Merging Social and Natural Histories at Kiskiak: A Historical Ecology Study

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Merging Social and Natural Histories at Kiskiak: A Historical Ecology Study

A thesis submitted in partial fulfillment of the requirement for the degree of Bachelor of Arts in Anthropology from The College of William and Mary

by

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Accepted for (Honors, High Honors, Highest Honors)

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Introduction

The following paper details an analysis of archaeological materials recovered from a Native site in Tidewater Virginia. The project builds on and contributes to an ongoing effort to investigate the historical ecology of Virginia Algonquian communities who dwelled at Kiskiak, a town located along the York River that was once a political center in the Powhatan chiefdom. Kiskiak is composed of several smaller sites, eight of which will be the focus of this analysis (Blanton et al. 2005; Gallivan 2016). Kiskiak’s archaeological record remains largely intact, with stratified deposits that are ideal for studies seeking a long-term perspective on the region’s cultural history. Excavations conducted by the William and Mary Center for Archaeological Research and later by William and Mary field schools, recovered a significant number of artifacts from the site, most dating to a phase known as the Woodland Period (1000 BC - AD 1600) (Blanton et al. 2005; Gallivan 2016). The primary goals of this research are twofold: to develop a tool for constructing a chronology for the Kiskiak locale and to use this method as the basis for examining the interplay between settlement intensity and changing environmental conditions during the Woodland Period.

In the past, anthropological archaeologists often explained the creation of landscapes as the result of human behavioral reactions and adaptations to given environmental conditions (e.g., Netting 1986; Steward 1955). Recently, a movement towards foregrounding people’s conscious role in the formation of landscapes has entered scholarly conversation (e.g., Balée 2006; Erikson 2008; McGlade 1999). A number of different archaeological approaches have begun to take agency seriously, including those aimed at interpreting the history of human-environmental relations. In a conscious break with cultural ecology, historical ecology emphasizes the importance of intentionality and agency of individuals and groups (Balée 2006: 77). Historical
ecologists emphasize that human-environmental relations may be either adaptive or maladaptive, though all such actions result in the creation of landscapes—broadly defined to include regional settings, built environments, representations of spaces, and experiences of places (Balée 2006). Landscapes, understood as the product of intertwined human and environmental histories, may be more or less diverse than those nature creates without human intervention (Balée 2013:3).

The first premise of historical ecology is to view landscape as the tangible manifestation of human and natural histories that are contingent (i.e. unpredictable and fully interdependent upon one another). Secondly, weight is placed on the role of human agency, the ability of an individual or group to effect change in the world in ways that are framed by social structures and cultural values. With this approach, the dichotomy between landscapes understood as only natural or social can be dissolved in order to shift towards a perspective that emphasizes “long-term social-natural co-evolution” (McGlade 1999:461).

The research discussed here likewise begins with the concept of landscape as a medium through which a greater understanding of the cultural history of Algonquian-speaking people in the Chesapeake can be achieved. During the Woodland Period (1000 BC - AD 1600), Algonquians living at Kiskiak developed an increasingly heavy reliance on estuarine resources, particularly shellfish. The transition from a foraging to agricultural lifestyle, circa AD 900, is also attested to in the stratified deposits uncovered in previous excavations by the William and Mary Center for Archaeological Research and later by William and Mary field schools (Blanton et al. 2005; Gallivan 2016). Due to the high integrity of the archaeological record at the site, Kiskiak provides an ideal opportunity to study the long-term impact these changes had on the landscape. When compared to evidence from the archaeological record that attests to fluctuations
in rainfall and temperature, further patterns between settlement intensity and the environment may be detected.

However, a firm control of time is necessary before any inferences can be made about these relationships. Archaeology has long relied on two distinct methods of telling time—relative and continuous chronologies (Kelly and Thomas 2016:104). Relative chronologies organize time by placing artifacts or stratigraphic layers in relation to one another as being either earlier or later in the sequence (Kelly and Thomas 2016:104). Relative chronologies often rely on the presence of diagnostic artifact types, particularly ceramics. Sometimes these are organized in frequency seriations, a process which creates a chronology through the changing abundance of diagnostic types (Kelly and Thomas 2016:107). As implied by the name, continuous chronologies organize time on a continuous scale. Methods used to generate continuous chronologies include radiocarbon dating, dendrochronology, and trapped charge dating (Kelly and Thomas 2016). The distinction between relative and absolute chronology parallels the difference between data that are recorded on an *ordinal* scale (small, medium, large) and those recorded on a ratio scale (10 cm, 25 cm, 53 cm).

A continuous, or “absolute,” chronology is central to any research program seeking to understand dynamic human-environmental relationships in a subtle way. For example, continuous chronologies are preferable for detecting the precise timing and tempo of changes evident in the archaeological record. As the most common method of absolute dating, radiocarbon dating provides a reliable temporal estimate, but the associated costs limit its widespread use in archaeological research projects. As a result, many researchers rely heavily on *relative* dating of archaeological contexts according to broad “phases” that often span several hundred years. However, phase-based dating, typically determined through the presence or
absence of diagnostic artifact types, runs the risk of imposing a step-like model of change rather than a continuous linear one (Plog and Hantman 1990:440).

A popular method of constructing chronologies, frequency seriation orders artifacts through time according to defined “types” that rise and fall in popularity and abundance. This approach to seriation often results in an imprecise chronology that hinders researchers from seeing the complex details of cultural change. Rather than relying on counts (i.e. frequencies) of ceramic types, an attribute-based system for inventorying ceramic sherds allows for an “absolute” seriation to be generated using linear regression analysis (Braun 1985; Klein 1994; Plog and Hantman 1990). When used alongside C14 dates from the same context, sherd attribute data may allow the researcher to produce an equation that can, in turn, be applied to undated contexts in order to round out a site’s chronology without extensive radiocarbon dating.

Essentially, the radiocarbon dates provide a solution to a simple mathematical equation that models changes in ceramic attributes. Using a linear regression equation of \( Y = mx + b \), values for the solution (Y) are provided by radiocarbon-dated contexts while values for the other variable (X) are provided by measurable ceramic attributes that change through time. In the linear regression equation, “\( m \)” refers to the slope of the line and “\( b \)” refers to the value of X when the line intercepts the Y axis (i.e. when the value of Y is zero).

Linear regression simply models the “best fit” between these variables, providing an equation that may be applied to contexts lacking radiocarbon dates. Since Kiskiak’s most intensive occupations occurred during the Woodland Period, the beginning of which is marked by the widespread production of pottery, the site stands as a promising location for a study such as this (Dent 1995:217). Through what statisticians refer to as the “least squares regression method,” I have generated an equation which seems to produce dates which are both accurate
(i.e. close to the true value) and precise (i.e. consistently exact). I then applied the resulting equation to forty contexts from Kiskiak. These dates created a reliable chronology spanning from the fourth to seventeenth century AD.

Once this chronology was in place, I used historical ecology as the guiding framework to investigate the following questions:

• How did settlement intensity change over time?
• What patterns can be identified between settlement intensity, rainfall, and temperature fluctuations?

In order to address these question, my studies relied on “proxy” data. A proxy is a measurable part of the archaeological record that stands in for direct measurements, enabling researchers to reconstruct social or environmental conditions in the past. In my study, ceramic and lithic artifact counts served as a proxy for settlement intensity. By considering the density of artifacts in a given context, a rough estimate for population size can be made across time. I drew the artifact information from the same forty contexts that produced the chronology as the data points for assessing settlement intensity. Following this, I compared data indicating rainfall variation (Cook et al. 2004) and temperature fluctuation (Cronin et al. 2005) for the same timespan against the cultural proxies. The resulting graphs were analyzed and revealed potential patterning among all environmental and cultural data at several points during the sequence. The following sections further detail both the methodology and patterns recognized in this study.

**Chronology and Time**

As emphasized above, precise control over time is crucial in archaeological investigations, regardless of the theoretical perspective driving the project. Because time is inextricably a part of the social experience, anthropology and several other disciplines have a
history of discourse on the subject. Time-reckoning, which refers to the use of culturally-specific events to understand and gauge the passing of time, has received some attention in anthropological literature (Munn 1992:96). While some events such as lunar phases and seasons occur naturally and are assigned significance by people, human agency also plays a role in the formation of “successive intervals” used to measure the passage of time (Munn 1992:102). Because each culture measures time differently according to a shared set of reference points, many notions of time exist in the world (Munn 1992:105). Some cultures perceive of time as being cyclical in nature, consisting of events that are infinitely repeating. More familiar to those of us in the Western world is a linear progression, in which time moves continuously forward without looping back on itself (Munn 1992:101).

As a discipline focused on the past, archaeology maintains a strongly contingent relationship with time. Without time, researchers would lack a fundamental context for comprehending any discoveries unearthed in excavations. Practically all aspects of archaeological research rely on time and the ability to create meaningful ways of measuring its passage in a linear fashion. Rooted in the Western notions of time and an objective (i.e. outsider’s) perspective on the past, archaeology typically applies a linear view of time, composed of uniform segments.

Building on this understanding of temporality, one of archaeology’s biggest strengths lies with its ability to piece together evidence that provides a long term perspective. Change and process are more easily identifiable than specific moments and events, largely due to the palimpsest nature of the archaeological record (Lucas 2008:62). What events are visible are often “irreversible” in nature, meaning they have such a significant impact that they create a change in the material record (Lucas 2008:63). These changes are what make the archaeological record
“self-filtering,” allowing archaeologists to construct a narrative that highlights the process of change through major occurrences (Lucas 2008:63).

It may not be possible to understand time through the archaeological record exactly as it was experienced by the Algonquians living at Kiskiak. Experienced time is subjective in nature, with moments seeming to pass at different speeds for different individuals and certain events demarcating important points in life. These variations in the rhythm of social life form significant conceptions of a temporality unique in time and space to both individuals and groups (Munn 1992:95). Because archaeology provides a long perspective on change, focused on significant moments in time, it is difficult to accurately grasp the complexities of experienced time that involve many more layers beyond what is visible to archaeologists. Nonetheless, it is important to have an objective means of reconstructing time in order to contextualize events and reconstruct histories. Since change must inevitably be measured across the passage of time, the interpretation of archaeological sites and materials often hinges on the availability of a reliable chronology.

As noted above, two distinct chronological types methods define temporal reconstruction in the discipline: relative and absolute. Absolute chronologies provide dates through independent lines of evidence, while relative chronologies are dependent on evidence that can be tied directly back into the data being studied (Lucas 2005:3). With the creation of radiocarbon dating methods, absolute dating became possible for “prehistoric” archaeologists, who often lack the advantage of written documents to date their finds. However, the associated costs limit its widespread use in many research projects. As a result, many researchers continue to rely heavily on relative dating of archaeological contexts according to broad “phases” that often span several hundred years. Unfortunately, phase-based dating, typically determined through the presence or
absence of diagnostic artifact types, runs the risk of masking much of the dynamic history of change within a culture (Plog and Hantman 1990:440). The need for greater precision at a more economical price raises an important question: Is there an alternative dating method that would allow for detailed chronological reconstruction with a minimum number of radiocarbon dates? The alternative dating method used in this study, *absolute seriation*, may be applied to ceramic attributes from 44YO2 and 44YO687 as a means of producing a reliable temporal reconstruction for the Kiskiak locale.

Applied as a phase-based dating technique, absolute seriation is a method by which artifacts are chronologically ordered according to changing attributes. This type of seriation does not produce dates precise enough to avoid obscuring minor variations in change. However, a seriation created through regression analysis of temporally diagnostic characteristics produces dates on a continuous scale with a known error factor. So long as the timespan of the sampled data is sufficiently representative, absolute seriation produces reliable dates for contexts and materials that fall within the defined range.

The need for more accurate and precise dating methods has been recognized by archaeologists for decades, especially in cases where cultural change is the primary interest of the researcher. David Braun argues that cultural processes are best understood when change is measured on a continuous scale (1985:510). In order to truly understand the “how and why” surrounding change, a detailed narrative capable of revealing conditions surrounding the period of disruption must be in place (Braun 1985:510). With this goal in mind, Braun uses a “time-series approach” to create an absolute seriation based on characteristics of ceramic pottery used in domestic food preparation in the Midwest (Braun 1985). A more complex and detailed method than the one applied in the research discussed below, time-series analysis addresses a series of
statistical inquiries through analysis of “a body of interrelated and often alternative algorithms” related to some variable across time (Braun 1985:514). However, the lines of evidence remain straightforward; radiocarbon dates and the mean thickness of ceramic sherds from the dated contexts provided the necessary information to produce a predictive model (Braun 1985:519-525). The resulting calculations generate a promising model for predicting absolute dates on a level comparative to traditional radiocarbon dating (Braun 1985:537).

The creation of an absolute ceramic seriation has also been proven effective in paleoenvironmental research through a study in the American Southwest where more precise dating helped to challenge the standing model of cultural change caused by environmental conditions (Plog and Hantman 1990). Recognizing the limitations of phase-based dating techniques, including the inability to account for minute variations, Stephen Plog and Jeffrey Hantman advocate for an attribute-based technique of chronological reconstruction (1990:441). Rather than relying on diagnostic artifact types that are by nature subject to variations, they developed an attribute-focused method which avoids imposing the gradual sense of change that typological approaches typically create (Plog and Hantman 1990:442). Using stepwise multiple regression analysis, a simpler approach than the one used by Braun, they produced an equation capable of predicting tree ring dates from corresponding frequencies in design attributes of ceramics with a relatively small error factor (Plog and Hantman 1990:445, 447). In this case, a detailed assessment of the archaeological record, made possible through absolute seriation, revealed abrupt changes in demography that were previously hidden by relative dating methods (Plog and Hantman 1990:453). Where environmental factors were once the accepted paradigm of change, cultural influences must now be considered in explanations of demographic fluctuations in the Black Mesa study area (Plog and Hantman 1990:453).
Previous research conducted by Michael Klein (1994), has demonstrated the potential power of this method of chronological reconstruction in Virginia as well. Drawing heavily from the methodologies detailed above, Klein uses multivariate regression to encompass all variables into a single-step, region-specific equation capable of calculating an absolute date (1994:29). The equation for the Tidewater region is (Klein 1994:321):

\[ Y = 1108.7742 + 0.7443 \times \text{(Mean Corrected Sherd Thickness)} - 792.2040 \times \text{(% Stamped + Plain + Fabric-Impressed + other Decorated Sherds)} +/\!- 249 \]

This equation provides estimated dates with an error factor of approximately 250 years, a significant improvement over phase based dating using diagnostic ceramics. For example, the Townsend series of ceramics has a documented dates range from AD 890 to AD 1590 (Egloff and Potter 1982). Problems remain, though, in Klein's equation. Since many of the radiocarbon dated contexts available for Klein's study post-date AD 1100, the equation generally produces results in that date range for the ceramic attributes typically found in the region. Ceramic production in the Tidewater region began as early as 1000 B.C., and the dating equation covers only the last part of this cultural sequence. As a result, this equation only accurately produces dates for a narrow time frame that omits much of the early history of habitation at Kiskiak. Since the ceramic evidence extends several centuries farther into the past, a new locally-applicable equation is needed.
Equation for the Kiskiak Locale

While all of these studies use statistical means to produce an absolute seriation, my research most closely parallels Klein’s. In accordance with Klein's approach, I recorded a range of ceramic attributes for possible inclusion in a linear regression equation. Again following Klein’s approach, I used the archaeological context as the unit of analysis (i.e. how each case in the data set are distinguished from one another). In other words, rather than using an individual ceramic sherd or a reconstructed vessel as a case in the data set, cases in my data set record the information from a group of sherds recovered archaeologically from a stratigraphic layer. In this way, I was able to calculate mean values (for variables measured on a ratio scale) or percentages (for variables measured on a nominal scale). Radiocarbon dates were used in their uncalibrated form, again in accordance with Klein’s approach. Calibration allows the researcher to match radiocarbon dates to calendrical dates by adjusting for small variations in atmospheric carbon. However, calibration adds another layer of mathematical complexity to the process, potentially obscuring problems in the absolute seriation. As with Klein's the absolute serration dates developed by my equation may, of course, be calibrated.

In order to arrive at an equation, it was first necessary to determine which variables vary with time in a patterned way. Within the Chesapeake, archaeologists have long observed a chronometric patterning of Native ceramic surface treatments and sherd thicknesses (Dent 1995; Egloff and Potter 1982; Klein 1994). Generally, ceramic vessels became thinner through time, likely due to changes in foodways and settlement patterns. As Native groups in the Chesapeake came to rely more heavily on boiled stews, eventually including those in which maize was the main ingredient, thinner vessel walls provided a more efficient means of transferring heat to the contents of a pot. As these groups shifted from foraging to agricultural, settling more
permanently in riverine towns, thinner, more fragile vessels became a viable option. Ceramic surface treatments varied through time and across the Chesapeake in a patterned way as well. A shift from cord-marked and net-pressed surfaces toward fabric-impressed and simple stamped surface treatments is evident across the coastal plain (Egloff and Potter 1982). These changes in ceramic production methods—a shift toward thinner vessels and those impressed with fabric or stamped with lines—offer promising avenues for building an absolute seriation.

In accordance with laboratory protocols for inventorying artifacts, sherd thickness and late surface treatment attributes (plain, simple stamped, or fabric-impressed) were quantified, then used in conjunction with seven radiocarbon dates spanning the history of occupation at 44YO2. The same laboratory steps were taken and joined with one radiocarbon date from 44YO687, to produce an absolute seriation when combined with the data from 44YO2. As noted above, the values used in the equation refer to average measurements or percentages, both keyed to the sample of sherds recovered from an archaeological context.

Since sherd thickness has proven to have a direct functional association with changes in cooking practices resulting from the shift to an agricultural lifestyle (Braun 1985:518), it was quickly chosen as a temporally-sensitive variable. In theory, a general decrease in thickness over time should be expected. However, the average thickness of sherds from the 7th century AD (roughly the midpoint for the timespan covered by the data) unexpectedly appeared to increase before following the anticipated pattern. While this suggests the possibility of a nonlinear relationship, it should be noted that the small sample size used in this research makes it difficult to definitively say either way.

The decision to limit the percentages of surface treatment attributes to only those appearing in the latter half of the Woodland Period came as a result of experimentation; the
statistical significance of the equation was highest (0.001) when only late surface treatments were included. In order to confidently assign a surface treatment, all sherds smaller than two centimeters were excluded from the analysis entirely. Overall, these patterns make it possible to develop a quantitative tool for dating individual contexts containing Native pottery.

The earliest context was radiocarbon dated to 1640 BP (or AD 310), placing it firmly in the Middle Woodland Period (Fig. 1). The average thickness of the sherds collected and analyzed from this context is 7.63 millimeters. Out of a total of twenty-one sherds, thirteen are too eroded or small to confidently assign a surface treatment and one is smaller than the two centimeter cut-off. The remaining seven sherds are either cord-marked (2) or net-impressed (5), resulting in a late surface treatment percentage of zero.

Bracketing the opposite end of the timespan covered in the equation, the latest context dates to 260 BP (or AD 1690) (Fig. 1). Average thickness of sherds from this late 17th century context is 6.88 millimeters. A larger sample size of 178 sherds was analyzed, twenty-three of which were ascribed surface treatments and met size requirements. Only one early surface treatment sherd was present, totaling the late percentage at 95.65. All three designated late surface treatments are accounted for: four plain (including those with decoration), fourteen simple stamped, and four fabric-impressed.

The remaining six dated contexts fall between these two endpoints and follow a predictable pattern, creating a linear relationship that can be modeled by statistical means. The following equation was generated through what statisticians refer to as the “least squares regression method”:
Date BP = 2170.536 - 13.534 X(percent late surface treatment) - 71.551 X(mean sherd thickness in mm) +/- 172

A least squares regression line is “the line that has smallest sum of squared residuals,” or squared vertical distances between the data points and the line itself (Norušis 2010:452). In using this method, a good fit between the data and the regression line is achieved because the line is closest to all points on the scatterplot (Fig 2). The Pearson correlation coefficient, which describes how well the model fits the data (Norušis 2010:453), is 0.967, indicating a strong positive correlation between variables. Moreover, the proportion of explained variation of the predicted dates, measured by the R squared value (Norušis 2010:457), stands at 0.935, indicating that approximately 94% of the variability in the dependent variable (date BP) can be explained by differences in the independent variables (i.e. sherd thickness and surface treatment). As long as the necessary sherd information is available, this equation will allow absolute dates to be calculated for excavated contexts with a relatively modest error factor of plus or minus 172 years. With a method for tracing Kiskiak’s chronology on a continuous scale in place, the process for selecting contexts for dating began.

A limited Phase II survey of the Naval Weapons Station identified twelve prehistoric sites, eight of which contained contexts used in producing the final chronology. While the equation is capable of producing a date for a context containing any number of sherds, it does not take into account how sample size and other variations could affect the estimate. Therefore, specific parameters were assigned to each potential context in order to determine which would compose the final chronology.
Both WMCAR and the William and Mary field schools excavated the sites according to stratigraphic levels marked by changes in soil color, followed by arbitrary levels assigned by the archaeologists as they excavated. Working under the assumption that strata more accurately reflect a period of similar cultural interaction than arbitrarily assigned levels, each level was combined into its respective stratum. Measuring the sherd count using the stratum as the unit of analysis also helped produce sample sizes large enough to confidently apply to the equation. Although every inventoried stratum was dated, it was immediately filtered from the results if fewer than fifteen sherds were counted. All features were excluded from the final chronology as well because they frequently represent a single moment in time. Most often indicating a potbust, including such a feature would weigh the sherd count heavily away from the average presence of artifacts in favor of a single event. Including potbusts runs the risk of imposing a higher degree of settlement intensity in that particular stratigraphic layer than is present in reality.

Finally, interpretations of Kiskiak’s history and the archaeological record as a whole contributed to the final selection of accepted dates. Within any given test unit, some dates were accepted while a small number of others were rejected simply because they were out of sequence. In rare instances, test units contain earlier deposits towards the surface, with later ones buried deeper. This is likely caused by erosion that has had a greater impact across certain parts of the locale more than others. Because these top layers are obviously disturbed, they were excluded regardless of the number of sherds recovered. If the later deposits appeared to be undisturbed and in sequence, they were regarded as acceptable for use. For example, at 44YO687 in test unit 19, the first stratigraphic layer containing ceramics dates to 599 AD, while the remainder of the layers dates consecutively from 1586 to 696 AD. Since majority of the sequence falls within an expected and reasonable timespan, those dates were accepted whereas
the first one was filtered. With these parameters in place, a total of forty dates was accepted, creating a continuously scaled chronology from 1630-331BP (320-1619AD).

Since the control of time is crucial in all archaeological investigations, having a method for tracing Kiskiak’s chronology allows for future research to expand in many directions. Environmentally-focused research programs like historical ecology produce the most satisfying results when a firm chronology is in place. Due to the high integrity of the archaeological record, Kiskiak provides an ideal opportunity to study the long-term interactions between humans and changing environmental conditions. The following section details the use of historical ecology as a framework for preliminary pattern recognition between settlement intensity, rainfall, and temperature variations for the constructed chronology.

**Historical Ecology**

Historical ecology is a relatively new research program that emerged as a response to previous theoretical frameworks, especially cultural ecology. Stemming from the move towards more scientific approaches to archaeology in the mid-twentieth century, cultural ecology views the environment as “an immutable given or fixed entity to which human societies adapt” (Erickson 2008:157). Cultural ecology takes a strong functionalist approach to adaptation by insisting that change within a culture is induced by necessary adjustment to a fluctuating environment (Steward 1955:5). The basic assumption is that poor environments produce simple societies whereas rich ones result in complex chiefly or state societies (Erickson 2008:157-158). Any change within a culture is “basically traceable to new adaptations required by changing technology” (Steward 1955:37). At any point in time, these new technologies are either
“permissive or prohibitive” with respect to the environment within which the culture exists (Steward 1955:38).

The major problem with this research program, which historical ecology attempts to rectify, is the exclusion of “human agency and intentionality” in the formation of landscape (Balée 2006:77). Rather than exerting a lasting and impactful influence on the local environment, societies adapted to the constraints placed upon them by nature (Balée 2006:76). By removing choice and freewill from the equation, cultural ecology overlooks an important part of human nature. Moreover, cultural ecology emphasizes a linear relationship between the natural world and the creation of indigenous technology (Balée 2006:76). More complex social phenomena is unexplainable “because the core postulates are based on the environmental determinism of societies with simple technologies” that follow the linear relationship model (Balée 2006:79). Without a means to explore social-natural connections in high-level societies, cultural ecology’s principles are unreliable and in need of adjustment.

Partially influenced by German landscape gardeners and landscape painters in Europe, geographers first proposed the “inseparability of humans and the environment in the context of a landscape” (Balée 2006:77). As many disciplines began to adopt this line of thought, historical ecology emerged as a research program that challenged past notions of human-environmental relations. For archaeologists, the landscape became the unit of analysis, recognized as having as many historical and cultural dimensions as evolutionary ones.

Thus, historical ecology embraces two key themes: agency and contingency. From simple band societies to complex social states, the research program recognizes humans as “agents of history manifesting cultural pasts” (Balée 2006:77). As agents, they practice a form of resource management that in turn etches the land with markers of the past (Balée 2006:77; Erickson
Historical ecology does not ignore ecological processes, but recognizes the complex and contingent relationships between the environment and human populations (Erickson 2008). The “result of their cyclical interaction” is manifested in the world as an engineered landscape (Balée 2006:82). Archaeologists study this landscape through an examination of “continuity and disjuncture” in the archaeological record, which attests to “the successes and failures of human strategies” (Erickson 2008:159).

Several anthropologists have been successful in applying this paradigm to their research, particularly in Amazonia (Balée 2013; Erickson 2008; Heckenberger et al 2008). The Amazon is typically thought of as one of the few regions of the world that remains natural and largely untouched by humans. However, recent archaeological evidence points towards an extensive number of anthropogenic features in the Amazonian landscape, including ring ditch sites, mound building, and raised fields (Erickson 2008:165). These features support the theory that the Amazon is not a pristine environment, but rather resembles a highly managed garden in an anthropogenic environment (Erickson 2008:158). Amazonian peoples were able to thrive because they “created, transformed, and managed” the environment around them (Erickson 2008:165).

Furthermore, an area known as the Upper Xingu basin in Brazil provides striking evidence for “self-organized built environments” (Heckenberger and Neves 2009:258). Linear earthworks in the archaeological record demarcate roads purposely engineered along solstice axes, as well as a north-south axis that served as a primary route for regional circulation of goods (Heckenberger et al 2008:1216). Along these roads are “wetland features such as raised causeways, bridges, and canoe canals,” clearly indicative of purposeful manipulation of the environment on behalf of the communities living in the landscape (Heckenberger et al
Together, these features link dispersed communities in the basin through a mosaic of intense human influence and relatively undisturbed forest (Heckenberger et al 2008:1217). Urban civilization is traditionally associated with a strong sense of centrality, which is seen in ancient Egypt and Mesopotamia (Heckenberger et al 2008:1217). Studies such as this underscore the importance of historical ecological approaches by demonstrating complex societies exist outside of this classical model.

Historical ecology has also been applied as a research program in California. The eight Channel Islands are located off the coast of Southern California, and have never been connected to the mainland during human occupation (Rick 2013:44). Relatively isolated, these islands nonetheless are home to a number of endemic mammals including island deer mice, harvest mice, and island foxes (Rick 2013:61). While it is possible for animals to reach the islands via swimming and “natural chance rafting events,” it is postulated that hunter-gatherers brought at least these three animals to the islands (Rick 2013:61). Through the introduction of new species into the islands’ ecosystems, humans altered their environment in a way that cannot be considered anything other than purposeful.

Out of the case studies presented here, Victor Thompson’s work on shell middens along the Georgia coast is closest to the environment and landscape at Kiskiak. Thompson argues that shell deposition “fundamentally altered the ecosystem by both creating and modifying upland habitats” (Thompson et al 2013:80). The marsh environments lining the coast are subject to sea level fluctuations which alternatively submerge landforms and reveal them (Thompson et al 2013:93). Shell middens formed by humans helped to “create or maintain upland environments” in spite of rising sea levels (Thompson et al 2013:93). As a result, the Georgia coastline was built overtime in concert with native communities’ use of the landscape (Thompson et al 2013:95).
Although not as applied in the archaeology of Native peoples in eastern Virginia, a historical ecological investigation of Kiskiak materials could aid in a shift towards exploring the deep history of the Chesapeake region in ways similar to those applied in Georgia.

**Chesapeake Regional History**

Before delving into the results of my research, knowledge about the region’s cultural history is necessary. During the transition from the Archaic Period to the Woodland Period, both sedentism and interaction between native communities increased (Blanton 1992; Dent 1995). Expansive trading networks began to form through the Middle Woodland (500 BC - 900 AD), before seeming to dissipate in the latter half of the period (Dent 1995). This is seen archaeologically through the homogenization of ceramic and lithic technologies (Dent 1995). With the arrival of Algonquian-speaking groups into the region somewhere around 100 to 200 AD (Potter 1993), it is possible that social or linguistic barriers attributed to the change in trading patterns (Fiedel 1987). It also seems possible that increased sedentism can be connected to the limitation of territories associated with the arrival of the foreign groups. In another perspective, Blanton suggests that an increase in population may have contributed to the rise of sedentism during this period (1992). Subsistence still largely consisted of native plants and animals (Blanton et al 2005), but the pressure of rising populations may have encouraged groups to remain in one location and begin to supplement traditional hunter-gatherer activities with agriculture (Blanton 1992). It is towards the end of the Middle Woodland, certainly by 1000 AD, that agriculture arrives in full (Blanton et al 2005:4). The adoption of agriculture likely contributed to the rise in popularity of ceramics as well, now in use for storage and cooking purposes (Blanton et al 2005:8). By the Late Woodland (900 - 1600 AD), sedentary village sites
were popular across the region, with agricultural practices having been integrated into society enough to produce “dietary staple[s]” (Blanton et al 2005:10). These are the subsistence and settlement practices that were in place during the time of the Powhatan chiefdom at the point of contact with Europeans.

Kiskiak’s history largely follows expected settlement patterns for the region. Situated on the mouth of Indian Field creek, which feeds into the York River, the sites contain evidence for sporadic occupation dating to the Archaic period up through more permanent settlement at Contact (Blanton et al 2005). Multiple sites have been recognized in the area, including 44YO2, likely the focal point of the community during the protohistoric period. Together, these sites and the archaeological material recovered from them, allow for a cultural history to be matched against an independent environmental record. As noted in the discussion surrounding chronology construction, eight sites partially composing the greater Kiskiak locale contributed cultural materials for the pattern recognition detailed below.

**Pattern Recognition at Kiskiak**

Once the forty contexts had been dated using the equation I generated, the next step was to plot the artifact counts of both ceramics and lithics on a line graph (Fig. 3). The fluctuation in count stands as a proxy for changing settlement intensity over time. I assume that the lower the count, the fewer people inhabiting the area, and vice versa. In order to investigate the Kiskiak community’s interactions with the environment, data attesting to environmental change through time is also needed; I chose to examine the connections between temperature and rainfall.

Beginning with temperature, I looked to reconstructions headed by Thomas Cronin, who used “Mg/Ca ratios from ostracodes and oxygen isotopes from benthic foraminifera as proxies”
Greatly simplified, ostracodes and foraminifera are marine crustaceans and protists respectively that are sensitive to water temperature change and can be found abundantly in aquatic environments (Cronin et al 2003; Cronin et al 2010). Sediment cores taken from the Chesapeake Bay contain the remains of these creatures, which are then analyzed for their compositions (Cronin et al 2010:302). The compositions are indicative of the ocean temperature at the time the creature died, thus allowing for a continuous and nuanced temperature record to be built in cooperation with the chronology available through the sediment core. In the published data set used in their study, Cronin et al offer a nine-point smoothed temperature value that “smooths out” some of the jumpiness inherent to the data (2005). These smoothed values represent the data I chose to incorporate into my research.

After obtaining the data for temperature, I then turned to drought reconstruction as a means of measuring rainfall amounts during the centuries covered by my constructed chronology. Drought is measured on a scale known as the Palmer Drought Severity Index (PDSI), ranging on a scale of positive values for wet conditions and negative values for dry ones (Palmer 1965). Cook et al used “climatically sensitive tree-ring chronologies” to reconstruct drought severity across the continental United States through time (1999). As with the temperature data, the PDSI reconstruction was so detailed that interpretation without simplification of the data yielded no comprehensible results. Taking the published raw data for the Chesapeake area (Cook et al 2004), I calculated the thirty-three year mean from the thirty-three years prior to the date assigned the value. A thirty-three year average was decided upon after dividing the timespan covered by my reconstructed chronology by the number of data points for settlement intensity (40). As a result, the PDSI data became more manageable and close to the sample size of the other variables.
With cultural and environmental data in place, all four variables were used to create a line graph. However, due to the difference in the range of values inherent to each data set, the resulting graph produced no decipherable patterns (Fig. 4). The decision was then made to calculate the Z-score for all data points. A Z-score is a statistical measurement of a number’s relationship to the mean and standard deviation of a batch of numbers (Norušis 2010). The Z-score of each value ranges, positively or negatively, from zero (the mean value) (Norušis 2010). A Z-score of 1 results from a case value that’s one standard deviation above the mean. A Z-score of -1 results from a case value that’s one standard deviation below the mean. By converting all values for each variable, the results can be accurately compared against one another on the same measurement scale. Once I calculated the Z-scores for all categories, the data were graphed again, this time with more enlightening results (Fig. 5).

Figures 6 and 7 show only temperature overlaid with ceramic and lithic counts. Cronin et al (2010) states that the temperatures around the Chesapeake Bay area actually peaked between 600 and 950 AD, centuries before the traditional dates for the Medieval Warm Period (MWP) of 800 to 1300 AD (Cronin et al 2003). (The first two vertical bars in figures 6 and 7 reflect the traditional dates for the MWP.) Pattern recognition for this crucial time is difficult due to the lack of cultural material dating to the latter half of the region’s warm period. Lithic artifacts appear to maintain a relatively continuous presence, neither rising nor falling drastically. However, roughly one hundred years into the warming period, ceramic counts increase before falling back to previous quantities. Because of the limited data for the timespan in which this drop occurs, the apparent decrease may not actually be present in the artifact population. If one assumes warmer temperatures result in improved yield from plants, ceramic use in storage may have increased as people began to adopt plant husbandry practices.
After the beginning of the Little Ice Age (LIA; ~1400 - 1900), marked by the third vertical bar in Figures 6 and 7, a stark difference between the two variables is apparent. At this point, communities had become largely sedentary and agriculture was a prominent part of subsistence practices. Cooler temperatures may indicate shorter growing seasons, which in turn effects the amount of food produced. Under a cultural ecology research program that does not provide much room for human agency, one might expect to see settlement intensity drop due to a lack of food. The pattern visible here indicates both lithic and ceramic counts actually increased at a time when temperature was steadily dropping. Whether this is due to the choices the Kiskiak community made regarding subsistence cannot be proven here, but it does prompt further investigation.

Figures 8 and 9 depict rainfall fluctuation alongside the same cultural materials. Compared to the end of the sequence, fewer correlations are seen in the beginning, possibly due to higher mobility and less reliance upon agriculture. A spike in both lithic and ceramic counts appears from approximately 400 to 550 AD, aligning with an increase in rainfall. However, the correlation does not appear to remain in the next 200 years, when rainfall continues to decrease as artifact counts climb once again. As a culture not yet reliant upon sedentary agriculture, the impact of rainfall variability would not be as high on a community still primarily engaged in traditional hunter-gatherer activities. Just as with temperature, more correlations begin to emerge after the beginning of the LIA. A correlation between both cultural materials and rainfall is present, again possibly related to the inclusion of agriculture. Interestingly, the cultural lines appear to respond to environmental change. The correlation is strongest with ceramic counts, strengthening the possibly of agricultural-related change. However, this does not necessarily point towards a deterministic model (Steward 1955). The error factor of the equation (+/- 172)
may contribute to the mismatch, in which case viewing the changes as responsive in nature might not be accurate.

**Conclusions**

The interpretations offered in this paper are only preliminary findings. It is most important to note that correlation does not equal causation. While the correlations are present within the data, causations are not known for certain. The patterns discussed here offer possible relationships and explanations, but need further study before any statements can be made with confidence. Moreover, improvements to the equation through additional radiocarbon data for the Townsend period (840 -1590 AD) may potentially provide clarification for the underrepresented timespan.

No correlations discussed here are conclusive, but they are indicative of possible connections between the communities living at Kiskiak and the landscape they dwelled in. As such, further study is needed to reveal additional correlations between settlement intensity and the environment. This research serves as a pilot study for such investigations, and endorses the usefulness of historical ecological approaches in the region. At this point, it appears that the communities living at Kiskiak did in fact respond to environmental changes at times during the sequence produced by my equation. However, there are also timespans during which the cultural proxies seem to suggest a more complex story that goes beyond an adaptation response. To really explore the potential behind this study, the sample size for the dated contexts should be expanded to include dates that fall within the Townsend period. With such nuanced data available for the environmental variables, an increase in the archaeological data would almost certainly provide a clearer picture of human-environmental interactions at Kiskiak.
With the modern world continuously threatened by overexploitation of resources, pollution, and global climate change, an understanding of the role humanity plays in shaping the world has never been more important. Archaeology has the potential to provide a long-term perspective on human-environmental relationships, a viewpoint lacking in many of the disciplines that seek to understand environmental change. By recognizing the recursive links between humanity and the environment throughout history, it may be possible to learn from the past and prevent future mistakes. The results of this study provide a promising methodology that could add to the knowledge of past socionatural relations, helping to foster a better approach to environmental stewardship in the modern era.
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Figures

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Fig. 1: Data from ceramic inventory and radiocarbon dating results used in the production of the equation.
Fig. 2: Least squares regression line generated from a comparison of radiocarbon dates to the dates produced by the equation.
Fig. 3: Artifact counts for ceramic and lithics across time (FCR excluded from final analysis)
Fig. 4: Original graph of all environmental and cultural variables, before Z-score
Fig. 5: Graph of all cultural and environmental variable using Z-score values
Fig. 6: Lithic counts (blue line) alongside temperature values (green line)

Fig. 7: Ceramic counts (blue line) alongside temperature values (green line)
Fig. 8: Lithic counts (green line) alongside PDSI values (blue line)

Fig. 9: Ceramic counts (green line) alongside PDSI values (blue line)
Fig. 9: List of all eight sites used in the formation of the final chronology

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