to social complexity because the surplus requires the addition of a leader to the social structure in order to manage the excess resources.

Hunter-gatherer social complexity is the result of a relationship between myriad conditions and consequences including settlement patterns and intensification. In the next section, I introduce one result of technological intensification and the relationship it shares with sedentism and social complexity: the bow and arrow.

THE BOW AND ARROW

The bow and arrow had a major impact on life in the prehistoric Southeast once it replaced the atlatl and dart as the primary weapon (Blitz 1988; Hudson 1999; Milner 1999; Tomka 2013). I begin this section by introducing the mechanics of the bow and arrow, next I introduce the bow and arrow in the context of historic Native American life through the ethnohistoric and ethnographic record. Then, I discuss archaeological evidence for the bow and arrow in prehistory and the problems associated with identifying the emergence of the new technology. Finally, I discuss some of the technological and social changes that were likely the result of the appearance of the bow and arrow.

The Mechanics of the Bow and Arrow

The physics and stealth of the bow and arrow made it more advantageous in warfare, and equal to if not better at hunting small and medium sized game than the atlatl and dart. Hughes (1998) and Tomka (2013) found that the bow and arrow provided better velocity and penetrating power compared to the atlatl and dart and the thrusting or throwing spear. Hughes (1998:365) also found that the size of the stone tip on the weapon matters in two aspects of projectile technology: penetration and matching. In order to adequately penetrate prey, the stone tip must be as small as possible. She also found that even though an atlatl dart can be hafted onto an arrow shaft and vice versa, "the reduction in performance and possibility of breakage would prevent prehistoric hunters from manufacturing mismatched weaponry". Matching the stone tip to its weapon system indicates that each system has specific metric requirements that are important for distinguishing atlatl darts and arrow points in the archaeological record.

Ethnographic and Ethnohistoric Examples

The bow and arrow played an important role in the lives of Southeastern peoples. The De Soto chroniclers provide valuable insights into how the bow and arrow was entangled in the lives of the peoples of the Southeast. Hernando de Soto, his army, horses, and servants and slaves left Havana for Florida on May 18, 1539 and spent the next four years travelling through the southeast (Hudson 1976; Clayton et al. 1993: Vol I). The several chroniclers of this expedition speak on numerous occasions of the skill and care with which the indigenous peoples made and used their bows and arrows and the importance they attached to their weapons:

> "…the Indians of La Florida, and especially the nobles, take the greatest pride in the beauty and elegance of their bows and arrows. Those they make for their adornment and carry every day, they fashion with the greatest possible nicety, each one striving to outdo the others with new inventions or greater elegance, so that it is a very gallant and honorable contest and rivalry that continually goes on among them" (Clayton, et al. 1993: Vol. II, pg. 291).

They also made arrows for warfare that were "common and worthless, though in case of necessity they make use of all of them, not distinguishing between the fine and the ordinary, or the valuable and the worthless" (Clayton et al. 1993:291). At the temple at Cofitaquichi, Garcilasco de la Vega describes bows that have been varnished and decorated with insets of pearls (Clayton et al. 1993: Vol II, 305). They were entangled with the ideology as well as utility of their bow and arrows.

One of the four De Soto narratives that survives was written by a man who is only known as The Gentleman from Elvas. The Gentleman from Elvas marveled at the skill of the indigenous peoples with the bow and arrow, stating that when they run away, they only flee as far as "the distance of an arrow shot…an Indian can shoot three or four arrows, and very seldom does he miss what he shoots at" (Clayton et al. 1993: Vol I, 59). Their chainmail was almost useless as defense against the arrows, and Elvas laments the cane arrows especially stating that "Those of cane split and enter through the links of mail and are more hurtful" (Clayton et al. 1993: Vol. I, 59). In the second book of *La Florida*, de la Vega recounts an event where a single shot from an arrow at close range immediately brought down and killed a horse. The force of the arrow was such that when the Spaniards opened the horse out of curiosity, they "found that the arrow had entered the breast and passed through the middle of the heart, stomach and intestines, stopping finally in the latter" (Clayton et al. 1993: Vol II, 234). According to this account, children are trained with the bow and arrow from as young as age three, and commonly make small, toy bows and arrows with which to practice killing such animals as lizards and flies (Clayton et al. 1993: Vol. II, 234). Dawe (1997) hypothesized that the unusually small triangular points present in the archaeological record may represent these toy arrows.

De Soto's chroniclers spoke of the varying shapes and sizes of arrow points at Cofitaquichi, a large territory located in South Carolina. The town of Cofitaquichi is thought to be located at the Mulberry Mound site in Camden, South Carolina (Hudson 1997). In the temple at Cofitaquichi, the Spaniards described six giant figures, the fifth of which had a bow and arrow with "a flint point for a head, the same shape and size as an ordinary dagger" (Clayton et al. 1993: Vol. II 301). When the Indian Ambassador travelling with Juan de Anasco slit his own throat because he disobeyed his wife in his service to the Spaniards, he did it with an arrow from his quiver "that had a flint head fashioned like the point and blade of a dagger, about six inches long" (Clayton et al. 1993: 291). The shape and size of this arrow is again referred to as the Spaniards are in the sixth room of the temple at Cofitaquichi —the room full of bows and arrows. De la Vega describes "arrowheads made of copper…with harpoons…and in the form of small chisels, lances and Moorish darts, which looked as if they had been made in Castilla. They [the Spaniards], noted also that the arrows with flint tips had different kinds of heads; some were in the form of a harpoon, others of small chisels, others were rounded like a punch, and others had two edges like the tip of a dagger" (Clayton et al. 1993: Vol II, 304-305). According to Ishi, the Last Yahi, the different shapes were meant for different types of prey (Pope 1965[1918]).

Ishi also spoke of the different sizes and shapes of points that were on arrows. Ishi was the last surviving member of what Alfred Kroeber termed the Yahi tribe, an unknown group of the Yana. He was found in a corral in Oroville, California and was later transported to Kroeber's Museum of Anthropology in San Francisco as a living exhibit. Dr. Saxton Pope was treating Ishi for tuberculosis at the museum and worked extensively with him on his archery until his death in 1916 (Thomas 2000). According to Ishi, "those [arrows] of great length, measuring a yard, and having large heads, were purely for ornamental purposes, or intended to be given as presents, or possibly to be used in times of war" (Pope 1965[1918]: 110). Other types, such as blunted points, were for hunting small game such as rabbits and birds. Pope also notes that Ishi made triangular shaped points for arrows, while larger, oval shaped points, were used as knives and spears (Pope 1965 [1918]: 110-118).

The Bow and Arrow in the Archaeological Record

Compared to the atlatl and dart, the bow and arrow was lighter, more accurate, and was able to be more easily used in the close quarters of the Eastern Woodlands (Blitz 1988; Milner 1999; Hudson 1979; Railey 2010). The atlatl, however, was not without its advantages: it allowed one hand to be free during the launch and it is ideal for those who use shields in warfare (Railey 2010). The greater velocity of the bow and arrow compared to the atlatl and dart, allows for greater penetration into prey and humans (Hughes 1998; Tomka 2013). While bows and arrow shafts are rarely preserved in the archaeological record, a diminution in the size of the projectile points from the Late Woodland period through the Mississippian period is thought to signal the use of the bow and arrow (Anderson, 1986; Sassaman, et al. 1990; Tomka 2013). Methods for distinguishing arrow points from atlatl dart points is a source of great debate in archaeology.

Atlatl Darts and Arrow Points

Though it is unclear precisely when the bow and arrow first appeared in many places, evidence indicates it was present during the Younger Dryas in the Upper Paleolithic between 11,000-9700 B.P. and was common by at least 8000 B.P. in Western Europe (Bergman 1993). In North America, evidence indicates that the bow and arrow first arrived between 11,000 B.P. and 5000 B.P. in the form of the Denbigh Flint Complex in Northwestern Alaska—considerably later than it was already in wide use elsewhere (McNeish 1958, cited in Blitz 1988; Ames, et al. 2010). Following a north to south and west to east trajectory, bow and arrow technology quickly spread across the continent, reaching the Southeast between 1500 and 1300 B.P. and is thought to have arrived in the Savannah River valley around the same time, as indicated by the appearance of small, non-stemmed triangular projectile points (Blitz 1988; Sassaman, et al. 1990).

Accurate dating of the bow and arrow has long presented problems to archaeologists; the small triangular bifaces considered to signify bow and arrow technology are remarkably similar in form to known dart specimens. These points are typically equilateral or isosceles triangles and lack any basal modification (Peacock 1986; Sassaman et al. 1990). Late in prehistory, arrow points and dart points appear to be morphologically similar and various statistical methods, such as discriminant function analyses, were used for distinguishing between the two based on size (Thomas 1978; Blitz 1988).

Although the bow and arrow does not appear to have been widely used until the Late Woodland based on the small triangular tradition, Bradbury (1997) suggests that it may have actually arrived during the Archaic. He employs a modified version of Thomas's (1978) discriminant function analysis to classify points as either arrows or darts. In this modified version, Bradbury found that using width and neck "was significantly better" than Thomas's four variable method at classifying points (Bradbury 1997: 212). He excluded length because many archaeological specimens are broken, resharpened or damaged. Excluding this measurement from the study also increases sample size. Of the 570 points that he tested, 40% were classified as arrow points, the largest number of which date to the Late Archaic. Aside from morphological similarity between temporally significant point functions, Bradbury also notes that not all arrow points were made from stone; some points were made from bone and antler and these do not preserve in the archaeological record in many areas, especially the Southeast. Bradbury is skeptical of the late adoption of the bow and arrow simply because of the apparent quickness with which it spread. Not to mention the fact that Shott (1997) and Bradbury (1997) found that the bow and arrow and atlatl and dart were used in conjunction with each other for 150 years. Bradbury's study supports the assertion that the bow and arrow was in use much earlier than previously thought, but was not the primary weapon until much later—around the same time that mound building, widespread use of pottery, and agriculture appear throughout the Southeast. This raises the question of the relationship between the adoption of the bow and arrow and changes in settlement during this time. The bow and arrow, pottery, mound building, and small-scale agriculture all begin during the Archaic, but do not appear widespread until much later. The reasons for this are unclear.

THE RESEARCH AREA AND DATA

The data for this study comes from collections primarily from archaeological sites located on the Department of Energy's Savannah River Site (SRS) in Aiken and Barnwell Counties, South Carolina (Figure 1.1). Construction began at the site in 1951, and since 1973, cultural resources on SRS have been managed by Savannah River Archaeological Research Program, a division of the South Carolina Institute of Archaeology and Anthropology. Approximately 50% of the 310 square miles of the SRS has been intensively surveyed archaeologically (Savannah River Archaeological Research Program

2016). The area of the SRS has been continuously occupied from the Paleoindian period (11,500-10,500 B.P.) to the Historic period (500 B.P.-present) (Sassaman et al. 1990)

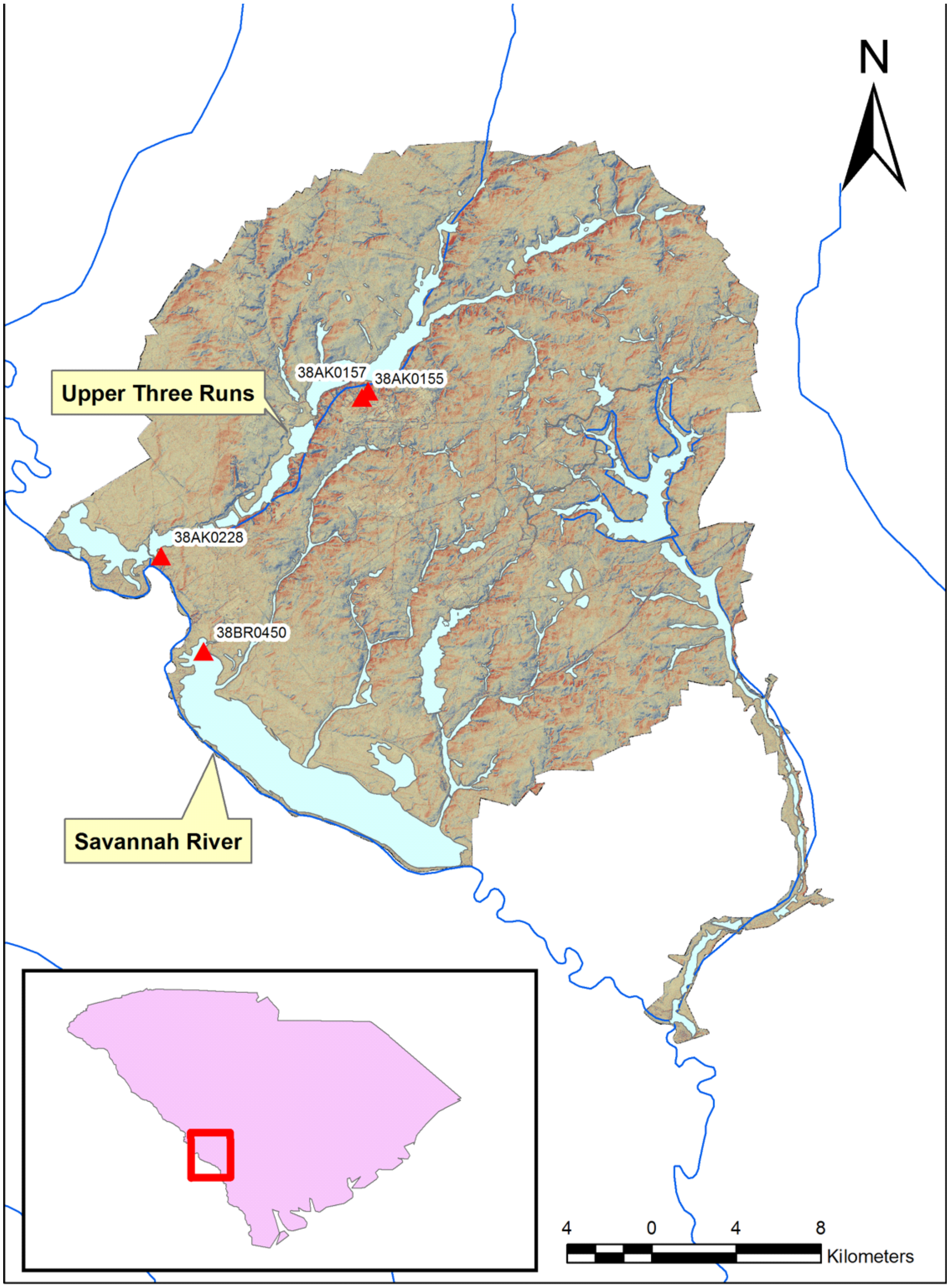


Figure 1.1 The Department of Energy's Savannah River Site, showing locations of sites mentioned in the text.

I begin this section with an overview of the environmental context of the SRS. Next, I provide an overview of the Woodland period in the Middle Savannah River valley. Finally, I discuss the data used to examine the relationship between the bow and arrow and increasing sedentism and social complexity.

Environmental Context of the Savannah River Site

The Savannah River Site is located in the Middle Savannah River valley in the Upper Coastal Plain of South Carolina. The Coastal Plain physiographic province in South Carolina is part of South Atlantic Slope region (Brooks et al. 1990). Bounded to the northwest by the Fall Line and to the southeast by the Orangeburg Scrap, the Upper Coastal Plain consists of Sandhills and the Aiken Plateau (Sassamn 1993). The Savannah River Site is located in the Aiken Plateau geographic region.

Reconstructions of the paleoclimate of the area are largely derived from pollen cores from northwest Georgia and North Carolina (Brooks et al. 1990). The current climate of the Middle Savannah River valley began to take shape approximately 12,500 B.P. near the end of the last glacial episode of the Pleistocene (Sassaman 1993). The current climate of the region is characterized by hot summers and mild winters, with the greatest amount of rainfall occurring in summer and the least amount in fall and winter (Brooks et al. 1990; Sassaman 1993). Pine began to move northward from the Florida Peninsula and after 6000 B.P. the modern climate was in place (Sassaman 1993).

Located between the continental and coastal air masses, the Upper Coastal Plain is a transitional, sub-tropic climatic zone and as such supports a variety of floral and faunal resources (Sassaman 1993). Pine dominated the region after it spread from Florida 6000 years ago, and continues to do so (Sassaman 1993). In the Savannah River swamp and flood plain, bald cypress and water tupelo are common (Brooks et al. 1990). Fauna include deer, bear, rabbit, raccoon, squirrel, and wood duck and were likely available year-round (Brooks et al. 1990). Also available in the swamp and bottomlands of the Savannah River were marine resources such as mussels and fish (Brooks et al. 1990).

The Woodland Period on the SRS

The Woodland period (3000-1150 B.P.) in the Middle Savannah River valley is marked by the introduction of Refuge pottery during the Early Woodland sub period (3000-2450 B.P.). Refuge pottery is grit tempered and typically has dentate stamped, simple stamped, and plain surface treatments (Sassaman et al. 1990). In the Savannah River valley, Thom's Creek pottery continues from the Late Archaic and postdates the fiber-tempered Stallings Island ceramic type, straddling the Late Archaic and Early Woodland periods (Sassaman 1993). Surface treatments of Thom's Creek pottery include plain, reed punctate, shell punctate, and finger pinching (Sassaman 1993). Stemmed triangular points such as the Thelma type are also characteristic of the period on the SRS (Sassaman et al. 1990). Distributions of Early Woodland sites on the SRS reflect intensified use of the upland in relatively small dispersed communities (Sassaman et al. 1990; Sassaman 1993). Noteworthy Early Woodland sites on the SRS include 38AK157, 38AK158, 38AK159, and 38AK224 (Sassaman 1993).

The beginning of the Middle Woodland period (2450-1450 B.P.) is demarcated by sand tempered, checked and linear check stamped ceramics known as Deptford (Sassaman et al. 1990; Sassaman 1993). The Deptford tradition was originally thought by

Milanich (1977) to be a coastal adaption, however the discovery of several interior Deptford sites such as G.S. Lewis-West on the SRS and 38LX5 in Lexington County, South Carolina challenge this idea (Brooks and Canouts 1984; Sassman et al. 1990; Sassaman 1993; Stephenson et al. 2002). Diagnostic hafted bifaces of the Middle Woodland period include Yadkin and Eared Yadkins (Sassaman 1993; Stephenson et al. 2002). Site distribution on the SRS demonstrates that Middle Woodland peoples begain to move out of the uplands and back into the riverine terraces (Sassaman et al. 1990; Sassaman 1993). The most significant Middle Woodland site on the SRS is G.S. Lewis-West (38AK228); however, Pie (38BR450), Mossy Point (38BR364), and the L-Lake sites (38BR259, 38BR495, 38BR527, and 38BR528) also have potentially important Middle Woodland components (Sassaman et al. 1990).

The addition of cord-marking to the Deptford tradition contributes to a difficulty in distinguishing the beginning of the Late Woodland and the end of the Middle Woodland. Sassaman et al. (1990) and Sassaman (1993) proposes that the boundary between Middle and Late Woodland is demarcated by a decrease in check stamping and an increase in cord marking around 1500 B.P. Settlement patterns during the Late Woodland consist of intensified use of the riverine zone and small dispersed sites in the inter riverine, upland areas (Brooks and Canouts 1984). Maize and squash are added to the diet in minor amounts during this period (Sassaman 1993).

Data

A total of 123 Yadkin and Eared Yadkin bifaces from sites on the SRS are included in the study; 70 from Phase II and III block excavations and the remainder from Phase I survey. One-hundred-seventy-one Yadkin and Eared Yadkins come from a private collection from Hampton County, South Carolina and are located at the Hampton County Museum. A collection of quartz Yadkin bifaces from the Thurmond Lake and Clark's Hill areas of Georgia and South Carolina is also included in the study. Raw materials include chert (283), rhyolite (6), orthoquartzite (2), and quartz (21). Yadkins represent the introduction of stemless triangular points in the archaeological record and their distribution is restricted in the Middle Woodland Deptford phase. They are medium to large and have a distinctive basal concavity (Coe 1964). Coeval with the triangular Yadkin is a smaller, triangular or lanceolate biface with slight side notching and protruding ears called an Eared Yadkin. The unique morphology and temporally restricted temporal distribution suggest these bifaces were important to the social changes that were occurring during the Middle Woodland.

The primary goal of this research is to assess whether Yadkins and Eared Yadkins functioned as arrow points. To that end, I used two methods of analysis: a discriminant function analysis and use-wear and macro-fracture analysis. These analyses seek to understand whether the Yadkins fall within the range of arrow points, while the use-wear and fracture analysis provides insight into how the bifaces were actually used. Because the bow and arrow was most useful against small and medium sized prey (Hughes 1998), A protein residue analysis (*sensu* Moore et al. 2016) was also performed on the points to provide insight into the species ranges that were actually being hunted, or processed, with the tools.

SUMMARY

In this chapter, intensification, the conditions, consequences, and causes of sedentism and social complexity among hunter-gatherers was discussed. Through archaeological, ethnographic, and ethnohistoric evidence the importance of the bow and arrow not only as a utilitarian tool for hunting and warfare, but as an important element of the social fabric of Native American culture was discussed. At the time that Yadkin points appear in the archaeological record in the Southeast (2500-2300 B.P.), the bow and arrow was already in use elsewhere in the United States (Ames et al. 2010; Bradbury 1997; Nassaney and Pyle 1999; Tomka 2013; Webster 1980).

Chapter Two provides the Woodland context of Yadkin and Eared Yadkin bifaces. Yadkin and Eared Yadkin bifaces dominate the archaeological record during the Middle Woodland period and in the Savannah River valley are associated with Deptford phase pottery (2250-2050 B.P.). Yadkin tool types were first described by Coe at the Doershuck site in North Carolina as “a large symmetrical, and well made triangular point”, with a distinctive basal concavity (Coe 1964: 45). Although Eared Yadkins were considered by Coe and later researchers as variants on the triangular Yadkins, it is demonstrated in Chapter Four that they should be treated as a separate type due to morphological and functional differences. Yadkins are found almost exclusively in Middle Woodland contexts, suggesting that they had an important role in the cultural changes that accompanied this period. The G.S. Lewis-West (38AK228) archaeological site serves as the case study for the Middle Woodland.

Chapter Three discusses the analytical methods used to determine the function of Yadkin and Eared Yadkin bifaces: discriminant function analysis, use-wear and macrofracture analysis, and protein residue analysis. The limitations and issues encountered during these analyses are also addressed. Chapter Four presents the results of the analyses and shows that Yadkins and Eared Yadkins differ in overall morphology and function. Finally, Chapter Five provides a synthesis of the analyses as well as directions for future work.

CHAPTER TWO: THE WOODLAND PERIOD

INTRODUCTION

In this chapter, I discuss increasing sedentism and social complexity in the context of the Woodland period in the Southeast generally and in the Savannah River valley specifically. Aspects of complex societies such as Adena and Hopewell are present in many places in the Southeast, however the Savannah River valley is on the periphery of their sphere of influence. The monumental earthworks that are so characteristic of Adena and Hopewell do not begin in the Southeast until much later in prehistory—during the Mississippian period.

I begin with a broad overview of the Woodland period in the Southeast, followed by a discussion of the Woodland period on the SRS. The Woodland period on the SRS differs in two primary ways from the Woodland elsewhere: there is a lack of mounds and large scale ceremonialism during this period and the level of agriculture that is present elsewhere is not yet apparent in the Savannah River valley. Overviews of Adena and Hopewell are presented as comparisons for the Woodland period. Next, I present case studies of two Woodland sites on the SRS. I focus the Early Woodland period discussion on the Refuge phase at 38AK157 and the Middle Woodland period discussion on the Deptford phase at G.S. Lewis-West in which Yadkin and Eared Yadkin bifaces occur. I also provide a summary of the Late Woodland in the Middle Savannah River valley using information from multiple sites on the SRS. Evidence for increasing sedentism and social complexity from the Early to the Middle Woodland include increases in site size, evidence of storage pits, incipient agriculture, and more permanent settlements, as well as changes in technology (Parry and Kelly 1987; Price and Brown 1985; Woodburn 1988).

THE WOODLAND PERIOD

The Woodland period in the Southeast is distinguished from its Archaic predecessor by the widespread adoption of pottery at 3000 B.P. and is divided into three subperiods: Early Woodland (3000-2450 B.P.), Middle Woodland 2450-1450 B.P.), and Late Woodland (1400-800 B.P.) (Anderson and Mainfort 2002). The Woodland period is characterized by an increase in sedentism and mound building, widespread exchange networks, mortuary ceremonialism, and incipient agriculture (Anderson and Mainfort 2002; Fritz 1993). This section describes the characteristics of the Early, Middle, and Late Woodland in the Southeast in general.

Social and settlement organization for the Early Woodland consists of sparse populations living in small, dispersed communities, similar to the preceding Archaic but with less extensive foraging zones (Anderson and Mainfort 2002). There is some evidence for the cultivation of native seed crops during the Early Woodland however they are not a major food source (Fritz 1993). It is during the Early Woodland that the Adena culture begins to take shape (Anderson and Mainfort 2002; Wright and Henry 2013).

The Adena culture spread out of the Ohio River valley into Indiana, West Virginia, Pennsylvania and in Kentucky settlements are seen not just in river valleys but also in the uplands (Greber 2005). The earliest dates for Adena place it at the Early/Middle Woodland boundary at 2450 B.P. and it continues through the Late Woodland in some areas of Kentucky at 1450 B.P. (Applegate 2005; Greber 2005; Hays 2010; Pollack and Schlarb 2013). Adena peoples subsisted by hunting and gathering but their dispersed habitation sites include small gardens (Greber 2005). The conical burial mounds that are characteristic of Adena were vacant ceremonial centers that did not support a residential population (Anderson and Mainfort 2002). Artifact assemblages include mica, copper, and marine objects such as shells, materials whose uses are intensified during the Middle Woodland by the Ohio Hopewell (Greber 2005).

During the Middle Woodland period, there is evidence for increasing exchange throughout the region, as well as mound building, and agriculture when compared to the Early Woodland period (Anderson and Mainfort 2002). Fritz (1993) notes that there is evidence for increasing reliance on native seed crops during this time. In the American Bottom area of Illinios and Missouri, maize agriculture appears in small amounts (Fritz 1993). Mound building reaches North Carolina at the Garden Creek site around 1750 B.P. (Wright 2013). Though settlement patterns remain roughly the same from the Early Woodland, people begin to spend more time in upland areas rather than river valleys (Trinkley 1990; Ward and Davis 1999). Evidence for increasing sedentism and social complexity includes larger settlements occupied for longer periods of time and increasing reliance on agriculture for subsistence (Anderson and Mainfort 2002; Fritz 1993).

A culture known as Ohio Hopewell rose, fell, and spread a "thin veneer" of influence into some areas of the Southeast (Anderson and Mainfort 2002:9). Abrams (2009: 175) states that Ohio Hopewell mounds represent an elaboration "on the cognitive template established by earlier Adena populations." Rather than largely dispersed mound sites, Middle Woodland Hopewell peoples began to concentrate mound centers in areas of habitation as farming communities began to form and sedentism increased (Abrams 2009). Like the preceding Adena, mounds have a variety of shapes and sizes, but are typically conical rather than platform with a low ditch or other earthwork surrounding the area (Abrams 2009; Greber 2005; Kimball et al. 2013). Hopewell prismatic blades and bladelets are diagnostic of participation in the Hopewell sphere (Kay and Mainfort 2014). A hallmark of Hopewellian mortuary practices is the movement of finished items via the Hopewell interaction sphere (Abrams 2009).

On the fringe of the Hopewell sphere of influence (Figure 2.1) in western North Carolina, the Biltmore and Garden Creek mounds are constructed between 1750-1150 B.P. (Kimball et al. 2013; Wright 2013). Rather than the conical mounds of the preceding Adena and of the Hopewell core, Garden Creek and Biltmore mounds are platform mounds, with surrounding ditches and exotic materials such as copper and mica (Kimball et al. 2013). In the ditch surrounding Biltmore mound, Kimball et al. (2013: 127) report forms of exotic ritual materials such as "exotic and locally made pottery; items of marine shell, copper, and mica…shaped carnivore jaws (black bear, red wolf, gray wolf, and dog)" that were subjected to a ritual "killing" where a hole is punched through the object prior to deposition.

Though Biltmore and Garden Creek represent the farthest eastern extent of Hopewell, they occur relatively late in the Hopewell sequence. While the mounds in North Carolina are beginning construction at 1750 B.P., the Hopewell core is experiencing the beginning of its end as mound and earthwork construction and the mica and copper trade networks cease (Abrams 2009). Between 1650-1550 B.P., communities on the edge of Hopewell ritual areas are beginning to enclose themselves with defensive structures (Abrams 2009).

Figure 2.1 Map of Hopewell influence area (Abrams 2009).

The Late Woodland period in the Southeast is characterized by population growth and increase in maize agriculture (Anderson and Mainfort 2002). The defensive structures of that begin in the Hopewell sphere as well as skeletal evidence indicates an increase in warfare (Anderson and Mainfort 2002; Blitz 1988; Milner 1999). In the Hopewell core, as well as in other areas of the Southeast, a shift from large, stemmed and notched bifaces to smaller, triangular bifaces is observed (Nassaney and Pyle 1999). In Ohio, Lowe Cluster, Steuben, and Chesser stemmed forms are replaced by Jack's Reef, Levanna, and Racoon Notched forms at 1350 B.P. (Nassaney and Pyle). In the Carolinas, outside of the Hopewell sphere of influence, the Late Woodland period does not differ much from the previous Middle Woodland settlement and subsistence patterns (Herbert 2002; Trinkley 1990).

THE WOODLAND PERIOD IN THE SAVANNAH RIVER VALLEY

The Woodland period was not experienced at the same time in the same ways in different places in the Southeast. While some areas—especially those in the Adena and Hopewell influence areas—experienced mound building and agriculture, others did not. In the next section, I will discuss the Woodland period in the Middle Savannah River valley, where pottery production occurs during the Late Archaic Stallings phase (5000-4500 B.P.) and mound building is absent during the Woodland period. My discussion will focus on the increasing sedentism and changes in technology and social organization that occurred during this period at two Woodland period sites on the SRS: The Early Woodland site of 38AK157 and the Middle Woodland at G.S. Lewis-West (38AK228). These sites were chosen for comparison because each site is representative of a particular phase during the Woodland period (Early Woodland Refuge and Middle Woodland Deptford respectively) and both have been extensively excavated.

Early Woodland (3000-2450 B.P.)

Mound building, horticulture, and pottery distinguish the Woodland period from its Archaic predecessor throughout much of the southeast (Anderson and Mainfort 2002; Sassaman et al. 1990). In the Savannah River valley, however, pottery arrives much earlier during the Late Archaic Stallings phase (ca. 4500-3000 B.P.) and mound building did not occur until much later (ca. 750 B.P.) (Sassaman et al. 1990). Rather, the Woodland period in the Savannah River valley is represented by the appearance of Refuge pottery with its dentate stamped, simple stamped, and plain surface treatments (Figure 2.2), and an increased use of upland areas for residential sites (Sassaman et al. 1990; Sassaman 1993). Triangular stemmed forms such as the Thelma, Fairfax, and Swannanoa types dominate the lithic assemblage for the Early Woodland in South Carolina (Figure 2.3). Otherwise, the Early Woodland in the Savannah River valley has many features in common with the preceding Late Archaic. Although farming is apparent elsewhere in the southeast during the Early Woodland period, people continued to rely on wild resources and lived in small, dispersed settlements (Anderson and Sassaman 2012; Fritz 1993: King and Stephenson 2016; Sassaman 1990).

Figure 2.2 Refuge Simple Stamped pottery (Steen and Smith 2015)

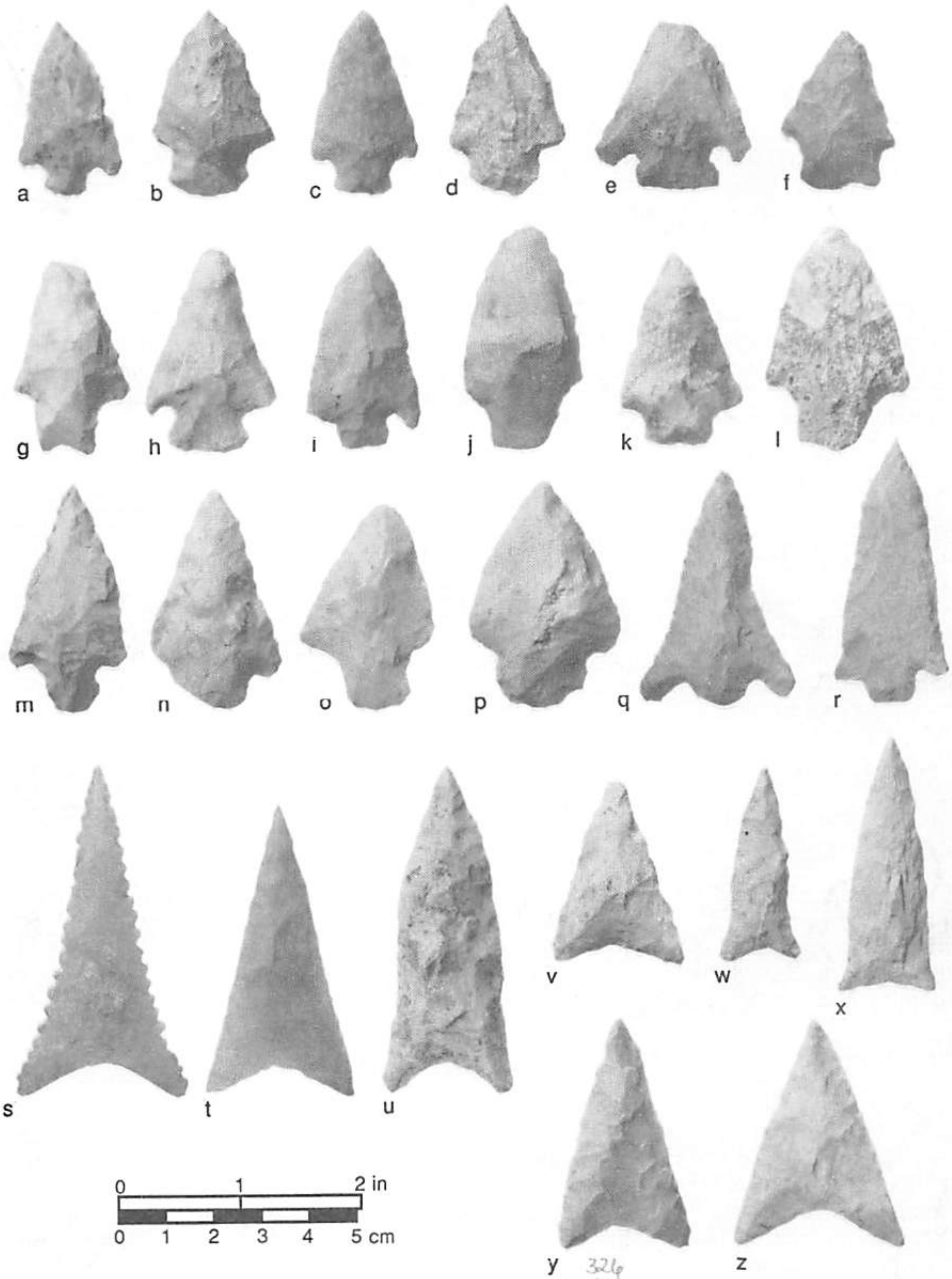


Figure 2.3 Early (a-r) and Middle Woodland (s-z) Hafted bifaces from the SRS (Sassaman et al. 1990) R is a Thelma point

Middle Woodland (2450-1450 B.P)

The appearance of Deptford ceramics and Yadkin bifaces are diagnostic of the Middle Woodland period in the Savannah River valley (Sassaman et al. 1990; Sassaman 1993; Stephenson et al. 2002). Deptford ceramics include check, linear check, and simple stamping (Figure 2.4) and have a geographic presence from central Alabama to Florida and Georgia and north to South and North Carolina (Figure 2.5) (Sassaman et al. 1990; Stephenson et al. 2002).

Figure 2.4 Deptford check stamped pottery. (Steen and Smith 2015)

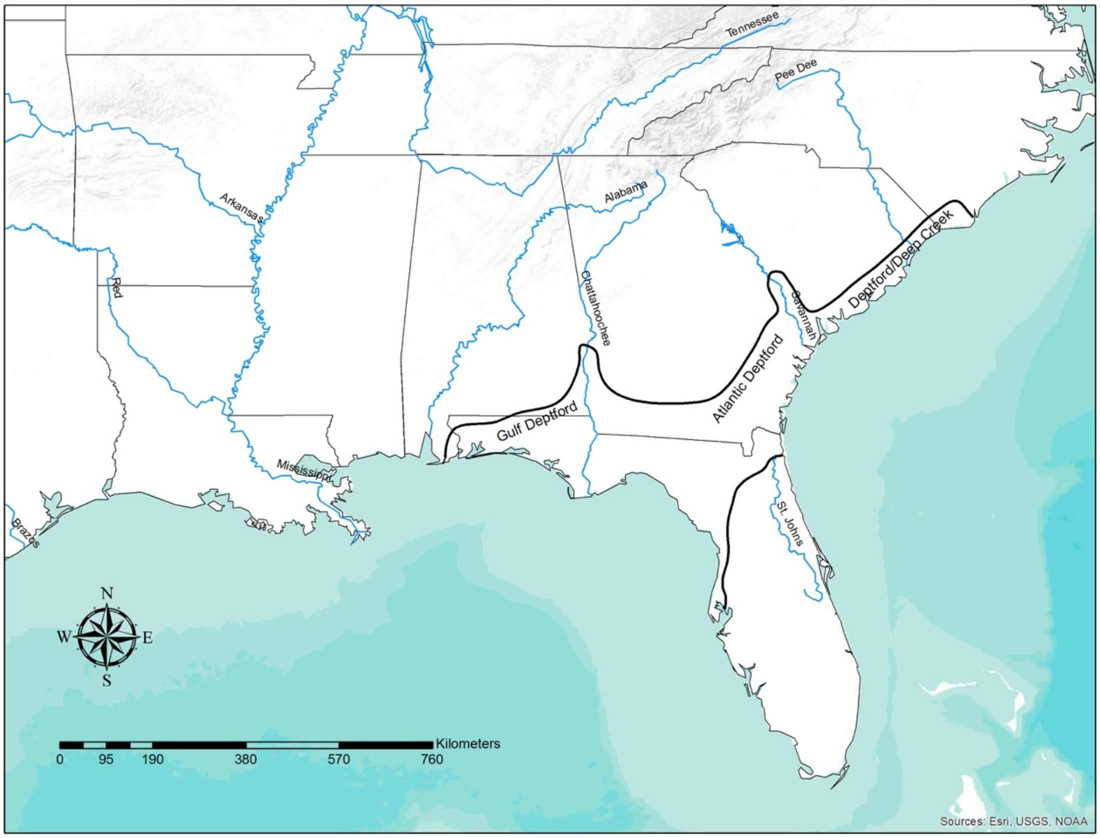


Figure 2.5 Distribution of Deptford pottery in the Southeast.

While early research suggested that Deptford people lived on the coast and moved into the interior river valleys during the fall to collect nuts and berries (Milanich 1971) more recent research is showing that the interior was continuously occupied throughout prehistory with large, semi-permanent Deptford sites occurring during the Middle Woodland period (Brooks and Canouts 1984; Scurry 2015; Stephenson 2002; Stephenson and Smith 2014). A pattern of annual resource use focused on the rivers with Middle Woodland people relying on the river zone during the late winter through summer and foraging in the interriverine areas from fall to winter (Scurry 2015).

Diagnostic lithics for the Middle Woodland include Yadkin and Eared Yadkin bifaces that are strongly associated with the Deptford phase (Figure 2.6) (Sassaman et al. 1990).

Yadkin bifaces are large triangular bifaces with a distinctive basal concavity and mark the introduction of the unstemmed triangular tradition in the Carolinas (Figure 2.7) (Coe 1964; Nassaney and Pyle 1999; Sassaman et al. 1990; Sassaman 1993).

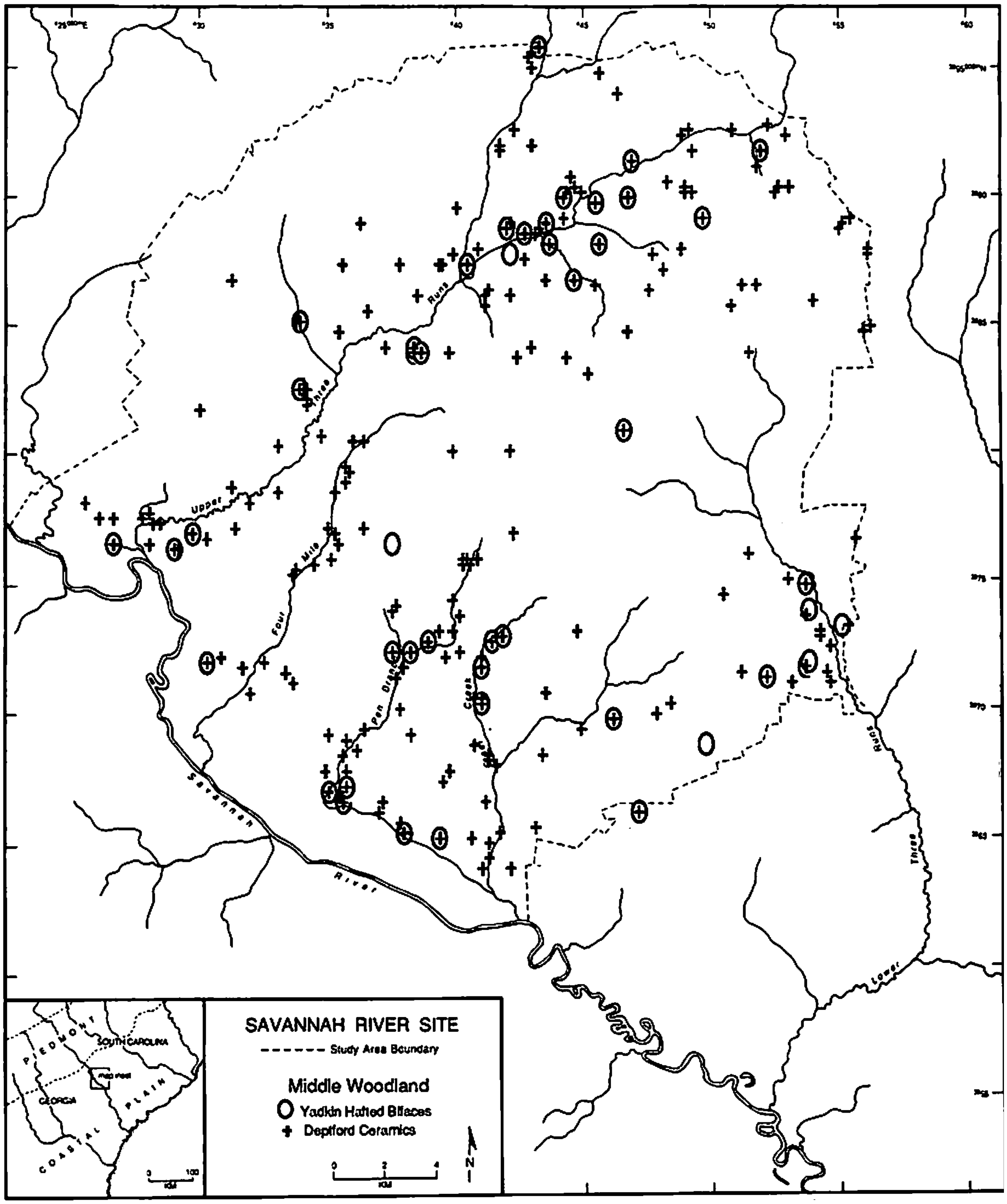


Figure 2.6 Sites with Yadkin bifaces and Deptford ceramics on the SRS. From Sassaman et al. 1990

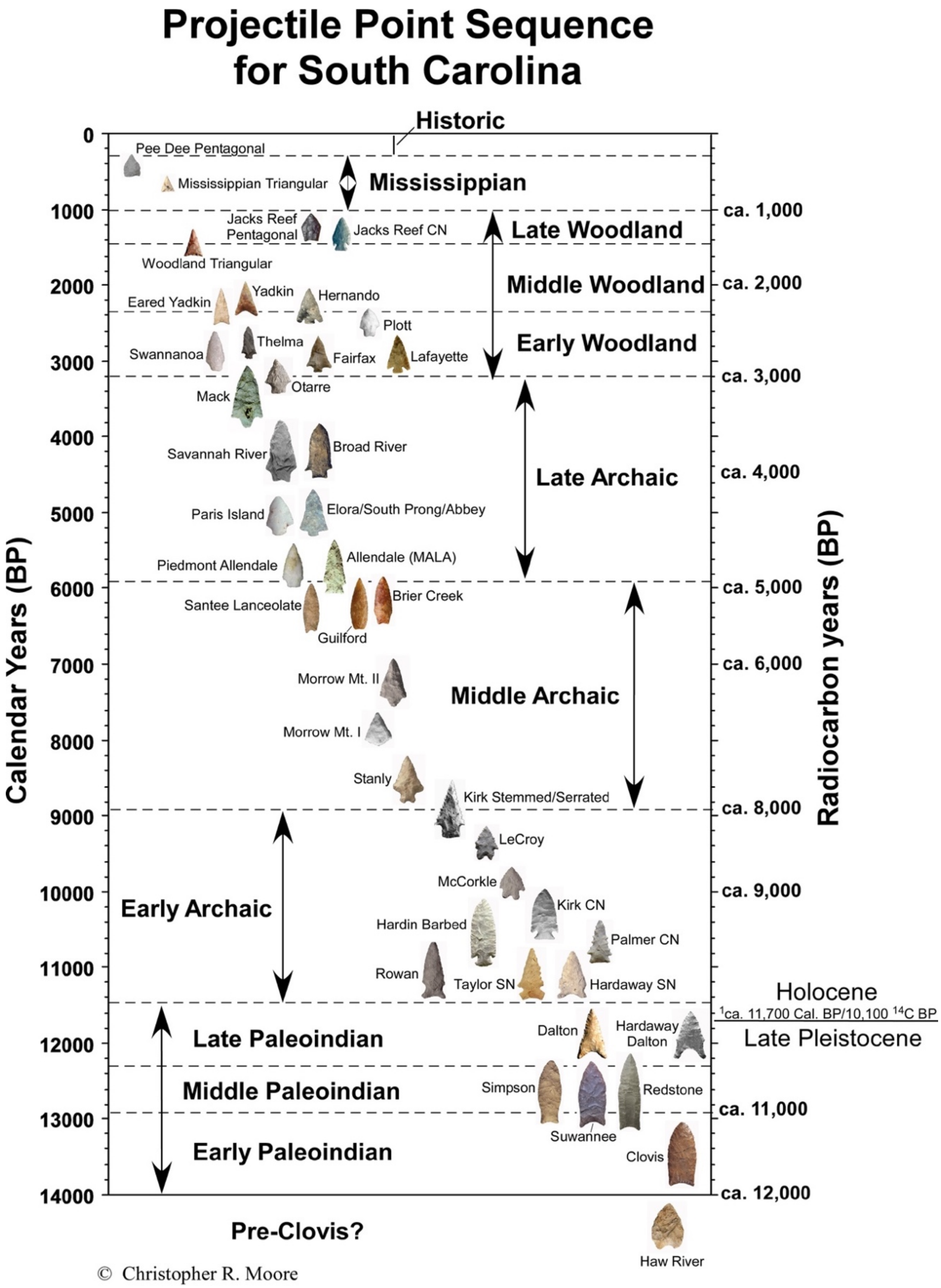


Figure 2.7 Projectile point sequence for South Carolina

Eared Yadkin bifaces are commonly found in association with Yadkin triangular bifaces and Deptford ceramics (Coe 1964; Sassaman et al. 1990). Eared Yadkins, however, are morphologically dissimilar from Yadkin bifaces because they have more of a lanceolate blade form, have smaller maximum widths, and are slightly side-notched with small ears extending from the base. There is also some difference in the distribution of the two types of bifaces throughout South Carolina. Eared Yadkins cluster around the Lynches River in the northeastern part of the state (Figure 2.8) while Triangular Yadkins cluster around the Thurmond Lake area (Figure 2.9). These distributions are likely reflective of raw materials: metavolcanics around the Lynches River and quartz around Thurmond Lake (Christopher Moore, personal communication 2016). Though both types can be manufactured from a variety of raw materials, the distributions do not support the idea presented by Coe (1964) that Eared Yadkins are related to Yadkins.

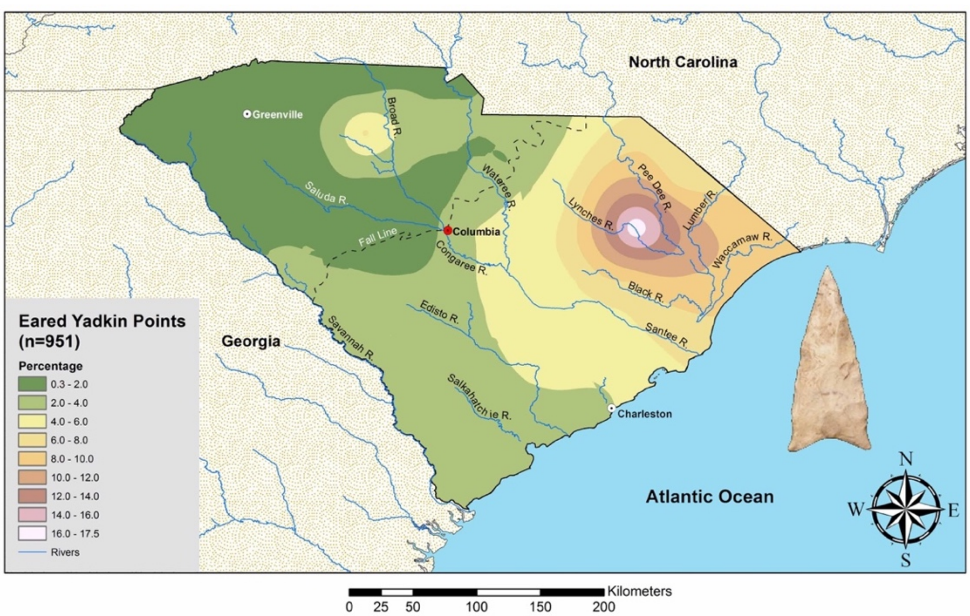


Figure 2.8 Distribution of Eared Yadkin bifaces in South Carolina.

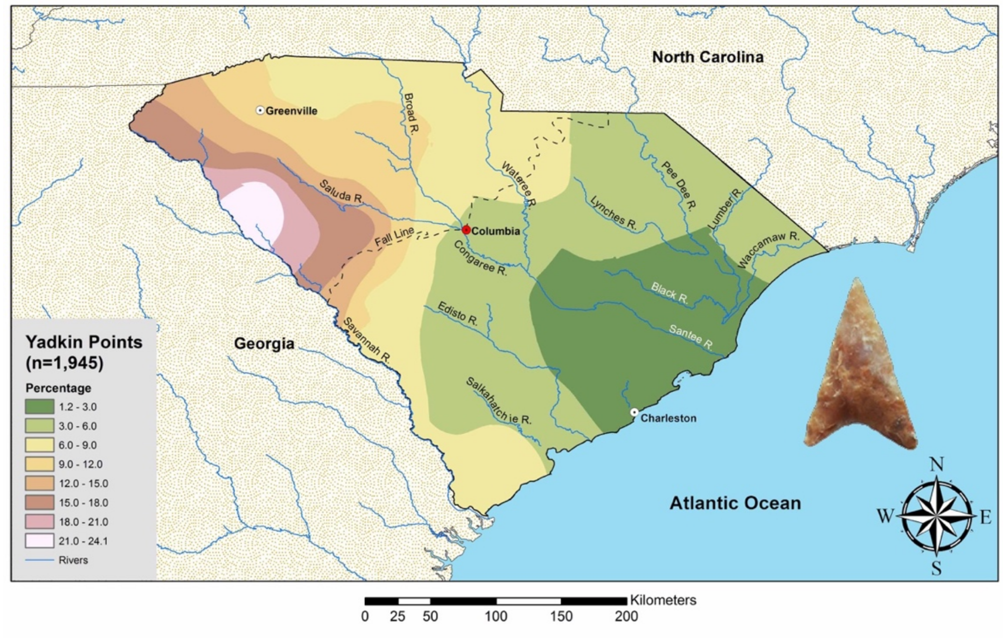


Figure 2.9 Distribution of Triangular Yadkins in South Carolina.

Late Woodland Period (1450-800 B.P.)

Check stamped ceramics continue into the Late Woodland period and some archaeologists note the difficulty in distinguishing the Late Woodland from the Middle Woodland on the basis of ceramics alone in South Carolina generally and in the Middle Savannah River valley specifically (Sassaman et al. 1990; Sassaman 1993; Stephenson and Smith 2013). In the Savannah River valley, the Late Woodland is delineated by an increase in cord marking on ceramics accompanied by an absence in check stamping as well as changes in lithic biface morphology (Sassaman et al. 1990). The triangular tradition that began with the introduction of Yadkin bifaces continues with the appearance of small triangular forms similar to Madison, Caraway, and PeeDee points (Figure 2.10). This type of triangular point is thought to represent the adoption of the bow and arrow as the primary weapon (Anderson and Mainfort 2002; Blitz 1988; Cooper 2014; Nassaney and Pyle 1999; Sassaman et al. 1990).

Figure 2.10 Late Woodland triangular points from 38BR495 on the SRS.

Land use and subsistence strategies in the Carolinas remains relatively unchanged from the Middle to Late Woodland periods, while elsewhere mound building and maize agriculture become widespread (Herbert 2002; Trinkley 1990). Maize agriculture spreads to South Carolina at the end of the Woodland period and a clear shift from small dispersed settlements to large villages and civic ceremonial mound centers can be seen marking the end of the Late Woodland (Herbert 2002; Judge 2016; Sassaman et al. 1990).

Two sites on the SRS offer an opportunity to discuss the increasing sedentism and social complexity: 38AK157, an Early Woodland upland site and G.S. Lewis-West, a Middle Woodland site located on a terrace of the Savannah River.

38AK157 Site structure at the Early Woodland site 38AK157 suggests that Early Woodland peoples who made Refuge pottery moved onto the uplands of the Aiken Plateau during spring and summer months (Sassaman 1993). Sassaman (1993) infers the seasonality of the site on the basis of a lack of internal hearths and the southeast orientation of the structures, which he derived largely from ethnoarchaeological studies conducted by Binford. Though he notes that there is a lack of evidence for internal hearths at other Refuge sites on the Aiken Plateau, explanations for this phenomenon other than seasonality are not offered. Sassaman infers the presence of relatively permanent structures at the site based on voids in artifact distributions however, evidence for storage pits is lacking at the Early Woodland component of the site (Sassaman 1993). Despite the lack of storage pits at the site, the relative permanence of the structures, and the presence of cooking features demonstrate that it was occupied for longer durations compared to the Late Archaic.

The lithic assemblage at 38AK157 presents evidence for increased sedentism from the Late Archaic period to the Early Woodland period. Evidence for repatination and flake refitting of bifaces showed that the Refuge occupants of the scavenged the tools from their Archaic predecessors and crudely worked the stone, sometimes only unifacially (Sassaman 1993). Early Woodland technological strategy also consisted of provisioning the habitation site with raw materials and use of unstandardized cores rather than the preparation of formal cores at the quarry site (Sassaman 1993).

Another characteristic of expedient technology that is evident at 38AK157 is the use of poor quality, local raw material. Formal technology "requires material of relatively good quality, since flawless pieces of certain minimum dimensions are needed" (Parry and Kelly 1987: 298). During the Early Woodland at 38AK157, there is increased use of the lower quality chert of the Barnwell formation, and orthoquartize begins to be used as a raw material for manufacturing Yadkin bifaces during the subsequent Middle Woodland period.

Use of amorphous cores such as scavenged Archaic bifaces is one of the characteristics of expedient technology (Parry and Kelly 1987). In their well-known and frequently cited paper on the subject, Parry and Kelly (1987) argue that increased sedentism was a causal factor for the rise in the use of expedient technology. Tools produced using an expedient technology are often minimally retouched and used only once, discarded once the task is complete. Sassaman (1993) reports that unifacial and single use tools characterize much of the lithic assemblage for the Early Woodland at 38AK157. They offer possible territorial circumscription as pressure from outside groups limited mobility and access to the chert quarries in Allendale as a possible cause for the technological shift.

The coincidental occurrence of expedient tools in domestic contexts has historically been interpreted as evidence of women's activities, which were previously rendered invisible by the abundance of hunting tools made by and for men's hunting activities

(Casey 1998; Gero 1991; Sassaman 1992). As sedentism increases, so too does the visibility of domestic areas in the archaeological record. With the increase in sedentism comes the need for hunters (interpreted to be men) to venture outside of the safety of the village or hamlet for prey (Casey 1998). Formal tools allow men to encode identity markers into the design of the tool. The association of hunting with men and thus formal tools, and domestic activities with women and thus expedient tools is based largely on the ethnographic record. The inference of the sexual division of labor in the past, however, presupposes that the gender dichotomy was the same in the past as it in the present, leading to the question of whether or not the equation of women with expedient tools and more permanent domestic contexts is adequate evidence for an increase in sedentism. Even without this evidence, expedient technology is linked to increased sedentism, as is the presence of relatively permanent structures, both of which are present at 38AK157 (Sassaman 1993).

G.S. Lewis-West This section summarizes what is currently known about the Woodland occupation of G.S. Lewis-West and places the site in the larger context of the Middle Woodland. The G.S. Lewis site is a multicomponent archaeological site spanning the Early Archaic through Mississippian periods. Initially discovered in 1977 during Phase I survey, the site was not excavated until 1984 during compliance operations for the dredging of a nearby canal (Sassaman 2002). The site is approximately 21 hectares and consists of two areas of excavation: G.S. Lewis-East which consists of Early and Late Archaic components and G.S. Lewis-West which consists of Middle Woodland through Mississippian occupations, including a 25-cm thick Woodland midden (Sassaman et al.

1990; Sassaman 2002). Thirty-two Yadkin bifaces and eight Eared Yadkin bifaces are from the Lewis-West portion of the site, comprising the largest Yadkin assemblage from a single site included in this study.

The first systematic investigation of G.S. Lewis-West was undertaken by the Savannah River Archaeological Research Program and a volunteer crew from the Augusta Archaeological Society in 1984 and 1989 (Sassaman et al. 1990; Sassaman 2002; Stephenson and Smith 2014). The 154 m^2 excavation at G.S. Lewis-West uncovered over 500 features including architectural remains and midden deposits along with subsistence remains (Stephenson and Smith 2014). Much of this evidence indicates increased sedentism and suggests year-round occupation of the site.

Plant and animal remains from G.S. Lewis-West indicate a continued reliance on wild resources such as deer, fish, turtle, hickory nuts, and acorns, but there is also compelling evidence for Maygrass cultivation (Wagner and Stephenson 2014). The increasing reliance on cultivation is marked by a shift from frequent logistical foraging trips to the uplands to intensified use of the valley and inter-riverine flood plain of the Savannah River valley (Stephenson and Smith 2013; Wagner and Stephenson 2014). An overall increase in Maygrass seed counts from Early to Middle Woodland throughout the entire Southeastern region suggests that cultivated plants were becoming a much more important part of the Woodland economy (Gremillion 2002).

Other evidence for increasing social complexity at G.S. Lewis west is in the number of structures present at the site when compared to the Early Woodland site 38AK157. Though the exact number of structures is not yet known, over 500 features are preserved beneath the midden, which date primarily to the Middle Woodland Deptford phase and the Late Woodland Savannah I phase (Sassaman et al. 1990). Evidence for mortuary ceremonialism is also present in the fact that one human and three dog burials were located at G.S. Lewis-West (Stephenson and Smith 2013). Some (Greber 2005; Hays 2010) note that a decrease in the number of individuals buried at Adena and Hopewell sites indicates increasing social stratification, it may be naïve to assume the same for G.S. Lewis-West; the single burial is likely an accident of excavation.

SUMMARY

The Woodland period in the Southeast and in the Middle Savannah River valley was a time of increasing sedentism and social complexity. Evidence for these changes include increased site size, longer duration of occupation, increasing reliance on farming and stored food, and increased mortuary ceremonialism. Yadkins are part of these changes marking the introduction of the triangular tradition in the Savannah River valley.

In the next chapter, I discuss the analytical methods used to determine whether Yadkin and Eared Yadkin bifaces were used as arrow points. A discriminant function analysis, use wear and macrofracture analysis, and protein residue analysis were employed for this study.

CHAPTER THREE: DATA AND METHODS

INTRODUCTION

This chapter outlines the materials and methods for the analysis of Yadkin bifaces from the Savannah River valley. Small, triangular, hafted bifaces are diagnostic of the Middle Woodland period when sedentism and social complexity were on the rise and important technological changes were beginning (Anderson and Mainfort 2002; Blitz and Porth 2013). Small triangular bifaces are unequivocally accepted as evidence of the bow and arrow (Anderson 1986; Anderson and Mainfort 2002; Blitz 1988; Milner 1999; Peacock 1986; Sassaman et al. 1990) because the shafts of arrows are smaller than the shafts of either spears or atlatl darts, and therefore their tips must be smaller as well (Shott 1997; Thomas 1978). Despite the importance of the arrival of the bow and arrow, the timing of this event and the circumstances of its adoption are not well understood (Blitz 1988). While the style change to triangular points is obvious, the size of the points is variable and in fact they continuously decrease in size throughout the Woodland period (Hughes 1999; Milner 1999; Sassaman et al. 1990; Shott 1993, 1997; Thomas 1978). The methods outlined in this chapter seek to understand whether Yadkin triangular bifaces can be classified as arrows or darts on the basis of morphology, and to understand how they were used by analyzing use-wear, breakage patterns, and protein residues.

Yadkin and Eared Yadkin Morphology

Yadkins were first described formally by Coe (1964) at the Doershuck site in North Carolina. They are distinct from previous biface traditions not only because they are triangular, but also by their exaggerated basal concavity (Figure 3.1). Yadkins are Middle Woodland triangular bifaces associated with the Deptford phase (Sassaman et al. 1990; Sassaman 1993; Stephenson and Smith 2014). Yadkin bifaces are found throughout the Southeast from northern Georgia, to the Carolinas and north to Maryland (Wood and Ledbetter 1990). In this study I measured Yadkins for maximum length, basal width, thickness, and weight (Figure 3.2).

Figure 3.1 Yadkin biface from 38AK546 on the Savannah River Site.

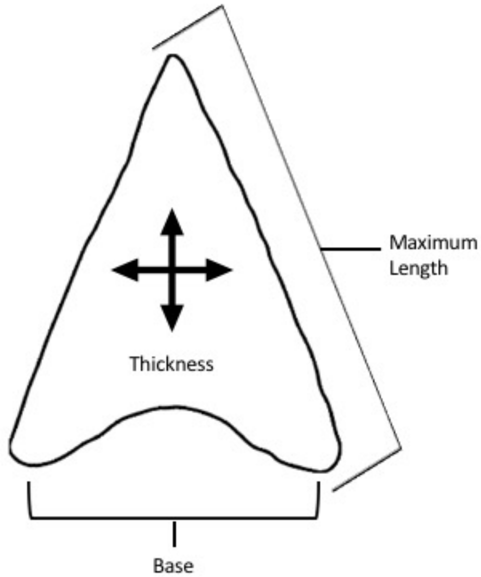


Figure 3.2 Diagram of metric attributes for Yadkins.

Coe also describes Eared Yadkins: a "pointed ear variety…is the same basic point but had shallow side notches toward that base that gave it its characteristic appearance" (1964:49). Though Coe and subsequent researchers (e.g. Sassaman et al. 1990; Wood and Ledbetter 1990) maintain that Eared Yadkins are a variation on the Yadkin form, there are morphological differences between Yadkins and Eared Yadkins that lead to the conclusion that Eared Yadkins are an entirely different formal type. Eared Yadkins are narrower, thinner, and have a less exaggerated basal concavity (Figure 3.3). There is also surprising variety among Eared Yadkins. Some Eared Yadkins appear to have stems, rather than side notching on a triangular blade (Figure 3.4). Others have deeper side notching that gives them the appearance of a shoulder (Figure 3.5), while the shallow side notching on others creates a triangular point with little to no observable shoulder (Figure 3.3).

Figure 3.3 Eared Yadkin with no shoulder.

Figure 3.4 Eared Yadkin with small stem.

Figure 3.5 Eared Yadkin with visible shoulder.

DATA

The data for this study comes from archaeological sites on the Savannah River Site (Figure 3.6), a private collection from Hampton County, South Carolina (Figure 3.7), and a private collection from the Thurmond Lake region of South Carolina (Figure 3.8). The numbers of each type of biface and their raw materials are listed in Tables 3.1 and 3.2. Though raw material did not have an affect on metric attributes, they did reflect the primary lithic raw materials of the area from which they were found (e.g. quartz is the dominant raw material in the Thurmond Lake area and this is reflected in the assemblage)

The The largest Yadkin and Eared Yadkin assemblages from block excavations on the SRS are from G.S. Lewis-West (n=38), 38AK155 (n=13), and 38AK157 (n=7). The remainder from the SRS are from Phase I survey. Table 3.3 shows the archaeological sites and number of each type of biface from that site.

Table 3.1 Raw materials for Yadkins

Collection	Chert	Quartz	Rhyolite	Orthoquartzite
SRS	87	1	2	2
Hampton County	86	1	0	0
Thurmond Lake	4	15	0	0

Table 3.2 Raw materials for Eared Yadkins

Collection	Chert	Quartz	Rhyolite	Orthoquartzite
SRS	29	1	1	0
Hampton County	71	1	0	0
Thurmond Lake	1	1	0	0

Table 3.3 Collections used in this study

Site	Yadkin	Eared Yadkin	Totals
38AK228	32	8	40
38AK157	7	0	7
38AK155	14	2	16
Other SRS Sites	40	60	100
Hampton County	87	72	159
Thurmond Lake/Clark's Hill	18	2	20
Total	198	144	342

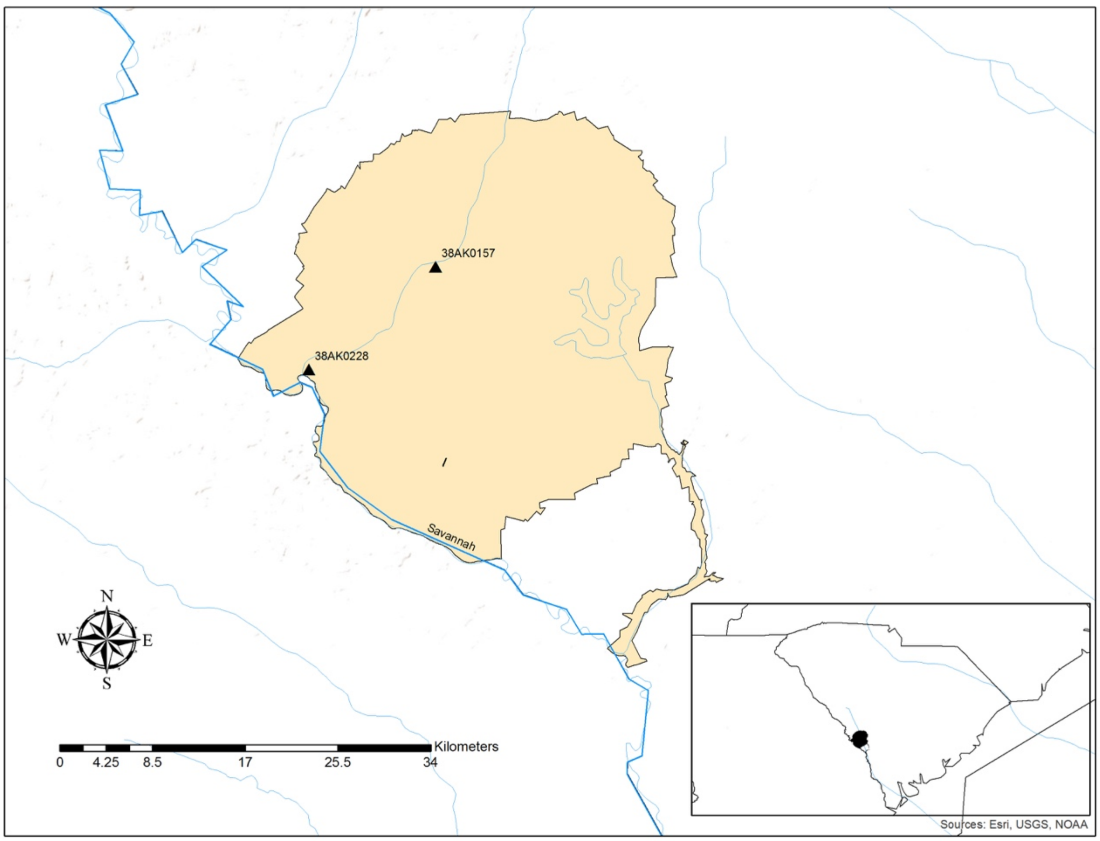


Figure 3.6 G.S. Lewis-West and 38AK157 on the Savannah River Site.

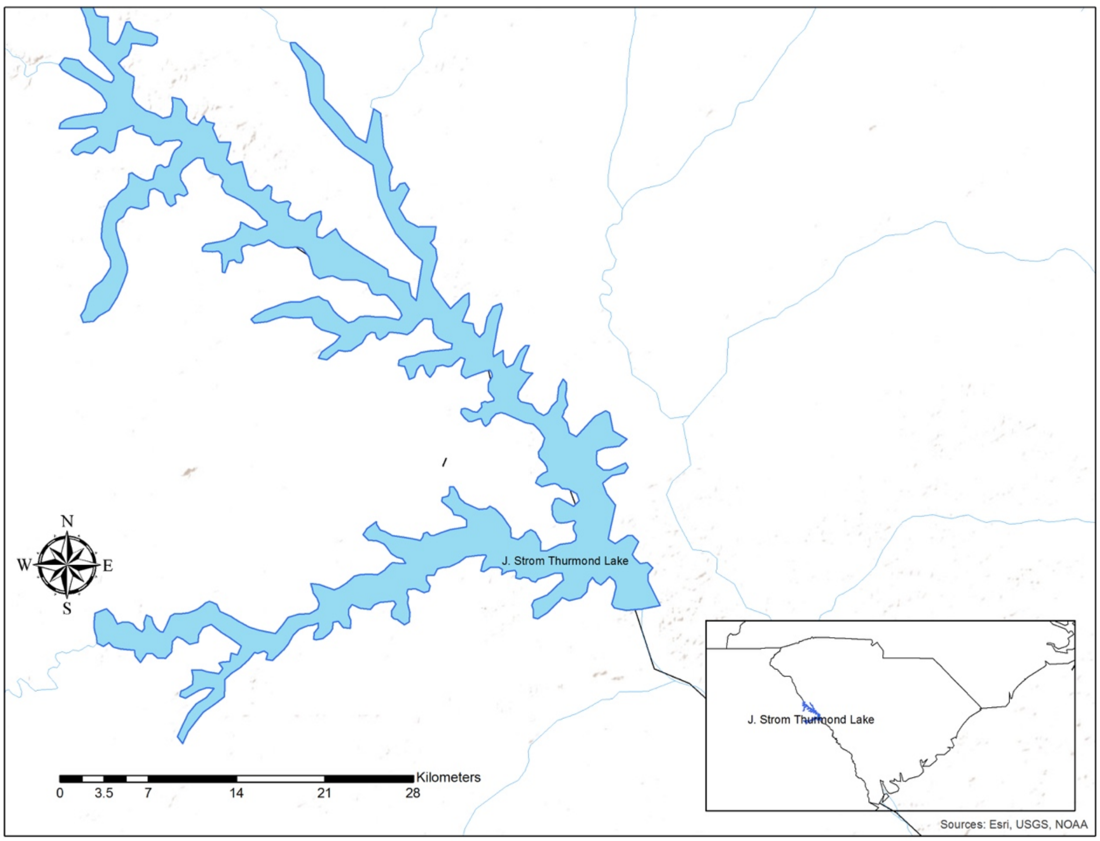


Figure 3.7 The location of the Thurmond Lake region of South Carolina.

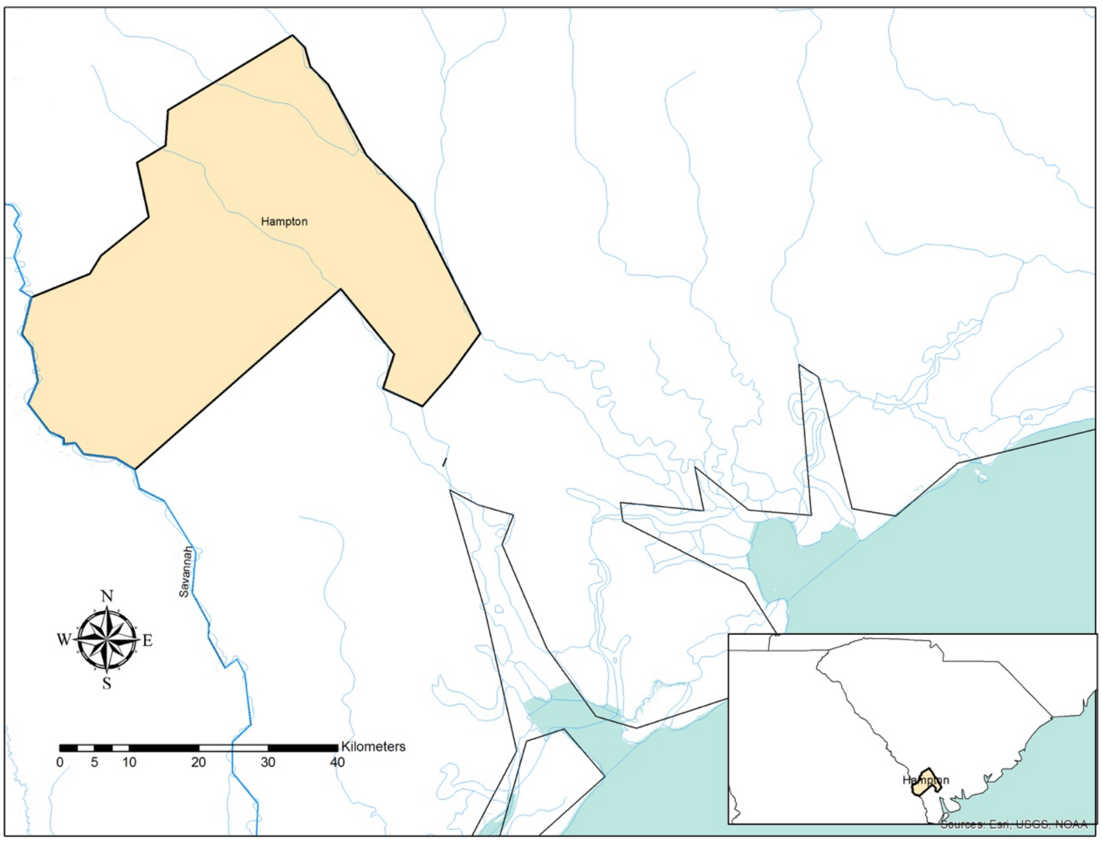


Figure 3.8 The location of Hampton County, South Carolina.

G.S. Lewis is a multicomponent site that encompasses approximately 21 hectares. It is located on the first terrace of the Savannah River at the confluence of Upper Three Runs Creek and the Savannah River (Sassaman et al. 1990). Excavations at the site began in 1984 and 1989 as part of a plan to dispose of canal dredge. Occupations at the site spans the Early Archaic to the historic period (Sassaman et al. 1990). G.S. Lewis is delineated into two areas: an eastern Archaic component (Lewis-East) and a western Woodland component (Lewis-West) (Sassaman et al. 1990).

North of G.S. Lewis, located along Upper Three Runs Creek, is 38AK155 and 38AK157. In the summer of 2004, staff of the Savannah River Archaeological Research Program excavated the National Register Eligible site 38AK155 as part of cultural resources compliance activities on the Savannah River Site (King 2016). The excavation showed that the site was occupied from the Middle Woodland to the mid-twentieth century (King 2016). Located approximately 500 meters to the east of 38AK155 is the Early Woodland site 38AK157 (King 2016).

The multicomponent site 38AK157 is situated on a ridge nose along Upper Three Runs Creek. Archaeological excavation of the site of the in 1990 revealed that the site was occupied from the Early Woodland Thom's Creek phase (4000-3000 B.P.) to the Late Woodland period (1500-500 B.P.). The site also has a minor nineteenth century component (Sassaman 1993). Site 38AK157 provided much needed information about the changing land-use patterns of hunter-gatherer groups as sedentism increased throughout the Woodland (Sassaman 1993).

G.S. Lewis-West and 38AK157 provide the social context for the Middle Woodland in the Middle Savannah River valley. Both sites have relatively large Yadkin and Eared Yadkin assemblages and together they offer a unique opportunity to compare technological organization and social complexity between a riverine site (G.S. Lewis-West) and an upland site (38AK157).

To augment the statistical basis of the discriminant function analysis, data obtainted from two private collections were added to the study. Housed at the Hampton County Museum, the Causey collection consists of artifacts from Hampton County, South Carolina. This collection spans nearly the entire prehistoric occupation of South Carolina, from Early Archaic through Mississippian. During 2015 and 2016, staff from the South Carolina Institute of Archaeology and Anthropology and Savannah River Archaeological Research Program, were asked to catalog the collection and assist in the design of an exhibit centered around the prehistory of South Carolina. As part of this project, I identified and analyzed 171 Yadkin and Eared Yadkin bifaces from this collection. Like those from the SRS, Yadkins in the Causey Collection are overwhelmingly made from Coastal Plain Chert.

Early in 2017 a private collection from the J. Strom Thurmond/Clark's Hill area of Georgia and South Carolina was donated to a member of the staff at Savannah River Archaeological Research Program for the purposes of identification and cataloguing. Included in this collection were 18 Yadkin and 2 Eared Yadkin bifaces. This collection is important because unlike the assemblages from the SRS and Hampton County, the Thurmond Lake/Clark's Hill collection is dominated by quartz. The addition of quartz to the data allowed a comparison of the metric attributes between point types and raw materials.

METHODS

In order to test whether Yadkin and Eared Yadkin bifaces functioned as arrow points or atlatl dart points, I used four methods: discriminant function analysis, use-wear analysis, macrofracture analysis, and protein residue analysis. This section begins with descriptions of Yadkin and Eared Yadkin bifaces and their morphological characteristics. In the next section, I introduce the discriminant function analysis and describe how the metric attributes of Yadkin and Eared Yadkin bifaces influence their functional classification. The following section describes the use wear and macrofracture analyses, and lastly the protein residue analysis.

Discriminant Function Analysis (DFA)

Discriminant function analysis (DFA) is a statistical method for determining group membership of an object. This method of analysis is based on the "assumptions that variables are from multivariate normal distributions and covariance matrices of defined groups are equal" (Shott 1993:430). The discriminant function analysis uses parameters from specimens whose group membership (in this case function) is known to produce classification equations that can later be applied to samples with unknown function. Thomas (1978) established discriminant function analysis as an effective means of distinguishing atlatl darts and arrow points. He used archaeological and ethnographic specimens with unquestionable function—still in their haft—to derive classification equations that can then be applied to archaeological collections of unknown or questionable function.

Thomas's study was not without its drawbacks. Although his analysis included 132 arrow points, he was only able to obtain 10 atlatl darts (1978). A second problem with Thomas' study is that he used stemmed and notched points from archaeological and ethnographic contexts in the Southwestern United States, making it of limited use in the Southeastern US where dart and arrow points are predominantly triangular and stemless.

In 1997, Shott re-examined Thomas's original analysis with 29 additional atlatl dart points. He was able to confirm Thomas's results. Importantly, he also adjusted Thomas's method and was able to successfully perform the DFA using only shoulder width and thickness. Shott derived four classification equations from his analysis: a four-variable equation that uses length, shoulder width, thickness, and neck width; a three-variable equation that excludes length; a two-variable equation that uses only shoulder width and thickness; and finally a one-variable solution that uses only shoulder width.

The four and three-variable solutions are not useful for the Yadkin and Eared Yadkin assemblages for two reasons: the first is that length was one of the most important discriminating factors in the four-variable equation, but length is the attribute most susceptible to reworking and use-wear and including length would significantly decrease the sample (Shott 1997). The second reason is that both equations use neck width which is not present on Yadkins because they are not side-notched and do not have stems.

I measured all bifaces for basal or maximum width, maximum length, maximum thickness, and weight (Figure 3.2). Bifaces that were complete enough were also measured for length. Those that were not (i.e. more than 50% broken) were excluded from the summary statistics for length. Shott's one and two variable equations were applied to each biface. There are two equations per classification: one for atlatl darts and one for arrow points; the equation that returns the higher value is the correct functional classification of that biface (Pluckhahn and Normal 2011; Shott 1993, 1997; Thomas 1978). The classification equations are as follows:

One-variable solution:

Dart: 1.4(shoulder width)-16.85

Arrow: 0.89(shoulder width)-7.22

Two-Variable solution:

Dart: 1.42(shoulder width) + 2.16(thickness) – 22.5

Arrow: 0.79(shoulder width) + 2.17(thickness) – 10.6

The variation among Eared Yadkins has led to a lack of standardization among researchers concerning which attributes to measure. For example, in the site report for the Mattassee Lake Sites along the Santee River, Eared Yadkins are included in Group 4 of the triangular points and are only measured for length, basal width, and weight (Anderson 1982). At the Pumpkin Pile site in Polk County, Georgia, Eared Yadkins are measure for length, width, thickness, haft length, stem width (assumed to be neck width), and basal width (Ledbetter et al. 1992). Both reports include Eared Yadkins in their triangular assemblages, and that is likely why they are measured as such.

Initially I followed the same convention of measuring Eared Yadkins as triangular points with maximum length, basal width, thickness, and weight (Figure 3.9). However, Shott (1993, 1997), Thomas (1978), and Hughes (1999) all found that shoulder width was a better discriminator between atlatl darts and arrow points than basal width. In order to assess the affects shoulder width may have on the functional classification of Eared Yadkins, the Savannah River Site Eared Yadkin assemblage was reanalyzed and neck and shoulder width measurements were obtained.

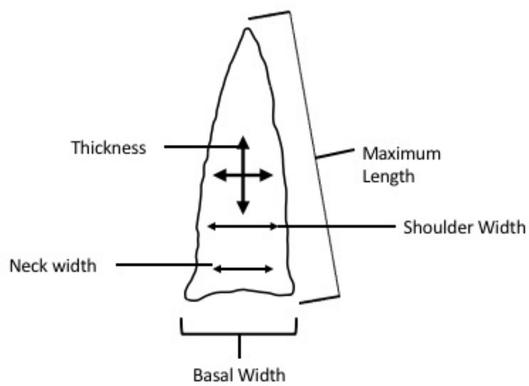


Figure 3.9 Metric attributes on Eared Yadkins.

Although a discriminant function analysis is a good way of determining tool function, no method is 100% accurate. Both Thomas's and Shott's equations rely on metric attributes obtained primarily from late pre-Contact or historic ethnographic assemblages. In the Southeast, however, it is common knowledge that bifaces tend to get smaller through time (Anderson 1986.; Cooper 2014; Judge 2017; Sassaman et al.

1993). Applying the metric parameters of bifaces that are already at the far end of that trend may create a situation where early arrow points that are larger are misclassified as atlatl darts. A second problem is that the classification equations can only determine membership in one of the groups. In other words, it can only classify a biface as either an atlatl dart or an arrow point but it cannot determine if a biface was used for a function other than atlatl dart or arrow point. This may create a situation where larger bifaces are classified as atlatl darts when their function may not be as a projectile at all. Discriminant function analysis must be used in conjunction with other methods to reliably determine tool function. In the next section, I describe the use-wear and macrofracture methods that augment the DFA.

Use-Wear Analysis

The application of lithic use-wear studies to determine tool function dates back to the nineteenth century when scholars observed edge rounding on stone tools from England (Hayden and Kamminga 1979). In North America, the field of lithic use-wear did not gain wide acceptance until the English translation of Sergei Semenov's *Prehistoric Technology* in 1964 (Hayden and Kamminga 1979). Lithic use-wear analysis is based on the observation that damage occurs to the surface of the tool as a result of use. This damage can be in the form of chipping or nibbling, polishing, striations, rounding, or breakage (Hayden and Kamminga 1979; Semenov 1964). Activities that produce these types of damage can be ascertained by observing the location of damage on the tool and the direction of use (Hayden and Kamminga 1979; Semenov 1964; Lawrence 1979).

A scraping motion, for example, where the tool is pushed in a direction perpendicular to the working edge produces fractures with the same orientation. A cutting motion, on the other hand where the tool is pushed or pulled parallel to the working edge produces fractures with an oblique orientation (Lawrence 1979). The location of use wear on the tool can provide information regarding exactly how that wear was formed. If wear is noticed only on the faces of the tool, the wear is likely the result of being placed in a container or bag; if the tool is primarily damaged along the lateral edges, it is more likely that the damage is the result of actual tool usage (Aldenderfer et al. 1989).

Use-wear analysis typically employs one of two methods: microscopic or macroscopic (Andrefsky 2005). Microscopic use-wear analysis typically involves the use of high-power equipment such as scanning electron microscopes (SEM) or metallurgical microscopes (Andrefsky 2005). This type of approach seeks to observe evidence of micropolishing and striations in order to determine what types of materials were worked with the tool (Lawrence 1979; Sain 2015). High powered microscopic approaches rely on the formation of a large, experimental reference collection. Akoshima and Kanomata (2015) note that there is a discrepancy between these experimentally produced polishes and striations and actual archaeological artifacts. The use-wear that accumulates on an archaeological specimen is the result of multiple episodes of normal human activity, while the use-wear that accumulates on experimental specimens is the result of one highly controlled episode of scientific experiment (Akoshima and Kanomata 2015). Archaeologists may be able to recognize polishes and use-wear on their experimental collections because they have the advantage of controlling the circumstances and knowing the mechanism, but the same use-wear and polishes on archaeological specimens can only be identified as ambiguous or not at all (Akoshima and Kanomata 2015).

Macroscopic use-wear analysis is an alternative to the microscopic method. The macroscopic approach is useful for several reasons. Using this method requires less time and more accessible equipment thus making it easier to analyze large amounts of tools in a short amount of time (Andrefsky 2005; Odell 1979). Damage in the form of chipping and nibbling is easily identifiable, as is the manner of use (cutting or scraping, for example). The macroscopic approach also alleviates some of the subjectivity of the terminology surrounding polishes. Terms such as “greasy” and “shiny” do not translate the same from one analyst to the other (e.g. Sain 2015). There is also no need for a large experimental collection to observe and document the types of damage that has accumulated on lithic tools because edge damage and breakage patterns are relatively unambiguous (Lauzén 2014).

Rots and Plisson (2014:156) note that because “lithic armatures are not exposed to repetitive motion…the only microscopic traces on the active part are scarce striations produced by embedded chips coming from the damage to the the tip itself”. The difficulty observing use-wear from use as a projectile was mitigated by the addition of a macrofracture analysis. Like macrowear, macrofracture analysis presents the opportunity to analyze a large number of points in a short amount of time. Since the focus of this study was to determine whether or not Yadkin and Eared Yadkin bifaces functioned as projectiles, the macrofracture analysis mitigated the drawbacks of the lack of wear noted by Rots and Plisson (2014) because it is based on the theory that only certain types of fractures can be the result of longitudinal impact and are thus termed diagnostic impact fractures (DIF) (Pargeter 2011).

According to Lombard (2005) and Pargeter (2011), there are four primary DIFs: step terminating bending fractures, spin-off fractures greater than 6 mm, bifacial spin-off fractures, and impact burinations (Figure 3.10). Some researchers have pointed out that this method cannot distinguish between use as an atlatl dart or an arrow point (Lombard 2005), and Pargeter (2011) discovered that DIFs can be the result of post-depositional processes such as trampling. Pargeter (2011) performed an experiment in order to determine how much of an assemblage's DIFs could be attributed to post-depositional processes. Though his experiment demonstrated that some DIFs were the result of trampling and knapping, he established a margin of error of less than or equal to 3% for evaluating assemblages for DIFs.

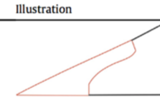
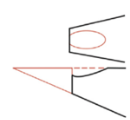
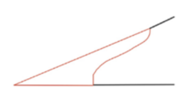
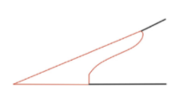
Fracture	Description	Illustration
Step terminating bending fracture (IF)	A bending fracture terminating in a 90° step.	
Spin-off fracture (bi and unifacial) (IF's)	A secondary fracture type originating from bending fractures such as step terminating or snap fractures. Spin-off fractures tend to have a feather-like termination and are concave in profile. These can be bifacial or unifacial. Only unifacial spin-off fractures >6 mm are considered in final impact fracture counts in this analysis.	
Impact burination (IF)	A bending fracture resembling a burin spall terminating in either a 90° step, feather or hinge on the lateral side(s) of a tool. These are distinguished from intentional burination by a lack of negative bulbs of percussion and crushing near the proximal ends.	
Feather terminating bending fracture	A bending fracture terminating in an acute angle or in a curve less than 90°.	
Hinge terminating bending fracture	A bending fracture terminating in an upturned curve or lip.	
Snap fracture	A bending fracture in which the bending forces act to snap the tool in a clean break.	

Figure 3.10 Descriptions of diagnostic impact fractures (Pargeter 2013)

Over the course of a three-week period in the summer of 2016, I performed a macroscopic use-wear and macrofracture analysis on 123 Yadkin and Eared Yadkin bifaces from the Savannah River Site. An AmScope stereomicroscope with a 2x objective and 10x eye pieces was used. The bifaces were examined for use-wear along the lateral edges, basal edges, the tip, and the edge along any breaks (Figure 3.11 and Figure 3.12). In addition to photos of use-wear, detailed notes were taken concerning the location (tip, lateral edges, etc.) and type of wear (nibbling, chipping, fracturing, etc.) and the type of fracture according to Lombard's (2005) and Pargeter's (2011, 2013) criteria.

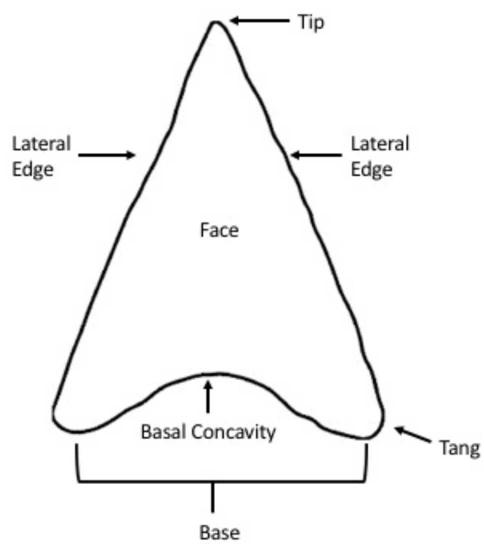


Figure 3.11 Locations on Yadkin bifaces that were evaluated for use-wear.

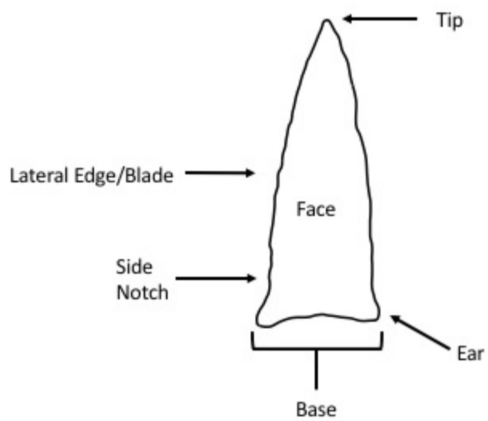


Figure 3.12 Location on Eared Yadkins that were evaluated for use wear.

The macrofracture analysis was performed using the same AmScope with 20x magnification on the bifaces from sites on the Savannah River Site. In addition to macroscopically looking for breakage patterns, the tips and edges of breaks were examined under magnification to determine whether they displayed microscopic evidence of fractures that were difficult to assign to a particular fracture type with the naked eye. The edges of the fractures were also examined for additional re-purposing or evidence of intentionally snapping the biface. Although DIFs present a difficulty in establishing that damage was the result of use an arrow points, it was useful for determining whether Yadkin and Eared Yadkin bifaces were used for non-projectile purposes (i.e. Peacock 1986).

Protein Residue Analysis

Increasing sedentism and social complexity in the Woodland period impacted many aspects of life including subsistence strategies (Fritz 1993). To demonstrate the impact a new weapons system such as the bow and arrow had on subsistence strategies such as hunting practices and prey selection, a protein residue analysis was performed on bifaces from the Savannah River Site. Protein residue analysis also provides information that is not preserved in the archaeological record such has the lashing on the shaft of the weapon. In South Carolina where the soils are very acidic and preservation of organic materials is poor, a protein residue analysis is useful where faunal analyses are not possible or where faunal remains are sparse.

Protein residue analysis uses cross-over electrophoresis (CIEP) in order to test residues remaining on the tools (Newman 2017). In this process, proteins are extracted from the tools using an ammonia solution in a small plastic boat. Each boat with the artifact is then placed in an ultrasonic bath for 10 minutes to allow the remaining protein to separate from the tool. Once the residue is extracted, it is placed in a vial, refrigerated, and then tested for reaction against anti-bodies of suspected hunting species (Newman 2017).

A total of 38 Yadkin and Eared Yadkin bifaces were submitted for protein residue analysis. Twenty-one Yadkins and 17 Eared Yadkins were selected. Because the method employed usually has a 20% return rate, efforts were made to increase the statistical likelihood of having positive results by selecting broken specimens or those with other obvious signs of usewear (Moore et al. 2016). The bifaces were tested for antibodies to bear, deer, dog, rabbit, cat, chicken, turkey, and duck (Newman 2017). The species were chosen because they were present during the Woodland period and were likely to have been hunted. Eleven of the 38 bifaces (28.9%) submitted for analysis were positive for protein residue. It is unclear whether this higher than normal rate for positive results is due to the efforts listed above or if it is because these bifaces are younger than those previously submitted and thus preservation of organic residue is better (e.g. Moore et al. 2016).

SUMMARY

In this chapter, I described the data and methods used to determine whether Yadkin and Eared Yadkin bifaces functioned as arrow points. I also discussed the morphology and variations of the different biface types as well as the difficulty presented by a lack of standardization for the metric attributes of Eared Yadkins. Yadkin and Eared Yadkin bifaces from the Savannah River Site, Hampton County, South Carolina, and the Clark's Hill/Thurmond Lake region of South Carolina and Georgia were evaluated using the classification equations from Shott's (1997) discriminant function analysis. Bifaces from the Savannah River Site were also evaluated using a use-wear and protein residue analysis. In the next chapter, I present the results of each of these analyses.

CHAPTER FOUR: ANALYSIS AND RESULTS

INTRODUCTION

The social and economic changes that take place during the Middle Woodland are reflected in the technology of the time period. While changes in pottery styles and increasing sedentism are reasonably well documented, the shift to the technology of the bow and arrow is less certain. A diminution in the size of projectile points begins at the end of the Archaic period and continues throughout the Woodland leading to the assumption that the bow and arrow had arrived and was increasingly in use, however a reduction in the size of projectiles is not sufficient evidence of a shift to the bow and arrow as other projectile technologies, such as the atlatl and the blow gun also support small projectile sizes. This chapter presents the results of the analyses of the Yadkin and Eared Yadkin bifaces from the Savannah River Site, Hampton County and Thurmond Lake areas of South Carolina through discriminant function analysis, use wear, and protein residue analysis in order to asses whether some or all the bifaces functioned as arrow points, and to understand other ways they may have been used. The analysis indicates that while Yadkin bifaces were multipurpose tools and did not function as arrow points, Eared Yadkin bifaces were specialized lithic tools that functioned as arrow points.

DISCRIMINANT FUNCTION ANALYSIS

Discriminant function analysis is a statistical means of determining group membership based on discrete metric attributes using specimens whose membership in a group is known (Thomas 1978). Once the discriminant analysis is performed on the known specimens, classification equations are produced that can then be applied to unknown specimens in order to determine the appropriate group membership.

The metric attributes for Yadkin bifaces is shown in Figure 4.1.

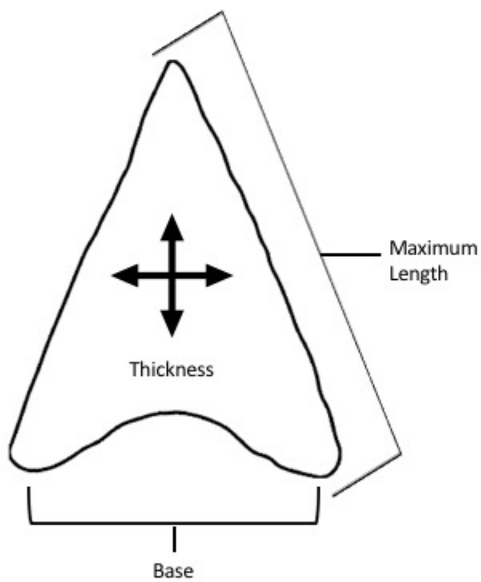


Figure 4.1 Diagram of metric attributes for Yadkin bifaces

For this study, classification equations from Shott's (1997) study of 171 hafted atlatl darts (39) and arrow points (132) were applied to 342 Yadkin and Eared Yadkin bifaces from South Carolina. Shott's study resulted in four classification equations: a four-variable equation using length, shoulder width, thickness, and neck width; a three-variable equation that uses shoulder width, thickness, and neck width; a two-variable equation that uses shoulder width and thickness; and a one-variable solution that uses only shoulder width. Equations that used length and neck width were excluded in order to increase the statistical sample, and because Yadkins are triangular and do not have necks. The equations used to determine the correct functional classification are:

One-variable solution:

Dart: 1.4(shoulder width)-16.85

Arrow: 0.89(shoulder width)-7.22

Two-Variable solution:

Dart: 1.42(shoulder width) + 2.16(thickness) – 22.5

Arrow: 0.79(shoulder width) + 2.17(thickness) – 10.6

The results and summary statistics for Yadkins that classified as atlatl darts are presented in Table 4.1. Though both equations were applied to the Yadkin assemblage, all bifaces classified the same in each equation. A total of 159 Yadkins classified as atlatl darts. Five of the Yadkin bifaces classified as arrow points. The summary statistics are presented in Table 4.3.

Table 4.1 Yadkins that classified as atlatl darts

Site	Base Width mm	Thickness mm	Length mm
38AK228 n=19	21.51-39.02	5.09-14.53	32.29-69.31
38AK157 n=5	25.95-34.55	5.44-8	33.8-52.18
38AK155 n=11	20.64-29.57	3.70-13.51	17.07-68.94
38BR450 n=5	23.01-32.37	5.46-15.91	35.97-71.82

Other SRS Sites n=23	21.44-36.79	4.32-13.43	34.73-66.91
Hampton n=79	19.07-40.45	3.93-11.58	25.71-75.26
Clark's Hill n=17	21.93-37.73	5.64-8.86	32.21-54.08

N=159

Table 4.2 Means for Yadkins that classify as atlatl darts

Site	Base Width mm	Thickness mm	Length mm
38AK228 n=19	29.68	7.39	49.78
38AK157 n=5	29.97	6.69	41.1
38AK155 n=11	25.51	6.49	33.25
38BR450 n=5	27.4	9.14	48.24
Other SRS Sites n=23	28.05	7.56	45.85
Hampton n=79	29.36	7.32	43.01
Clark's Hill n=17	27.43	7.2	41.54

n=159

Table 4.3 Yadkins that classify as arrow points

Site	Base Width mm	Thickness mm	Length mm
38AK228	15.97	5.41	34.75
38AK228	15.18	6.69	30.1
38AK335	15.56	4.82	Broken
38AK774	13.06	5.82	33.5
38AK155	17.28	4.19	27.17

N=5

Eared Yadkins were also analyzed using Shott's one and two variable equations and like Yadkins, basal width was substituted for shoulder width in the equations. Figure 4.2 shows the metric attributes for Eared Yadkins. Forty-three Eared Yadkin bifaces classified as arrow points (Table 4.4) and 68 classified as atlatl darts (Table 4.5).

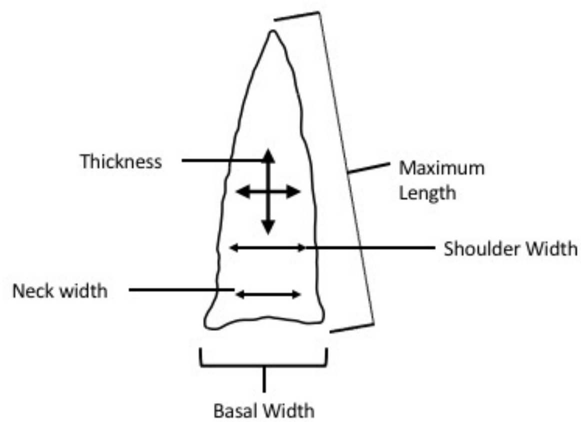


Figure 4.2 Metric attributes on Eared Yadkins

Table 4.4 Eared Yadkins that classify as arrow points

	Base Width mm	**Length mm**	**Thickness mm**
Min	10.09	25.47	1.45
Max	18.87	59.37	8.91
Mean	16.65	36.9	5.94

N=43

Table 4.5 Eared Yadkins that classify as atlatl darts

	Base Width mm	Length mm	Thickness mm
Min	18.43	25.62	3.94
Max	35.82	61.77	10.52
Mean	21.75	42.28	6.63

N=68

Due to the misconception that Eared Yadkins are related to Yadkins, there is inconsistency in the archaeological literature concerning the relevant metric attributes. Some researchers measure them similar to Yadkins (maximum length, width, thickness), while others measure them similar to stemmed forms (length, stem width, neck width). To assess whether this had an affect on the function classification of each biface, 28 Eared Yadkins form the Savannah River Site were re-analyzed using shoulder width. The SRS sample was chosen for re-analysis simply because there was consistent access to the bifaces. Those Eared Yadkins that did not have obvious or pronounced shoulders were measured at the widest point along the blade above the notches.

Ten of the Eared Yadkins that classified as atlatl darts using basal width reclassified as arrow points using shoulder width (Table 4.6). Excluded from Table 4.6 is one biface from 38AK155. This biface classified as an arrow in the two variable equation using shoulder width, but as a dart in the one variable equation using shoulder width, and also as a dart in both the one and two variable equation using basal width. The difference between the solutions for the one and two-variable equations using shoulder width is only 0.04 when it classifies as an arrow points, but is much more pronounced when the biface classifies as an atlatl dart. The classification as an atlatl dart is therefore considered correct.

Table 4.6 Eared Yadkins that classify as arrows using shoulder width

	Base Width mm	Shoulder Width mm	Neck Width mm	Thickness mm	Length mm
Min	19.08	15.86	15.4	3.94	34.83
Max	21.43	18.34	17.46	8.51	52.21
Mean	19.8	16.79	16.56	5.81	42.46

N=10

Approximately 36% of the Eared Yadkins from the SRS reclassified as arrow points using shoulder width. None of the bifaces that reclassified did so from arrow point to dart point, rather they all reclassified from dart point to arrow point.

The majority (approximately 62%) of Eared Yadkins classified as atlatl dart points and approximately 38% classified as arrow points. Two conclusions can be drawn from the discriminant function analysis. First, the results show that Yadkins and Eared Yadkins had entirely different functions. This, coupled with the fact that Eared Yadkins begin slightly earlier, demonstrates that Yadkin and Eared Yadkins are two distinct formal tool types and should be treated as such (Sassaman et al. 1990). The results also show that the bow and arrow was present by at least the early Middle Woodland. The earlier appearance of Eared Yadkins and the fact that they continue and are coeval with Yadkins, indicates that they were likely not made specifically for use with the bow and arrow at the beginning. Instead, the Eared Yadkin form that was already present was modified for use with the bow and arrow. A decrease in overall size of projectile points is thought to accompany the arrival of the bow and arrow; Figure 4.3 shows that the Eared Yadkin assemblage from G.S. Lewis-West followed that trend in both basal and shoulder width.

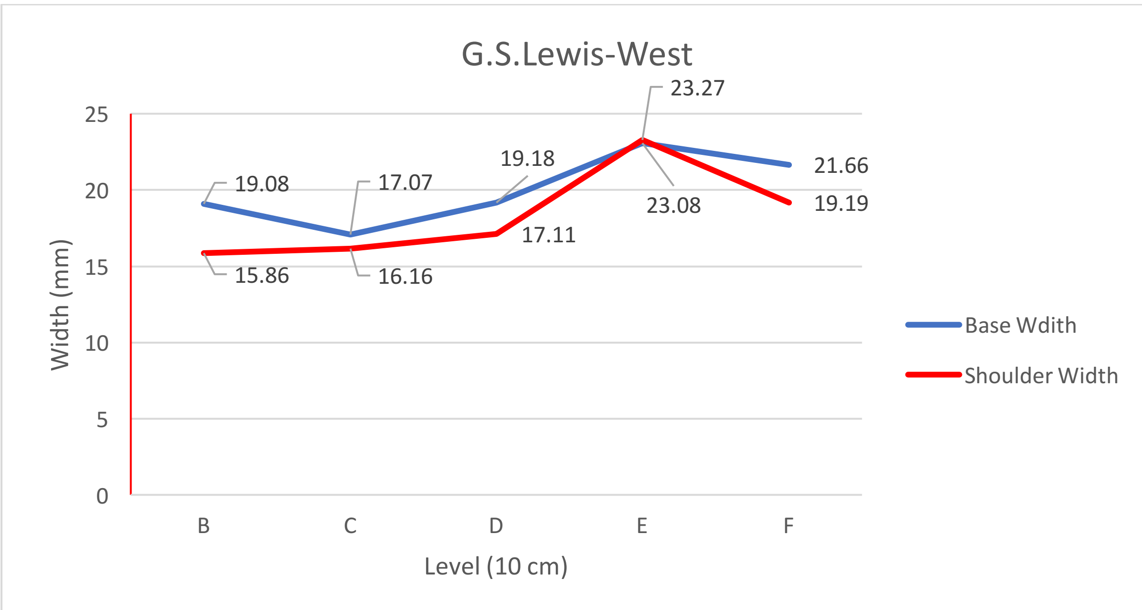


Figure 4.3 Plot by level of Eared Yadkins at G.S. Lewis-West (38AK228*)*

The functional classifications of Yadkin and Eared Yadkin bifaces shows that arrow points have should and basal widths of less than 20mm, usually between 18-19mm. It also shows that length is likely not an important discriminating attribute between the atlatl dart points and arrow points since either can be as long as 59 mm.

The discriminant function analysis shows that the bow and arrow was present as early as the Middle Woodland period in the Savannah River valley between 2350 B.P.

and 1700 B.P., though it did not replace the atlatl. These dates are considerably earlier than the Late Woodland/Early Mississippian arrival for the bow and arrow at 1250 B.P.

USE WEAR ANALYSIS

Due to the fact that there is considerable overlap in the metric attributes of atlatl darts and arrow points, a use wear analysis was also conducted on 123 bifaces from the Savannah River Site. Access to this collection was not restricted either by time or location of the specimens so it was an ideal assemblage for the use wear analysis.

The analysis was performed over a three-week period in the summer of 2016 using an AmScope stereomicroscope at 20x magnification. The tip, lateral edges, base, and tangs or ears were examined for signs of use wear in the form of chipping, nibbling, or microfracturing (Figure 4.4 and Figure 4.5). In addition, the edges along the breaks of any bifaces that were broken were examined for signs of use along the sharp edges or for signs of intentionally snapping the biface.

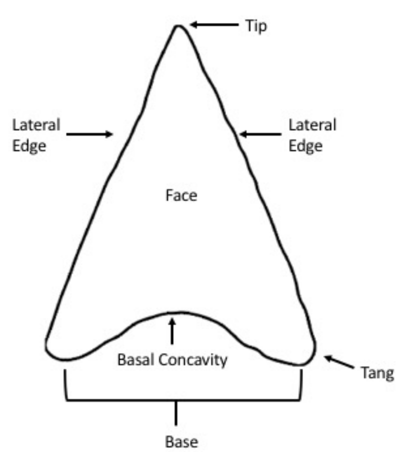


Figure 4.4 Locations on Yadkins that were evaluated for use wear.

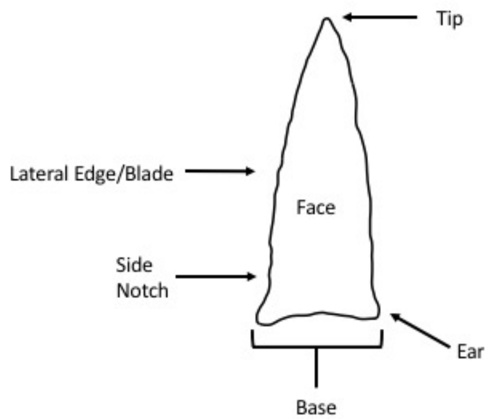


Figure 4.5 Locations on Eared Yadkins that were evaluated for use wear.

Out of the 123 total bifaces that were examined, one biface from G.S. Lewis-West did not show any signs of use wear (Figure 4.6); use wear on the two orthoquartzite samples was unobservable due to the coarseness of the raw material; and two others made from quartz showed no signs of microscopic use wear other than being broken. Fourteen other bifaces showed no signs of use wear either in the form of edge damage or breakage; one of these bifaces was likely a preform, judging from it's large and chunky morphology and another biface appeared to be a manufacturing failure. One Yadkin biface was reworked into a drill (Figure 4.7) and another was worked into a hafted scraper (Figure 4.8 and 4.9). Figure 4.10 shows a Yadkin from 38AK706 that showed signs of pressure flaking and wear on one of the tangs at the base.

Figure 4.6 Yadkin from G.S. Lewis-West that showed no signs of use wear.

Figure 4.7 Yadkin biface worked into a drill.

Figure 4.8 Yadkin biface worked into a hafted scraper.

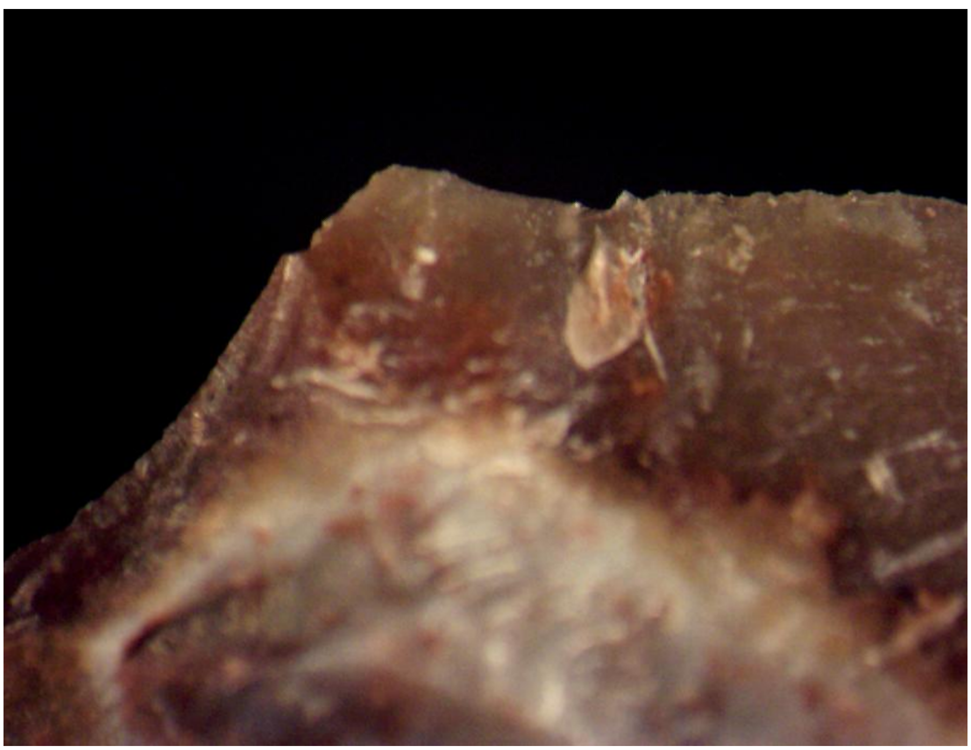


Figure 4.9 The same biface at 20x magnification showing wear on the distal tip.

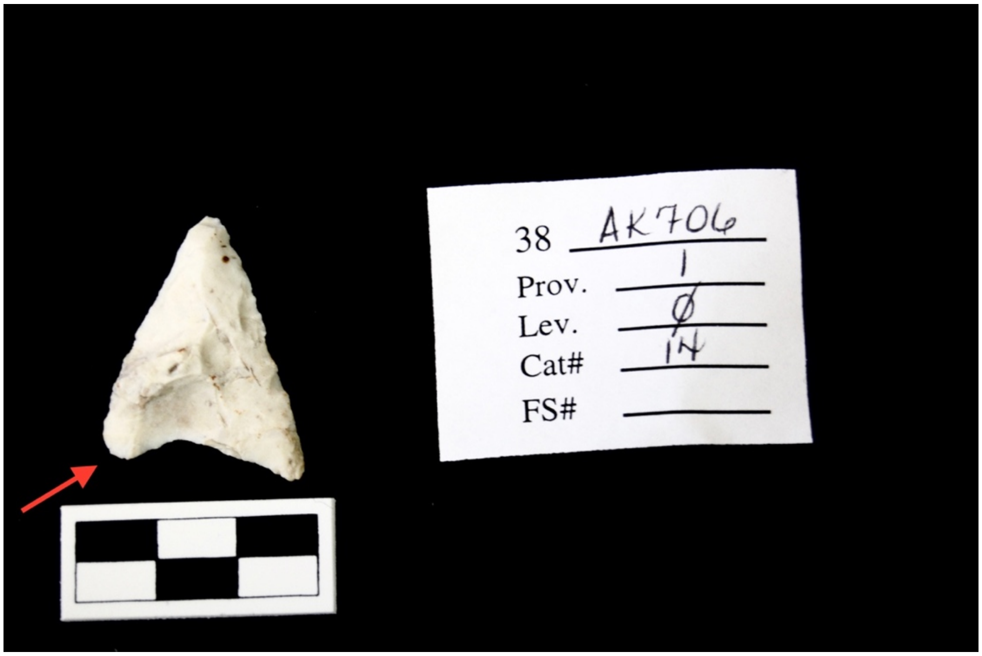


Figure 4.10 Yadkin biface with sharpened tang.

Fifteen percent of the bifaces showed signs of use wear on the lateral edges and 4 showed signs of tip rounding. Those that showed signs of lateral edge damage, did so only on one of the lateral edges, indicating that a cutting or sawing motion was the cause, but only two of the bifaces with lateral edge damage from use are Eared Yadkins. Eighty-five bifaces were broken.

In addition to analyzing the bifaces for signs of use in the form of chipping and nibbling, the broken bifaces were analyzed and categorized according to Pargeter's (2011) criteria. The SRS assemblage showed that it was common for the ears or tangs on triangular Yadkins to break, though the cause of this type of break is unclear, hafting damage is a possible interpretation. Thirty-seven or 30% of the bifaces were categorized as bend breaks or lateral snaps. A bend break occurs when bending forces exert pressure through the faces of the tool and causes it to snap, terminating with a hinge towards the distal portion (Hayden and Kamminga 1979; Sain 2015). Jennings (2011) and Sain (2015) attribute a high number of bend breaks to intentionally snapping the biface using a hammer stone. Evidence of use of a hammer stone is not present on any of the bend breaks in the SRS assemblage, but that cannot rule out intentionality. It is possible that people used the shaft as leverage to snap the biface or the fractures occurred as the tool was wrenched out of its target. The number of unambiguous diagnostic impact fractures was low for the SRS assemblage: only nine, 4 of which were Eared Yadkins and 2 of those classified as arrow points. Sassaman (1993) observed in the 38AK157 report that none of the fractures on Yadkin bifaces from that site exhibit signs of diagnostic impact fractures.

Figure 4.11 Impact fracture on an Eared Yadkin from G.S. Lewis-West.

One pattern that became immediately clear was that none of the Eared Yadkins were reworked into other tools forms, and only 3 showed signs of resharpening after use or breakage. Contrasted with the Yadkin assemblage in which two other tool forms (drill and hafted scraper) are present and with the fact that at least 3 additional Yadkin bifaces showed signs of reworking after breakage, and one showed signs of use along the edge of a break (Figure 4.12), it seems that Eared Yadkins were special purpose tools while Yadkins were used for a variety of tasks.

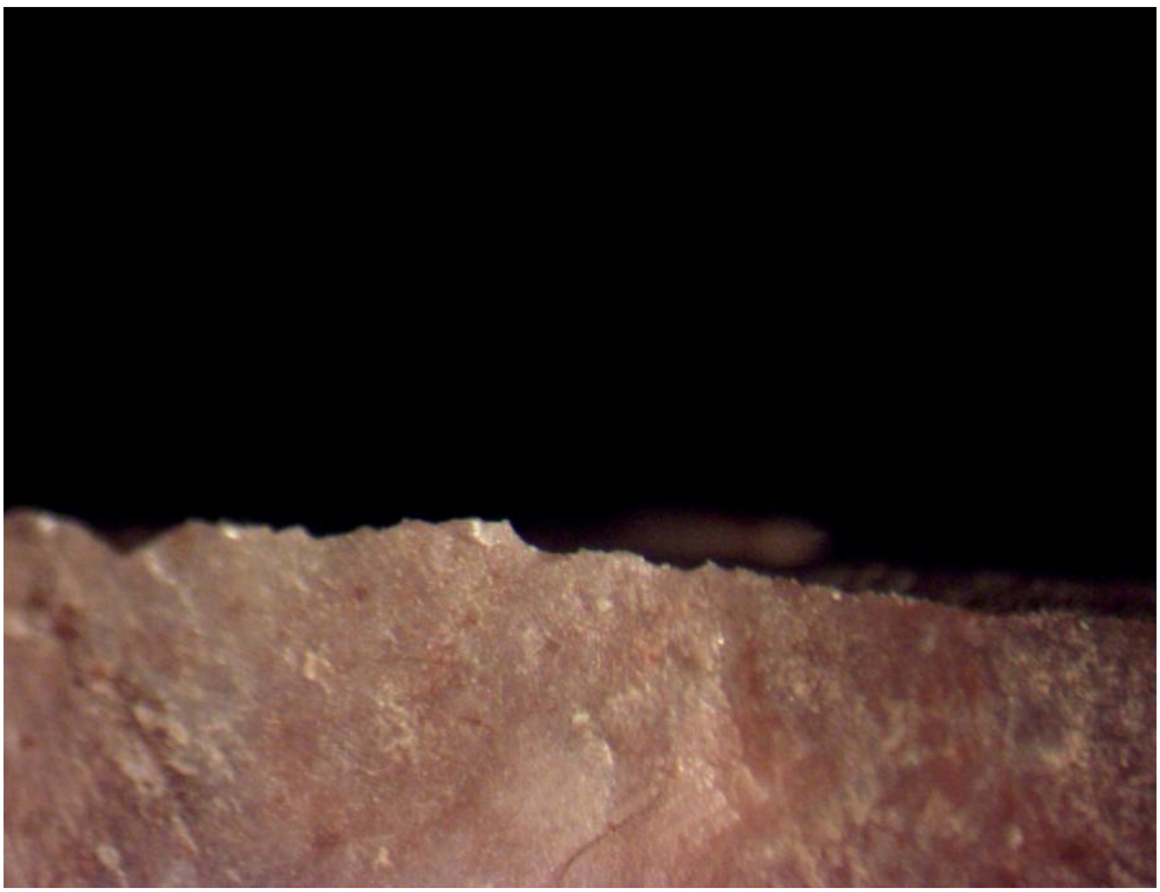


Figure 4.12 Photo of chipping along edge of a bend break on a Yadkin from 38AK390 at 20x magnification.

PROTEIN RESIDUE ANALYSIS

A protein residue analysis was performed on the Yadkin and Eared Yadkin assemblages to evaluate hunting strategies and prey selection (Hughes 1998). This method is useful in the Southeast where preservation of organic materials is poor. The method has proved useful on Archaic period bifaces because faunal remains from that time are absent in the Southeast (Moore et al. 2016). Since the bow and arrow is most useful against small and medium sized prey, residues form a higher proportion of those prey should be evident on the Eared Yadkin that classified as arrow points, than on the Yadkins.

Twenty-one Yadkins and 17 Eared Yadkins were submitted for protein residue analysis. Since this method of residue analysis usually has a 20% return rate, efforts were made to increase the statistical likelihood of positive results by selecting broken specimens or those with other obvious signs of use wear.

The analysis was performed using crossover immunoelectrophoresis (CIEP) by Dr. Margaret Newman at the University of Calgary. The analysis returned 11 positive results, a comparatively high rate. Deer was the most common species represented in the sample, being present on 5 of the 11 bifaces. It was followed by rabbit (3), bear (3), duck (2), and turkey (1) (Table 4.7). The presence of rabbit along with other animals on the same bifaces indicates that rabbit sinew was likely used for lashing the tool onto its shaft, though use as butchering or hunting both prey is equally plausible.

Table 4.7 Results of the protein residue analysis

Site	Sample #	Residue	Type	Function	Use-Wear
38AK155	1	Deer, Turkey	Yadkin	Dart	Broken
38AK155	2	Deer	Yadkin	Dart	Broken
38AK155	3	Bear	Yadkin	Dart	Broken
38AK155	21	Duck	Eared Yadkin	Dart	Broken Tip
38AK157	4	Duck	Yadkin	Dart	Broken
38AK228	13	Deer	Yadkin	Dart	Broken
38AK228	15	Deer, Rabbit	Yadkin	Dart	Broken
38AK390	27	Bear, Rabbit	Eared Yadkin	Arrow	Impact
38AK390	28	Bear	Eared Yadkin	Dart	Broken
38AK431	16	Rabbit	Eared Yadkin	Dart	Broken
38BR450	18	Deer	Eared Yadkin	Dart	Broken

All the bifaces that tested positive for residue were broken: one with a small tip fracture; the arrow had an impact fracture; and the remainder were bend breaks. 38AK155, 38AK157, 38AK390 and 38AK431 are all upland sites located along Upper Three Runs Creek while G.S. Lewis-West and 38BR450 are located on terraces of the Savannah River.

The presence of prey of all size ranges on both point types and the fact that only one arrow point was positive for residue does not prove my hypothesis that smaller prey would be present in higher quantities on Eared Yadkins than Yadkins. The results do show that Middle Woodland peoples hunted a variety of prey. Smaller bones such as those of turkey, duck, and rabbit do not normally preserve in the acidic soils of the Southeast, and these results demonstrate that they were either eaten, used for lashing or—more likely—both. Black bearskins were probably used for clothing, and bear grease was used in the historic period as an insect repellent, which likely accounts for surprising results of 3 bifaces with bear residue (Clayton et al. 1993).

CONCLUSIONS

The results of the functional analysis show that Eared Yadkins were special purpose tools and were likely reworked with the arrival of the bow and arrow. Yadkins, on the other hand, appear to be multipurpose tools, suited to a variety of tasks. When a Yadkin broke either during use or manufacturing, it was worked into a different tool or the sharp edge of the break was used to accomplish a task—much like an expedient tool.

The poor preservation of faunal remains due to acidic soils in the Southeast means that smaller prey such as birds and rabbits do not preserve well in the archaeological record. The results of the protein residue analysis can help to fill the gap of faunal analysis left by poor preservation.

The next chapter synthesizes the results of the functional analysis with the evidence for increasing sedentism and social complexity to argue that rather than providing a causal explanation for the correlation between the arrival of the bow and arrow and social complexity, there is a two-way relationship. The bow and arrow did not cause social complexity, nor did social complexity cause the adoption of the bow and arrow, the relationship between the two is more complex than simple cause and effect.

CHAPTER FIVE: DISCUSSION AND FUTURE WORK

INTRODUCTION

The primary goal of this thesis is to establish the presence of the bow and arrow during the Middle Woodland period (2450-1450 B.P.) in the Savannah River valley. A functional analysis of Yadkin and Eared Yadkin bifaces—diagnostic lithics of the Middle Woodland period—was undertaken. Yadkin and Eared Yadkin bifaces are found exclusively during the Middle Woodland Deptford phase (2350-1650 B.P.) and their unique triangular shape and basal concavity indicate they played an important role in the reorganization of Middle Woodland society.

Chapter one demonstrated the mechanics of the bow and arrow and the ways metric attributes of projectiles must match the weapons system for which they are manufactured. The deeper penetrating power, velocity, and convenience of the bow and arrow is often cited by archaeologists as evidence for an adaptationist model for embracing the bow and arrow. Ishi and De Soto, however, show that the bow and arrow was more than just a utilitarian weapon; the temple at Cofitequechi displayed elaborate works of art centered around the bow and arrow. Ishi talks about the bow and arrow as an ornamental object and states that some were used as gifts.

Chapter two established the social context for the Middle Woodland period. Increasing sedentism and social complexity can be observed in the intensification of resource procurement, cultivation, and the size and duration of settlements. During the time that Yadkins and Eared Yadkins are being manufactured in the Southeast, the Ohio Hopewell culture is dominating the Midwest. The influence of this complex society was felt as far east as western North Carolina when Biltmore and Garden Creek mounds were constructed, but it never crossed the Savannah River into South Carolina. Though the Hopewell were not able to spread into South Carolina, the Early and Middle Woodland peoples who lived along the Savannah River and the creeks and tributaries were beginning to become more sedentary and socially complex.

Evidence for seasonal habitation at the Early Woodland site 38AK157 is apparent in the structures and cooking areas of the site. Though people continued to settle in small, dispersed camps through the Early Woodland, the Late Archaic peoples foraged more often and did not stay in one place for as long. There is evidence for a shift from a formal core technology to an expedient one at 38AK157—a shift that has long been associated with the shift to more sedentary communities.

At G.S. Lewis-West, over 500 features including structural remains and storage pits were preserved beneath a Woodland and Mississippian midden (Stephenson, personal communication). Though the exact number of structures and storage pits is not yet known, there are appreciably more during the Deptford phase at G.S. Lewis-West than the Early Woodland Refuge phase at 38AK157. Storage pits, increased Maygrass seeds, and semi permanent and permanent structures are evident at the G.S. Lewis-West site. Mortuary ceremonialism is also apparent in the human and dog burials at the site.

Chapters three and four provided the methods and results of the functional analysis. In chapter three, the discriminant function analysis, use wear analysis, and protein residue analysis were introduced. In chapter four, the discriminant function analysis showed that Eared Yadkins likely functioned as early arrow points while Yadkins functioned either as darts or some other tool; the discriminant function analysis cannot classify Yadkins as anything other than arrow or dart, a use wear analysis was performed to mitigate this issue.

The use wear analysis indicated that a higher proportion of Yadkins were reworked into other tools forms (drill or scraper) or were resharpened than Eared Yadkins, none of which were reworked into other tool forms. This leads to the conclusion that Yadkins were multipurpose tools while Eared Yadkins were a specialized tool form.

In areas of the southeast where the acidic soils do not promote preservation of organic materials such as bone, protein residue analysis is a good alternative to faunal analysis. The results of the protein residue analysis showed that Middle Woodland people of the Savannah River valley made use of a variety of resources. Bear, deer, turkey, duck, and rabbit residues were found on both point types. Though each species was probably hunted or butchered with the tools, the use of rabbit sinew as lashing or bear grease as insect repellent is equally likely.

The widely accepted date for the arrival of the bow and arrow in the Savannah River valley is during the Late Woodland and Early Mississippian boundary, sometime between 1250 and 1050 B.P. when mound building and agriculture become common. This study shows that the bow and arrow was present several centuries before that, making its first appearance around 2350 B.P. during the Deptford phase of the Middle Woodland. This study also shows that it did not replace the atlatl and dart as the primary weapon but that the two weapons systems were used concurrently, despite the hypothesized adaptive advantages of the bow.

CAUSES FOR THE ADOPTION OF THE BOW AND ARROW

The reasons for the adoption of the bow and arrow and its apparent replacement of the atlatl and dart has long vexed archaeologists in North America (Ames et al. 2010; Bettinger 1999; Blitz 1988; Bradbury 1997; Christenson 1986; Hughes 1998; Nassaney and Pyle 1999; Railey 2010; Shott 1993, 1997; Tomka 2013; Webster 1980). Most archaeologists have sought explanations for the adoption of the bow and arrow through explicitly adaptationist perspectives (e.g. Blitz 1988; Blitz and Porth 2013; Hughes 1999; Tomka 2013).

The design characteristics indicate that the bow and arrow conferred a greater adaptive advantage to those who adopted it. The bow and arrow was lighter, stealthier, and easier to use in the close quarters of the Eastern Woodlands than the atlatl and dart (Blitz 1988). It is also hypothesized that it is easier to learn to use a bow and arrow than it is an atlatl and dart (Nassaney and Pyle 1999). It also penetrates deeper and is more accurate than the atlatl and dart (Hughes 1999; Tomka 2013).

Other studies attempt to account for the adoption of the bow and arrow from a social perspective (e.g. Bingham et al. 2013, Blitz and Porth 2013; Reed et al. 2013). Explanations for the adoption of the bow and arrow in these studies is still couched heavily in evolutionary, adaptationist terms. Bingham et al. (2013) propose social coercion theory as the cause for the link between the bow and arrow and social complexity. In fact, they use social coercion theory to propose that the bow and arrow actually caused societies in North America to become more complex.

Social coercion theory is based on the idea that "conflicts of interest between nonkin species (conspecifics) in crowded (Malthusian) environments limit social cooperation, preventing the formation of large, sustainable cooperative social units unless these conflicts are somehow controlled or managed" (Bingham et al. 2013: 85). They assert that it was the bow and arrow that allowed effective policing of "free-riders" in order to maintain control. According to this theory, the policing advantage of the bow and arrow allowed leaders to control workers and to construct the monumental architecture that is the hallmark of the Woodland period in certain areas and by extension the Mississippian mounds in the Carolinas—outside of the Adena and Hopewell influence areas.

If social coercion theory were adequate to explain the adoption of the bow and arrow, then there should be evidence that it quickly replaced the atlatl and dart as the primary weapon and that monumental architecture and large, Mississippian-like villages should occur immediately after its arrival. This is not the case for the Savannah River valley. Platform and other mounds do not reach the Savannah River valley until late in prehistory, circa 1050 B.P. at the beginning of the Hollywood phase. There is archaeological evidence for the atlatl and dart into the Late Woodland, and De Soto reported that it was still being used in the 16th century (Clayton et al. 1993).

There is evidence in the Yadkin and Eared Yadkin assemblage that the atlatl and dart was still being used alongside the bow and arrow during the Middle Woodland: only 43 Eared Yadkins classified as arrow points, and only 5 Yadkins. The dominance of small triangular points in the archaeological record at the Woodland/Mississippian transition (800 B.P.) indicates that there was a lag of 1600 years between the initial appearance and the adoption as the primary weapon of the bow and arrow.

DIRECTIONS FOR FUTURE WORK

Based on the results of this study and the fact that current theories are not sufficient to account for the adoption of the bow and arrow in the Savannah River valley, more work is needed. If the bow and arrow does convey an evolutionary advantage, why was there such a lag in its replacement of the atlatl and dart in the Savannah River valley? Once it was adopted as the primary weapon, why did people continue to use the atlatl and dart once they did adopt the bow and arrow as the primary weapon?

An analysis of the remainder of the lithic assemblage for the Deptford phase at G.S. Lewis-West may provide insight into these questions. Is there evidence for other biface forms that may have been used as arrow points? Were only formalized tools used as arrow points in the Savannah River valley, or is there evidence that expedient tools may have been used as projectiles as well?

Answers to these questions must not be limited to the evolutionary perspective. Though this perspective does demonstrate that the bow and arrow had performance characteristics that made it more advantageous in certain situations over the atlatl and dart, it does not account for the choices people made. Ultimately, people decide whether or not to adopt a new technology and when and how to adopt it; theories for addressing and answering the questions posed above must account for this fact.

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