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Prismatic Blade Production at the Sinclair Site, Tennessee: Implications for Understanding Clovis Technological Organization

Jesse W. Tune , Thomas A. Jennings, and Aaron Deter-Wolf

The Tennessee Division of Archaeology documented an extensive Paleoindian lithic quarry and workshop at the Sinclair site in Tennessee in 2008. We present the first detailed description of the lithic assemblage here, which focuses on aspects of its prismatic blade technology. Quantitative and qualitative attributes of 117 blades are assessed to characterize the assemblage and investigate human behaviors related to its formation. We then compare the blades from Sinclair to other blade assemblages. Blades at Clovis workshop sites are large and generally unstandardized. Mobile Clovis bands selected long, highly standardized blades from workshop sites, cached them as resource insurance, and crafted and used them as tools at campsites. The prismatic blade assemblage at Sinclair and other sites throughout the Midsouth suggests that this region played an important role in the development of prismatic blade technology at the end of the Pleistocene.

Keywords: Clovis, Paleoindian, prismatic blade technology, lithic technological organization, hunter-gatherer behavior

La División de Arqueología de Tennessee documentó una extensa cantera y taller lítico Paleoindio en el sitio de Sinclair en Tennessee en 2008. Aquí se presenta la primera descripción detallada del conjunto lítico y se enfoca en aspectos de la tecnología de briznas prismáticas presentes en el sitio. Se evalúan los atributos cuantitativos y cualitativos de 117 briznas para caracterizar el ensamblaje e investigar los comportamientos humanos relacionados con su formación. Luego, las briznas de Sinclair se comparan con otros conjuntos de briznas. Las cuchillas en los sitios de los talleres de Clovis son grandes y generalmente no están estandarizadas. Los grupos móviles de Clovis seleccionaron briznas largas y altamente estandarizadas de los sitios de los talleres, las almacenaron en caché como seguro de recursos y las diseñaron y usaron como herramientas en los campamentos. El conjunto de cuchillas prismáticas en Sinclair y otros sitios en Midsouth sugiere que esta región jugó un papel importante en el desarrollo de la tecnología de cuchillas prismáticas al final del Pleistoceno.

Palabras claves: Clovis, Paleoindio, tecnología de briznas prismáticas, organización tecnológica lítica, comportamiento del cazador-recolector

Research into early lithic assemblages in North America shows that prismatic blades (hereafter referred to as blades) were an essential part of Clovis lithic technology during the Late Pleistocene. The discovery of a cache of 17 blades at Blackwater Draw in 1962 and subsequent discoveries of blades in association with butchered mammoths led Green (1963:157) to conclude that there was “unequivocal proof of a blade

industry as an integral part of the [Clovis] complex.” Later research at sites like Anadarko, Keven Davis, and Gault further solidified Green’s hypothesis that blades struck from prepared cores were a significant component of Clovis lithic technology (Bradley et al. 2010; Collins 1999; Ham-matt 1970; Waters et al. 2011).

Kilby (2015) has demonstrated that blades and blade cores were a frequent component of

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utilitarian Clovis caches across much of the Southern Plains. Blades from Clovis contexts are documented from Texas and Oklahoma at the Gault, Keven Davis, Pavo Real, Aubrey, and Anadarko sites (Bradley et al. 2010; Collins 1999; Ferring 2001; Hammatt 1970; Waters et al. 2011). Extensive evidence of blade production has been documented in the Allendale Brier Creek Complex and other locations throughout South Carolina and Georgia (Sain and Goodyear 2016; Smallwood 2015). Clovis blade technology is also documented in the Tennessee and Ohio River drainages (Ellerbusch 2004; Norton et al. 2011; Sanders 1990; Stanford et al. 2006). Though not as thoroughly reported as other sites, the Carson-Conn-Short site in Tennessee and the Adams site in Kentucky demonstrate extensive Clovis prismatic blade production in the Midsouth (Haag et al. 2014; Norton et al. 2020; Sanders 1990; Stanford et al. 2006).

The blade assemblage from the Sinclair site in Tennessee provides a unique opportunity to comprehensively study blade technology and how it may have fit within a broader Clovis technological organization. The Sinclair assemblage is characterized here based on quantitative and qualitative attributes and is compared to other known Clovis and post-Clovis blade assemblages. We hypothesize the objective of Clovis blade making, examine whether variation in blade morphology can be explained by site type, and place the blades from the Sinclair site within a broader Clovis technological context. Finally, we assess whether Clovis blades can be statistically differentiated from non-Clovis blade technologies.

The Sinclair Assemblage

The Sinclair site (40WY111) overlooks the Buffalo River in Wayne County, Tennessee. Large, tabular, rectangular-to-angular chert nodules are readily accessible on-site. Broster and Norton's (2009) investigation documented at least 10 discrete activity areas and hundreds of Clovis and other Paleoindian artifacts. The site area was severely disturbed in 2007 and 2008 by bulldozing and plowing to convert the wooded landscape into pastureland. Because of the limited

spatial information available, we cannot evaluate how discrete activity areas may have been affected by recent postdepositional activities.

Broster and Norton's (2009) surface survey was conducted opportunistically, resulting in a collection of complete and broken blades and cores, which are curated at the Tennessee Division of Archaeology (TDOA). Photographs were taken of blade cores, and representative examples were collected as part of the TDOA's investigations; however, the limited number of cores collected does not allow a meaningful assessment of core-reduction techniques used at Sinclair at this time. Additionally, broken Clovis preforms and fluted points, bifaces, and debitage were recovered in 2008. Broster and Norton (2009) note that Late Paleoindian bifaces and debitage occurred in a single discrete area. The site assemblage also includes previously unreported Early and Middle Archaic artifacts.

Clovis Blade Technology

The term "blade" refers here to a flake with parallel to slightly convergent edges and with parallel or subparallel flake scars on the dorsal face running parallel to the long axis, having a length-to-width ratio of at least 2:1, and removed from a prepared core (Collins 1999:191). Clovis blades are typically prismatic-like in cross section and possess small striking platforms, diffuse bulbs of percussion, a smooth interior surface, and subparallel scars on the exterior surface (Collins 1999). Crabtree (1968) adds that blades are associated with a specialized lithic reduction technique requiring the use of carefully prepared cores; that is, they are not fortuitously produced long, narrow flakes.

The production of blades is one of two formal core-reduction strategies known to have been used by Clovis flintknappers, the other being bifacial core reduction. Conical and wedge-shaped cores were used by Clovis flintknappers to produce blades (Bradley et al. 2010; Collins 1999; Waters et al. 2011). Given the typical roundness of river cobbles, these raw material packages naturally lent themselves to the production of conical blade cores. Rectangular to subrectangular tabular raw material packages were more conducive to producing wedge-shaped

blade cores. This pattern in raw material package shape and blade core morphology is supported by data from the Gault site (Waters et al. 2011). Although Collins (1999) recognized that conical and wedge-shaped cores were used by Clovis flintknappers for blade production, his proposed six-stage reduction sequence is most applicable for assessing conical blade cores.

Waters and coauthors (2011; also see Bradley et al. 2010) conducted a detailed study of Clovis blade technology at the Gault lithic workshop where wedge-shaped, rather than conical, cores were mainly used. The rectangular shape of tabular Edwards Plateau chert nodules at Gault may have favored wedge-shaped reduction and may explain why wedge-shaped cores outnumber conical cores by 9 to 1 (Waters et al. 2011). Most notably, Waters and coauthors (2011) documented that late-stage blades produced from wedge-shaped cores retain a straighter profile, whereas on conical cores, late-stage blades typically exhibit a high degree of curvature, as noted by Collins (1999).

Methods

Summary statistics were calculated for a sample of 117 blades and blade fragments from the Sinclair assemblage. Following Collins (1999) and others (Eren and Redmond 2011; Waters et al. 2011), we documented the overall size of blades by the sum of length, width, and thickness. The results are summarized and presented here, with raw measurements provided in Supplemental Table 1 to aid future additional comparative analyses.

Qualitative attributes of complete blades were documented to assess relative stages of blade removal. We combined the six stages of reduction defined by Collins (1999) into *early* (1–2), *middle* (3–4), and *late* (5–6) stages to better reflect the continual variation observed between blades from successive removal episodes. Early-stage blades are characterized by a high percentage of dorsal surface cortex and few flake scars, large bulbs of percussion, large striking platforms, and a relatively straight longitudinal profile. Middle-stage blades are characterized by numerous dorsal flake scars and less cortex, moderate bulbs of percussion, and slight-to-moderate longitudinal

curvature. Late-stage blades are characterized by dorsal surfaces with numerous flake scars and minimal to no cortex, diffuse bulbs of percussion, small platforms, and strong longitudinal curvature. The rate of reduction for blade width and length is assessed by calculating the percent loss after each stage of the reduction process.

Eren and coauthors (2018) use the presumably Archaic period Gibson assemblage (Tunnell 1978) to highlight the potential utility of using a known non-Clovis assemblage to help identify Clovis blades in assemblages without clearly associated Clovis points. We chose not to use the Gibson assemblage here because, as Collins (1999:171) notes, “So many of the Gibson specimens are retouched that the cache might more accurately be referred to as a cache of scrapers.” Nor do we include the Goodson Rockshelter assemblage as an outgroup because that site is so newly reported and the affinity of the artifacts is currently being debated (Eren et al. 2021; Huckell et al. 2019). Instead, we use two blade assemblages—Barton (Ricklis 1994) and Kirchmeyer (Hester and Shafer 1975) associated with Perdiz points—that are diagnostic of the Late Prehistoric Toyah phase in Texas (Collins 1999). Toyah blades have been shown elsewhere to be morphologically distinct from Clovis blades (Collins 1999; Jennings and Smallwood 2018). Following Eren and coauthors (2018), we use discriminant function analysis (DFA) to compare blades. We use the Gault Clovis assemblage to define Clovis blades and group Barton and Kirchmeyer in a Toyah group as the non-Clovis outgroup.

We then compared all Clovis blade assemblages discussed here based on site type. Assemblages from lithic workshops (Sinclair, Gault, and Pavo Real) were compared to blade caches (Blackwater Draw, Keven Davis, and Anadarko) and multi-use campsites (Murray Springs, Paleo Crossing, and Nuckolls; Figure 1). However, the Blackwater Draw (Green cache), Keven Davis, and Anadarko assemblages do not have radiometric dates or Clovis points directly associated with them. We tested for broader technological patterns related to Clovis band movement across the landscape. Coefficients of variation (CVs) were calculated to compare relative standardization among assemblages (Eerkens and

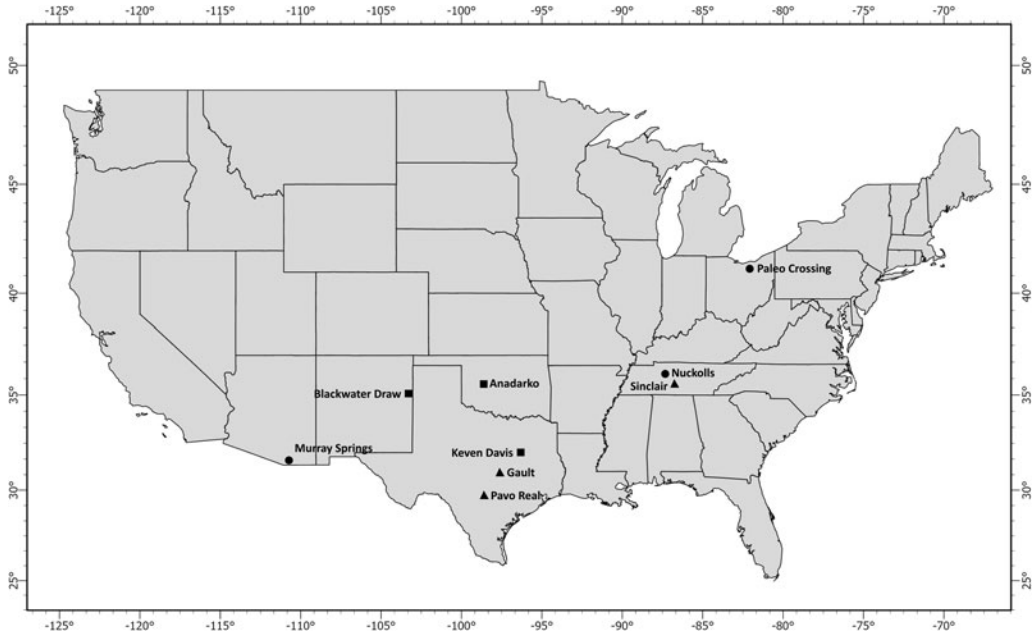


Figure 1. Distribution of Clovis prismatic blade assemblages compared in this study. Triangles denote workshops, circles denote campsites, and squares denote caches.

Bettinger 2001). Comparative statistical tests included parametric ANOVA and nonparametric Kruskal-Wallis depending on the outcomes of normality and variance tests (VanPool and Leonard 2011).

Results

Sinclair Blades

All blades analyzed from Sinclair are macroscopically consistent with Fort Payne chert. The assemblage consists of 47 complete blades, 33 proximal fragments, 11 medial fragments, and 26 distal fragments. Although all stages of blade production are represented at Sinclair, the assemblage is dominated (57.45%; $n = 27$) by early-stage blades (Figure 2; Supplemental Table 2).

All variables are normally distributed with equal variances, with the exception of thickness. A series of ANOVA tests (and Kruskal-Wallis for the thickness comparison) were conducted with Bonferroni post-hoc comparisons to quantitatively identify differences between blade stages (Table 1). The only significant difference identified between reduction stages was blade width

($p = 0.033$). Post-hoc comparison shows that this significance is driven by the difference between early- and middle-stage blades ($p = 0.042$). This is not surprising: it likely reflects the fact that the production of blades occurred along a continuum in a lithic-reduction process, rather than in discrete steps.

Although the length-to-width ratios between stages are nearly significant ($p = 0.055$), there appears to be an inverse relationship between blade size and length-to-width ratios within the Sinclair assemblage. Earlier-stage blades have smaller length-to-width ratios and larger dimensions, and later-stage blades have higher length-to-width ratios and smaller dimensions. This suggests that, although all dimensions decrease throughout blade reduction, width decreases faster and to a greater extent than length. This pattern is reinforced when percent loss in dimensions is calculated throughout the blade-reduction process (Table 2). The average blade width is reduced by 20.08% from the early to middle stage, and by 2.01% from the middle to late stage; average blade length is reduced by 3.39% from the early to middle stage, and by 0.80% from the middle to late



Figure 2. Representative selection of prismatic blades from the Sinclair site. Early-stage blades (a) 08-49-40 and (b) 09-5-94. Middle-stage blades (c) 08-49-690 and (d) 08-49-104. Late-stage blades (e) 08-49-41 and (f) 09-5-98. Catalog numbers correspond to the inventory provided in Supplemental Table 1. (Color online)

stage. However, the presumed removal of late-stage blades from the Sinclair site may influence these relationships by skewing the sample toward the earlier end of the reduction process.

When assessing the blade dimensions and relationships between those dimensions by stages of reduction, notable patterns emerge. The CVs of individual blade dimensions increase

throughout the reduction process (Supplemental Table 2), and the correlations between length-to-width and width-to-thickness become stronger (Table 3). Essentially, as blade cores are reduced, individual blade dimensions become more variable, and the correlations between those dimensions become stronger. The lack of statistical significance of correlations

Table 1. Results of ANOVA and Kruskal-Wallis Tests of Complete Prismatic Blades by Reduction Stages from the Sinclair Assemblage.

Measurement	<i>F/H</i>	<i>df</i>	<i>p</i>
Length	0.119	2	0.888
Width	3.700	2	0.033
Thickness	3.244	2	0.197
Length:width ratio	3.093	2	0.055
Length + width + thickness	0.871	2	0.426

Notes: ANOVA measured length, width, length:width, and length + width + thickness; Kruskal-Wallis tests measured thickness.

in late-stage blades is likely related to the very small sample size ($n = 3$).

Comparison to other Blade Assemblages

DFA successfully distinguishes Clovis from non-Clovis (Toyah) blades (Supplemental Table 3). Of the 74 blades from sites previously described as Clovis, only 3 (4%) are incorrectly classified as non-Clovis. Of the 18 non-Clovis blades, 3 (16%) are incorrectly classified as Clovis. For both Clovis and non-Clovis, the blades that are classified incorrectly all come from workshop sites. This suggests that, even though Clovis blades can be distinguished from non-Clovis blades *at the assemblage level*, individual blades do occasionally overlap morphologically. For Sinclair, 43 of 47 (91.5%) are classified as Clovis. This analysis supports the Clovis affinity of Sinclair blades.

Individual blades from Sinclair are larger than those from most other Clovis assemblages (Supplemental Table 4). The Sinclair assemblage falls within the known range of variation for Clovis blades and groups with other workshop sites (Figure 3). Although maximum dimensions and overall size may be affected by factors such as raw material package size, comparisons of morphological ratios and relative measures of assemblage variability more directly reflect

Table 2. Comparison of Percent Change in Complete Blade Dimensions by Reduction Stage in the Sinclair Assemblage.

Stage of Reduction	Length	Width
Early–Middle	–3.39%	–20.08%
Middle–Late	–0.80%	–2.01%

Table 3. Results of Pearson's Correlations between Length, Width, and Thickness for Complete Prismatic Blades in the Sinclair Assemblage.

Length and Width				
	<i>N</i>	<i>r</i>	<i>r</i> ²	<i>p</i>
Early–Stage	27	0.573	0.330	0.002
Middle–Stage	17	0.635	0.402	0.006
Late–Stage	3	0.711	0.505	0.497
Width and Thickness				
	<i>N</i>	<i>r</i>	<i>r</i> ²	<i>p</i>
Early–Stage	27	0.463	0.214	0.015
Middle–Stage	17	0.548	0.300	0.023
Late–Stage	3	0.981	0.962	0.125

technological aspects that are independent of such factors. Thus, they may provide more meaningful insight into blade technologies in general. Length-to-width ratios are highest in caches and lowest in campsites. Based on the calculated CVs, cached blade lengths are the most standardized (Figure 4). Campsite blade widths are most standardized, and cached blade thicknesses are most standardized. Campsite blade length-to-width ratios are most standardized. For all four measures, workshop blades are the most variable and the least standardized.

Discussion

Given sufficient raw material size and availability, it appears that the objective of Clovis blade technology was to produce standardized, long, narrow blades while maximizing overall size. Those standardized blades were then selected to be modified into tools and used at other sites. Late-stage blades, those that fit into what Waters and coauthors (2011) refer to as cache-quality blades, were likely removed from Sinclair to be used as tools at other locations. Sain and Goodyear (2016) noted a similar pattern in the Allendale Brier Creek Clovis Complex.

The Sinclair, Gault, and Pavo Real workshop sites are dominated by large, earlier-stage blades with variable length-to-width ratios. Blackwater Draw, Keven Davis, and Anadarko caches are dominated by large, later-stage blades with more standardized length-to-width ratios, blade lengths, and blade thicknesses. The Paleo Crossing, Murray Springs, and Nuckolls campsite

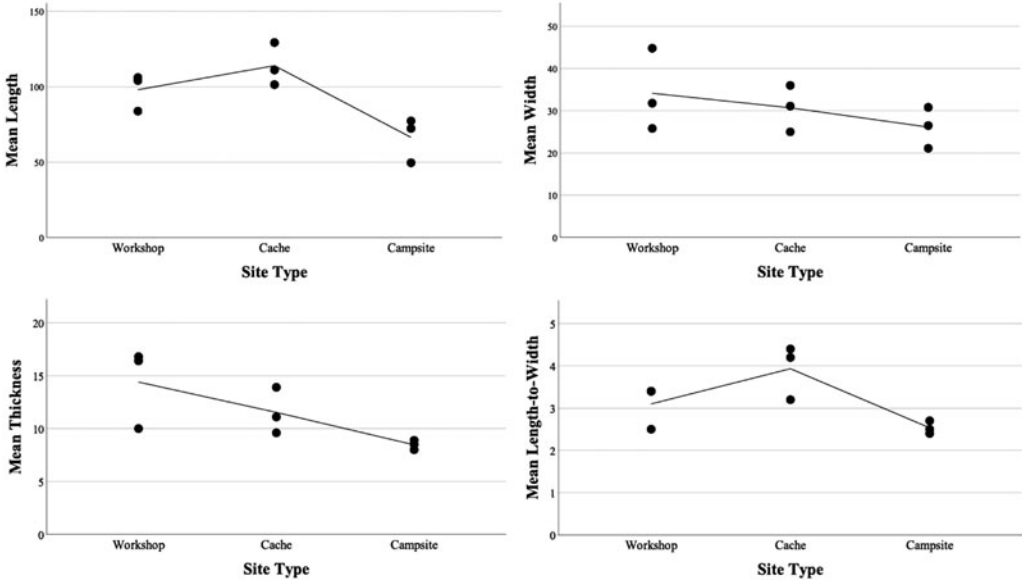


Figure 3. Scatterplots of blade means grouped by site type. Lines represent means within each site type.

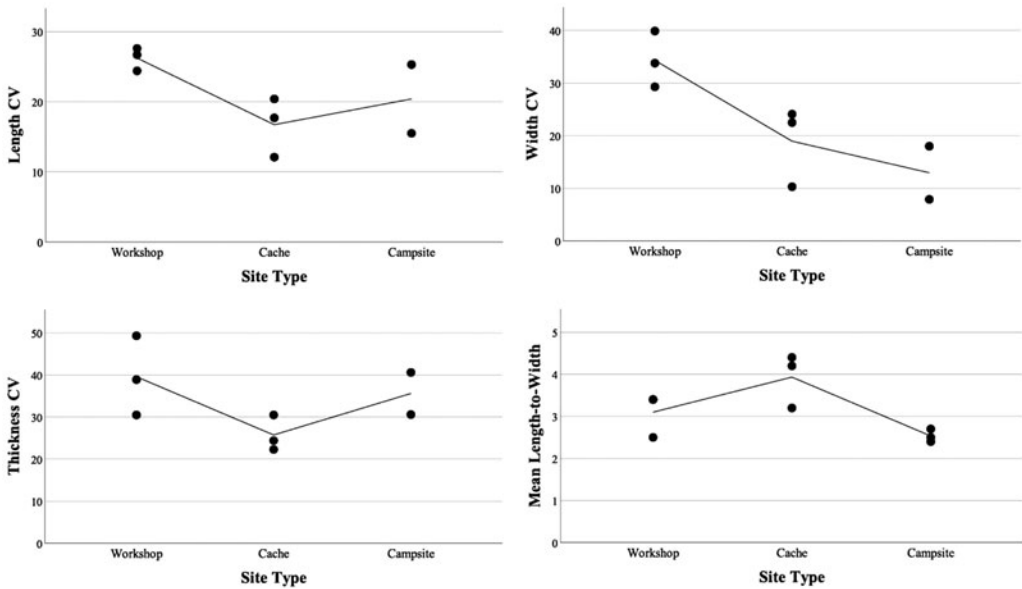


Figure 4. Scatterplots of blade CVs grouped by site type. Lines represent means within each site type.

assemblages are dominated by blade tools of variable lengths that demonstrate extensive use and reduction, resulting in small length-to-width ratios. Campsite blades, however, still retain high width and length-to-width standardization.

These assemblage-level differences reveal how blade technology was organized across the landscape (Figure 5). The Sinclair, Gault, and Pavo Real sites are chert quarries where primary reduction of raw materials occurred; the

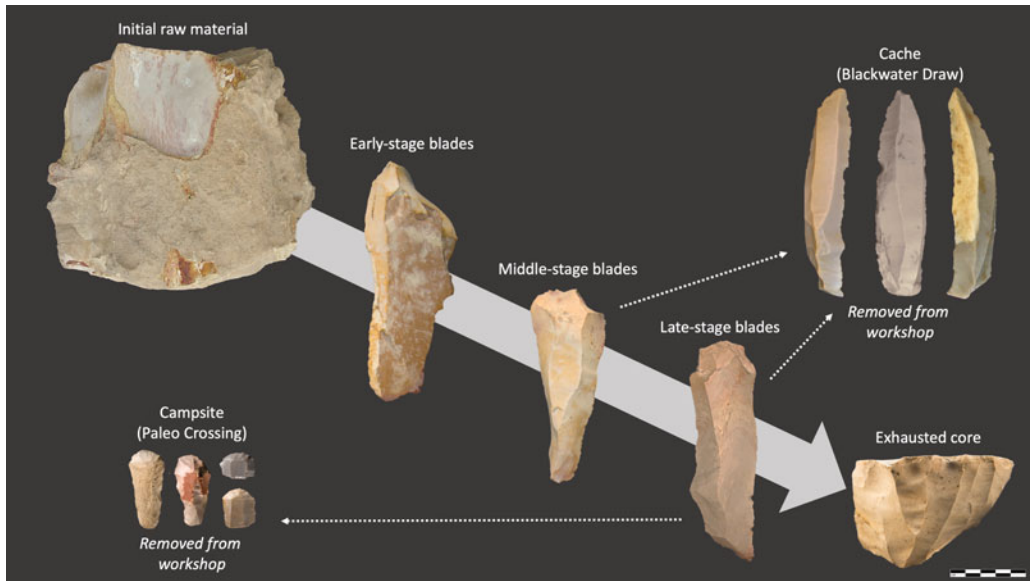


Figure 5. Generalized organization of Clovis prismatic blade technology (images of Paleo Crossing artifacts used with the permission of Metin I. Eren, Kent State University; images of Blackwater Draw artifacts used with the permission of David Kilby, Texas State University). (Color online)

assemblages there reflect early-stage reduction. Workshop assemblages are highly variable in terms of blade dimensions and ratios and contain very few blade tools. Keven Davis, Blackwater Draw, and Anadarko are cache sites where middle- to late-stage blades were intentionally deposited in anticipation of future use (Kilby 2014). All three assemblages are made up of relatively large, very standardized blades and few blade tools. The Murray Springs, Nuckolls, and Paleo Crossing sites are locations where a variety of activities occurred. These assemblages are dominated by late-stage blades and have substantially higher quantities of blade tools.

Conclusion

The Sinclair site in Tennessee is a chert quarry and workshop that were extensively used during the Late Pleistocene. Although Early Paleoindian through Early Archaic biface fragments are documented at Sinclair, it appears that one of the main activities at the site was the production of prismatic blades. We show that these blades are technologically and morphologically Clovis. Early-stage blades dominate the Sinclair

assemblage, suggesting that late-stage blades were removed from the site for use elsewhere. As more sites are being reported in the region, it is clearer that the Midsouth was a substantial center of Clovis technological innovation and potentially of its diffusion. We propose that the Midsouth, specifically the Lower Tennessee River drainage, was a core region of Clovis blade technology.

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Data Availability Statement. All data used in this study are available in in-text tables and supplemental online material. A complete inventory with accession numbers is provided in the supplemental online material. The Sinclair dataset discussed here is permanently curated at the Tennessee Division of Archaeology.

Competing Interests. The authors declare none.

Supplemental Material. For supplemental material accompanying this article, visit <https://doi.org/10.1017/aaq.2022.16>.

Supplemental Table 1. Inventory and Description of the Sinclair Blade Assemblage.

Supplemental Table 2. Descriptive Statistics for Complete Prismatic Blades from the Sinclair Assemblage.

Supplemental Table 3. Results of DFA Using Gault as a Clovis Proxy and Barton and Kirchmeyer as Non-Clovis Proxies.

Supplemental Table 4. Descriptive Statistics for Clovis Prismatic Blade Assemblages.

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