**RAW MATERIAL, CONTEXT, TIME, AND GEOGRAPHY:**

**LITHIC TECHNOLOGICAL ORGANIZATION IN THE**

**SOUTHERN CADDO AREA**

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*It is generally assumed that differences in raw material articulate with stone tool morphology.*

The assumption is that the ability to execute formal technological designs is severely limited by the quality of the raw material. Toolkits based on high quality raw materials are thought to be easier to design because fracture is easier to control ([Goodyear 1989:3](#_ENREF_7); [Luedtke 1992](#_ENREF_13)). In contrast, toolkits based on poor quality raw material are more difficult to design because fracture is unpredictable and results in severe, irreparable errors during reduction. Even where low raw material abundance would encourage formal technological design, raw material quality is thought to be the overriding factor constraining lithic technological organization ([Brantingham, et al. 2000:257](#_ENREF_3)).

Recent morphological analyses of Caddo bottles and Gahagan bifaces have yielded new insights related to both Caddo ceramic and lithic production, as well as the identification of a previously unrecognized shape boundary within the southern Caddo area ([Selden Jr. 2017](#_ENREF_25), [2018a](#_ENREF_26), [2018b](#_ENREF_27), [2019](#_ENREF_28), [2021a](#_ENREF_29), [2021b](#_ENREF_30); [Selden Jr., et al. 2020](#_ENREF_31); [Selden Jr., et al. 2014](#_ENREF_33); [Selden, et al. 2018](#_ENREF_34)). This effort expands that research program to include morphological analyses of arrow points, and the working hypotheses employed in this study were derived from a series of ongoing exploratory network analyses using the Caddo ceramic and lithic types ([Selden Jr. 2021a](#_ENREF_29)).

PERDIZ ARROW POINT SAMPLE

The Perdiz sample used in this analysis comes from Camp, Harrison, Nacogdoches, San Augustine, Smith, and Shelby counties, and consists of whole/intact Perdiz arrow points from 10 sites across the southern Caddo area, which were manufactured using chert, jasper, quartzite, and silicified wood (Figure int1:a). Raw material distributions differ among the sites where chert occurs across the greatest geography (Figure int1:a). Use of quartzite and jasper were limited to Camp County, where jasper Perdiz arrow points were recovered only at the Tuck Carpenter site (41CP5) (Figure int1:a). Silicified wood was employed for Perdiz manufacture in Nacogdoches and Shelby Counties; however, Washington Square Mound (41NA49) is the only burial context where silicified wood Perdiz points have been recovered (Figure int1:a). While the full range of these raw materials were used in Caddo burials, only chert and silicified wood points were found to occur outside of burial contexts (Figure int1:b). Raw materials also differ through the Middle, Late, and Historic Caddo periods, where chert and silicified wood are present throughout all three periods; while jasper and quartzite occur only in Middle Caddo mortuary contexts (Figure int1:c). Radiocarbon and relative dates are discussed in more detail below; however, the median of that temporal range was used to assign the Perdiz points to the appropriate temporal period (Middle Caddo, A.D. 1200-1450; Late Caddo, A.D. 1450-1680; and Historic Caddo, A.D. 1680+) (Figure int1:d).



Figure int1. Raw materials a, by site; b, by mortuary context; c, by temporal period (Middle, Late, or Historic Caddo), and d, Temporal span of contexts in the Perdiz sample. *Double click image to view in full resolution.*

*41CP5, Tuck Carpenter Site*

The Tuck Carpenter site is a well-studied Late Caddo period Titus phase cemetery on Dry Creek in the Big Cypress Creek basin, and was occupied by the Caddo from the 15th to the 17th century A.D. Burials with Perdiz points are the earliest in the cemetery, and likely date from A.D. 1430-1500 ([Perttula, et al. 2017:197](#_ENREF_22)). A single radiocarbon date was obtained from Burial 10: 360 + 60 B.P. The calibrated age range at 2 sigma is A.D. 1442-1646, with a median probability of A.D. 1546 (using INTCal 20 and Calib 8.20).

Fifty seven Perdiz points have been recovered from burial features at the Tuck Carpenter site ([Perttula 2009](#_ENREF_15); [Turner 1978](#_ENREF_36), [1992](#_ENREF_37)). A second collection from the site includes an additional 18 Perdiz points from 13 of the burial features made from Ogallala quartzite and local chert gravel sources; including one that was made from a non-local novaculite ([Perttula, et al. 2017:Table 2](#_ENREF_22)).

*41CP12, Johns Site*

The Johns site is a Titus phase cemetery in the Prairie Creek valley in the Big Cypress Creek basin. No radiocarbon dates have been obtained from the site, but the decorative motifs associated with the ceramic vessels recovered from burials suggest that the cemetery was used from A.D. 1430-1600 ([Perttula, Walters, et al. 2010b](#_ENREF_20)). Forty-eight Perdiz points were recovered from 16 burial features. They were made from local chert, quartzite, and petrified gravel sources (87 percent), non-local sources (10.8 percent, mainly from Red River gravels), and chalcedony (2.2 percent).

*41CP20, B. J. Horton Site*

This ancestral Caddo cemetery in the Big Cypress Creek basin includes at least 19 burials, from which two Perdiz points were recovered ([Perttula, Walters, et al. 2010a:9](#_ENREF_19)). Use of the cemetery by the Caddo occurred primarily between A.D. 1500-1550 ([Perttula and Miller 2014:494](#_ENREF_18)).

*41HS15, Pine Tree Mound Site*

The Pine Tree Mound site is a large Titus phase mound center with associated habitation deposits, family cemeteries, and a large community cemetery ([Fields and Gadus 2012](#_ENREF_5)). Perdiz arrow points (n = 68) represent 53 percent of the arrow points that could be typed from the site, most (n = 50) from burial contexts and the remainder from habitation deposits. Perdiz points from burial contexts tend to have been made from non-local lithic raw materials, typically chert (42 percent), while none of the non-mortuary Perdiz points are made on non-local raw material ([Fields and Gadus 2012:566](#_ENREF_5)) (Fields and Gadus 2012:566).

There are 92 radiocarbon dates available from the Pine Tree Mound site ([Fields and Gadus 2012:Table 4.13](#_ENREF_5); [Selden Jr. and Perttula 2013:Table 2](#_ENREF_32)). Most of the calibrated dates fall between A.D. 1451-1495 and A.D. 1397-1429 ([Selden Jr. and Perttula 2013:Table 3](#_ENREF_32)), but calibrated age ranges suggest that the settlement “was established in the A.D. 1300s and persisted until at least the mid 1600s” ([Fields and Gadus 2012:299](#_ENREF_5)).

*41NA49, Washington Square Mound Site*

The Washington Square Mound site is located in the Angelina River basin and is a mound center with associated habitation deposits and a cemetery. Excavations in one mound uncovered two shaft tombs with abundant grave goods, but no Perdiz offerings ([Corbin and Hart 1998](#_ENREF_4); [Perttula, Walters, Nelson, et al. 2010](#_ENREF_21)). However, 14 Perdiz points were recovered from a burial feature in the Oak Grove Cemetery portion of the Washington Square Mound site ([Perttula, Walters, Nelson, et al. 2010:Figure 77](#_ENREF_21)). Another seven Perdiz points came from habitation areas near the main burial mound ([Perttula 2009:Table 14](#_ENREF_15)). Of those, 71 percent are on gray chert of likely central Texas origin, and the remainder were made from local quartzite.

Twelve radiocarbon dates have been obtained from the Washington Square Mound site ([Corbin and Hart 1998:Table 4](#_ENREF_4); [Selden Jr. and Perttula 2013](#_ENREF_32)), indicating use of the site in both Early (A.D. 900-1200) and Middle Caddo periods. The best dates that can be associated with Perdiz points at the site range from cal. A.D. 1238-1445.

*41NA206, Spradley Site*

The Spradley site includes late 17th to early 18th century archeological deposits with European trade goods from habitation deposits in the Bayou La Nana valley in the Angelina River basin ([Perttula and Marceaux 2018](#_ENREF_17)). Those habitation deposits, which have no associated radiocarbon dates, contain numerous Perdiz points (n = 31). Approximately 94 percent were manufactured from local silicified wood, quartzite, and gravel cherts, and the remainder are from non-local brownish-gray to translucent gray chert, likely from central Texas raw material sources ([Perttula and Marceaux 2018:Table 7](#_ENREF_17)).

*41SA135, Jack Walton Site*

This site is located on Attoyac Bayou ([Middlebrook 2010](#_ENREF_14)), and is an ancestral Caddo site with habitation deposits of likely Middle Caddo period age (A.D. 1200-1400). There are no radiocarbon dates from the site. Excavations at the site recovered seven Perdiz points.

*41SM193, Redwine*

The Redwine site (41SM193) site is a Middle Caddo period component located 22 km from the river on a north-flowing tributary (Auburn Creek) of the Sabine River ([Walters and Haskins 1998](#_ENREF_38)), which includes habitation deposits and a small cemetery. The site has one calibrated date of A.D. 1300-1454, at 2 sigma, with a median calibrated probability of A.D. 1356. The 11 Perdiz points from habitation deposits were manufactured on black, brown, and grayish-tan chert as well as Ogallala quartzite ([Walters and Haskins 1998:14](#_ENREF_38)). An additional 13 Perdiz arrow points were among the grave goods recovered from two burial features ([Walters and Haskins 1998:35](#_ENREF_38)).

*41SY43, Old Timers Site*

The Old Timers site is located in the Sabine River basin, and includes post-A.D. 1400 Late Caddo habitation deposits concentrated in the northern area of the site. Excavations recovered eight Perdiz points, all with serrated blades and made from cherts, 75 percent local gravel cherts, and an additional 25 percent of gray cherts from non-local raw material sources ([Perttula 2018:77](#_ENREF_16)).

*41SY280, Syb’s Site*

This ancestral Caddo site of the Late Caddo Salt Lick phase is located along the Toledo Bend Reservoir, west of the now inundated Sabine River floodplain ([Perttula 2018:Figure 55](#_ENREF_16)). It has a number of habitation clusters that include daub and fired clay from areas of burned ancestral Caddo house structures. There are no radiocarbon dates from the site, but the decorated ceramic vessel sherds in the collection areas suggest that the site relatively dates to a period beginning at A.D. 1400 through the late A.D. 1500s. One Perdiz arrow point was recovered from Area 13 of the site ([Perttula 2018:Table 33](#_ENREF_16)).

METHODS AND RESULTS

*Elliptical Fourier Analysis*

Two-dimensional (2D) images of the Perdiz arrow points were collected at a 600dpi resolution to produce uncompressed tiff files. Images were subsequently masked in Adobe Photoshop 2020 (v. 21.2.3), exported as jpegs, then imported to R ([R Core Development Team 2020](#_ENREF_23)), where the Momocs package was used for the subsequent elliptical Fourier analysis (EFA) ([Bonhomme, et al. 2014](#_ENREF_2)). EFA is a common tool for analyses of stone tool shape ([Gero and Mazzullo 1984](#_ENREF_6); [Ioviţă 2009](#_ENREF_8), [2010](#_ENREF_9); [Ioviţă and McPherron 2011](#_ENREF_10); [Ioviţă, et al. 2017](#_ENREF_11); [Ivanovaitė, et al. 2019](#_ENREF_12); [Saragusti, et al. 2005](#_ENREF_24); [Serwatka 2015](#_ENREF_35)), and provides visualizations that can contribute meaningfully to traditional descriptions, as well as linear and/or orthogonal metrics. The outline of each projectile was retained, and all specimens were normalized to a common centroid, then rescaled using centroid size ([Bonhomme, et al. 2017](#_ENREF_1)). The *calibrate harmonic power* function was used to identify the number of harmonics necessary to capture Perdiz point shape ([Bonhomme, et al. 2014](#_ENREF_2)), and 11 harmonics were retained to achieve 99 percent harmonic power.

An exploratory measure (EFA-PCA) was employed to assess variability among the raw materials (Figure gm1). The primary differences among PC1 occur most notably in blade width, while differences in PC2 relate most readily to stem length. This can be seen in the graph where a broader blade with a long stem occurs at the top right, and a narrower blade with a shorter stem at bottom left.



Figure gm1. EFA-PCA for Perdiz points by temporal period (Middle Caddo [MC], Late Caddo [LC] and Historic Caddo {HC]), mortuary context (Mortuary [M] and Not [N]), and raw material (chert [C], jasper [J], quartzite [Q], and silicified wood [S]). *Double click image to view in full resolution.*



Figure gm3. Comparison of mean shapes by temporal period (Middle Caddo [MC], Late Caddo [LC] and Historic Caddo {HC]), mortuary context (Mortuary [M] and Not [N]), and raw material (chert [C], jasper [J], quartzite [Q], and silicified wood [S]). *Double click image to view in full resolution.*

DISCUSSION

To test the hypothesis that Perdiz arrow point shape differs by raw material type, Perdiz arrow points from 10 Caddo sites were aggregated for a study of two-dimensional geometric morphometrics. Results demonstrate significant differences in Perdiz shape among raw materials. Those points made from chert were found to differ in shape significantly from those made from jasper, quartzite, and silicified wood, and points made from silicified wood differ from chert, jasper, and quartzite. However, Perdiz points made from jasper and quartzite do not differ significantly in shape. Additional tests were run to assess whether Perdiz shape differs by site and mortuary context. Results demonstrate some significant morphological differences by site, providing additional information regarding potential geographic constraints. There was also a significant morphological difference between those Perdiz points that have been recovered in and out of mortuary contexts.

CONCLUSION

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