Modeling Belle Glade Lithic Use Behaviors: A Case Study from Highlands County

Article · January 2014

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MODELING BELLE GLADE LITHIC USE BEHAVIORS: A CASE STUDY FROM HIGHLANDS COUNTY

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Introduction

The study of lithics (i.e., the contextual analysis of stone tools and debitage) provides archaeologists with an opportunity to examine a resilient category of material evidence that has the potential to signify both behavior and chronology. Lithic assemblages are investigated by archaeologists in North America and around the world as chronological markers diagnostic of specific cultural horizons and as indicators of cultural behavior. Archaeologists study cultural activity related to raw material procurement, reduction techniques, and tool design associated with categories of behavior such as hunting, fishing, and food processing (Andrefsky 1994, 2008a, 2008b, 2009, 2012; Jelinek 1976; MacDonald 2008; Odell 1980, 1981, 1988, 2000, 2001, 2003; Shott 1993). What we consider here is how might human behavior in an area where lithic resources are absent differ from behavior in an area where they are abundant? With this research, we construct a predictive model designed to engage this question from the perspective of a case study in an environmental context lacking lithic resources. The model proposed in this study we have called The Regional Model of Lithic Dispersion.

In south-central Florida, raw materials necessary for the manufacture of stone tools are rare, or even nonexistent. Yet, the scarcity of lithic resources containing tool-stone across the landscape does not restrict one's ability to strategically interpret cultural behavior. On the contrary, Andrefsky (1994:23) asserts that the availability of such resources represents the most significant factor influencing the "organization of technology." Lithic assemblages within such an area may be applied toward answering questions related to the impact of geomorphological characteristics of the landscape on human behavior. This context provides an unparalleled opportunity to consider research questions such as how village location relative to a chert outcrop affects patterns of discard, curation, and conservation of lithic materials, or how lithic manufacture practices are affected by a lack of locally available tool-stone.

South-central Florida provides an excellent case study for the archaeological examination of a region containing significant archaeological resources but lacking locally available lithic raw materials (Figure 1). This paper presents an analysis of the lithic assemblage from the largest prehistoric Belle Glade Village site in Highlands County (the Blueberry site, 8HG678) to examine lithic-use behavior associated with the Belle Glade culture in this region. The site represents the only sustained, research-driven public archaeology project in the County, providing detailed excavation records and meticulously organized lithic data that could be applied toward this study. Therefore, this site was chosen as a case study because of its location, approximately 55 kilometers from the nearest naturally occurring tool-stone source (Austin 1997), and because of the well-organized lithic dataset it provided. Additionally, this site was chosen because the lithic dataset was previously summarized by the authors (Butler 2008a; Butler and Lawres 2011), and because a sample of tools from the lithic assemblage had previously been sourced to the outcrop of their origin (Austin 2008). This previously completed work provided a dataset that was prime for analysis; the sourcing data facilitated an additional layer of interpretive potential by providing the ability to conduct a contextual investigation of trade and interaction while prioritizing lithic-use behavior.

Since it is known that tool-stone sources are distant from all interior Belle Glade sites, it is the objective of this paper to provide a case study demonstrating how this environmental constraint has the potential to impact lithic assemblages in this context and how the inhabitants of Belle Glade sites implemented strategies to deal with this constraint. While it has been established that this constraint has the potential to affect assemblages (Andrefsky 1994, 2009; Austin 1997; MacDonald 2008; Newman 1994; Odell 2000, 2001, 2003), this study specifically questions how the environmental context of south-central Florida shapes the organization and structure of lithic assemblages, as well as the behaviors associated with them, at archaeological sites in this region.

Rather than reporting on the categorization of finished tools or elements of tools such as use-wear or re-use (i.e. Austin 1997), this study explicitly focuses on what can be learned from investigating the density and type of tools, and extant reduction sequence stages relative to raw material proximity. Consistent with this goal, our research questions

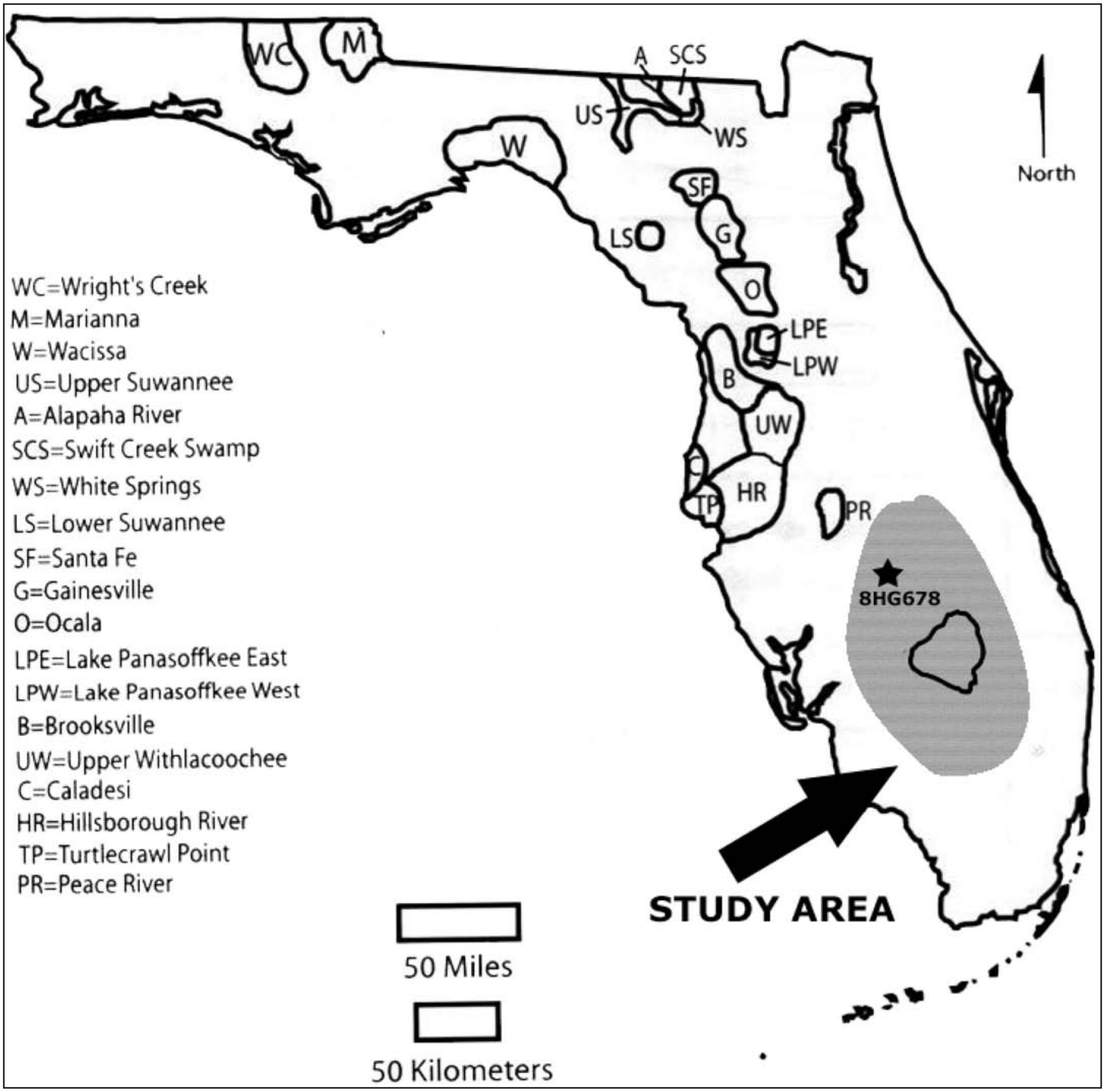

Figure 1. Location of study area (shaded area; Kissimmee River Valley and Okeechobee Basin) and the Blueberry site (8HG678) relative to lithic sources in Florida. Modified from Endonino 2007:91).

how this environmental context may impact patterns of lithic manufacture and use as well as how it may affect human activity related to the acquisition, use, and provisioning of tool-stone at Belle Glade sites in interior south-central Florida. Specifically, we posit that Belle Glade peoples exhibited two behavioral responses to this environmental constraint that are reflected in the strategies of lithic provisioning at sites in the region. These two strategies differ in that one is aimed at provisioning an individual while the other at provisioning an entire site or place (Kuhn 1995; Thacker et al. 2012). Each of these strategies is positively correlated with the environmental context of a site.

In the study area, place provisioning strategies are associated with large village sites adjacent to relatively deep waterways conducive to long distance transport, such as a river system. Conversely, individual provisioning strategies in the study area are associated with sites that do not have immediate access to a deep waterway but may have indirect access through seasonal water systems, such as lowland basins or sheet-flow drainage ways. Due to the lack of locally available tool-stone in south-central Florida, each of these strategies are part of an overall process of landscape supplementation in which people overcome environmental constraints through interactions and relationships with people that have access to the resources sought after (Delcourt and Delcourt 2004). These interactions resulted in what Austin (2004) has described as a down-the-line exchange system.

This research, and our proposed model, takes cognizance of a previously established model referred to by Pecora in 2001 as the Reduction Juncture Model and then in 2002 as the Lithic Transport Stage Model (Pecora 2001, 2002), both of which seek to designate sites into a series of categories based on their lithic assemblages. Pecora delineates specific criteria related to how the lithic assemblages of sites relate to where they reside in the operational sequence of bifacial tool production. The Late Reduction Juncture category established by Pecora (2001) represents sites with lithic assemblages most distant from raw tool-stone sources. What Pecora did not address is how lithic-use behavior manifests in a region devoid of locally available lithic resources. The two primary assumptions of Pecora's approach are that there will be a predictable pattern of lithic reduction based on proximity to a source of lithic resources and that these resources impact behavior consistently, representing a sequential process relative to regional access to available tool-stone sources. The question we prioritize with this analysis is: what if there is not a locally available source of tool-stone? Because we are focusing on a region and a site case study that we know are distant from lithic resources, sites furthest from lithic sources are the most relevant component of Pecora's research to this study and the development of our behavioral model. However, since we do not initiate our study with the assumption that we are going to encounter lithic procurement sites or quarry sites adjacent to sources of lithic material in south-central Florida, the expectations for our research are significantly different than Pecora's (2001, 2002). Rather than being developed to account for a continuum of sites nearby and distant from lithic resources, the model we propose is designed as a predictive tool for sites in regions that are known not to contain accessible outcrops of tool-stone. Additionally, it provides interpretive power to explain the variation exhibited in lithic assemblages in the region.

Therefore, our model, which we designate as The Regional Model of Lithic Dispersion, differs significantly from Pecora's sequential categorization model. Rather than noting that lithic assemblages found at sites distant from tool-stone sources are typically different from those found closer in regions that contain procurement sites for tool-stone, we are investigating how the characteristics of lithic tools and debitage at sites are the byproduct of human choices designed to optimize and reuse a scarce resource within a region devoid of tool-stone sources. Therefore, rather than only discuss this type of lithic assemblage relative to other categories of lithic assemblages, this analysis is qualified by a specific cultural and environmental context (one which lacks locally available tool-stone sources).

This model is applied as a regional interpretive framework designed to facilitate a consistent and strategic interpretation of lithic assemblages specifically from interior Belle Glade sites where we expect to find 1) lithic material entering sites as either small cores, late-stage preforms or finished tools 2) a large proportion of finish flakes 3) re-use of flakes and tools and 4) small diversity of tool types (Figure 2). The Regional Model of Lithic Dispersion also designates two behavioral strategies (accounting for two distinct assemblage types) in this context. These assemblage types and the strategies they represent are designated here (and clarified further in the discussion and conclusion) as Minimal Reduction Assemblages and Removed Reduction Assemblages, which represent distinct patterns of lithic-use behavior observed in a region without locally available sources of tool-stone (south-central Florida).

Cultural and Temporal Context

The Blueberry site (8HG678) was chosen as a case study for lithic use behavior because of the well-organized lithic dataset it provided for this research, its distant location from lithic raw material sources, and because it represents an intense, long-standing, Belle Glade occupation (Butler 2008a, 2008b; Butler and Lawres 2011). The site is situated along the eastern edge of an upland ridge (the Lake Wales Ridge) adjacent to a substantial wetland (Indian Prairie) in southeast Highlands County, Florida. The Belle Glade archaeological culture represents the most prevalent and the most recent pre-contact cultural manifestation in the south-central Florida region. This region of the state has been the focus of professional archaeological research since the 1930's when Matthew Stirling conducted excavations under the auspices of the Work Projects Administration (Stirling 1935a, 1935b; Johnson 1991:6). In the late 1940's, the initial cultural chronology for the region was proposed by Willey (1949:71, 125-126) in his report of the Belle Glade site and the Big Mound City earthworks. This research provided the original chronology (Belle Glade I and Belle Glade II) for the Okeechobee Basin as a culture area associated with the Belle Glade type site and Belle Glade Culture (Willey 1949:71; Johnson 1991). In 1966, William Sears revisited the organization of archaeological culture areas of South Florida suggested that the Okeechobee Basin was a distinct culture area separate from the Glades culture area of South Florida (Johnson 1991; Sears 1966). Additionally, Sears' research (1967, 1971, 1977, 1982; Sears and Sears 1976) refined the cultural chronology of the Belle Glade region, establishing the four-period (Belle Glade I – IV) chronology still used today (Johnson 1991:8).

Contemporary knowledge of this archaeological culture is based largely on Sears' research from the Fort Center site complex (8GL13) in Glades County, Florida (Sears 1982). While notable studies have taken place in this area (i.e., Austin 1996, 1997, 2000; Austin and Piper 1986; Brooks 1983; Butler 2008a, 2008b; Hale 1984; Johnson 1991; Mitchell 1996; Mount 2009; Thompson and Pluckhahn 2012, 2014)

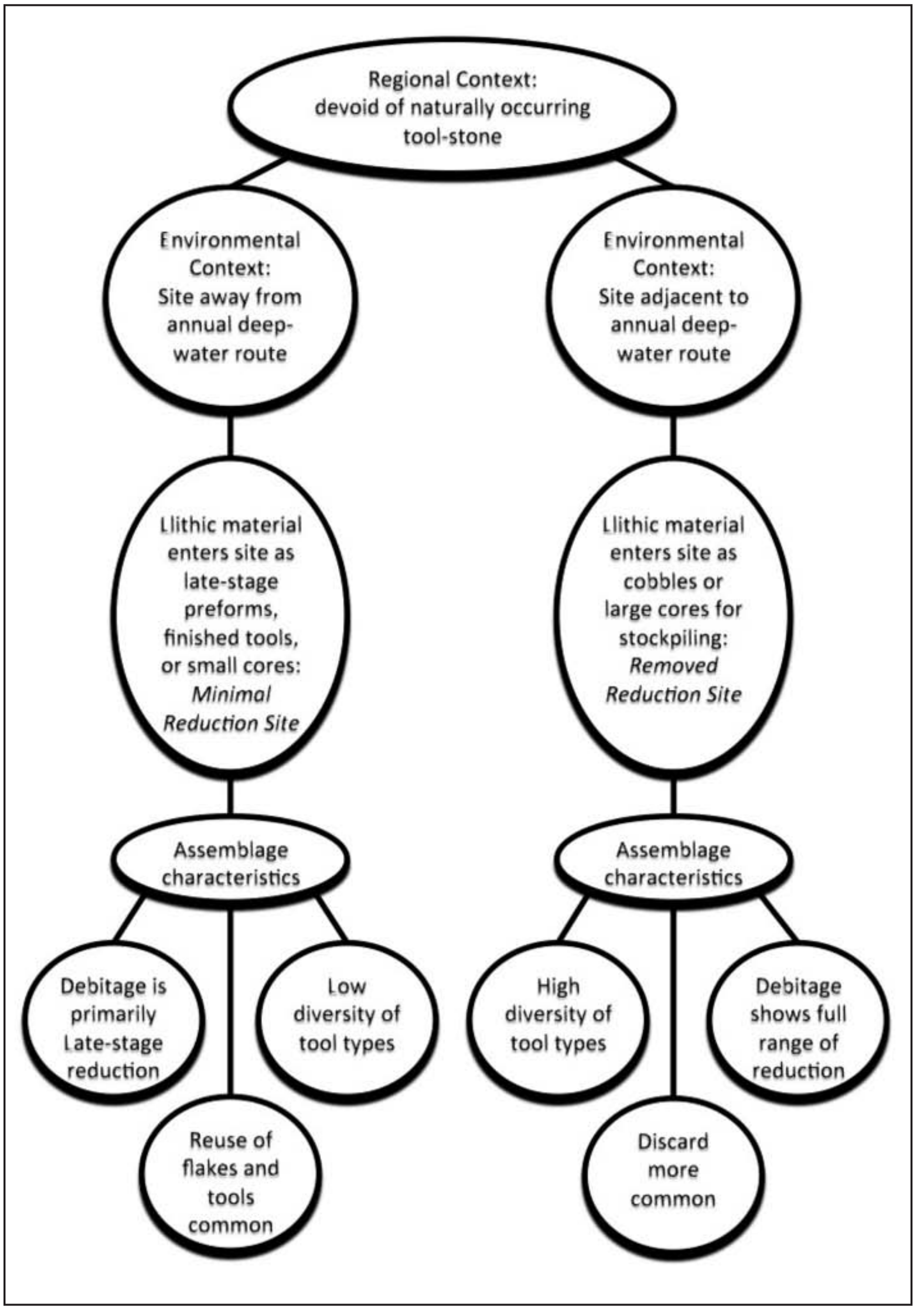

Figure 2. Regional Model of Lithic Dispersion: Context and attributes of lithic assemblages.

these studies have not deviated greatly from the temporal and cultural divisions originally established by Sears (1982). The Belle Glade cultural sequence temporally spans 2,700 years, from approximately 1000 B.C. – 1700 A.D. (Austin 1996, 1997; Butler 2008b; Milanich 1994; Sears 1982). This temporal span is divided into four periods: Belle Glade I (1000 B.C. – A.D.200), Belle Glade II (A.D.200 – 600 or 800), Belle Glade III (A.D.600 or 800 – 1200 or 1400), and Belle Glade IV (A.D.1200 or 1400 – 1700) (Butler 2008a; Johnson 1991, Sears 1982). Currently, these divisions are based largely on shifts in settlement patterns and landscape alteration, dominant pottery types, subsistence strategies, mortuary patterns, interaction spheres, and a growing number of radiocarbon dates (Austin 2000; Butler 2008a; Sears 1982; Thompson and Pluckhahn 2012).

Contemporary research has clearly established the Blueberry site as a significant cultural resource providing evidence showcasing an example of a site at the nexus of lowland and upland environs occupied during the later phases of Belle Glade culture (Butler 2008a, 2008b). Evidence from the Phase I research initiative that occurred between 2005-2008, along with research from ongoing Phase II excavations (Figure 3), provide evidence indicating that the period of the most intense occupation of this site occurred at the terminus

Figure 3. Location of Test Units 1-5 at the Blueberry site. Orthoimagery data: Florida LABINS, 2012. Coordinate system: NAD 83, UTM Zone 17N.

of the Belle Glade III (A.D. 600 – 1200) period and persisted throughout the Belle Glade IV (A.D. 1200 – 1700) cultural sequences (Butler 2008a, 2008b).

The primary Belle Glade occupation at the Blueberry site is demonstrated by an intact cultural stratum that serves as a clear indicator of both integrity and continuity during this phase of the occupation. In areas of the highest concentration of uninterrupted cultural activity, the cultural stratum manifests as a black-earth sheet midden (a spatially and vertically anthropogenic stratum). The thickness of this midden stratum ranges between approximately 14 cm and 32 cm in thickness and has an exceedingly high density of artifacts, features, and ecofacts. This stratum contains multiple intact post mold, pit, and hearth features. This archaeological deposit also contains an extremely high density of Belle Glade Plain pottery and faunal remains. The midden contains a low density of split bone fragments and tools (such as bone pins), and a low density of lithic tools and debitage. Further, in some areas of the site there are two midden deposits separated by a comparatively low-density sedimentary matrix. In addition to diagnostic artifacts and the stratigraphic sequence serving as chronological indicators, sediment samples were collected from the base, middle, and top of the midden deposits within multiple test units and submitted for AMS dating of charred botanicals contained within the matrix. The six dates attained from samples taken from the middens provide a 2-sigma calibrated date range of cal. A.D. 1160 to A.D. 1660 (Table 1).

A spatial and analytical examination of post mold features along with the complete analysis of three intact hearth features indicate that inhabitants collected and processed foods throughout the year; they constructed permanent structures that were oval in shape and typically manufactured with pine foundation posts (Allgood 2008; Bonzani 2008; Butler 2010; Fradkin 2012). The inhabitants of the site purposely situated their permanent structures in proximity to a freshwater seep spring that emerges from the top of the ridge and flows into the adjacent lowland basin. Analysis of three hearth samples and a preliminary evaluation of trends in the Phase II faunal assemblage provide evidence pointing to a consistent subsistence strategy over time (Allgood 2008; Bonzani 2008; Butler and Clover 2009; Fradkin 2012). Prior research (Mitchell 1996) and current evidence clarifies that inhabitants primarily harvested aquatic resources (predominantly small fish along with aquatic turtles), which is consistent with other Belle Glade sites in the region (Hale 1984, 1989; Mitchell 1996; Thompson and Pluckhahn 2012). Consistency observed in the initial distributional analysis of the size of fish remains recovered from the Belle Glade midden indicates the likely use of nets to harvest small catfish (Butler 2008a). This opinion is shared by Jessica Allgood (2008:19) and Arlene Fradkin (2012:5), who conducted independent analyses of intact hearth features from the site. Allgood (2008) conducted an analysis of faunal remains from two hearth features, Feature 5 and Feature 53 recovered from Test Unit 4 (see Figure 3); Fradkin (2012) analyzed Feature 8 from Test Unit 6. This evidence points to a significant subsistence tactic serving as a cultural trait that we feel should be prioritized as a potential diagnostic characteristic for Belle Glade people throughout the region. This strategy has been suggested for other Belle Glade sites in the Lake Okeechobee Basin as well (Hale 1989). In addition to this strategy, inhabitants also harvested upland resources such as deer, turkeys, squirrels, and tortoises.

The primary Belle Glade occupation of the site lasted over four hundred years and resulted in the construction of at least three earthen mounds, the alteration of a pond, permanent structures, and at least one linear ridge/embankment/occupation mound. This relatively long-standing occupation points to the viability of this diverse landscape as an ideal location in the region for supporting a village the size (+/- 64 acres/26 hectares) of the Blueberry site (Butler 2008b). The duration of the occupation at the site provided the opportunity to develop trade networks with distant groups facilitating access to artifacts (and even food) from outside the Kissimmee Valley Region. For example, one of the hearth features provided evidence of the importation of marine resources (Lutjanidae spp., Sciaenidae, Mugil sp. and Carcharius sp.) in small amounts (Allgood 2008). This evidence, in conjunction with the presence of four native [non-European, non-smelted] copper artifacts (two native copper bosses, one rolled native copper specimen, one native copper tablet from Mound A), dozens of marine shell tools, dozens of utilized shark teeth, one greenstone duckbill pendant, one quartz lithic tool, one pumice fragment in cultural context, and, of course, lithics from outside the immediate region demonstrates a long-standing tradition of interaction with inter- and intra-regional trade networks (Butler and Clover 2009).

The exotic artifacts (manufactured of native copper, greenstone and quartzite) and earthen mounds indicate the likelihood of elite members of Belle Glade culture having access to differing resources that may be viewed as prestige items due to the long-distance importation of these resources and their strategic location at the site. Austin (1997:160) suggests the possibility of imported, finished stone tools representing prestige items in the Belle Glade region. Elite access to prestige items has been suggested at the Fort Center site in the Belle Glade region (Sears 1982). In addition to prestige items, it is likely that the Blueberry site (like virtually all large, long-standing American Indian villages in the Southeast) was associated with ritual and ceremony. A well-represented artifact category typically associated with ritual and ceremony found in abundance at the site is red ochre. Red ochre fragments have been recovered from the midden stratum of all units excavated thus far during the Phase II excavation. Additional evidence related to the ceremonial component of the site is a ceramic effigy head (Reynolds 2001) and a lead-iron tablet (Luer 2010) which were both recovered from Mound B. Further supporting evidence (i.e., data from additional features as well as from hearth features in immediate association with other prestige goods) is needed to make any definitive conclusions with regard to the level of significance associated with ceremonialism at the Blueberry site, however.

Table 1. AMS dates from site 8HG678.

Sample Number	Material Dated	Provenience	Uncalibrated Age	$^{13}C/^{12}C$ Ratio	Calibration Method	1 Sigma Calibrated Results	2 Sigma Calibrated Results
BETA 242895	charcoal from sediment	TU5 Base of Midden	490 +/- 50 BP	-23.5 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1410 to 1440 (Cal BP 540 to 510)	Cal AD 1330 to 1340 (Cal BP 620 to 610)/Cal AD 1400 to 1460 (Cal BP 560 to 490)
BETA 242894	charcoal from sediment	TU5 Base of Midden	680 +/- 40 BP	-25.4 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1280 to 1300 (Cal BP 670 to 650) and Cal AD 1370 to 1380 (Cal BP 580 to 570)	Cal AD 1270 to 1320 (Cal BP 680 to 630)/Cal AD 1350 to 1390 (Cal BP 600 to 560)
BETA 242892	charcoal from sediment	TU4 Top of Midden	320 +/- 40 BP	-25.2 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1490 to 1640 (Cal BP 460 to 310)	Cal AD 1460 to 1660 (Cal BP 490 to 290)
BETA 230297	charcoal from sediment	TU4 Base of Midden	660 +/- 40 BP	-26.7 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1290 to 1330 (Cal BP 660 to 620) and Cal AD 1340 to 1400 (Cal BP 610 to 560)	Cal AD 1280 to 1410 (Cal BP 670 to 540)
BETA 218552	charcoal from sediment	TU1 Center of Lower Midden	820 +/- 40 BP	-24.7 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1190 to 1260 (Cal BP 760 to 690)	Cal AD 1160 to 1280 (Cal BP 790 to 670)
BETA 218553	charcoal from sediment	TU1 Center of Upper Midden	740 +/- 40 BP	25.1 o/oo	INTCAL 98 (Stuiver et. al. 1998)	Cal AD 1260 to 1290 (Cal BP 690 to 660)	Cal AD 1230 to 1300 (Cal BP 720 to 650)

Methods

The lithic assemblage reported in this paper was recovered from five 2-x-2-m test units (Test Units 1-5, see Figure 3). To maximize controlled recovery and comparison of data within 5 cm levels, each of the 2-x-2-m units were divided into four 1 x 1 m quadrants. The locations of these test units were systematically chosen based upon the distributional analysis of data from the Phase I research, the presence or absence of the midden stratum in shovel tests, and the evaluation of the landforms comprising the geomorphology of the immediate landscape.

To quantify tools and debitage, the analysis of this assemblage included the use of quantitative and qualitative measurement and the classification of attributes. The attributes chosen for the analysis of this assemblage were selected in order to maximize the potential to infer behaviors associated with the manufacture and acquisition of lithic materials at the site based on debitage type relative to the lithic tool assemblage. These attributes include dimensional measurements, weights, categorical designations (including both flake types and tool types), provenience, and Sullivan-Rozen designations (Sullivan and Rozen 1985). The Sullivan-Rozen typology is useful for this study because it represents a system for evaluating whether a lithic assemblage is most likely the byproduct of core reduction behavior versus tool production behavior (Prentiss 1998:636). These attributes were catalogued for both waste flake categories as well as tool categories.

Dimensional measurements include length, width, and thickness. These attributes were chosen because they have the potential to elucidate patterns in both reduction techniques and reduction stages present within the assemblage. The length attribute was measured using the maximum length technique. This technique involves taking a measurement from the proximal end of the specimen, which is the end with the striking platform, to the distal end of the specimen, which is the end with the termination. However, many flakes are not formed as a straight line, so the measurement is a straight-line distance taken perpendicular to the striking platform width (Andrefsky 2005; Odell 2003). The width attribute was measured using the maximum flake width technique. This technique involves taking a measurement that is a straight-line distance perpendicular to that line used in determining flake length (Andrefsky 2005; Odell 2003). The maximum width line intersects the flake length line at the widest point of the specimen. The thickness attribute was measured using the maximum flake thickness technique. This technique involves taking a straight-line distance measurement from the dorsal to ventral side of the specimen that is perpendicular to the flake length line (Andrefsky 2005:101). This line intersects the flake length line at the thickest point dorsal to ventral of the specimen. All of these measurements were taken with the ventral surface facing the analyst and the proximal end facing upwards. Additionally, these measurements were used to establish flake size grades, following the work of Austin (1997). These size grades were categorized into 0.5 cm classes, further aiding in interpreting reduction stages and techniques present within the assemblage. Individual weights were measured using a My Weigh i201 series scale that measures to the nearest hundredth of a gram. Weights were subsequently categorized into 0.05 g classes.

The flake assemblage was classified into four categories based on morphological characteristics of the specimens, or flakes. For this study, the term flake is used to describe pieces of stone that are detached during the process of lithic manufacture (Andrefsky 2005; Odell 2003). The categories of flake types used in this analysis are: bifacial thinning flakes, core reduction flakes, indeterminate flake type, and retouch flakes. Bifacial thinning flakes are flakes that have been detached during the process of bifacial reduction. These flakes "often contain a striking platform that is rounded or ground, indicating preparation… [and are] usually thin relative to width, with a feathered termination" (Andrefsky 2005:253). Along with a striking platform, these flakes usually have a characteristic bulb of percussion and a lip on the interior portion of the platform (Holdaway and Stern 2004; Whittaker 1994). Furthermore, these flakes usually have a significant amount of curvature. This curvature decreases in bifacial thinning flakes that are detached further along in the manufacture process (Andrefsky 2005; Odell 2003). Core reduction flakes are those that have been detached from a prepared core. These flakes lack a prepared striking platform. Indeterminate flakes are those that do not exhibit the characteristics necessary to classify the specimen into one of the other morphological categories. This may include flakes that have broken and no longer include the diagnostic proximal end and shatter. Shatter is a detached piece of stone that was unintentionally created during the process of lithic manufacture; it does not exhibit the diagnostic characteristics of intentionally created flakes (i.e., it does not have a bulb of percussion or striking platform) (Andrefsky 2005; Odell 2003). Edge retouch flakes are those that are created in the final stages of lithic manufacture or to resharpen the edge of a previously completed tool. The manufacture of this form of flake may be the product of either percussive or pressure techniques. Additionally, the Sullivan-Rozen typology (Sullivan and Rozen 1985) for waste flake analysis was applied to the assemblage. Using this system, waste flakes were further categorized as complete, proximal, medial-distal, or non-orientable.

A spreadsheet was created that contained the measurements and categorical associations of each specimen from the lithic assemblage. Also contained within this spreadsheet is the provenience for each specimen. This contextual information includes the test unit the specimen was recovered from, the level within that test unit, the quadrant of that level, and the stratigraphic association of that level. The majority of the bifacial lithic tool assemblage was recovered from feature contexts, such as refuse pits. Thus the stratigraphic context for these tools does not coincide with the straightforward stratigraphic analysis used for the rest of the assemblage.

The methods used to analyze this assemblage in a quantitative fashion employed the use of SPSS version 19.0 to run descriptive statistical analyses. Descriptive statistics were used to quantify the frequencies of each variable present within the dataset. Frequency tables were created for lithic categories, lithic tools, and waste flakes within the assemblage collected during Phase II excavations. Additionally, frequency tables for Sullivan-Rozen categories and flake size categories were created for the Phase II assemblage as well as the assemblage reported by Austin (1997). The frequency tables for each of these analyses provided the frequency of observations for each variable, the percentage each variable comprised of the total assemblage analyzed, and the cumulative percentage each variable provided to the whole of each analysis. These statistical figures provided the basis for both interpretation and comparison to previous research at the Blueberry site.

Results

A total of 272 lithic specimens were recovered during Phase II excavations of Test Units 1-5 at the Blueberry site (Table 2). Of these 272 specimens, 243 (89.3 percent) were categorized as waste flakes or debitage (Table 3). The frequencies of the lithic categories present within this assemblage reveal that the majority of the waste flake types present within this assemblage are characteristic of the later stages of lithic manufacture. Bifacial thinning flakes and retouch flakes represent 67.3 percent of the total lithic assemblage and 75.3 percent of the total waste flake assemblage. The distribution confirmed by percentages reported here provides evidence corresponding to the late stages of lithic manufacture. This pattern is significant to this study because it demonstrates that late stage manufacturing was the primary behavior associated with lithic manufacture being conducted at the Blueberry site. Furthermore, edge retouch flakes, which are associated with the final stage of reduction as well as tool re-sharpening activities, represent 50.4 percent of the total lithic assemblage and 56.4 percent of the total waste flake assemblage.

At the time of this study, there have been twenty-nine lithic tools recovered during Phase II excavations at the Blueberry site. The frequency distributions of these tools are summarized in Table 4. These tools are classified into four categories: bifacially manufactured tools, utilized flake tools, blades, and cores. Bifacial tools comprise 51.6 percent of the total tool assemblage (15 specimens), while utilized flake tools comprise 41.4 percent of the total tool assemblage (12 specimens). A single core and a single blade comprise the remainder of the lithic tool assemblage (0.8 percent). Of the fifteen bifacial lithic tools there are four categories represented: non-diagnostic bifaces (Figure 4), a Hernando type projectile point (Figure 5), a Newnan type projectile point (Figure 6), and Pinellas type projectile points (Figure 7). There are four specimens of non-diagnostic bifacial tools. These specimens are all fragments of what appear to have been projectile points, but are all medial, medial-distal, or distal fragments. Therefore, the diagnostic bases, or proximal ends, are missing, rendering these tools unclassifiable into specific projectile point types. These specimens represent 26.7 percent of the bifacial tool assemblage and 13.8 percent of the total lithic tool assemblage. Hernando, Newnan, and Pinellas projectile point types were recovered from the area of the site containing the intact sheet midden. The Hernando and Pinellas points were recovered from the midden matrix and the Newnan was recovered more than 30 cm below the midden stratum. There is only one specimen that represents the Hernando type projectile point. This specimen represents 6.7 percent of the bifacial tool assemblage and 3.4 percent of the total lithic tool assemblage. Of the Newnan type, there is a single specimen that also represents 6.7 percent of the bifacial tool assemblage and 3.4 percent of the total lithic tool assemblage. Pinellas type projectile points comprise the majority of the bifacial tool assemblage (9 specimens, 60.0 percent) and 31.0 percent of the total lithic tool assemblage. Furthermore, the lithic tool assemblage comprises a small component (10.7 percent) of the overall lithic assemblage. Bifacial tools comprise 5.5 percent of the total lithic assemblage, while utilized flake tools comprise 4.4 percent and the single core and single blade both account for 0.4 percent each. This summary makes it clear that the diagnostic lithics recovered from the midden matrix correspond to the Belle Glade cultural period. Additionally, the discovery of complete diagnostic points without evidence of the full spectrum of reduction indicates a pattern of behavior that is consistent with there being a lack of a nearby tool-stone source. This evidence supports the notion that it was common for nearly complete tools (rather than preforms or cores) to be imported to the site. As will be clarified next, when reduction did occur onsite, (which was probably the exception rather than the norm) it was most likely the byproduct of reducing small-cores conducive to transport as opposed to larger cobbles of parent material in the form of chert or agatized coral.

Examination of the Sullivan-Rozen analysis shows that this assemblage has characteristics that differ from those reported in Austin's (1997) study. These data are presented in Table 5. The sample reported by Austin (1997:484, Table 76) is dominated by medial-distal flakes (32.8 percent); complete flakes (27.3 percent) comprise the second largest category. The Phase II assemblage demonstrates the exact opposite distribution, with complete flakes (40.7 percent) dominating the assemblage and medial-distal flakes (25.5 percent) comprising the second largest category. While these statistical distributions are much different than those presented by Austin (1997), there is consistency with his experimental assemblages. The Phase II assemblage demonstrates a Sullivan-Rozen distribution that nearly matches the small core waste flake assemblage reported by Austin (1997:248).

The flake size distribution analysis contradicts the findings of the Sullivan-Rozen analysis, however. According to Austin (1997:268) assemblages manufactured from core reduction techniques associated with small cores (which he describes as small chert nuclei) are comprised of a significantly larger proportion of flakes that fit within a size grade of 1.5-2.0 cm. Recent studies (e.g., Braun 2005) prioritizing the context of core reduction suggest the potential impact of raw material availability on core reduction strategies. For example, as discussed by Andrefsky (2009:76), Braun (2005) assesses "… the degree to which different core technologies conserve raw material given differences in raw material availability at various locations… His study shows that stone toolmakers elected to conserve raw material in the face of lithic resource constraints by changing technological strategies." Braun's research suggests that core reduction taking place at locations distant from raw material sources aims to minimize raw material waste and maximize reduction efficiency when compared to evidence from sites in closer proximity to raw material sources (Braun 2005). According to Andrefsky (2009:76):

> Brantingham and Kuhn (2001) obtained similar results when they modeled Levallois core technology for efficiency and effectiveness: Levallois cores were relatively efficient at minimizing raw material waste while at the same time maximizing productivity in terms of the number of usable tools produced. In essence, Levallois technology may have been selected as a strategy of retouch as a raw material conservation technique. This emphasizes the importance of economic constraints on stone tool production strategies

The research of Andrefsky (2009), Austin (1997), Brantingham and Kuhn (2001) and Braun (2005) point to specific characteristics of lithic assemblages that are distant from their source of origin and are therefore consistent with our proposed interpretive model for south-central Florida. These researchers all assert that when tool-stone is a scarce resource, it will be utilized more conservatively than in a region facilitating plentiful access. Further, they suggest that this pattern of conserving tool-stone results in an assemblage with identifiable characteristics distinct from those in more resource rich regions. Austin's (1997) research also suggests strategic choices designed to maximize efficiency as well as minimize labor related to transport. Specifically, Austin's sample from the Blueberry site suggests that if cores are discovered at sites in such a context, then small cores (rather than larger, heavier cobbles) are expected (Austin 1997).

The Phase II assemblage reported here (Table 6) demonstrates that the overwhelming majority of waste flakes in the assemblage fit within a size grade of <1 cm. In fact, the flake size distribution demonstrates that as flake size increases the frequency of flakes decreases. The flake weight distribution further reinforces the results of the flake size distribution, which is to be expected. These results are presented in Table 7. The majority of the waste flake assemblage (70.6 percent) falls within a range of being less than .10 g. Further, 25.2 percent of the assemblage weighs less than .01 g, and 32.6 percent of the assemblage falls within a range of .01-.04 g. The characteristics of the waste flakes in the assemblage could certainly be the byproduct of re-sharpening complete tools or finishing late stage preforms. This would be consistent with later stages of lithic manufacture and be consistent with the basic tenets of our model.

Table 2. Frequencies of lithic categories present within the Phase II assemblage from 8HG678.

Lithic Category	Number of Observances	Percent	Cumulative Percent
Bifacial Lithic Tool	15	5.5	5.5
Blade	1	0.4	5.9
Bifacial Thinning Flake	46	16.9	22.8
Core Reduction Flake	4	1.5	24.3
Core	1	0.4	24.6
Indeterminate Flake Type	51	18.8	43.4
Retouch Flake	137	50.4	93.8
Shatter	5	1.8	95.6
Utilized Flake Tool	12	4.4	100
Total	**272**	**100**	

Table 3. Frequencies of waste flake categories present within Phase II assemblage from 8HG678.

Flake Type	Number of Observances	Percent	Cumulative Percent
Bifacial Thinning Flake	46	18.9	18.9
Core Reduction Flake	4	1.6	20.6
Indeterminate Flake Type	51	21	41.6
Retouch Flake	137	56.4	97.9
Shatter	5	2.1	100
Total	**243**	**100**	

Discussion

The results from this study show that Phase II Blueberry site assemblage exhibits three primary characteristics: 1) there is minimal evidence of primary reduction activities; 2) there is a large amount of evidence of late reduction activities; and 3) there is minimal diversity in lithic tool types. These characteristics are demonstrative of the Reduction Juncture model set forth by Pecora's (2001) model, developed for analyzing and comparing lithic assemblages at archaeological sites relative to patterns of raw material acquisition and use, and rests on the assumption that sites with lithic assemblages could be classified into categories, or junctures, based upon the lithic assemblage present. Sites containing lithics are presumed to represent places where the reduction of lithics was a primary behavior and that the sequence of reduction should be the focus of research. This differs greatly from our approach, which focuses on lithic-use behavior that is not centered on a continuum of reduction.

Generalized categories for Pecora's continuum were established as: Early Reduction Junctures, Middle Reduction Junctures, and Late Reduction Junctures. Pecora's 2001 Reduction Junction Model (2001:178, Table 10.1) defines six reduction stages based on perceived "pauses" in Collin's 1975 reduction sequence model. Flake size grades are used as a primary indicator of stage membership. For this analysis, we adapted one of Pecora's continuum stages into what we label The Regional Model of Lithic Dispersion. This model is both a predictive and interpretive device designed to provide a baseline for drawing inferences from lithic assemblages in the Belle Glade cultural region. This research utilizes

Table 4. Frequencies of lithic tool types present within Phase II assemblage from 8HG678.

Tool Type	Number of Observances	Percent	Cumulative Percent
Biface	4	13.8	13.8
Blade	1	3.4	17.2
Core	1	3.4	20.7
Hernando	1	3.4	24.1
Newnan	1	3.4	27.6
Pinellas	9	31.0	58.6
Utilized Flake	12	41.4	100.0
Total	**29**	**100.0**	

Figure 4. Non-diagnostic bifacial tools in Phase II assemblage. Photo courtesy of the Florida Museum of Natural History (Accession number 2012-49).

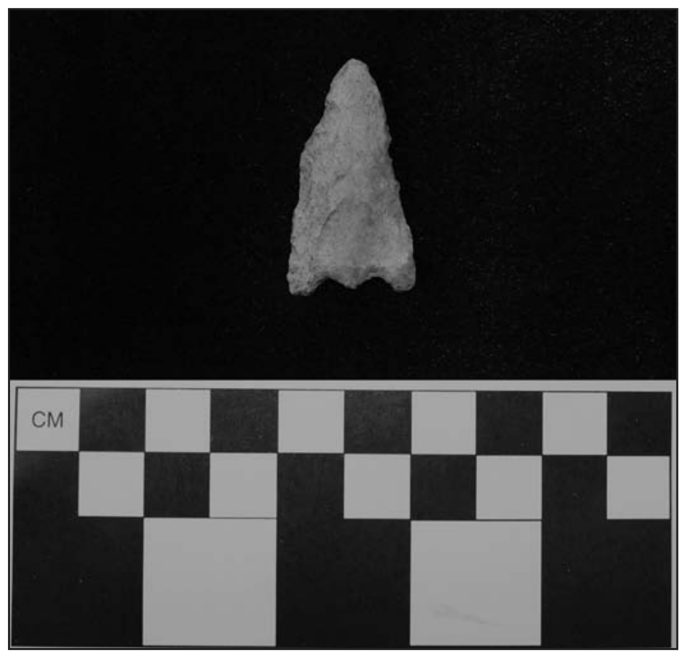

Figure 5. Hernando type projectile point from Phase II assemblage. Photo courtesy of the Florida Museum of Natural History (Accession number 2012-49).

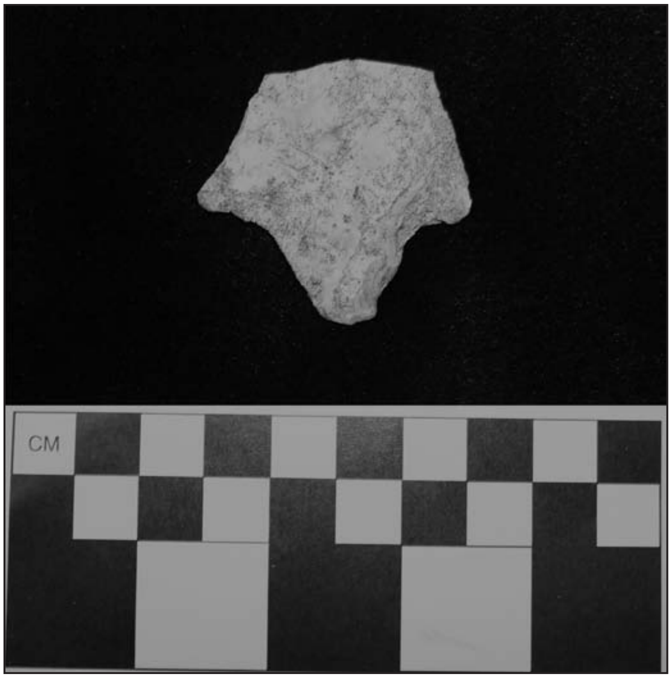

Figure 6. Newnan type projectile point from Phase II assemblage. Photo courtesy of the Florida Museum of Natural History (Accession number 2012-49).

Figure 7. Pinellas type projectile points from Phase II assemblage. Photo courtesy of the Florida Museum of Natural History (Accession number 2012-49).

the Kissimmee Valley - Okeechobee Basin region and the Blueberry site lithic assemblage as case studies to demonstrate the applicability of this proposed model.

Classifying lithic cultural activity at sites into these three categories is based on three primary attributes of lithic assemblages, including: 1) the density of flake categories within the assemblage and their associated stage within the lithic manufacturing process; 2) the diversity of the lithic tool assemblage; and 3) relative abundance of the lithic assemblage relative to the overall artifact assemblage at the site. For example, a lithic quarry site can be classified as an Early Reduction Juncture because it will produce large flakes associated with the initial stages of reduction, known as primary reduction, in the lithic manufacturing process (Andrefsky 2001, 2005; Jelinek 1976). Likewise, according to this approach, artifact assemblages at quarry sites will typically be dominated by lithic materials and demonstrate a high diversity of lithic tools, both complete and incomplete. A site with a relatively small lithic assemblage that contains a high percentage of edge retouch flakes and very few decortification flakes, or any other debitage associated with the early stages of reduction, as well as a minimal diversity in lithic tools, can be classified as a Late Reduction Juncture.

The characteristics exhibited by our analysis of this lithic assemblage support the hypothesis that the Blueberry site represents a Late Reduction Juncture as defined by Pecora's (2001) Reduction Juncture Model. However, our analysis also demonstrates that in a region devoid of tool-stone sources, there is not a sequence of reduction relative to local source locations because none exist. Based on these results and the preliminary assessment of the additional examples cited in this research, we feel that the evidence justifies the development of a regional model to explain behavior where the sequence he proposes does not transpire. For example, in a region without significant quarries, we should not expect to find quarry sites demonstrating primary reduction. Nor should we expect to find a somewhat linear pattern of reduction relative to these sites if they do not exist in the region. Therefore, we base our interpretive model on two premises: first, the environment does not provide local resources suitable for lithic manufacture; second, because of this environmental constraint we can develop a testable interpretive model that accounts for lithic assemblages in this context. Each characteristic of the Blueberry site sample outlined below is consistent with the proposed Regional Model of Lithic Dispersion (see Figure 2).

Bifacial thinning flakes and edge retouch flakes represent 67.3 percent of the total lithic assemblage and 75.4 percent of the total waste flake assemblage. These two types of waste flakes are correlated to the later stages of lithic manufacture. Furthermore, edge retouch flakes, which are associated with the final stage of reduction as well as tool re-sharpening

Table 5. Frequencies of Sullivan-Rozen categories for the 8HG678 Phase II lithic assemblage and the 8HG678 lithic assemblage reported in Austin (1997:484).

	Current Assemblage			Assemblage from Austin (1997)		
S-R Category	**Number of Observances**	**Percent**	**Cumulative Percent**	**Number of Observances**	**Percent**	**Cumulative Percent**
Complete	99	40.7	40.7	35	27.3	27.3
Medial-Distal	62	25.5	66.3	42	32.8	60.1
Non-Orientable	50	20.6	86.8	26	20.3	80.4
Proximal	32	13.2	100	25	19.5	100
Total	**243**	**100**		**128**	**100**	

activities, represent 50.4 percent of the total lithic assemblage and 56.4 percent of the total waste flake assemblage. These percentages, along with the relative lack of evidence associated with primary reduction techniques, suggest that the occupants of the Blueberry site were only employing the lithic reduction techniques associated with the later and final stages of lithic manufacture. These characteristics are consistent with The Regional Model of Lithic Dispersion developed here. What makes Pecora's interpretation different in this analysis is that we are explicitly prioritizing the interpretation of lithics within their environmental context and we are not assuming that a continuum of reduction occurs in a context without local sources of tool-stone. Specifically, we underscore the importance of lithic raw material sources (as a component of the environment) to site locations and predict that a lack of raw material sources in a region impacts the composition of lithic assemblages.

While our approach is different than Pecora's continuum model, some of the characteristics of what he describes as a Late Reduction Juncture site are consistent with the basic tenants of

Table 6. Frequencies of flake size ranges for the 8HG678 Phase II lithic assemblage and the 8HG678 lithic assemblage reported in Austin (1997).

	Current Assemblage			Assemblage from Austin (1997)		
Flake Size (in cm)	**Number of Observances**	**Percent**	**Cumulative Percent**	**Number of Observances**	**Percent**	**Cumulative Percent**
<1	185	76.1	76.1	46	36.5	36.5
1.1-1.5	37	15.2	91.4	55	43.7	80.2
1.6-2.0	10	4.1	95.5	14	11.1	91.3
2.1-2.5	8	3.3	98.8	2	1.6	92.9
2.6-3.0	1	0.4	99.2	5	4	96.8
3.1-3.5	1	0.4	99.6	3	2.4	99.2
3.6-4.0	1	0.4	100			
4.1-4.5						
4.6-5.0				1	0.8	100
Total	**243**	**100**		**126**	**100**	

The Regional Model of Lithic Dispersion (see Figure 2). For example, Pecora (2001) stated that diversity in the lithic tool assemblage would be minimal at a Late Reduction Juncture site. Such is the case at the Blueberry site where Pinellas type projectile points comprise 60.0 percent of the bifacial tool assemblage and 31.0 percent of the total lithic tool assemblage. Pinellas type projectile points and utilized flakes represent the two primary lithic tool types at the Blueberry site. These two tool categories comprise 72.4 percent of the total lithic tool assemblage. These percentages are demonstrative of a cultural practice of minimalism. Therefore, rather than representing behavior that is part of a continuum of reduction, lithic-use behavior at the Blueberry site was designed to maximize the productivity of a scarce resource. The inhabitants of the site had a long-standing tradition and preference for either the Pinellas Point type or with the people who manufactured them, and they did not go out of their way to diversify over time. In addition to a lack of diversity in projectile point types, there is also a lack of diversity in tool categories. For example, there is virtually a complete absence of lithic scraper tools (Butler and Lawres 2011). The presence of flakes associated with the final stages of tool manufacture, the recovery of a small number (or a single number) of point types, and the propensity for utilizing flakes that would be discarded as debitage closer to a lithic raw material source are three patterns that characterize the Blueberry site lithic assemblage.

Table 7. Frequencies of weight distributions for the Phase II lithic assemblage from 8HG678.

Weight Categories	Number of Observances	Percent	Cumulative Percent
<.01	61	25.2	25.2
.01-.04	79	32.6	57.8
.05-.09	31	12.8	70.6
.10-.14	16	6.6	77.2
.15-.19	6	2.5	79.7
.20-.24	6	2.5	82.2
.25-.29	3	1.2	83.4
.30-.34	8	3.3	86.7
.35-.39	1	0.4	87.1
.40-.44	1	0.4	87.5
.45-.49	4	1.7	89.2
.50-.54	5	2.1	91.3
.55-.59	3	1.2	92.5
.65-.69	1	0.4	92.9
.70-.74	1	0.4	93.3
.85-.89	1	0.4	93.7
.90-.94	2	0.8	94.5
>1.00	13	5.4	100
Total	**242**	**100**	

The lack of diversity of tool and flake types seen in the lithic tool assemblage suggests further implications for cultural activity associated with the lithic assemblage recovered at the Blueberry site. Andrefsky (2001) posited that low diversity of lithic tools at a site infers that the majority of lithics would have been transported in the form of bifacial blanks, preforms, or completed tools. The lithic assemblage of the Blueberry site supports this hypothesis as 51.6 percent of the lithic tool assemblage is represented by completed bifacial tools. The lack of primary reduction debitage and the lack of a lithic raw material source further support this hypothesis.

Further evidence to corroborate this pattern, which we believe is indicative of a site from a region devoid of tool-stone resources, is demonstrated by the Sullivan-Rozen flake size and flake weight distributions discussed above. In his analysis of a sample from the Blueberry site, Austin (1997:559) stated that the inhabitants likely employed a combination of patterned tool manufacture and small core reduction techniques. His findings were based on a combination of flake size distributions and Sullivan-Rozen distributions in comparison to experimental assemblages. Moreover, they are consistent with the results of the current analysis. Sullivan-Rozen distributions point to small core reduction techniques, while flake size and flake weight distributions point to patterned tool manufacture. These findings in conjunction with the categorical distributions (see Table 2) demonstrate that small cores were utilized in lithic manufacture, but patterned tool manufacture was the primary manufacturing behavior. Indeed, Austin (1997:559) came to similar conclusions: "Bifaces appear to have entered the site as late-stage preforms or finished implements while cores entered the site as small chert nuclei." We believe that the findings reported in Austin's study and our research both point to a pattern of behavior that is most likely to occur at sites not in close proximity to sources of tool-stone.

A strategy such as this would also be aimed at maximizing the use and use-life of scarce materials, which is indicated by the bifacial lithic tools showing evidence of re-sharpening and/or reuse. Tool recycling and reuse have been well documented by several other researchers that span numerous areas of the world (Andrefsy 2008a, 2008b; Austin 1997; Frison 1968, 2004; Goodyear 1974; Jelinek 1976; MacDonald 2008; Quinn et al. 2008; Shott and Nelson 2008). Due to the need to consistently re-sharpen lithic tools, it is common to find diminutive forms of tool types. This is known as the Frison effect (Jelinek 1976). At some sites tool reuse and recycling is taken to the extreme. Goodyear (1974) noted this pattern at Dalton sites, where lithic tools are reused and re-sharpened until their size and shape are so reduced that they are recycled as awls. Studies focused on the curation of lithic tools from other areas of the world have demonstrated similar effects on assemblages that have been re-sharpened and reused over long periods of time, perhaps over the course of generations (Andrefsky 2008a, 2008b; MacDonald 2008; Quinn et al. 2008; Shott and Nelson 2008). The evidence at Blueberry suggests a similar curation effect. All of the diagnostic tools from the Blueberry site's lithic assemblage are diminutive forms of their type. These tools, along with the many waste flakes that were utilized, would have been discarded at a site with lithic raw materials that were locally available (Butler 2008a; Butler and Lawres 2011). This cultural pattern of reuse over discard is consistent with the scarcity of lithic raw materials and may well be indicative of behavioral patterns associated with lithics throughout the interior Belle Glade region (Austin 1997).

All characteristics of the Blueberry lithic assemblage point to a strategy of provisioning at the individual (or small group of individuals) level, which would involve ensuring that an individual, rather than a community, would have the requisite materials for tasks requiring lithic tools (Kuhn 1995). This provisioning strategy is exemplified by the importation of finished (or nearly finished) bifaces or other lithic tools to a site in anticipation of use. This strategy emphasizes minimizing transport cost and maximizing conservation of raw material (Thacker et al. 2012). Moreover, sites where this strategy was practiced produce lithic assemblages that are consistent with the attributes of Pecora's (2001) Late Reduction Juncture: "site assemblages resulting from the strategy of supplying individuals with raw material have less unfinished raw material waste and more evidence of resharpening or reshaping of tools" (Thacker et al. 2012: 106). However, many researchers that have utilized this framework for understanding provisioning behaviors have emphasized that the provisioning of individuals is typically correlated with high residential mobility and thus short occupation spans (Smith et al. 2013; Thacker et al. 2012). The Blueberry site stands out in this regard, as it was a continuously, and densely, occupied site for centuries (Butler 2008a). We contend that the environmental and geomorphological context of south-central Florida provides a proximate cause for this strategy at sites in the Belle Glade region. The Blueberry site is located in the western portion of the Belle Glade cultural region on the eastern terminus of an upland alluvial ridge (Lake Wales Ridge). Moreover, while the site is adjacent to a substantial lowland basin that would have been seasonally inundated (prior to the twentieth century drainage of peninsular Florida) it is located more than two kilometers from an annual deep-water transport route. We argue that sites with similar characteristics (large, permanent settlement) in similar locations (i.e., not adjacent to interconnected, annual deep-water routes) will follow similar behavioral patterns of provisioning and thus exhibit lithic assemblages with characteristics much like that seen at Blueberry.

A preliminary review of a randomly selected sample of sixteen sites (8HG22, 8HG27, 8HG31, 8HG32, 8HG35, 8HG51, 8HG880, 8HG881, 8HG882, 8HG887, 8HG888, 8HG910, 8PB43, 8PO992, 8PO995, 8PO5306) within the region demonstrates that many Belle Glade lithic assemblages exhibit the same characteristics as Blueberry (Figure 8). Austin and Ballo (1987), Austin and Piper (1986), Horvath (1998), Stevens (1997), and Stevens et al. 1997) discuss the debitage at these sites as being indicative of late stage manufacturing techniques. Further, Austin and Ballo (1987), Austin and Piper (1986), and Davenport et al. (2011) claim that some of the assemblages represent curated technologies, or those that are re-sharpened and reused over long periods of time. These characteristics also accord well with Austin's (1997) findings for general lithic use and acquisition in South Florida, an area known for its lack of locally available raw materials. It should be noted that some of these sites are located near annual deep-water routes, such as the Kissimmee River, but they do not share the same characteristics of being large, permanent settlements. However, the lack of caches of cores or cobbles indicates a strategy of provisioning the individual. This pattern differs, however, from the provisioning strategy practiced at some other noteworthy Belle Glade sites in proximity to deep-water routes (primarily in the eastern and southern portions of the Belle Glade cultural region) that are large, permanent settlements.

Some sites adjacent to interconnected, annual deep-water routes (such as Fort Center, [8GL13], Ritta Island [8PB92] and the Ortona Earthworks and Mounds site [8GL4, 8GL5, and 8GL80]) contain small chert cobbles, which is a characteristic that demonstrates a strategy aimed at place provisioning rather than individual provisioning. Place provisioning strategies entail stockpiling or caching large amounts of raw materials for long-term use (Kuhn 1995). According to Thacker et al. (2012) inhabitants of place provisioned sites do not necessarily exhibit the same economizing behaviors of those at sites where individual provisioning occurred. Thus, lithic assemblages at these sites typically "display the entire range of production activities from barely worked cobbles to discarded finished tools" (Thacker et al. 2012:106). Lithic material entering sites in the form of chert cobbles as opposed to late stage preforms or finished tools does not seem to represent the most common pattern in the south-central Florida region. However, this pattern should not be overlooked and therefore a contingency for these data is accounted for in the regional model developed in this study. In regions where lithic resources are absent, it is clear that some sites have access to trade networks facilitating access to chert cobbles (in addition to more typical intra-regional trade networks providing preforms and finished tools). Place provisioning in this context manifests as evidence demonstrating the reduction of chert cobbles that were undoubtedly selected for ease of transport and to maximize tool production potential (relative to the size and quality of the core). Apart from lithic material entering sites as chert cobbles or nodules (and evidence of their reduction), we expect lithic assemblages in regions devoid of lithic resources will demonstrate attributes accounted for in The Regional Model of Lithic Dispersion.

The place provisioning strategy is reflected in the organization of lithic technology at sites such as Fort Center located on Fisheating Creek, the Ortona Earthworks and Mounds adjacent to the Caloosahatchee River west of Lake Okeechobee and Ritta Island located in the southern portion of Lake Okeechobee. The Fort Center lithic assemblage reported by Steinen (Sears 1982) contained a number of chert cobbles, waste flakes, and projectile points. In a subsequent analysis of these materials, Austin (1997, 2004) states that the majority of these materials originated in sources from the northern portion of the state. Furthermore, while the exact forms of debitage present at the site are not reported (they are generalized as 'waste flakes') it appears that, based on statements by Austin (1997:441), that the entire reduction continuum is exhibited in the Fort Center assemblage. With regard to the flake to flake tool ratio at the site Austin (1997:441) states, "The comparatively high F:FT ratio for Fort Center is somewhat surprising given its distance from a chert source, but the ratio is strongly influenced by the large number of waste flakes associated with the reduction of the chert cobbles at Mound A". Therefore, the reduction continuum present at this site is related to the processing of cobble cherts (i.e., small cores or chert nodules).

In his analysis of the lithic assemblage from the Ritta Island site, Austin (in Davenport et al. 2011) notes that the assemblage is unusual for the region in both its sheer size as well as the manufacturing techniques employed at the site. Contrary to that seen at the Blueberry site and other Belle Glade sites, the debitage primarily represents the product of "the bipolar reduction of chert cobbles" (Davenport et al. 2011:755); Austin (2004) found similar patterns of bipolar reduction at the Brickell Point site (8DA12). The presence of chert cobbles and primary reduction flakes, as well as late stage reduction flakes, clearly demonstrates that place provisioning is represented at Ritta Island as well as Brickell Point. Further, the manufacturing objective at Ritta Island seems to have been focused on the production of microlith technologies rather than the more traditional lithic technologies seen throughout the region. In Davenport et al. (2011:755-756), Austin does note that while there is some evidence of core reduction techniques present at the site there is a dearth of "evidence for on-site biface production beyond a few biface thinning flakes and retouch flakes. The various bifacial implements… all appear to have entered the site as complete specimens." The fact that bifaces were imported rather than manufactured on site, where an abundance of raw lithic material was provisioned, is intriguing. They may represent an item that was traded in order to maintain relationships with other groups, or they may represent a curated technology that was brought with individuals that returned from long-distance trips. Perhaps inhabitants of these sites in a region devoid of lithic resources understood it was in their best interest to maintain strategic trade relationships with multiple sources of flakable stone whenever possible.

While details of the lithic assemblage are somewhat limited, the 1990-1991 investigations of the Ortona Earthworks and Mounds site provides evidence pointing to a place provisioning strategy. Carr et al. (1995) report that the lithic assemblage contained at least two chert cores and a small number of decortification flakes. When discussing the lithic assemblage recovered from Mound A, they refer to two lithic cores (Carr et al. 1995:247). Additional evidence for primary reduction activities at the site was discovered in Mound B where two specimens described as "primary cortex, lithic flakes" (Carr et al. 1995:249) were recovered. Evidence from this site is also consistent with the tenets of our model that prioritizes reuse of lithic materials in that "Twenty-five lithic flakes were found suggesting tool reworking activities"

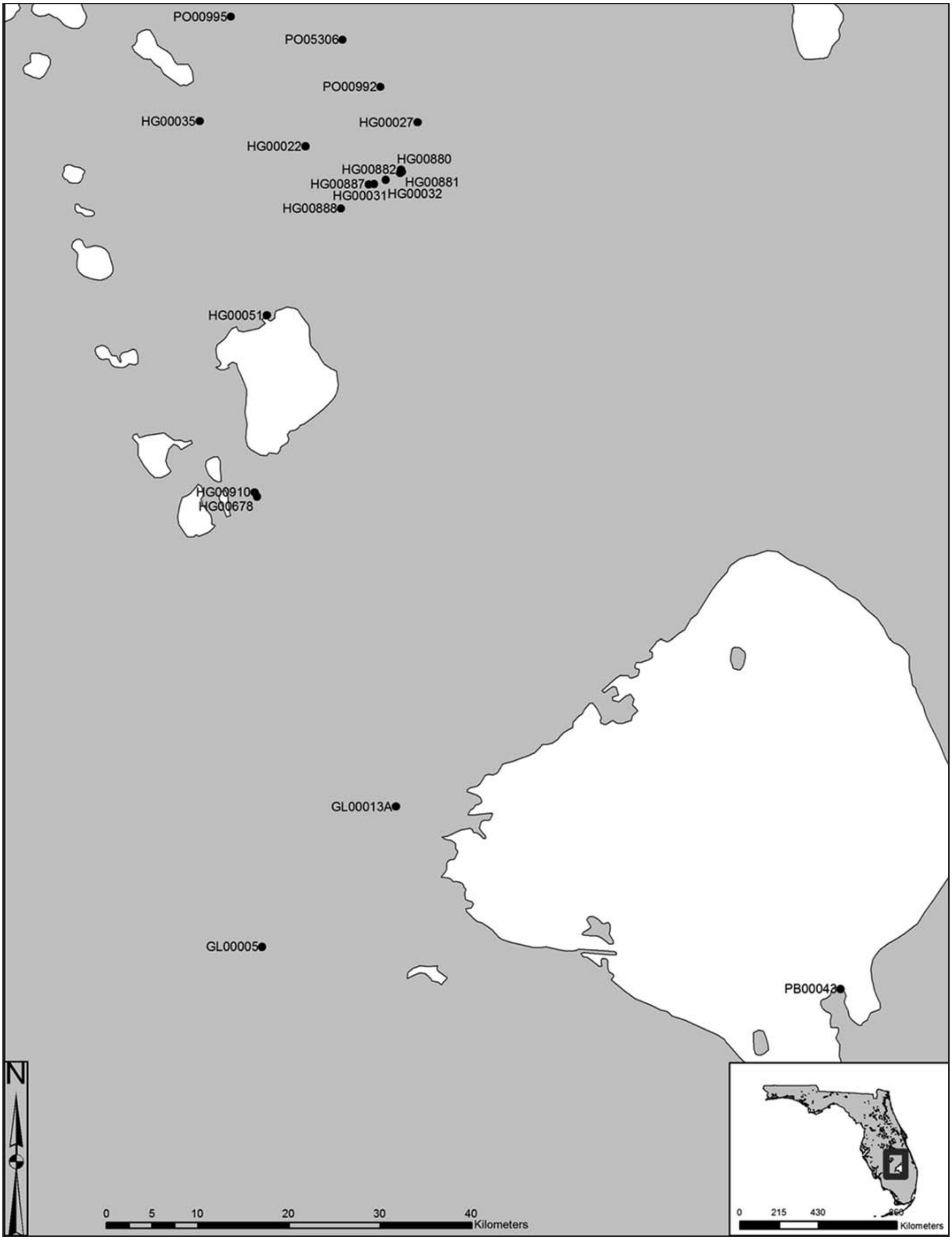

Figure 8. Location of sites in study. Base map data: Florida Geographic Data Library.

(Carr et al. 1995:247). Likewise, the summary of the lithic assemblage states: "Several complete or fragmentary projectile points or knives were found" (Carr et al. 1995: 257).

How these materials were procured is a more difficult question to answer. The closest source of lithic raw materials is the Peace River Quarry cluster, which is more than 50 km from the Blueberry site (Butler 2008a, 2008b; Butler and Lawres 2011). Previous research on lithics at the Blueberry site included a sample of 55 lithic specimens recovered from Phase I testing; this research analyzed and sourced the lithic specimens in the sample. Twenty-five of the 55 specimens (45 percent) were sourced to the Peace River chert formation (Austin 2008). The remainder of the sample was sourced to formations in the more northerly portion of the state (Brooksville quarry cluster, Hillsborough River quarry cluster, Withlacoochee quarry cluster). It is possible that the residents of the site used a strategy of embedded procurement (Binford 1979) in which they would obtain lithics from the Zolfo Springs outcrop during regularly schedule travels for hunting or other activities. It is much more likely that this material was obtained via indirect procurement, or trade. It is easier to justify this strategy due to the prevalence of material goods that originated outside the immediate region, such as Lutjanidae spp., shark teeth, marine shell, copper, and greenstone (Butler and Clover 2009). These materials document the existence of a trade network that the residents of Blueberry were enmeshed in. Further, it is likely that the same people they obtained Peace River chert from also supplied at least some of the marine items recovered from the site since the Peace River represents a direct route to the Gulf Coast.

The raw materials that were sourced to more northerly origins (such as the Brooksville, Ocala and Hillsborough River quarry clusters shown in Figure 1) are also indicative of indirect procurement. It is possible that due to existing cultural affiliations between Belle Glade sites that these materials were obtained from the inhabitants of Fort Center. As Austin (1997, 2004; Davenport et al. 2011) has noted the Fort Center and Ritta Island sites possibly represent important centers in a down-the-line exchange system that imported raw lithic materials from more northerly locations. This system likely terminated at the Brickell Point site (Austin 2004). Thus, Belle Glade sites located along deep-water routes, such as Fisheating Creek (Fort Center) and Lake Okeechobee (Ritta Island), used this trade system to enact a place provisioning strategy. Provisioning, however, was not merely for future use in tool manufacture, but for trade purposes as well. If this is the case it is likely that the inhabitants of Blueberry obtained materials from this trade system. Since Blueberry is located some distance from a central trade route (i.e., the deep-water aquatic routes) it is at the end of a trading continuum for lithic material; in this continuum sites further from the point of origin receive materials that are diminutive in nature. In other words, the residents of Blueberry were receiving bifaces (possibly used as cores) and blanks due to people farther up the line in the system (i.e., the intermediaries closer to the center of the system) either removing pieces of raw material for their own use prior to trading or fashioning bifaces and blanks to minimize transport cost. Thus, Blueberry represents a site that was likely involved in two separate systems of indirect procurement of lithic materials. First, they were receiving materials from the west side of the Lake Wales Ridge (Peace River formation; likely from the Zolfo Springs outcrop) via overland trade. Second, they were receiving materials from the north (Ocala and Brooksville quarry clusters) and the northwest (Hillsborough River quarry cluster) via trading partners to the southeast.

In summary, the model we propose here is aimed at both predicting and interpreting lithic assemblages in the Belle Glade cultural region and other regions devoid of locally available tool-stone. This model proposes four primary attributes of sites in such a region (see Figure 2). This model recognizes that while individual provisioning is most common, there are two types of lithic assemblages that are recognized as distinct based on the presence or absence of small cores or cobbles (and or evidence of small core reduction). The difference in these assemblage types is strongly correlated to both the environmental context of a site as well as its residency attributes. Specifically, large, permanent habitation sites located away from interconnected, annual deep-water routes, such as lake and river systems, are expected to produce lithic assemblages that exhibit evidence for lithic material entering sites as late-stage preforms or finished tools. We label sites with these characteristics as Minimal Reduction Sites. We expect these assemblages to show: minimal diversity in lithic tools and debitage (which should be dominated by flake types indicative of late stage reduction techniques); minimal resource waste (i.e., high frequency of utilized flakes); high rates of curation; and importation of nearly complete tools to minimize transport cost (see Figure 2). All of these characteristics are further explainable by Kuhn's (1995) framework of provisioning strategies, specifically the strategy of provisioning individuals.

Conversely, large, permanent habitation sites located in close proximity to annual deep-water routes are expected to include characteristics that typically manifest at the opposite end of the reduction spectrum: high diversity in debitage (entire continuum of reduction sequence); low rates of curation; and stockpiling of raw materials in the form of cobbles. For the model proposed here we label these sites where the full spectrum of reduction takes place at sites distant from raw material sources in the region as Removed Reduction Sites. The characteristics typical of these sites are also explainable by Kuhn's (1995) framework in the form of place provisioning strategies. While this pattern is distinct from the Minimal Reduction Sites, it is not yet known if patterns of core reduction at these sites differ from sites in the region found closer to raw material sources. However, we suspect this is the case and suggest this comparative study as a focus for future research since this pattern has been observed with previous studies demonstrating more efficient core reduction strategies at sites distant from raw material resources (Andrefsky 2009, Braun 2005, Brantingham and Kuhn 2001).

Conclusion

The Regional Model of Lithic Dispersion presented in this analysis emphasizes the connection between the composition of lithic assemblages and the environmental context of their deposition. This model underscores the importance of interpreting lithic assemblages relative to their environmental context. For this study, the model was developed and applied toward the analysis of lithic assemblages in a region devoid of locally available raw material for lithic tool production. By developing a model within a framework emphasizing provisioning strategies, we address not only how tool stone was transported to the site and how it was used, but that at least two sets of behaviors related to maximizing and economizing this resource are exhibited in the lithic assemblages at Belle Glade sites.

The Regional Model of Lithic Dispersion suggests there are two types of lithic assemblages expected at Belle Glade sites in the region. The first behavioral pattern and resultant lithic assemblage (Minimal Reduction Sites) are those where individuals are provisioned with tool stone. These assemblages are expected at large village sites located in areas without direct access to deep-water routes. Assemblages at these types of sites are expected to reflect the characteristics of Pecora's Late Reduction Juncture. The second type of assemblage (Removed Reduction Sites) is where an entire site may have been provisioned, a process known as place provisioning (Kuhn 1995). Sites are placed into this category based on evidence of primary reduction, or cobbles themselves being present in assemblages. Our model predicts that this assemblage type is most likely to be found at large village sites with immediate access to deep-water routes and thus participated in a down-the-line exchange system in the Belle Glade region. Clearly, the Blueberry site is classified into our Regional Model of Lithic Dispersion as a Minimal Reduction Site in which individuals were provisioned, while sites such as Fort Center, Ritta Island and the Ortona Earthworks and Mounds complex represent Removed Reduction Sites. Thus, The Regional Model of Lithic Dispersion is both a predictive and explanatory model that is grounded in the contextual analysis of lithic assemblages. Further, it is formulated in a way that is based on the preponderance of the currently available data and, thus, is designed to be revised to incorporate future data from a region where much additional work is needed.

Future research in the region should test the applicability of this model at other Belle Glade sites in south-central Florida, as these sites are located in similar geomorphological locations that are distant from sources of raw lithic materials. Additionally, future research should be directed towards a comprehensive comparative study that attempts to correlate various attributes (i.e., site size, site function, temporal association, etc.) with the parameters of this model. Likewise, future research should compare assemblages from Removed Reduction Sites relative to their location to raw material sources to test for a correlation between relative distance and evidence of place provisioning and primary reduction debitage. It is hoped that a comprehensive model of Belle Glade lithic use can be developed using this case study as a baseline.

Acknowledgments

The authors would like to express their sincere gratitude to Anne and Charles Reynolds, the owners of the Blueberry site property, for their utmost and continued support throughout the entirety of the ongoing archaeological excavations at the Blueberry site. Their support has been the backbone of all the research that has taken place at this incredibly significant site. Also, we would like to recognize the analytical expertise of Jessica Allgood (faunal analysis), Dr. Rene Bonzani (floral analysis), Dr. Robert Tykot (copper analysis), Dr. Robert Austin (lithic sourcing and analysis), and Dr. Arlene Fradkin (faunal analysis). Also, we would like to thank Ryan Murphy and the hundreds of student (high school: Walker Academy and college level: UCF, Rollins, Valencia) and adult volunteers (especially KVAHC members) who have contributed to this project since its inception.

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