The differences in the means of both variables (Table 13.18) were significant: haft length t=3.35, df=54, p=0.00; tip angle proportion t=2.35, df=47. p=0.02. According to these figures, the points were derived from two different statistical populations, implying different blade and haft treatments. Combined with earlier findings regarding blade:haft-length ratios, the further implication is that the larger, longer-hafted Lackawaxen points were more extensively and asymmetrically resharpened than the small stemmed points.

Table 13.18 Variation in Haft Length and Tip Angle Proportion for Large and Small Points

		Haft Length		**Tip Angle Proportion**
Lackawaxen	Mean	13.5 mm	Mean	0.29
	Standard Deviation	4.5	Standard Deviation	0.26
	Coefficient of Variation	0.34	Coefficient of Variation	0.92
Woodland I Stemmed	Mean	10.6 mm	Mean	0.14
	Standard Deviation	1.95	Standard Deviation	0.12
	Coefficient of Variation	0.18	Coefficient of Variation	0.83

In terms of edge shape, there was little difference observed in the frequency of blade edge complexity: approximately 39 percent of both types had simple edge shapes, while 61 percent had more complex shapes. The tip angle means among the two blade shape classes are different for both types, as seen in Table 13.19, yet in neither case was the difference strongly significant: Lackawaxen, t=1.72, df=16, p=0.11; Woodland I stemmed, t=1.83,df=34, p=0.08.

Table 13.19 Variation in Blade Shape and Tip Angle Proportion for Large and Small Points

	Blade Edge Shape	**Mean Tip Angle Proportion**
	simple	0.19
Lackawaxen	complex	0.33
	simple	0.10
Woodland I Stemmed	complex	0.17

Summary

The analysis of form in the projectile points from Hickory Bluff highlighted the variety inherent in the collection. A large number of hafting element forms was present, and there was a large amount of raw material variation. This variety ultimately resulted in an inability to demonstrate detailed correlations between the various dimensional and material attributes studied. Nonetheless, general trends were observed, such as a correlation between artifact size and raw material: that is, cryptocrystalline material tended to be selected for the manufacture of small points, a choice at least in part directed by material availability.

There appear to be many influences on artifact morphology, both the original form and the archaeological form. These influences include style, function, raw material type, craftsmanship, use and resharpening. Several of these effects were examined in detail in the Hickory Bluff collection and again, overall patterns were recognized. Among them, for example, the characteristics of the raw material and in particular, raw material form, were important at the site. Most of the points made from materials common in the locally available Columbia Fm. gravel—jasper, quartz, quartzite—were of a size range consistent with manufacture from the gravels. Resharpening, investigated through attributes of the relative size and shape of the blade, may have been carried out differently depending on point size: short hafted points appeared to have been reworked less.

In the end, many of the correlations sought in the data were more readily identified in subjectively typed points than when using only morphological attributes, such as stem form. The implications are that 1) typing is indeed a subjective process, more complicated than quantifying a series of dimensional attributes, suggesting that 2) the attribute combinations chosen were not detailed nor specific enough to describe meaningful groups in the data; and 3) some of the criteria used subjectively are probably the very attributes of symmetry and length that are being sought in the analyses. However subconsciously or unintended, we were, in a sense, arguing from conclusions—begging the question, in formal rhetorical terms.

Style or repeated form does exist, and was present, in the artifacts in the Hickory Bluff collection. We were merely unable to describe it in detail analytically in an assortment of points as diverse as this. There are many significant attributes involved in defining types, and there is a complex interplay between the variables that defies easy, simplified or summary description. A larger, more uniform database, representing a tighter archaeological assemblage, would be easier to work with, since at least some variables would be controlled. It thus remains to review data from other collections in the state, and from newly excavated collections, to build on the information developed in this study.

TOOL USE AND FUNCTION

Macroscopic Analyses

Macroscopic and microscopic analytical techniques for lithics have been employed in numerous technical reports to examine and identify tool use and function. Experimental studies based on replication of tools and controlled use have provided a basis for examining variability on tool edge modification (e.g., Hayden 1979; Keeley 1980). Macroscopic analysis focuses on visible tool edge modification using low power magnification and estimation of edge angles (e.g., Andrefsky 1998; Chapman 1977). Microscopic analysis emphasizes variation in polish and striations along tool edges viewed under high magnification and attempts to determine type of activity, type of motion, and type of residue indicating material worked.

With any given archaeological tool kit, variations in use and re-use may blur functional interpretations. The purpose of this macroscopic analysis is to provide a basis for identifying patterning along tool edges using a simple and cost-effective approach. It is recognized that this patterning represents only one point in the use trajectory of the tool.

Tool edge angles and use wear were analyzed for all collected tools and modified flakes from Hickory Bluff. Tool edge angle is considered to be a measurable attribute that is a basic indicator of tool use activities (Carmichael 1985; Wilmsen 1974) (Table 13.20). Use wear patterns or edge damage suggests different types of activities and/or materials or mediums on which tools were used (Carmichael 1985; Chapman 1977; Crabtree 1974; Hayden 1979) (Table 13.21). Use wear was identified using a 10x lens.

Table 13.20 Edge Angles and Probable Tool Function

Edge Angle*	Basic Function
26 to 35 degrees	Light cutting activities; cutting meat, skin, or other soft materials; wood whittling; hide processing
46 to 55 degrees	Medium cutting and scraping activities; scraping hides; shredding plants; heavy cutting of bone, wood, or antler
66 to 75 degrees	Heavy cutting and scraping activities; heavy scraping; sawing, cutting, or working of hard materials

*edge angle categories are estimates

Table 13.21 Use Wear Patterning and Suggested Activity

Use Wear Pattern	Suggested Activity
Unifacial Microflakes	Scraping Activities
Bifacial Microflakes	Cutting or sawing activities
Rounding or Blunting	Cutting or scraping of soft materials (i.e., soft wood, grasses, hides)
Striations	Scraping of a medium harder than the tool; oriented in the direction of tool use
Polish	Cutting of vegetal materials; soft scraping of hides

Because variation may occur along tool edges and faces on a single tool, employable units (EUs) were used as the focus of this analysis. Employable units (EUs) have been defined as "that segment or portion (an edge, projection, facial arris, or facial surface) of an implement that would provide a continuous work surface without reorienting the entire implement when that implement is used against another material to perform work" (Knudson 1979: 270). For this study, each portion of the tool edge with distinct or different retouch or use wear was defined as an EU (Knudson 1979).

As indicated in Section 12.0, all chipped stone tools were examined using a 10X hand lens in bright light. Type of retouch and use wear were recorded along each working tool edge. Edge angle was also measured at the approximate center of each tool edge using a goniometer.

Projectile Point Edge Modification

Morphological variation in the Mid-Atlantic projectile point assemblages is the result of numerous factors including stylistic changes through time, technological changes in hafting, raw material availability, and resharpening episodes and re-use, as discussed in the previous section. Additional resharpening and re-use indicators such as alternate beveling and use wear edge damage provide further information on blade edge modification and projectile point use trajectories.

Alternate beveling occurs when flakes are removed unifacially from each edge but on opposite faces of the artifact, creating a rhomboid cross-section. Alternate beveling is considered a resharpening byproduct resulting from reworking a hafted artifact (Odell 1996:61). However, alternate beveling may also be associated with intention manufacture resulting from functional or stylistic parameters or raw material availability and size (Odell 1996).

Variations in projectile point edge wear at the Hawthorne Site (Custer and Bachman 1986) suggested differential use for four point types. In that study, use wear on the large narrow blade, stemmed ironstone and quartzite projectile points implied heavy cutting associated with butchering activities. Side-notched and corner-notched quartz point use wear indicated cutting or sawing, also associated with butchering. The few broadspear artifacts exhibited varied use wear patterns and were identified as multi-functional tools. The small narrow bladed stemmed points demonstrated edge damage consistent with projectile point usage. Examining use wear edge damage at the Hawthorn Site provided functional interpretations associated with different projectile point morphologies.

A sample of twenty-five complete projectile points was selected from the Hickory Bluff assemblage and subjected to macroscopic edge analysis to identify types of edge modification. Each blade edge was examined under a 10x hand lens and observations were recorded. The sample was judgmentally selected based on completeness of the artifact and type of material likely to demonstrate edge modification on the macroscopic level (e.g., cryptocrystallines and quartz).

Edge Damage. Extensive edge damage in the form of step terminations was observed on nine of the 25 projectile points (Table 13.22). Some serial hinge fracturing was also present. Heavy edge rounding was noted on the coarse-grained quartzite Savannah River point (#1305-1). The presence of step and hinge fractures along the edges suggested unsuccessful attempts at resharpening, which resulted in blunted blade edges and may have contributed to immediate discard.

Alternate Beveling. Seven projectile points exhibited alternate bevels resulting from unifacial retouch on opposite faces and alternating edges (Table 13.22). This pattern creates a rhomboid cross section on the blade with an axis that is not parallel to the base axis. The seven alternately beveled projectile points consisted of five Woodland Narrow Blade points, one Adena, and one Savannah River. Because the unifacial retouch is consistent, the direction of retouch can be determined. Four of the alternately beveled projectile points were unifacially retouched on the right side indicating knapping from the left; three alternately beveled points were retouched on the left side indicating knapping from the right.

Within this selected sample, five of seven Woodland Narrow Blade projectile points exhibit alternate bevels, more than any other point type. This beveling may indicate alternate resharpening while hafted; however, it also may represent a specific manufacturing technique or represent maximizing limited raw material resources.

Use wear. Relatively few types of use wear were observed on the selected projectile point sample. These consisted mostly of removal of unifacial and bifacial microflakes. Polish was originally noted on several of the chert and jasper points; however, these materials demonstrated consistent polish or shininess along flake scar ridges on the blade faces as well as along the edges and it was impossible to determine at the macroscopic level whether the polish was natural or cultural.

Table 13.22 Edge Damage and Alternate Beveling for Selected Projectile Points

Catalog No.	Point Type	Impact Fracture	Edge Fracturing	Alternate Bevel	Knapping Direction
9-1-A	Woodland Wide Blade	None	None	None	
93-2-C	Untyped Stemmed	None	Step	None	
265-1	Brewerton	None	Step	None	
310-1	Woodland Narrow Blade	None	None	Yes - right	Left
582-1	Lackawaxen	Yes	Step	None	
673-2	Bare Island	Yes	None	None	
676-1	Woodland Narrow Blade	None	None	Yes - right	Left
793-2	Adena	None	None	None	
961-1	Lackawaxen	None	Step	None	
1187-4	Woodland Wide Blade	Yes	None	None	
1305-1	Savannah River	None	Rounded	Yes - left	Right
1359-3	Woodland Narrow Blade	None	None	None	
1776-6	Adena	None	None	Yes - right	Left
2403-1	Lackawaxen	None	Step	None	
2404-1	Bare Island	None	None	None	
2414-1	Woodland Narrow Blade	None	None	Yes - left	Right
2425-1	Woodland Narrow Blade	None (step fractures around tip)	None	Yes - left	Right
2430-1	Woodland Wide Blade	None	None	None	
2732-1	Woodland Narrow Blade	None	None	Yes - right	Left
3195-1	Adena	None	Step	None	
3223-1	Bare Island	None	Step	None	
3229-1	Bare Island	None	Step	None	
3930-1	Poplar Island	None	None	None	
3965-17	Woodland Narrow Blade	None	None	None	
4101-4	Bare Island	None	Step	None	

Most of the modification observed on the blade edges consisted of random unifacial or bifacial microflake removal interrupted by subsequent retouch or resharpening episodes (Table 13.23). The extent of this modification was minimal and difficult to define. It was suggestive of manufacture or prior use wear. Only one projectile point, a Woodland Narrow Blade point (2414-1) exhibited use wear associated with other activities besides use as a piercing tool for dispatching game. Alternate unifacial microflake removal was present on the blade edges suggesting use as a drill or boring tool. Based on the placement of the use wear, the point was used in a counterclockwise rotation.

Table 13.23 Use Wear on Selected Projectile Points

Catalog No.	Point Type	Blade Edge 1 Damage	Blade Edge 2 Damage	Manufacture	Use wear
9-1-A	Woodland Wide Blade	Random unifacial microflakes	None	Yes	No
93-2-C	Untyped Stemmed	None	None	None	None
265-1	Brewerton	None	None	None	None
310-1	Woodland Narrow Blade	None	None	None	None
582-1	Lackawaxen	None	None	None	None
673-2	Bare Island	Unifacial microflakes (ventral)	Unifacial microflakes (dorsal)	Yes	No
676-1	Woodland Narrow Blade	None	None	None	None
793-2	Adena	Unifacial microflakes	Unifacial microflakes	Yes	No
961-1	Lackawaxen	Unifacial microflakes near tip	None	Yes	No
1187-4	Woodland Wide Blade	None	None	None	None
1305-1	Savannah River	None	None	None	None
1359-3	Woodland Narrow Blade	None	Random bifacial microflakes	Yes	No
1776-6	Adena	Serrated	None	Yes	No
2403-1	Lackawaxen	None	Unifacial microflakes; rounding	Yes	No
2404-1	Bare Island	Random unifacial microflakes (ventral)	Random unifacial microflakes (dorsal)	Yes	No
2414-1	Woodland Narrow Blade	Unifacial Microflakes (ventral)	Unifacial microflakes (dorsal)	No	Yes
2425-1	Woodland Narrow Blade	Alternate unifacial microflakes	Random unifacial microflakes	Yes	No
2430-1	Woodland Wide Blade	None	Random bifacial microflakes	Yes	No
2732-1	Woodland Narrow Blade	None	None	None	None
3195-1	Adena	None	Unifacial microflakes	Yes	No
3223-1	Bare Island	None	None	None	None
3229-1	Bare Island	None	None	None	None
3930-1	Poplar Island	None	None	None	None
3965-17	Woodland Narrow Blade	None	Unifacial microflakes	Yes	No
4101-4	Bare Island	None	None	None	None

Bifaces

Twenty-five bifaces exhibited 30 edges with use wear (Table 13.24). Retouch along these edges consisted primarily of bifacial flake removal, although some edges displayed unifacial retouch (Figure 13.45). One edge was utilized with no retouch. Edge angles exhibited three major distributions with some variations. The major groups were centered on 45°, 55°, and 65° (Figure 13.46). Activities suggested by edge angle and use wear include general cutting and scraping; processing vegetal remains for food or fiber, hide working, and wood working (Table 13.25).

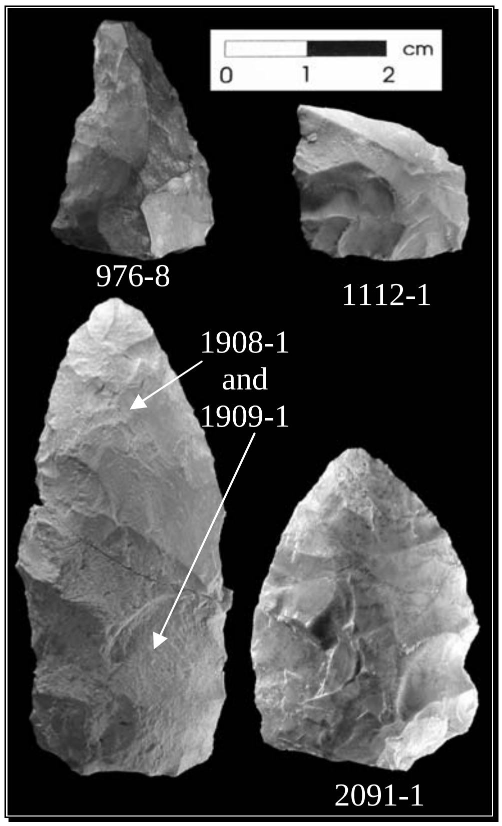

Figure 13.45 Biface Use Wear Examples

Table 13.24 Biface Tool Edges with Use Wear from Hickory Bluff

Catalog No.	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
225-1	Early stage biface	Jasper	2	1	Bifacial	Unifacial/bifacial microflakes	
976-8	Late stage biface	Jasper	2	1	Bifacial	Unifacial microflakes	Possible haft wear
1112-1	Late stage biface	Jasper	3	1	Bifacial	Bifacial microflakes	
1137-8	Late stage biface	Jasper	3	1	Bifacial	Bifacial microflakes	
1251-2	Early stage biface	Jasper	2	1	None	Unifacial microflakes	
1908-1	Late stage biface	Jasper	2	2	Bifacial	Minimal polish	
1940-10	Early stage biface	Rhyolite	2	1	None	Unifacial microflakes/ground	
2012-5	Late stage biface	Jasper	2	1	Bifacial	Unifacial microflakes	Use on ventral and dorsal surfaces on same edge
2091-1	Late stage biface	Jasper	3	2	Bifacial	Unifacial microflakes/polish; bifacial microflakes	EU with bifacial microflakes may be possible haft wear
2406-1	Late stage biface	Jasper	3	1	Bifacial	Unifacial microflakes	
2574-2	Late stage biface	Jasper	2	1	Bifacial	Unifacial microflakes	Use on broken edge
2673-1	Late stage biface	Chert	4	2	None	Bifacial microflakes; unifacial microflakes	
3803-2	Late stage biface	Chert	1	1	Bifacial	Unifacial microflakes	
4022-7	Late stage biface	Jasper	2	1	Bifacial	Unifacial microflakes	
4073-3	Late stage biface	Jasper	1	1	Bifacial	Bifacial microflakes/rounding	
EU11/4/A	Late stage biface	Argillite	3	2	Bifacial	Unifacial microflakes	
EU18/3/C	Late stage biface	Chert	2	1	Bifacial	Unifacial microflakes	
EU31/4/A	Early stage biface	Jasper	2	1	Bifacial	Bifacial microflakes	
EU65/4/B	Late stage biface	Jasper	2	1	Bifacial	Unifacial microflakes	
EU65/4/C	Early stage biface	Jasper	1	1	Bifacial	Unifacial microflakes	
EU69.70/6	Late stage biface	Jasper	2	2	Bifacial/ Unifacial	Unifacial microflakes	
EU80/2/A	Late stage biface	Chalcedony	1	1	Bifacial	Unifacial microflakes/ rounding	
EU82/1/A	Late stage biface	Chert	2	1	Bifacial	Unifacial microflakes	
EU99/4/B	Early stage biface	Jasper	2	1	Bifacial	Bifacial microflakes	
ST418/2/A	Late stage biface	Jasper	2	1	Unifacial	Unifacial microflakes	

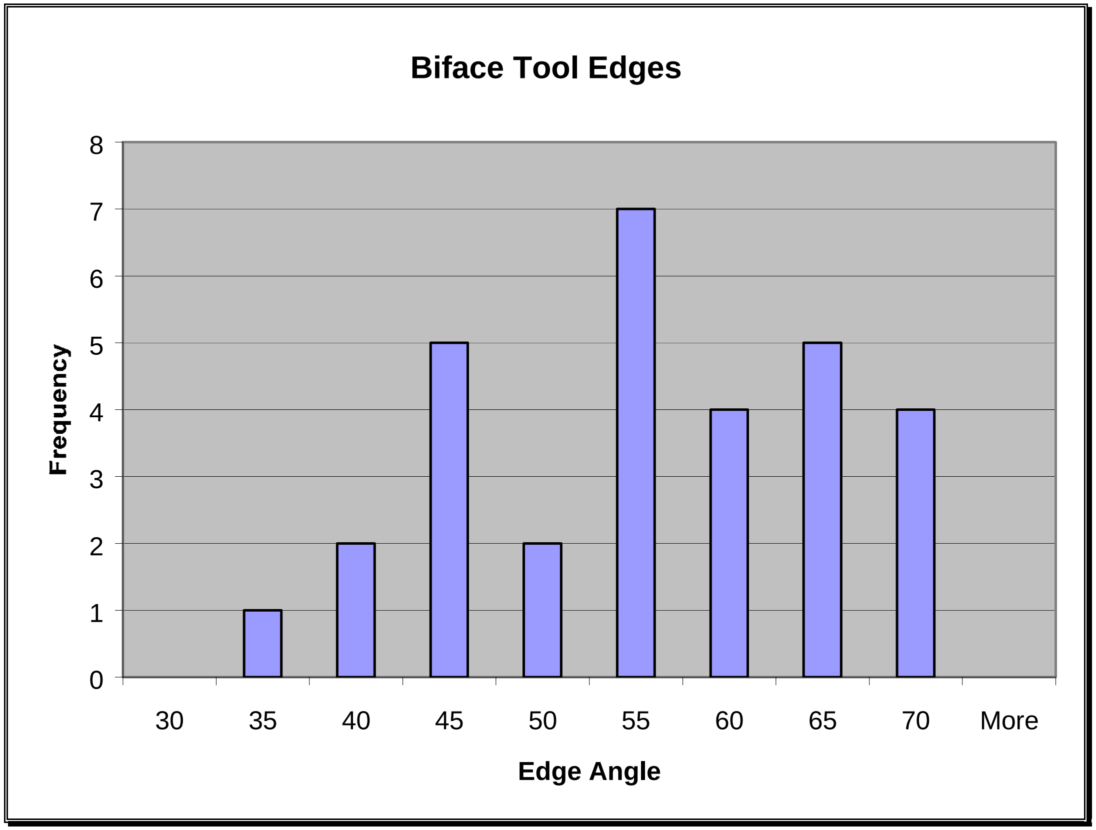

Figure 13.46 Biface Tool Edge Angles

Table 13.25 Biface Edge Angles and Possible Function Based on Use Wear

Edge Angle	**Scraping** (unifacial microflakes)	**Cutting** (bifacial microflakes)	**Scraping / Cutting** (unifacial / bifacial microflakes)	**Cutting of vegetal materials** (polish)	**Cutting soft materials** (bifacial microflakes; rounding)	**Scraping wood, grasses, hides** (unifacial microflakes; rounding/ blunting)	**Scraping soft hide** (unifacial microflakes; polish)
35-50°	4	4				1	1
51-59°	5	2		1	1	1	
60-70°	8		1	1			
Total	17	6	1	2	1	1	1

Unifaces/Scrapers

Forty-eight unifaces exhibited 82 primary edges and 39 edges with hafting evidence. Retouch consisted of both unifacial and bifacial flake removal along the uniface margins and indicates initial edge preparation, shaping, resharpening, or edge rejuvenation. Sixty-nine edges were retouched (Table 13.26); 87 percent of the retouch was unifacial. Only 13 percent demonstrated bifacial retouch. Three of the bifacially retouched edges suggest edge rejuvenation to adjust the edge angle on the working margin (Figure 13.47) (Frison 1968).

Figure 13.47 Edge Rejuvenation of Uniface 4181-1

Table 13.26 Uniface Primary Edge Angles and Retouch Type

Edge Angle	Unifacial retouch	Bifacial retouch
30-50°	5	
51-65°	26	6
66-80°	24	3
81-90°	5	
Total	60	9

Edge angles from the primary edges exhibited two major distributions with some variations in the largest trend. The major groups were centered on 45° and 75°, with a minor peak at 60° (Figure 13.48). This pattern suggests consistency in edge angles for scraping tools with minor variations resulting from different mediums.

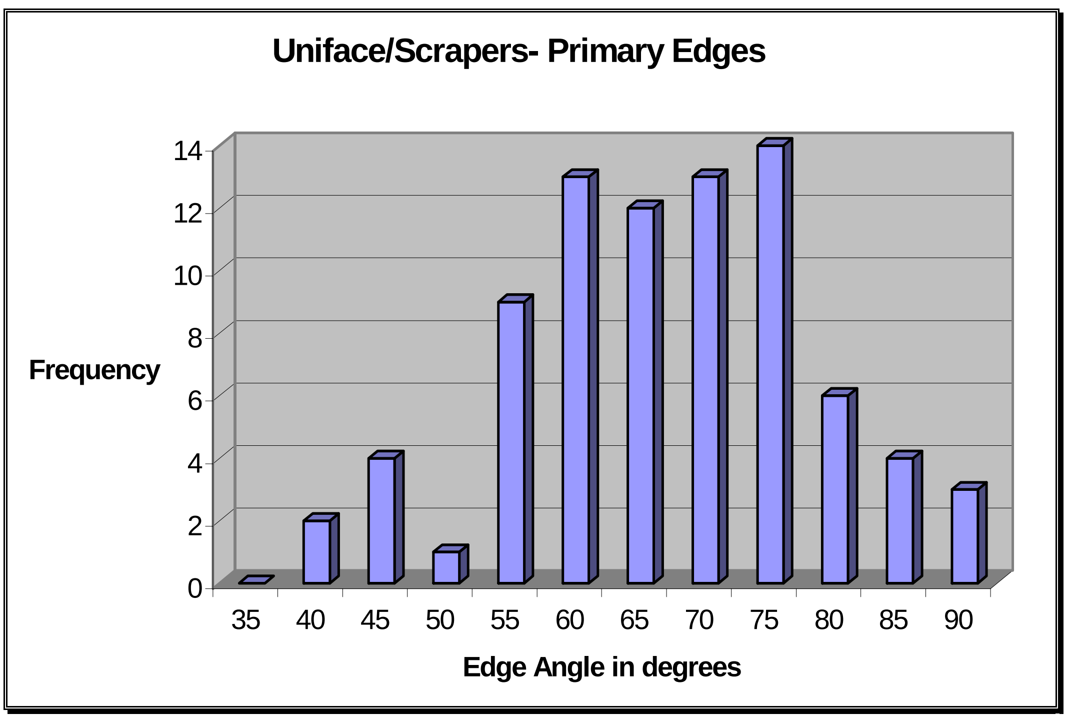

Figure 13.48 Primary Edge Angles of Unifaces/Scrapers

Seventy-five primary edges were identified and all exhibited use wear (Table 13.27). Activities suggested by edge angle and use wear include general scraping; processing vegetal remains for food or fiber, hide working, and wood working. Over 50 percent of the uniface/scrapers displayed polish, rounding and/or unifacial microflake removal suggestive of hide working. Different types of hide working use wear may occur based on the condition of the hide (i.e., fresh wet hide or dry hide or leather) (Keeley 1980:49).

Table 13.27 Uniface Primary Edge Angles and Possible Function based on Use Wear

Edge Angle	**Scraping** (unifacial microflakes)	**Scraping / Cutting** (unifacial / bifacial microflakes; rounding; polish)	**Scraping wood, grasses, hides** (rounding / blunting)	**Scraping wood, grasses, hides** (unifacial microflakes; rounding / blunting)	**Scraping soft hide** (unifacial microflakes; rounding; polish)
30-50°	3			2*	1
51-65°	7	1		4	18
66-80°	9			4	19
81-90°	2		3		2**
Total	21	1	3	10	40

* striations
** one edge with grinding

Edge angles from the hafted edges also demonstrated two major distributions centered on 50° and 65° with a minor peak at 80° (Figure 13.49). This pattern suggests consistency in edge angles for scraping tools with minor variations resulting from different mediums. Eighteen edges were retouched (Table 13.28); 67 percent of the retouch was unifacial. Only 33 percent demonstrated bifacial retouch.

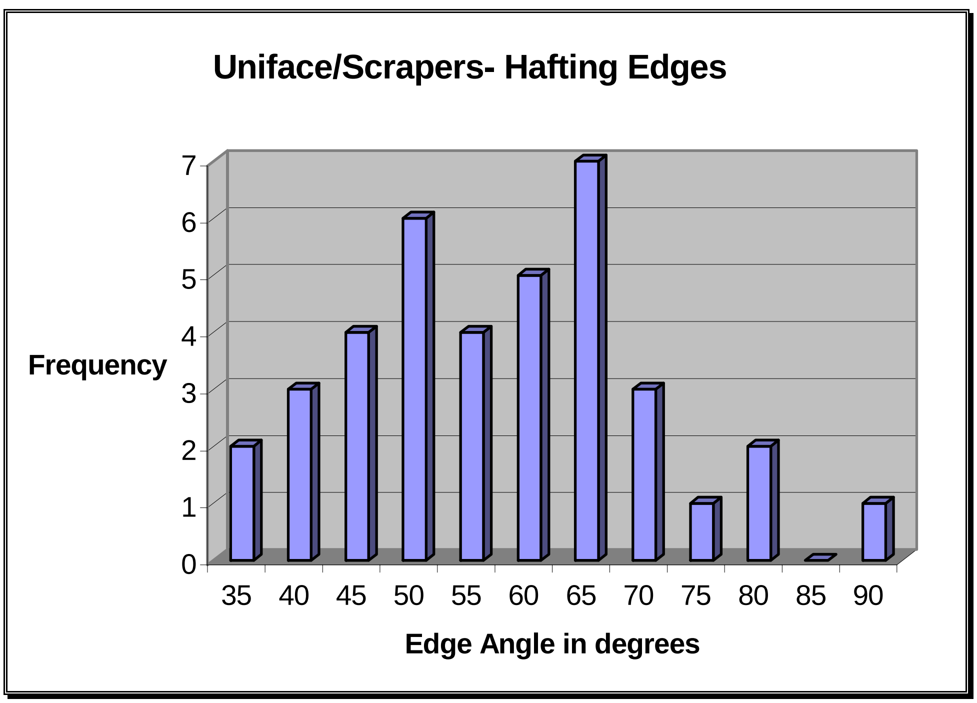

Figure 13.49 Hafting Edge Angles of Unifaces/Scrapers

Table 13.28 Uniface Hafting Edge Angles and Retouch Type

Edge Angle	Unifacial retouch	Bifacial retouch
35-55°	5	3
56-70°	6	3
71-90°	1	0
Total	12	6

Thirty-nine hafting edges were recorded on 21 uniface/scrapers and 35 exhibited use wear (Table 13.29). Rounding and polish were present on 29 hafting edges (Figure 13.50). Polish and rounding of the hafting edges would be expected from the hafted tool abrading against the haft, most likely wood or antler attached by sinew.

Table 13.29 Uniface Hafting Edge Angles and Use Wear

Edge Angle	Unifacial microflakes	Bifacial microflakes	Unifacial/ bifacial microflakes; rounding; polish	Rounding/ blunting	Rounding; polish	Unifacial microflakes; rounding/ blunting	Bifacial microflakes; polish; rounding	Unifacial microflakes; rounding; polish
35-55°	3	1	1		6	3	1	3
56-70°	1	1		2	3		2	4
71-90°				1		2		1
Total	4	2	1	3	9	5	3	8

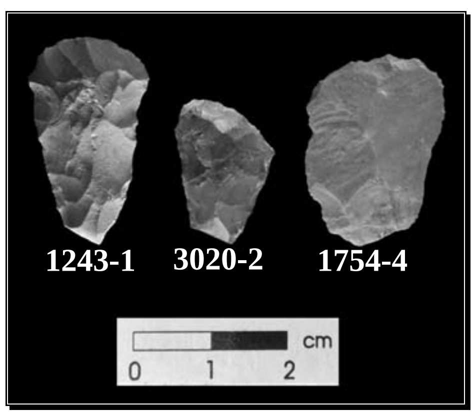

Figure 13.50 Hafting Use Wear Examples

One quartzite uniface was very large (155 x 53.1 x 29.2 cm) and square in cross section (Figure 13.51). The two lateral edges were unifacially retouched, exhibited steep edge angles (86° and 87°), and use wear resulted in rounding on these edges. The distal end exhibited a flat abrading surface. The edge angle and use wear is consistent with heavy scraping of soft materials such as wood and possible functions for this tool include wood working activities such as removing bark or smoothing wood items

Specialized Tools

Several retouched and utilized flake tools exhibited distinctive morphologies, edge modifications and use wear associated with specific tool use. These specialized tools included awls/punches, celts, concave scrapers, choppers, drills, and gravers.

Awls/Punches. Nine tools exhibited pointed edges with rounding, polishing or blunting on the tip (Figure 13.52; Table 13.30). Polish was observed on the jasper and chert tools; blunting and rounding was documented only on the quartz tools. Edge angles varied from 25° to 72°. Three of these tools were late stage bifaces with bifacial retouch on the pointed edge. The rest of the tools were utilized or retouched flakes with multiple EUs with different types of use wear on adjacent edges. The pointed edge on the flake tools exhibited use wear only with no retouch.

The pointed edge on artifact 848-7 exhibited extensive use wear. In addition to heavy polish on the tip, striations perpendicular to the edge and unifacial microflake removal on the dorsal side were observed. The edge angle was 25°.

The rounded tool edge and the type of use wear for these nine tools was consistent with use as piercing or boring tools used on soft materials such as hides (Keeley 1980:52). The straight push method of preparing holes in hides resulted in fractured tips. The drilling method of preparing holes created polish along the edges and tip similar to use wear identified for these Hickory Bluff tools.

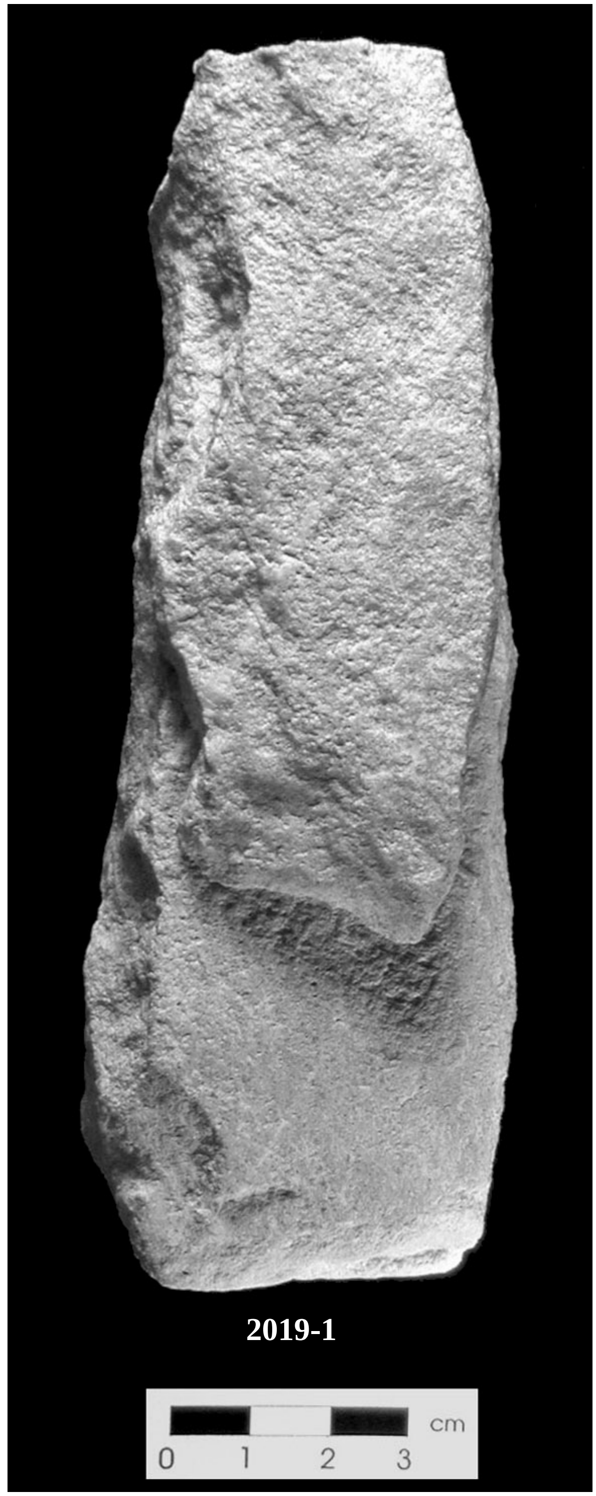

Figure 13.51 Possible Woodworking Tool (2019-1)

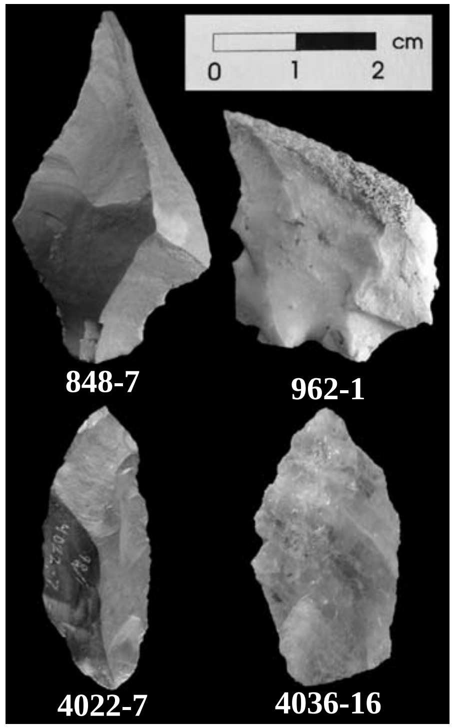

Figure 13.52 Possible Awl/Punch Examples

Table 13.30 Awl/Punch Tool Edges from Hickory Bluff

Catalog No.	Tool Type	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
848-7	Awl/Punch/ Multipurpose	Utilized flake	Jasper	4	1	None	Heavy polish on tip; striations on tip perpendicular to edge; unifacial microflake removal	
962-1	Awl/Punch/ Multipurpose	Utilized flake	Jasper	2	1	None	Polish	Heat altered on tip
2416-1	Awl/Punch	Late stage biface	Rhyolite	3	1	Bifacial	Polish	
3629-1	Awl/Punch	Utilized flake	Quartz	1	1	None	Minimal rounding	Pebble tool
3921-1	Awl/Punch	Late stage biface	Chert	3	1	Bifacial	Polish	
4022-7	Awl/punch	Late stage biface	Jasper	2	1	Bifacial	Polish	Heat altered
4036-16	Awl/Punch	Retouched flake	Quartz	2	1	None	Rounding	Pebble tool; tip is curved
4071-14	Awl/Punch	Utilized flake	Jasper	1	1	None	Polish	
4263-1	Awl/punch	Retouched flake	Quartz	3	1	None	Blunting	Pebble tool

Celts. Both the groundstone celt and celt fragment exhibited use wear in the form of striations, edge crushing, and battering (Figure 12.36). The distal fragment (2400-1) made of granite exhibited a 63° edge angle with multiple striations perpendicular and oblique to the tool edge. Irregular flake removal and crushing occurred along the tool edge. Based on the edge angle, this tool fragment would be classified as an axe (Hranicky 1995:23); use wear indicates cutting or chopping, probably associated with woodworking activities such as bark notching (Hranicky 1995: 49).

Artifact 2652-1 was an oval quartzite cobble with a faint groove located more than a third of the way from the proximal end. A small abraded area was evident at the terminus of the faint groove with one edge suggesting that this tool was hafted and that use created abrasion between the tool and the haft. Both the poll and distal end were rounded and exhibited battering, indicating use as a pounding tool.

Choppers. Five tools displayed seven edges with battering or rounding (Figure 13.53; Table 13.31). These five tools were primarily quartzite. Five edges were bifacially retouched; two edges had use wear only. Three of these tools exhibited curved pointed edges with battering or rounding (2264-12, 2358-2, 4245-1). Battered tip edge angles varied from 35° to 48°. Battered edges had edge angles ranging from 42° to 68°.

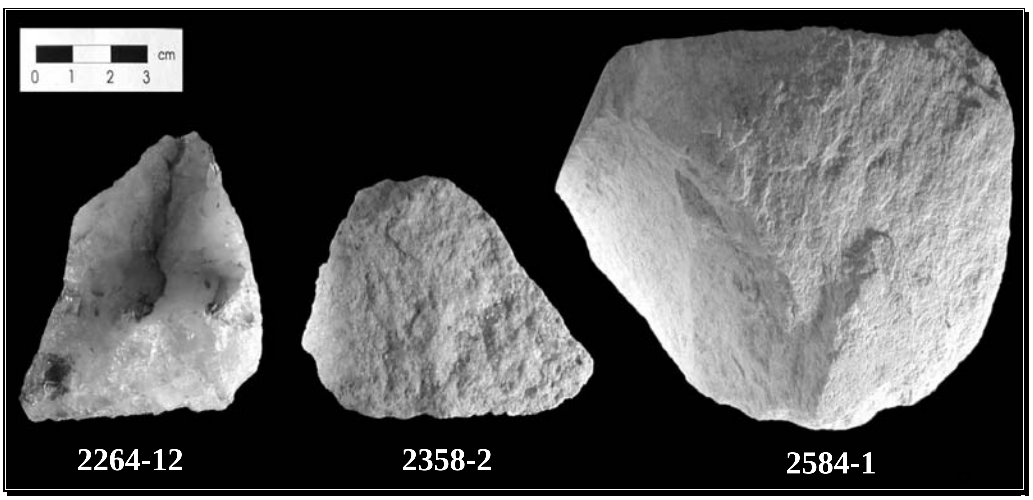

Figure 13.53 Chopping Tool Examples

Choppers may be considered a hand-held tool used for butchering game, usually by separating joints and crushing bone to remove the marrow. Choppers were rarely used to cut wood (Hranicky 1995:14).

Concave Scrapers or Spokeshaves. Six tools displayed concave edges with unifacial retouch, unifacial microflake removal and rounding (Figure 13.54; Table 13.32). All six tools were made from jasper. Edge angles varied from 43° to 74°. One tool (334-2) was an early stage biface; however, the concave edge was not retouched. The remaining five tools were utilized or retouched flakes; only one flake tool (3838-5) contained EUs with different types of use wear on adjacent edges.

Concave or C-shaped scrapers have been identified as arrow shaft straighteners or arrow shaft makers (Hranicky 1995: 86), although steep-angled, concave edges would be suitable for working any curved object. Rounding use wear may indicate preparation of a hard surface such as antler, bone or wood.

Table 13.31 Chopping Tool Edges from Hickory Bluff

Catalog No.	Tool Type	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
2264-12	Chopper	Retouched flake	Quartz	2	1	Bifacial	Battering/ polish	Similar to 2358-2
2358-2	Chopper	Retouched flake	Quartzite	2	2	Bifacial	Battering	Similar to 2264-12
2584-1	Chopper	Early stage biface	Quartzite	2	2	Bifacial	Battering/ rounding	
3892-2	Chopper	Retouched flake	Quartzite	1	1	Bifacial	Battering/ rounding	Cobble tool
4245-1	Chopper	Early stage biface	Chert	3	1	Bifacial	Battering/ rounding	Curved tip

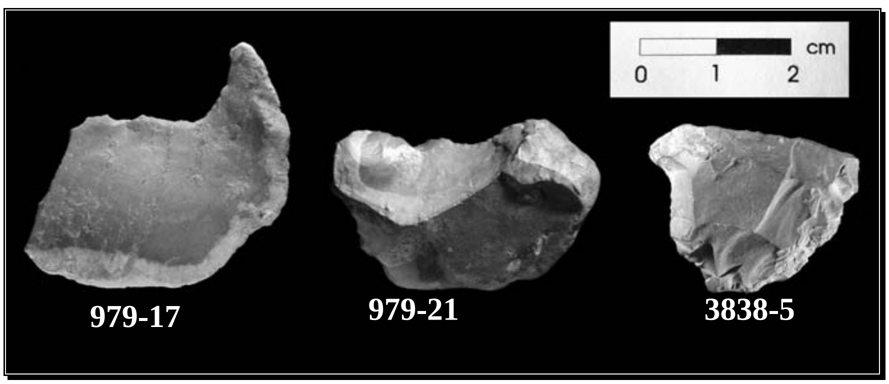

Figure 13.54 Concave Scraping Tool Examples

Table 13.32 Concave Scraping Tool Edges from Hickory Bluff

Catalog No.	Tool Type	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
334-2	Concave Scraper	Early stage biface	Jasper	2	1	None	Unifacial microflakes	Geode crystals at proximal end
979-17	Concave Scraper	Utilized flake	Jasper	1	1	None	Unifacial microflakes/rounding	Pebble tool
979-21	Concave Scraper	Utilized flake	Jasper	1	1	None	Unifacial microflakes/rounding	Pebble tool
3763-8	Concave Scraper	Retouched flake	Jasper	1	1	Unifacial	Rounding	Pebble tool
3838-5	Concave Scraper/ Graver/ Multipurpose	Retouched flake	Jasper	3	1	None	Unifacial microflakes; rounding	

Drills. Seven tools contained alternately beveled edges creating a rhomboid or diamond shaped cross section (Figure 13.55). All seven tools were of jasper or chert (Table 13.33). One distal tool fragment (1937-11) was a late stage biface with bifacial retouch and alternate unifacial flake removals. Based on the patterning of use wear, the tool was used in a clockwise direction. Another late stage biface drill (EU7/4/A) was bifacially retouched with unifacial microflake removal on one edge and bifacial microflake removal on the other edge. Two late stage bifaces exhibited no use wear; however, they displayed the distinctive rhomboid cross section created by bifacial retouch (4222-2) and alternate unifacial retouch (3929-3). One retouched flake tool (2468-2) was unifacially retouched on one edge with unifacial microflake removal; the edge angle was 62°. The tip of this tool was not retouched but exhibited bifacial microflake removal around the tip. The edge angle was 60°.

Figure 13.55 Drill Examples

Two artifacts in this category were small cobble tools (2689-3 and 3251-1) and were morphologically similar. Artifact 2689-3 contained 4 EUs. EUs 1 and 2 formed an ultra-sharp tip and displayed unifacial retouch on alternate faces (Figure 13.50). Use wear was unifacial microflake removal and polish. Edge angles were 67° and 57°. EUs 3 and 4, located on the proximal edge of the tool, were unifacially retouched on alternate faces, suggesting hafting preparation. Edge angles were 68° and 78°. Artifact 3251-1 had 3 EUs. EUs 1 and 2 formed the pointed tip and were unifacially retouched on alternate faces (Figure 13.56). This retouch produced a severe alternate bevel with the tip axis perpendicular to the cobble base axis. Use wear was observed on EU 1 with two distinct areas of unifacial microflake removal on the dorsal and ventral faces. Edge angles were 61° and 72°. EU 3 was the tool tip; it exhibited no retouch but had unifacial microflakes on the ventral side. The edge angle was 52°.

Table 13.33 Drill Tool Edges from Hickory Bluff

Catalog No.	Tool Type	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
1937-11	Drill	Late stage biface	Chert	2	2	Bifacial	Unifacial microflakes	Clockwise use
2468-2	Drill	Retouched flake	Jasper	2	2	Unifacial	Unifacial/bifacial microflakes	
2689-3	Drill ? Pick?	Retouched flake	Jasper	4	2	Unifacial	Unifacial microflakes/polish	Cobble cortex; possibly hafted; similar to 3251-1
3251-1	Drill? Pick?	Retouched flake	Jasper	3	2	Unifacial	Unifacial microflakes	Pebble tool; similar to 2689-3
3929-3	Drill	Late stage biface	Jasper	2	2	Bifacial	None	Alternate beveling
4222-2	Drill	Late stage biface	Jasper	2	2	Bifacial	None	
EU7/4/A	Drill	Late stage biface	Jasper	2	2	Bifacial	Unifacial/bifacial microflakes	Clockwise use

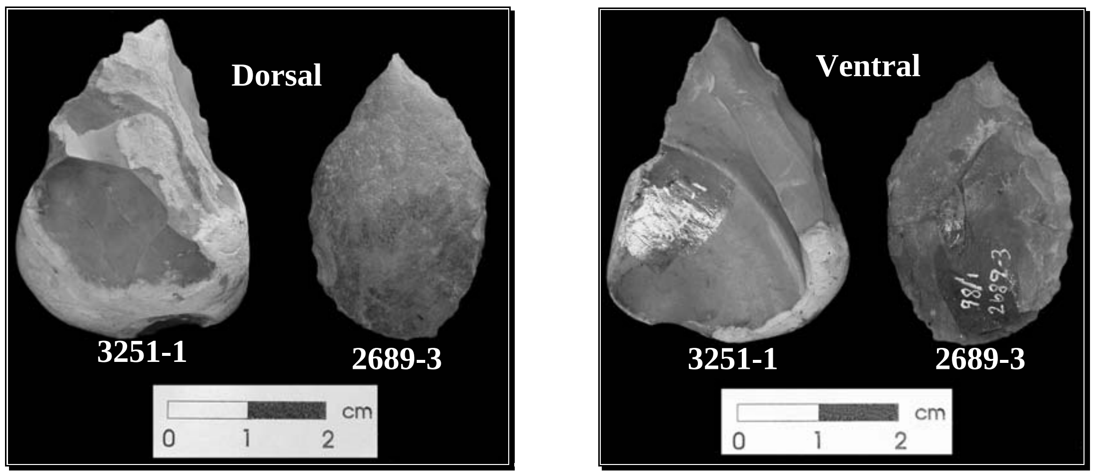

Figure 13.56 Alternately Beveled Pebble Tools

The shape of the bit and the type and location of the use wear suggests a twisting (i.e., drilling) motion. The removal of unifacial microflakes indicated use on hard material such as bone, stone or wood. Three tools (1937-11, 2689-3, 3251-1) demonstrated alternate unifacial microflake removal along the bit edges, which is consistent with twisting motion in one direction. Use wear patterning on artifact 1937-11 may be indicative of a clockwise twisting motion. Two tools (2468-2 and EU7/4/A) exhibited both unifacial and bifacial microflake removal consistent with twisting motion in both directions.

Gravers. Fifteen tools contained sixteen small protrusions with microflake removal, polish or rounding on the tip (Figure 13.57; Table 13.34). Only one tool (2406-1) did not exhibit use wear, which may be the result of subsequent retouching and discard before use. Most of these tools were utilized and retouched flake tools; three were late stage bifaces. The predominant use wears were unifacial microflake removal and polish. One tool (3838-5) exhibited bifacial microflake removal and rounding on the tip. Edge angles ranged from 24° to 80°. The tips of four tools were heat altered and reddened. It is unclear whether the stone was heat altered prior to flint knapping or whether the tip was intentionally heat treated during tool use.

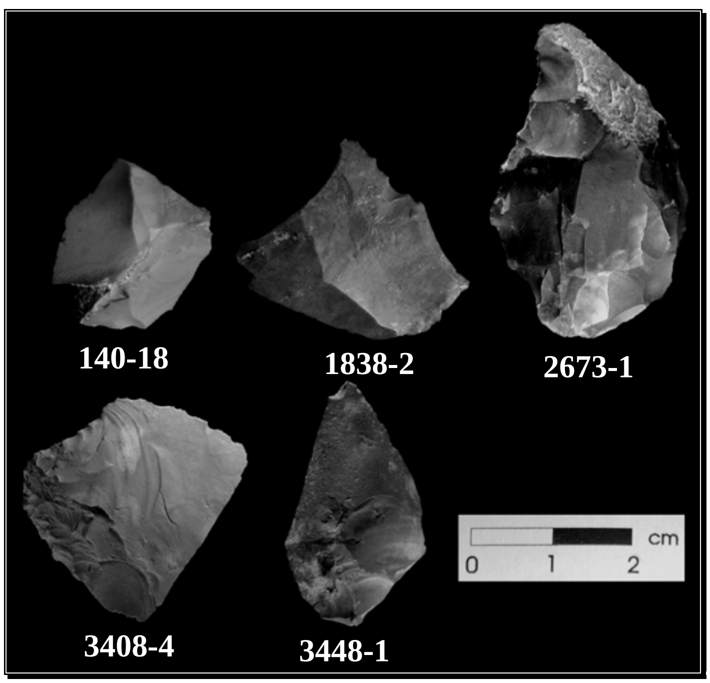

Figure 13.57 Graver Tip Examples

Table 13.34 Graving Point Tool Edges from Hickory Bluff

Catalog No.	Tool Type	Catalog Type	Material Type	Total EUs	Related EUs	Retouch	Use wear	Comments
140-18	Graver	Utilized flake	Jasper	1	1	None	Unifacial microflakes / polish	Heat altered on tip
502-4	Double Graver	Utilized flake	Jasper	2	2	None	Unifacial microflakes / polish	
555-4	Graver	Late stage biface	Rhyolite	3	1	Bifacial	Unifacial microflakes	
1838-22	Graver	Utilized flake	Jasper	1	1	None	Unifacial microflakes / polish	Heat altered
2406-1	Graver	Late Stage Biface	Jasper	3	1	Unifacial	None	
2512-1	Awl / Graver	Utilized flake	Jasper	1	1	None	Unifacial microflakes / polish	Pebble tool
2644-8	Graver?	Utilized flake	Jasper	1	1	None	Unifacial microflakes / polish	Pebble tool; two concavities with use wear on either side of a polished tip
2673-1	Graver / Multipurpose	Late stage biface	Chert	4	1	None	Unifacial microflakes	
3333-5	Graver / Multipurpose	Utilized flake	Jasper	2	1	None	Unifacial microflakes	
3336-1	Graver	Utilized flake	Chert	1	1	None	Unifacial microflakes	
3408-4	Graver	Retouched flake	Jasper	2	1	Unifacial	Unifacial microflakes / polish	Heat altered tip
3448-1	Graver / Multipurpose	Utilized flake	Jasper	2	1	None	Unifacial microflakes	Pebble tool; heat altered
3838-5	Concave Scraper / Graver / Multipurpose	Retouched flake	Jasper	3	1	None	Bifacial microflakes / rounding	
ST102/2/A	Graver	Retouched flake	Chert	2	2	Unifacial	Unifacial microflakes	Alternate beveling from use

The presence of unifacial microflake removal along the tip edges indicates a scraping or planing motion rather than a cutting or slicing motion. The presence of polish would suggest use on soft materials or plant fibers. Hranicky (1995: 86) indicates one possible function of gravers may be to fledge feathers for darts and arrows. Alternative functions may include incising designs on bone, shell or wood; or splitting or separating plant fibers for basket baking.

Retouched and Utilized Flake Tools

Retouched flakes reflect at least one episode of resharpening along an edge; utilized flakes exhibit only use wear with no subsequential resharpening. Both types of flake tools suggest expedient use and discard, although retouched flake tools indicate sequential use requiring resharpening or minimal curation and re-use.

Retouched flake tools were identified by the presence of at least one retouched edge; however, additional edges may have been retouched, utilized or both. Specialized retouched flake edges have been previously presented and are not included here. Sixty-nine edges were observed on 49 retouched flake tools. One tool (2689-3) displayed two unifacially retouched proximal edges that suggested hafting preparation.

Retouch consisted of both unifacial and bifacial flake removal along the flake margins and may indicate initial edge preparation, resharpening, or edge rejuvenation. Fifty-five edges were retouched (Table 13.35); 80 percent of the retouch was unifacial suggesting edge preparation for, or use as, scraping tools. Only 20 percent demonstrated bifacial retouch.

Table 13.35 Retouch Flake Edge Angles and Retouch Type

Edge Angle	Scraping (unifacial retouch)	Cutting/Sawing/Scraping (bifacial retouch)
20-49°	5	4
50-69°	26	6
70-80°	11	1
93°	2	0
Total	44	11

Edge angles from retouched flake tools exhibited a trimodal grouping with clusters centered around 40°, 55-60°, and 75° (Figure 13.58). This pattern suggests differences in edge angles related to light cutting/hide scraping activities/wood whittling; medium cutting/scraping activities; and heavy cutting/scraping tasks.

Forty-nine retouched flake edges exhibited use wear (Table 13.36). Activities suggested by edge angle and use wear include processing vegetal remains for food or fiber, hide working, and wood working, as well as other generalized cutting and scraping tasks.

Utilized flakes are the most basic of expedient tools representing a single use and then discard. Specialized utilized flake edges have been previously presented and are not included here. Utilization was identified on 169 edges on 131 flakes.

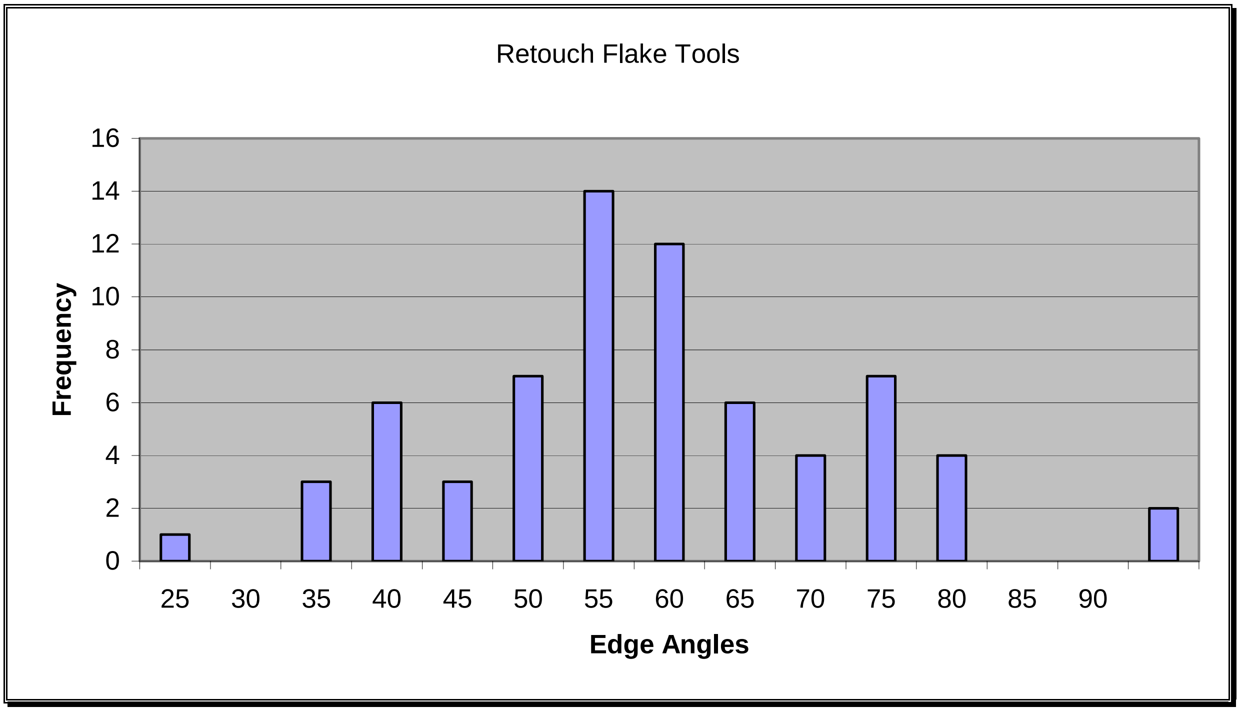

Figure 13.58 Retouched Flake Tool Edge Angles

Table 13.36 Retouched Flake Edge Angles and Possible Function based on Use Wear

Edge Angle	Scraping (unifacial microflakes)	Cutting/Sawing (bifacial microflakes)	Scraping/Cutting (unifacial/ bifacial microflakes)	Cutting/scraping wood, grasses, hides (rounding/ blunting	Cutting wood, grasses, hides (bifacial microflakes; rounding/ blunting)	Scraping wood, grasses, hides (unifacial microflakes; rounding/ blunting)	Cutting vegetal materials (bifacial microflakes; rounding; polish)	Scraping soft hide (unifacial microflakes; rounding; polish)
20-49°	3	3		2			1	1
50-69°	13			3		1		4
70-80°	5			1		5*		2
93°	1			1		3		
Total	22	3	0	7	0	9	1	7

* one edge also exhibited striations

Edge angles from utilized flake tools exhibited multiple groupings with clusters centered around 30°, 40°, 55-60°, 70°, and 80° (Figure 13.59). Activities suggested by the use wear on the 169 edges include processing vegetal remains for food or fiber, hide working, and wood working, as well as other generalized cutting and scraping tasks (Table 13.37).

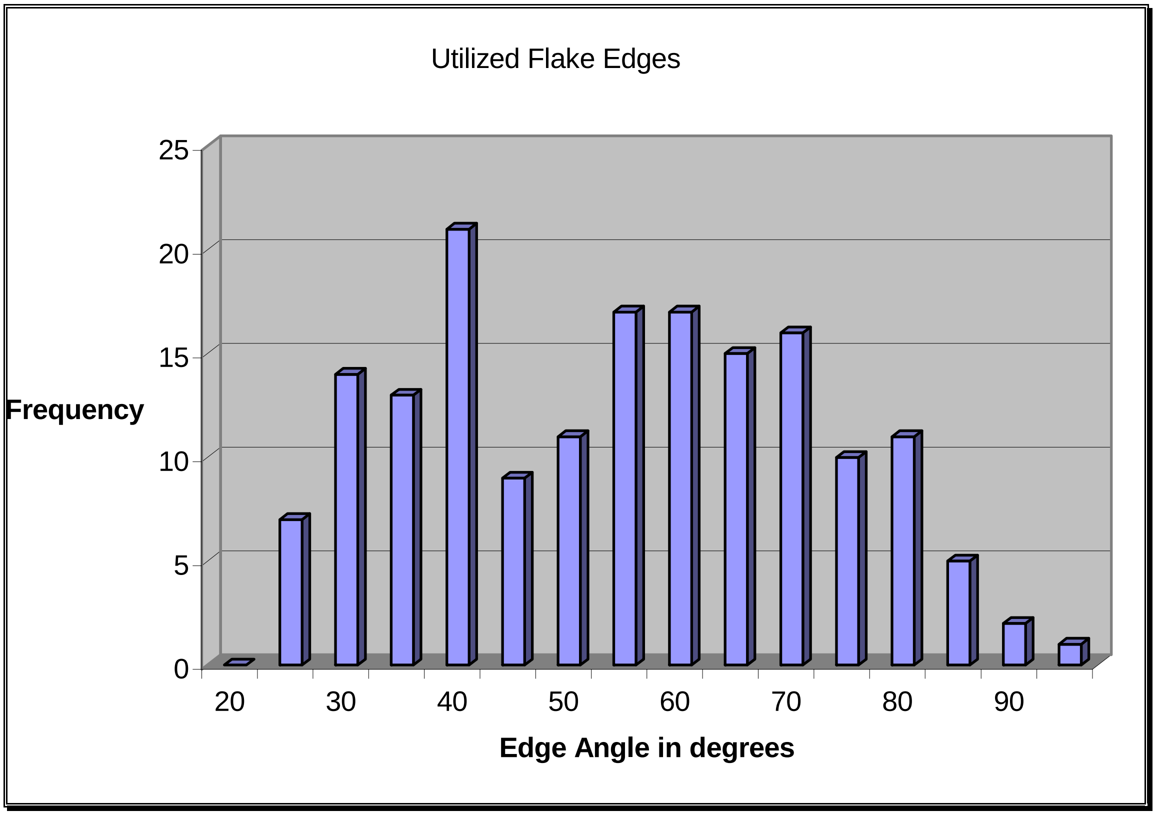

Figure 13.59 Utilized Flake Tool Edge Angles

Table 13.37 Utilized Flake Edge Angles and Possible Function based on Use Wear

Edge Angle	Scraping (unifacial microflakes)	Cutting/Sawing (bifacial microflakes)	Scraping/Cutting (unifacial/bifacial microflakes)	Cutting/scraping wood, grasses, hides (rounding/ blunting	Cutting wood, grasses, hides (bifacial microflakes; rounding/ blunting)	Scraping wood, grasses, hides (unifacial microflakes; rounding/ blunting)	Cutting vegetal materials (bifacial microflakes; rounding; polish)	Scraping soft hide (unifacial microflakes; rounding; polish)
20-35°	8	4	1	4		3	9	5
36-40°	12		1		3	3		2
41-60°	32	3	3*	2	1	6	1	6
61-75°	29				1	4		7
76-120°	13			1		1		4
Total	94	7	5	7	5	17	10	24

* two flake tools exhibited polish

Battered Edges (Hammerstones)

Four types of impact modification were observed on the Hickory Bluff cobble tool assemblage: point battering, face or edge battering, fracturing, and perimeter battering. Point battering consisted of pointed or rounded ends of cobbles with localized irregular pock-marked surfaces resulting from repeated impact and crushing of the cobble end. Face or edge battering suggests a pounding strategy where exact control was not required. Ninety-two cobble tools exhibited 170 battered edges (Table 13.38).

Differential battering on cobble tools suggests use as direct percussors in flintknapping activities and use as pounding tools for opening nuts, bone, and other materials (Chapman 1975; Kraft 1972, 1975; Ritchie 1980; Stewart 1986c). Pointed ends of hammerstone provided for control of force and focus on a restricted area on the core (Chapman 1977: 413; Crabtree 1967) creating removal of thinner flakes or blades. Hammerstones with semi-convex or flatter surfaces created wider flakes with diffuse bulbs of percussion (Chapman 1997: 413; Crabtree 1967).

Table 13.38 Battered Surfaces on Hickory Bluff Cobble Tools

Catalog No.	Tool Type	Material Type	Total EUs	Battered Points/ Ends	Battered Faces/ Surfaces
140-9	Hammerstone	Quartz	1	1	
154-1	Hammerstone	Quartzite	2		2
186-5	Hammerstone	Quartz	2	1	1
267-1	Hammerstone/pitted stone	Quartzite	4	3	
268-1	Hammerstone	Quartz	3	2	
349-38	Hammerstone	Quartzite	1	1	
371-2	Abrader/hammerstone	Quartzite	4	1	
414-1	Abrader/hammerstone	Quartzite	10	4	
417-1	Hammerstone	Quartzite	2	2	
449-2	Hammerstone	Quartzite	3	2	1
550-1	Hammerstone	Quartz	3	3	
663-2	Abrader/hammerstone	Quartzite	1	1	
775-6	Hammerstone	Quartzite	1		1
821-2	Hammerstone	Quartzite	1	1	
844-2	Hammerstone/pitted stone	Quartzite	3	1	
876-1	Hammerstone	Quartzite	1	1	
933-4	Hammerstone	Quartzite	1*	1	
1016-4	Hammerstone	Quartzite	1	1	
1092-1	Hammerstone	Quartz	1	1	
1127-1	Hammerstone	Quartzite	1	1	
1143-1	Hammerstone/abrader/pitted stone	Quartzite	5	2	
1241-2	Hammerstone	Quartzite	2	1	
1268-2	Abrader/hammerstone	Quartzite	3	2	
1269-13	Hammerstone	Quartzite	2	2	

Table 13.38 Battered Surfaces on Hickory Bluff Cobble Tools (Continued)

Catalog No.	Tool Type	Material Type	Total EUs	Battered Points/ Ends	Battered Faces/ Surfaces
1288-1	Hammerstone/pitted stone	Quartz	4	3	
1326-9	Pitted stone/hammerstone	Quartzite	2	1	
1330-1	Double pitted stone/hammerstone	Sandstone	3	1	
1331-4	Hammerstone/pitted stone	Quartzite	2		1
1335-2	Hammerstone	Quartzite	2		2
1341-1	Hammerstone	Quartz	2		2
1453-2	Hammerstone	Siltstone	1*	1	
1519-1	Pitted stone/hammerstone	Quartzite	2	1	
1523-2	Hammerstone/abrader	Quartzite	6	3	
1593-1	Abrader/hammerstone	Quartzite	2	1	
1615-1	Hammerstone/pitted stone	Quartzite	3		2
1694-1	Hammerstone	Quartzite	2	1	1
1695-14	Hammerstone	Quartzite	2		2
1758-1	Double pitted stone/hammerstone	Quartzite	3	1	
1786-1	Hammerstone	Quartzite	1	1	
1792-1	Hammerstone	Quartzite	5	3	2
1838-21	Hammerstone	Quartzite	1	1	
1842-1	Hammerstone	Quartzite	3	2	1
1843-1	Hammerstone	Quartzite	3	2	
1900-3	Hammerstone	Quartzite	1	1	
1959-1	Abrader/hammerstone	Quartzite	6	2	
1959-3	Hammerstone	Quartzite	2		2
2051-20	Hammerstone	Quartzite	1	1	
2058-1	Hammerstone	Quartzite	3		3
2058-3	Hammerstone	Quartzite	2	2	
2218-1	Abrader/hammerstone	Quartzite	2	1	
2220-1	Hammerstone/abrader/pitted stone	Quartzite	5	2	
2267-1	Hammerstone/utilized flake	Quartzite	2		2
2379-1	Abrader/double pitted stone/hammerstone	Quartzite	7	2	
2394-1	Hammerstone	Quartzite	2	2	
2459-18	Hammerstone	Quartz	1	1	
2493-1	Hammerstone	Quartzite	2	2	
2535-11	Hammerstone	Quartz	2	1	
2625-1	Hammerstone	Quartzite	2	2	
2645-6	Hammerstone/pitted stone	Quartzite	5	2	2
2645-7	Abrader/hammerstone	Quartzite	5		X
2651-1	Abrader/hammerstone/pitted stone	Quartzite	3	1	
2655-2	Hammerstone	Quartzite	4	3	1

Table 13.38 Battered Surfaces on Hickory Bluff Cobble Tools (Continued)

Catalog No.	Tool Type	Material Type	Total EUs	Battered Points/ Ends	Battered Faces/ Surfaces
2670-3	Hammerstone	Jasper	1	1	
2698-1	Hammerstone/pitted stone	Quartzite	3	1	
2733-1	Hammerstone/pitted stone	Quartzite	3	2	
2761-1	Hammerstone	Quartzite	2	1	
2761-2	Hammerstone	Quartzite	1	1	
2761-3	Hammerstone	Quartzite	4	4	
2781-17	Hammerstone	Quartz	2		2
2849-1	Abrader/hammerstone	Quartzite	5	2	
2888-1	Hammerstone	Quartzite	5	4	1
2909-7	Hammerstone	Quartzite	1	1	
2984-3	Abrader/hammerstone/pitted stone	Quartzite	8	2	
3209-2	Hammerstone	Quartzite	3	2	1
3311-3	Hammerstone	Quartzite	2	2	
3339-2	Hammerstone	Quartzite	1	1	
3406-15	Hammerstone	Quartzite	4		3
3464-1	Hammerstone	Quartzite	2	2	
3465-1	Hammerstone/pitted stone	Quartzite	3	2	
3592-1	Hammerstone/pitted stone	Quartzite	3	2	
3845-1	Hammerstone	Quartzite	2	1	
3860-5	Hammerstone	Quartzite	4	4	
3946-3	Hammerstone	Quartzite	2	1	1
3968-1	Hammerstone/pitted stone	Quartz	2	1	
3997-2	Hammerstone	Quartzite	1	1	
3997-1	Abrader/hammerstone	Quartzite	7	3	
4009-2	Double pitted stone/hammerstone	Quartzite	4	1	
4235-2	Hammerstone	Quartzite	2	1	1
4304-5	Hammerstone/pitted stone	Quartzite	2	1	
Eu9/5	Abrader/hammerstone/double pitted stone	Quartzite	8	3	
Eu39/2	Hammerstone	Quartzite	2	1	1
Eu55-64/3	Hammerstone	Quartzite	2	1	1
Total				131	39

* edge is both battered and fractured

Fracturing was observed on the end of oblong cobbles in the form of several large flake removals; these flake removals were initiated from the end of the cobble rather than from the sides (Figure 13.60). Such fracturing may indicate use such as severe impact with a hard object resulting in fracture rather than crushing, or may suggest specific manufacturing processes resulting in intentional flake removal. Fifteen cobble tools displayed 16 fractured ends (Table 13.39).

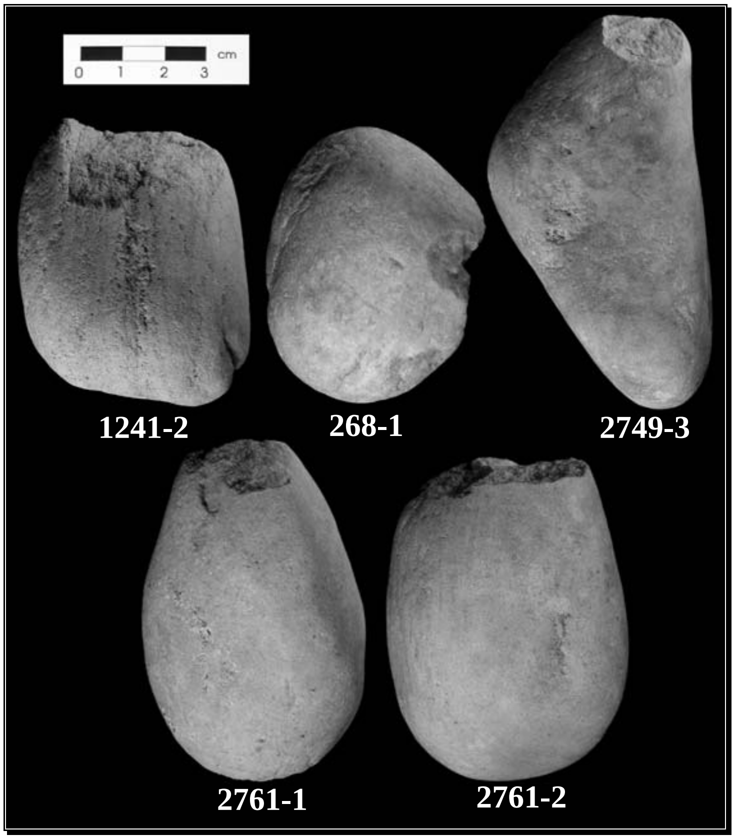

Figure 13.60 Fractured Edge Examples

Table 13.39 Fractured Ends on Hickory Bluff Cobble Tools

Catalog No.	Tool Type	Material Type	Total EUs	Fractured/Crushed EUs
268-1	Hammerstone	Quartz	3	1
674-1	Hammerstone / pitted stone	Quartzite	2	1
844-2	Hammerstone / pitted stone	Quartzite	3	1
933-4	Hammerstone	Quartzite	1*	1
1241-2	Hammerstone	Quartzite	2	1
1453-2	Hammerstone	Siltstone	1*	1
1758-1	Double pitted stone	Quartzite	3	1
1843-1	Hammerstone	Quartzite	3	1
2698-1	Hammerstone / pitted stone	Quartzite	3	1
2749-3	Hammerstone / pitted stone	Quartz	3	2
2761-1	Hammerstone	Quartzite	2	1
2984-3	Abrader / double pitted stone / hammerstone	Quartzite	8	1
3406-15	Hammerstone	Quartzite	4	1
3845-1	Hammerstone	Quartzite	2	1
4009-2	Double pitted stone / hammerstone	Quartzite	4	1
Total				16

* edge is both battered and fractured

Perimeter battering was characterized by consistent pock-marked surfaces around 80 to 100 percent of the cobble perimeter, creating a circular or oval shape (Figure 13.61). Perimeter battering was considered characteristic of tool shaping rather than actual use modification. Ten cobble tools exhibited perimeter battering (Table 13.40).

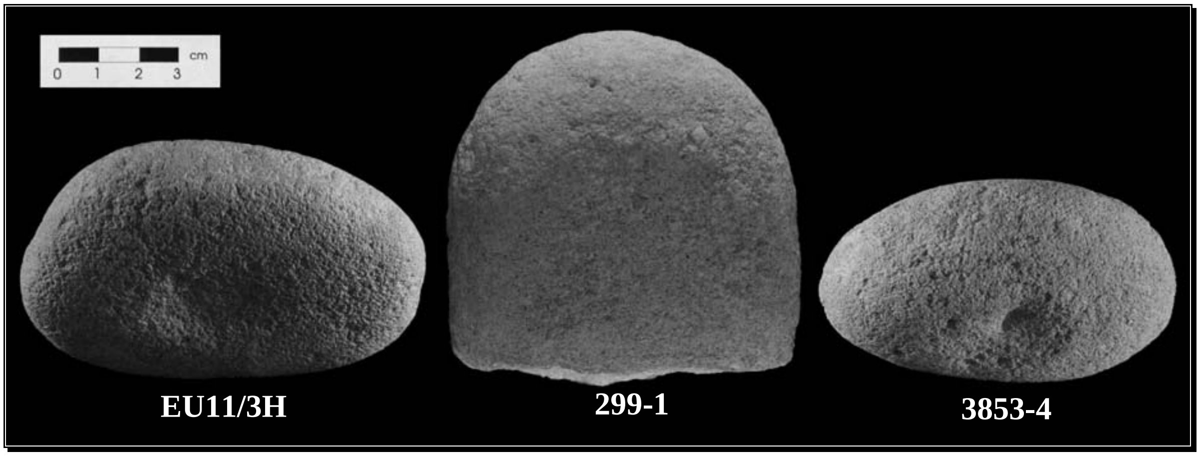

Figure 13.61 Perimeter Battering Examples

Table 13.40 Hickory Bluff Cobble Tools with Perimeter Battering

Catalog No.	Tool Type	Material Type	Comments
299-1	Double pitted stone	Quartzite	Battering along 100% of perimeter
1455-12	Pitted stone	Quartzite	Perimeter shaping
2277-1	Hammerstone	Quartzite	battering along 80% of perimeter
2571-2	Hammerstone	Quartz	battering along 80% of perimeter
2646-1	Double pitted stone	Quartzite	Battering along 100% of perimeter
3843-4	Double pitted stone	Quartzite	Battering along 100% of perimeter
3987-6	Double pitted stone	Quartzite	battering along 100% of perimeter
EU11/3/H	Double pitted stone	Quartzite	Battering along 100% of perimeter
EU110/3/A	Hammerstone	Quartzite	battering along 90% of perimeter
EU125/2/A	Hammerstone/abrader	Quartzite	battering along 90% of perimeter

Abraders

Abrading surfaces consisted of flattened and smoothed areas, edges, or surfaces of cobbles. Abraders may have been used to polish and resharpen groundstone tools such as celts and axes (Hranicky 1995: 12); to prepare striking platforms during flintknapping activities (Crabtree 1967; Crabtree 1999:6); and to smooth wooden implements. Abrading core platforms will eventually produce multiple parallel lines and cross-hatching on the abrading surface (Crabtree 1967). Specific activities on softer materials, such as woodworking, may create polish on an abrading surface (Figure 13.62). Twenty-six tools exhibited 70 abrading surfaces (Table 13.41). Visible polish was noted on 30 surfaces (about 43 percent).

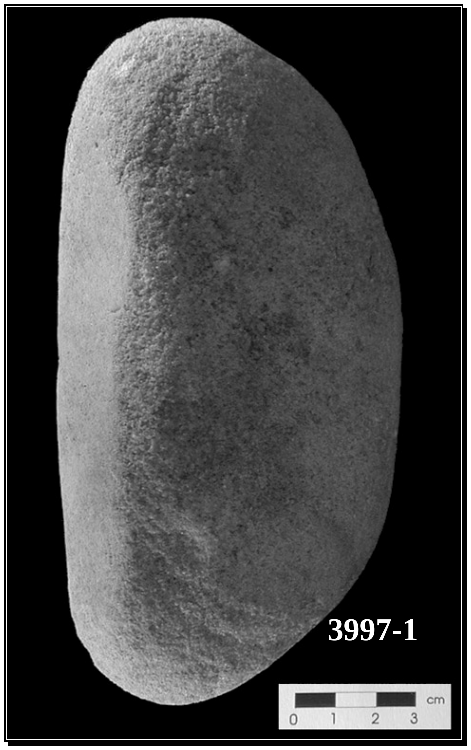

Figure 13.62 Abrading Surface Example

Table 13.41 Abrading Surfaces on Hickory Bluff Cobble Tools

Catalog No.	Tool Type	Material Type	Abrading Surfaces	Comments
371-2	Abrader / hammerstone	Quartzite	3	Two polished surfaces
414-1	Abrader / hammerstone	Quartzite	6	
663-2	Abrader / hammerstone	Quartzite	1	One polished surface
869-1	Abrader / pitted stone	Quartzite	3	Two polished surfaces
1126-2	Pestle / abrader	Quartzite	1	
1143-1	Hammerstone / abrader / pitted stone	Quartzite	2	One surface with light polish
1268-2	Abrader / hammerstone	Quartzite	1	
1523-2	Hammerstone / abrader	Quartzite	2	
1593-1	Abrader / hammerstone	Quartzite	1	
1959-1	Abrader / hammerstone	Quartzite	4	Four polished surfaces
2019-1	Abrader	Quartzite	1	
2034-56	Abrader	Siltstone	4	Polish on one end
2080-1	Abrader / pitted stone	Quartzite	4	Two polished surfaces
2218-1	Abrader / hammerstone	Quartzite	1	One polished surface
2220-1	Hammerstone / abrader / pitted stone	Quartzite	2	
2379-1	Abrader / double pitted stone / hammerstone	Quartzite	3	Two polished surfaces
2645-7	Abrader	Quartzite	5	Three surfaces with light polish
2651-1	Abrader / hammerstone / pitted stones	Quartzite	1	

Table 13.41 Abrading Surfaces on Hickory Bluff Cobble Tools (Continued)

Catalog No.	Tool Type	Material Type	Abrading Surfaces	Comments
2849-1	Abrader / hammerstone	Quartzite	3	Three polished surfaces
2984-3	Abrader / hammerstone / pitted stone	Quartzite	4	Three polished surfaces
3997-1	Abrader / hammerstone	Quartzite	4	Two heavily polished surfaces
4272-3	Abrader	Quartzite	4	
EU11/3	Abrader / pitted stone	Quartzite	3	Two polished surfaces
EU125/2/A	Hammerstone / abrader	Quartzite	2	
EU72/9/8	Double pitted stone / abrader	Quartzite	2	
EU9/5	Abrader / hammerstone / double pitted stone	Quartzite	3	One polished surface
Total			70	

Pitted Stones

Forty-four cobble tools displayed 59 pitted surfaces; 14 tools contained pitted surfaces on opposite faces (i.e., double pitted stones) (Table 13.42). One tool (954-7) also exhibited two pitted surfaces; however, one surface was located on the face and the other surface was located on the tool edge. Fifty-five pitted recesses were dimpled, indicating a battering or pounding use that removed fragments from the working surface (Figure 13.63). Four pitted recesses were smoothly ground, suggesting a rotary motion (Figure 13.64).

Table 13.42 Pitted Surfaces on Hickory Bluff Cobble Tools

Catalog No.	Tool Type	Material Type	Total EUs	Pitted surfaces	Comments
267-1	Hammerstone / pitted stone	Quartzite	4	1	Dimpled recess
299-1	Double pitted stone	Quartzite	2	2	Dimpled recesses
674-1	Hammerstone / pitted stone	Quartzite	2	1	Dimpled recess
844-2	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
869-1	Abrader / pitted stone	Quartzite	4	1	Dimpled recess
954-7	Pitted stone	Quartz	2	2	Dimpled recesses
1143-1	Hammerstone / abrader / pitted stone	Quartzite	5	1	Dimpled recess
1213-3	Pitted stone	Quartzite	1	1	Dimpled recess
1288-1	Hammerstone / pitted stone	Quartz	4	1	Dimpled recess
1326-9	Pitted stone / hammerstone	Quartzite	2	1	Dimpled recess
1331-4	Hammerstone / pitted stone	Quartzite	2	1	Dimpled recess
1330-1	Double pitted stone / hammerstone	Sandstone	3	2	Dimpled recesses
1455-12	Pitted stone	Quartzite	1	1	Dimpled recess
1519-1	Pitted stone / hammerstone	Quartzite	2	1	Dimpled recess
1615-1	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess

Table 13.42 Pitted Surfaces on Hickory Bluff Cobble Tools (Continued)

Catalog No.	Tool Type	Material Type	Total EUs	Pitted surfaces	Comments
1758-1	Double pitted stone / hammerstone	Quartzite	3	2	Dimpled recesses
2080-1	Abrader / pitted stone	Quartzite	5	1	Dimpled recess
2220-1	Hammerstone / abrader / pitted stone	Quartzite	5	1	Dimpled recess
2379-1	Abrader / double pitted stone / hammerstone	Quartzite	7	2	Ground recesses
2488-1	Pitted stone	Quartzite	1	1	Dimpled recess
2645-6	Hammerstone / pitted stone	Quartzite	5	1	Dimpled recess
2646-1	Double pitted stone	Quartzite	2	2	Dimpled recesses
2651-1	Abrader / hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
2698-1	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
2733-1	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
2749-3	Hammerstone / pitted stone	Quartz	3	1	Dimpled recess
2830-1	Pitted stone	Quartzite	1	1	Dimpled recess
2984-3	Abrader / hammerstone / pitted stone	Quartzite	7	1	Dimpled recess
3465-1	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
3483-4	Double pitted stone	Quartzite	2	2	Dimpled recesses
3591-1	Double pitted stone	Quartzite	2	2	Dimpled recesses
3592-1	Hammerstone / pitted stone	Quartzite	3	1	Dimpled recess
3617-1	Pitted stone	Sandstone	1	1	Dimpled recess
3843-5	Double pitted stone		2	2	Dimpled recesses
3843-4	Double pitted stone	Quartzite	2	2	Dimpled recesses
3968-1	Hammerstone / pitted stone	Quartz	2	1	Dimpled recess
3987-6	Double pitted stone / hammerstone	Quartzite	3	2	Dimpled recesses
4009-2	Double pitted stone / hammerstone	Quartzite	4	2	Dimpled recesses
4304-5	Hammerstone / pitted stone	Quartzite	2	1	Dimpled recess
Eu11/3/H	Double pitted stone	Quartzite	2	2	Dimpled recesses
Eu72/9/8	Double pitted stone	Quartzite	2	2	Ground recesses
Eu9/5	Abrader / hammerstone / double pitted stone	Quartzite	8	2	Dimpled recesses
Eu11/3	Abrader / pitted stone	Quartzite	4	1	Dimpled recess
Eu9/3/D	Pitted stone	Quartzite	1	1	Dimpled recess
Total				59	

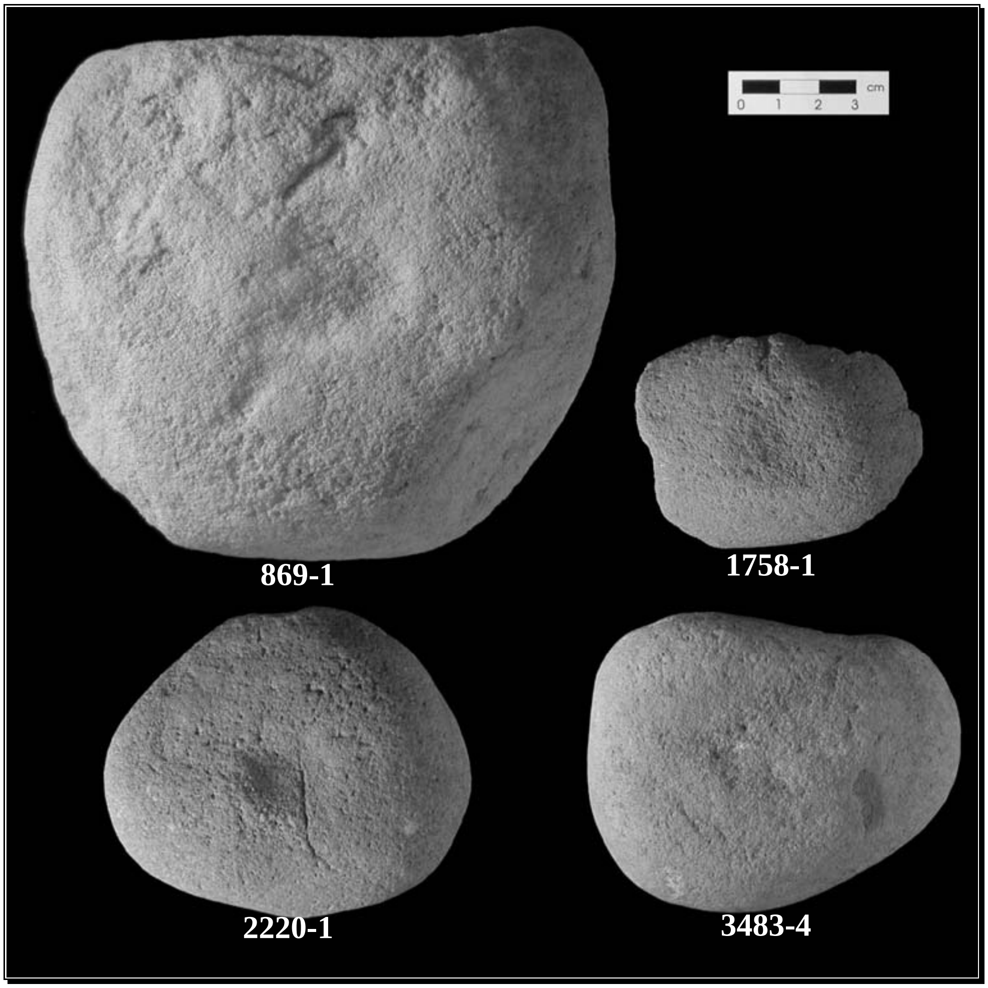

Figure 13.63 Pitted Recesses - Dimpled Use Wear

Variations in recess diameter and depth were slight between the three types of pitted stone tools (Table 13.43). Dimpled recesses on double pitted stones exhibited the largest means for recess diameter and depth; whereas dimpled recesses on single pitted stones displayed the smallest means for those measurements. The variations in diameter and depth between double pitted and single pitted stones may suggest intensity of use and may represent the difference in curation versus expedient use.

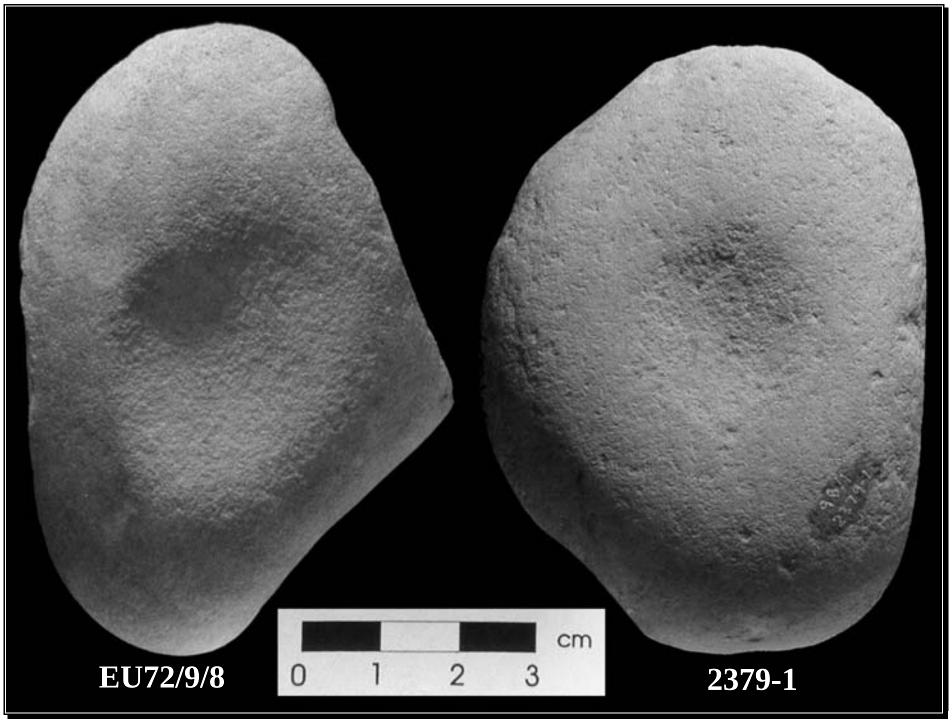

Figure 13.64 Pitted Recesses - Ground Use Wear

Table 13.43 Descriptive Statistics for Pitted Recesses

Tool/Surface Type	**Double Pitted Recesses (dimpled)**		**Double Pitted Recesses (ground)**		**Single Pitted Recesses**	
Measurement*	Diameter	Depth	Diameter	Depth	Diameter	Depth
Count	23	23	4	4	30	30
Range	12.4-59.2	0-5	21-30.7	1-2	10.8-70.5	0-4
Mean	30.3	1.69	25.5	1.5	24.54	1.3
Standard Deviation	11.67	1.32	4.73	0.57	10.87	0.95
Coefficient of Variation	0.38	0.78	0.18	0.38	0.44	0.73

*All measurements in millimeters

Ritchie and Funk (1973:56) identified pitted stones from Native American sites in New York, where they comprised 6 percent of the artifact collections. Many of the pitted recesses had evidence of being produced by rotary action of some solid pointed implement, but others had been gouged out by a narrow pointed object. The large recesses were 25 mm in diameter with depths of 11 mm. The smaller pits tended to be about 16 mm in diameter and 6 mm in depth. The larger stones tended to have several pits of varying sizes, indicating that larger pits were not further used, and new pits were begun. Ritchie and Funk (1973:56) also describe a specific type of pitted stone, discoidal pebbles that often exhibit one pit centered on each face and with battering from use as hammerstones. Occasionally these discoidal pebbles had two pits on one face. Fragmentary or irregular stones display pitted recesses in various places. Although function has not been determined, investigators have inferred that the objects assumed utilitarian importance (Ritchie and Funk 1973). Various functions have been proposed for pitted stones including nut cracking, fire-making, or as anvils for stone tool reduction (Chapman 1975; Kraft 1972, 1975; Ritchie and Funk 1973; Ritchie 1980; Funk 1993).

Spears (1975) designed a series of experiments in an attempt to determine the function of pitted stones from archaeological contexts. The experiments included nut cracking and bipolar flaking using hammerstones and anvils. The morphology of pitted recesses on hammerstones and anvils was measured and some degree of variation was noted. A hammerstone used in a nut cracking experiment produced a pitted recess that measured 30 x 30 mm and with a depth of 5 mm. The pitted recesses on anvils ranged from 15 x 20 mm to 30 x 35 mm, with recess depths of 1 to 2 mm.

Pitted recesses on anvils used in bipolar experiments were of variable size and shape, and were dependent on the morphology of the struck cobble (Spears 1975). For example, anvils that were used to strike smooth stones produced recesses measuring 20 x 25 mm, with a depth of 3 mm. Anvils used to strike jagged stones produced recesses measuring 10 x 20 mm, with a depth of 4 mm. Anvils repeatedly used to strike smooth and jagged stones had a larger morphology, measuring as large as 30 x 40 mm, with a depth of 4 mm. While these experiments provided systematic observations and data, findings were preliminary and the investigators suggested that a great deal of variability should be expected among different nut types, stone materials, and duration of percussion. The experimental data were compared against archaeological specimens. While inferences as to aboriginal function were suggested, variability in the pitted recesses indicated nut processing and bipolar percussion, although additional functions were considered possible.

The majority of the Hickory Bluff pitted stones may have functioned as hammerstones for nut cracking and bipolar reduction. These types of battering and pounding activity would create dimpled recesses. Two pitted stones displayed finely ground recesses on both sides suggesting use as mortars for processing of small quantities of materials. Since small hand-held mortars would be ineffective and time consuming for general food processing, it is likely that these two tools represented specialized functions such as grinding plants and herbs for medicinal purposes, grinding pigments for use in decoration or for ritual/ceremonial use. Specialized function is further indicated for 2379-1 since it was found alongside its pestle in Feature 202.

Pestles

Three small linear cobbles exhibited battering on the distal ends (Table 13.44). The morphology and use wear is consistent with use as pestles. In addition to end battering, shaping was also evident in the form of flattened sides and a rounded square cross-section. Two pestles displayed minimal pitting on the sides, consistent with the location of finger grips identified for this tool type (Figure 13.65) (Hranicky 1995:52).

Pestles were used to grind, mash or mix foodstuffs, such as grains and nuts (Hranicky 1995:63). However, the small size of the three artifacts and the co-occurrence of one (2379-2) with a small hand-held mortar suggests other types of activities. Because of the small size of the tools, it is unlikely that they were used for food preparation. Only small quantities of foodstuffs could be processed at a time, lengthening food preparation time. These small pestles may have been used for grinding or mashing medicinal plants and herbs or processing pigments for dyes (i.e., dyes for decoration on ceramics, basketry, wood, and hides, or dyes for ritual/ceremonial use).

Table 13.44 Pestles at Hickory Bluff

Catalog No.	Tool Type	Material Type	Total EUs	Battered Ends	Comments
2379-2	Pestle	Quartzite	2	2	Minimal pitting on 3 faces at the tool midpoint (probable finger grips)
2193-2	Pestle	Quartzite	1	1	Four flat faces; one with polish
1126-2	Pestle/abrader	Quartzite	2	1	Minimal pitting on one face (probable finger grip)

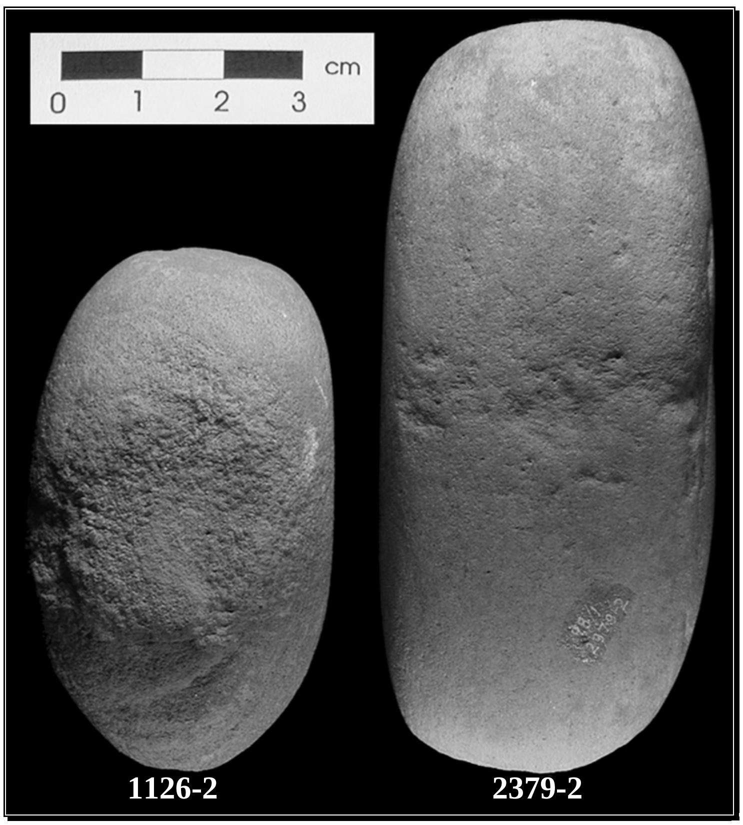

Figure 13.65 Finger Grips on Pestles

Mortar

One large mortar (2281) was pecked over 80 percent of the surface and had a large circular pitted recess in the center (Figure 12.35). The pitted recess was dimpled, with no evidence for grinding. Mortars are used for pounding or grinding activities associated primarily with grinding, mashing/pulverizing, and mixing foodstuffs such as grains and nuts. The use wear on this artifact is consistent with pounding and/or mashing/pulverizing foodstuffs.

Microscopic Analyses

Introduction

Microscopic use wear and residue analyses were performed on a sample of 50 unifacially retouched lithic artifacts from Hickory Bluff by Dr. Bruce Hardy, Grand Valley State University, Michigan. All artifacts were minimally handled prior to analysis with the majority being unwashed. A subset of the sample was washed prior to analysis and used in displays in a public outreach program. Five sediment samples and four non-artifactual (unmodified) lithic samples were also examined to look for potential residues that were not use-related.

The artifacts can be typologically classed as unifaces or endscrapers. Previous functional studies on similar tool types from a variety of locations and time periods suggest that unifaces/endscrapers are often, though not exclusively, used as hafted wet or dry hide processing tools (Schultz 1992; McDevitt 1994; Sliva and Keeley 1994; Boszhardt and McCarthy 1999; Petraglia et al. 1996). While hide processing may have been a common function of unifaces, this does not mean that all unifaces were used for this task. In fact, it is difficult to generalize functions of morphological types across assemblages either spatially or temporally (Siegel 1984). The current study provides evidence that unifaces at Hickory Bluff were used for processing hides as well as starchy plants and bone or antler.

Methods

Each artifact was examined for the presence of residues or wear related to use using reflected light microscopy at magnifications ranging from 100 to 500 diameters using an Olympus BX-60 microscope. Line drawings were made of each artifact and the location of any wear and residues recorded on the drawing. All residues and wear patterns were photographed and compared with experimental and published material for identification (Anderson-Gerfaud 1990; Brunner and Koman 1974; Hardy 1994; Hardy and Garufi 1998; Hoadley 1990; Hather 1993). Potentially recognizable residues using this technique include animal (hair, feather, skin, bone, antler, and blood) and plant (starch grains, cellular tissue, wood fragments, and phytoliths) material (Anderson 1980; Anderson-Gerfaud 1981, 1986, 1990; Barton et al. 1998; Briuer 1976; Fullagar and Field 1997; Gorski 1997; Hardy 1994; Hardy 1998; Hardy and Kay 1998; Hardy and Garufi 1998; Hurcombe 1992; Jahren et al. 1997; Kealhofer et al. 1999; Loy 1983, 1986, 1993; Loy and Wood 1989; Loy and Hardy 1992; Loy et al. 1992; Shafer and Holloway 1979; Sobolik 1996). Use wear identification concentrated on striations, polish, and edge rounding to help identify the area of an artifact that was used and the use-action. Use wear was not used to identify specific use-materials beyond the level of hard/high silica vs. soft material (Fullagar 1991). Sediment samples and non-artifactual (unmodified) lithics were examined for the presence of residues that were not use related. If residues were found in the sediment or non-artifactual samples as well as on artifacts, then the residues on the artifacts were considered to be possible contaminants not related to tool use.

To provide further comparative material, a series of hideworking experiments were previously conducted with the cooperation of Dr. Joe Jacquot of the Department of Biology at Grand Valley State University, Michigan and his biology students. Dr. Jacquot and his students were provided with replicated flint scrapers (n=10) that were used, unhafted, in scraping both wet and dry hides. Duration of use ranged from 1 minute to 20 minutes per scraper. The results of these experiments were used to identify hide scraping attributes on the Hickory Bluff sample.

Results

Forty of 50 Hickory Bluff artifacts (82 percent) showed some type of functional evidence (Table 13.45).

Table 13.45 Summary of Residue and Use Wear Result for the Hickory Bluff Sample

Catalog No.	Hafting Residue[a]	Hafting Wear[b]	Use-Residue[c]	Use wear[d]	Inferred Use	Contact Material
114-5	Plant	Striae oblique, ⊥, ∣	-----	Striae ∣, polish	Scraping	-----
132-3	-----	-----	Skin	Striae / polish / edge rounding	Scraping	Hide
586-1	-----	-----	-----	-----	-----	-----
592-6	-----	Striae ∣	Skin	Polish	Scraping	Hide
602-1	-----	Striae oblique, ⊥, ∣	Skin	Striae ⊥	Scraping	Hide
675-4	-----	-----	-----	Striae ⊥, oblique	Scraping	Unknown
676-11	Plant tissue	Striae ∣	-----	Striae oblique, ⊥, ∣	Scraping	Plant
742-2	-----	-----	-----	Striae ⊥, oblique edge rounding	Scraping	Unknown
764-6	-----	Striae ∣	-----	Striae ⊥	Scraping	Unknown
783-7	-----	-----	-----	Polish, edge rounding	Unknown	Unknown
964-1	-----	Striae ⊥, oblique	Skin	Striae ⊥	Scraping	Hide
1002-1	Wood	Striae ∣	-----	Striae ⊥, edge rounding	Scraping	Hard
1116-2	-----	-----	-----	-----	-----	-----
1141-7	-----	Striae ⊥	Bone / antler	Striae ⊥, oblique on tip	Boring, scraping	Bone / antler
1161-1	-----	-----	Skin	Striae ∣, ⊥	Scraping / slicing	Hide
1169-1	-----	Striae ⊥	Bone / antler	Striae oblique, ⊥, ∣	Scraping	Bone / antler
1187-3	-----	Striae oblique, ⊥, ∣	-----	Striae oblique, ⊥, ∣	Scraping	Unknown

Table 13.45 Summary of Residue and Use Wear Result for the Hickory Bluff Sample (Continued)

Catalog No.	Hafting Residue[a]	Hafting Wear[b]	Use-Residue[c]	Use wear[d]	Inferred Use	Contact Material
1243-1	-----	Striae ∣, oblique	-----	Striae ⊥	Scraping (recently resharpened?)	Unknown
1287-1	-----	-----	-----	Striae oblique	Unknown	Unknown
1312-1	-----	-----	-----	-----	-----	----- (quartz)
1355-1	-----	Striae ∣	-----	Striae ⊥	Scraping	Unknown
1441-3	-----	Ridge abrasion	-----	Striae oblique, ⊥, ∣	Scraping	Unknown
1621-3	-----	Striae ∣, ridge abrasion	-----	Striae oblique, ⊥	Scraping	Unknown
1686-1	-----	Striae ⊥	-----	Striae ⊥	Scraping	Unknown
1754-4	-----	Striae oblique, ⊥, ∣	-----	Striae oblique, ⊥, ∣	Scraping	Unknown
2233-2	-----	-----	-----	Striae ⊥, oblique, edge rounding	Scraping	Hard
2290-2	Reflective black resin (mastic?)	Striae ∣	-----	Striae ⊥, polish	Scraping	Unknown material
2307-1	-----	Polish	-----	Striae oblique	Scraping	Unknown
2568-2	-----	-----	-----	-----	-----	-----
2645-4	-----	-----	Skin	-----	-----	Hide
2722-4	-----	-----	-----	Striae ⊥, light polish	Scraping	Unknown material
2725-1	-----	-----	Starch grains near edges	Striae ⊥, ∣	Scraping/slicin g	Starch
2872-2	-----	Striae ⊥, polish	-----	Striae ⊥	Scraping	Hard material
2923-1	-----	-----	-----	Uniform polish on ventral surface	-----	-----
3020-2	-----	Polish	-----	-----	Unknown	Unknown
3237-6	-----	Heavy polish	Skin or bone	Striae ⊥, polish, edge damage	Scraping	Hide or bone
3260-3	-----	-----	-----	Striae ⊥	Unknown	Unknown
3372-1	-----	Abraded ridges	-----	Light polish	-----	-----
3495-4	-----	-----	-----	Light polish	Unknown	Unknown
3728-5	Plant fiber	Striae oblique, polish	-----	Striae ⊥, polish	Scraping	Unknown material

Table 13.45 Summary of Residue and Use Wear Result for the Hickory Bluff Sample (Continued)

Catalog No.	Hafting Residue[a]	Hafting Wear[b]	Use-Residue[c]	Use wear[d]	Inferred Use	Contact Material
1243-1	-----	Striae ∣, oblique	-----	Striae ⊥	Scraping (recently resharpened?)	Unknown
3760-3	-----	Striae ∣	-----	Striae oblique, polish	Scraping	Unknown
3760-4	-----	Striae ∣	Skin	Striae ∣	Slicing	Hide
3999-8	-----	Striae oblique, ∣	-----	-----	Unknown	Unknown
4002-2	-----	Striae oblique, ⊥, ∣	-----	Striae ⊥, ∣	Scraping	Unknown material, possibly both ends used
4002-3	-----	-----	-----	-----	-----	-----
4062-5	-----	Striae oblique, ⊥, ∣	-----	Striae ⊥, heavy polish	Scraping	Unknown
4181-1 (bifacial flaking)	-----	-----	-----	Heavy polish	Scraping	Unknown
4225-1	-----	-----	-----	Polish on tip	Unknown	Soft
4475-2/ 4478-5	-----	-----	-----	-----	-----	-----
4476-3	-----	-----	-----	Striae ⊥, polish	Scraping	Unknown

a. Hafting residues are confined to the proximal 1/3 to 1/2 portion of the artifact.

b. Hafting wear confined to proximal 1/3 to 1/2 of the artifact. ∣ and ⊥ refer to parallel and perpendicular to the long axis of the artifact respectively.

c. Use-residues are confined to the distal portion of the artifact near or on the working edge.

d. Use wear is confined to the distal portion of the artifact near or on the working edge. ∣ and ⊥ refer to parallel and perpendicular to the working edge respectively.

Residues. The residues observed on Hickory Bluff artifacts included plant fragments (woody and non-woody tissue), bone or antler particles, and fragments of skin tissue. Residues were identified by comparison to published or experimental material. In the case of the identification of skin tissue, new hide-working experiments were undertaken to obtain more comparative material. Skin tissue observed on artifacts used to scrape dry hide closely matched the morphology of putative skin tissue residues on Hickory Bluff artifacts (Figure 13.66, 13.67, and 13.68). These skin residues were considered to be use-related due to their distribution on the tool surface. Skin fragments were confined to the distal portion of the tool and were most commonly found near the retouched edge on both the dorsal and ventral surfaces. Sixteen out of fifty artifacts (32 percent) exhibited residues, including eight with skin tissue (16 percent), three with bone or antler particles (6 percent), and five with plant remains (10 percent).

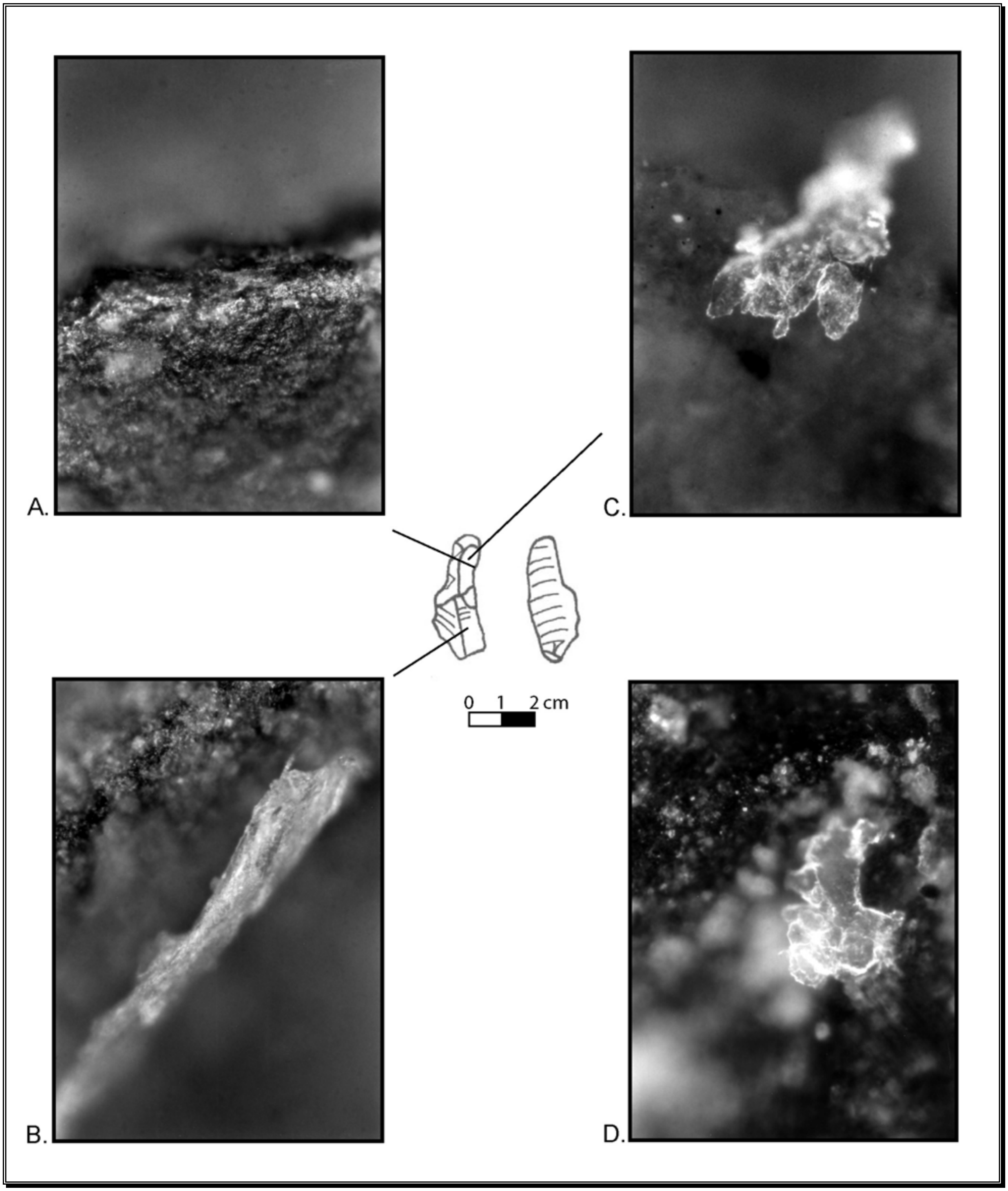

Figure 13.66 Microscopic Evidence of Putative Skin Tissue Residues on Artifact 1161-1

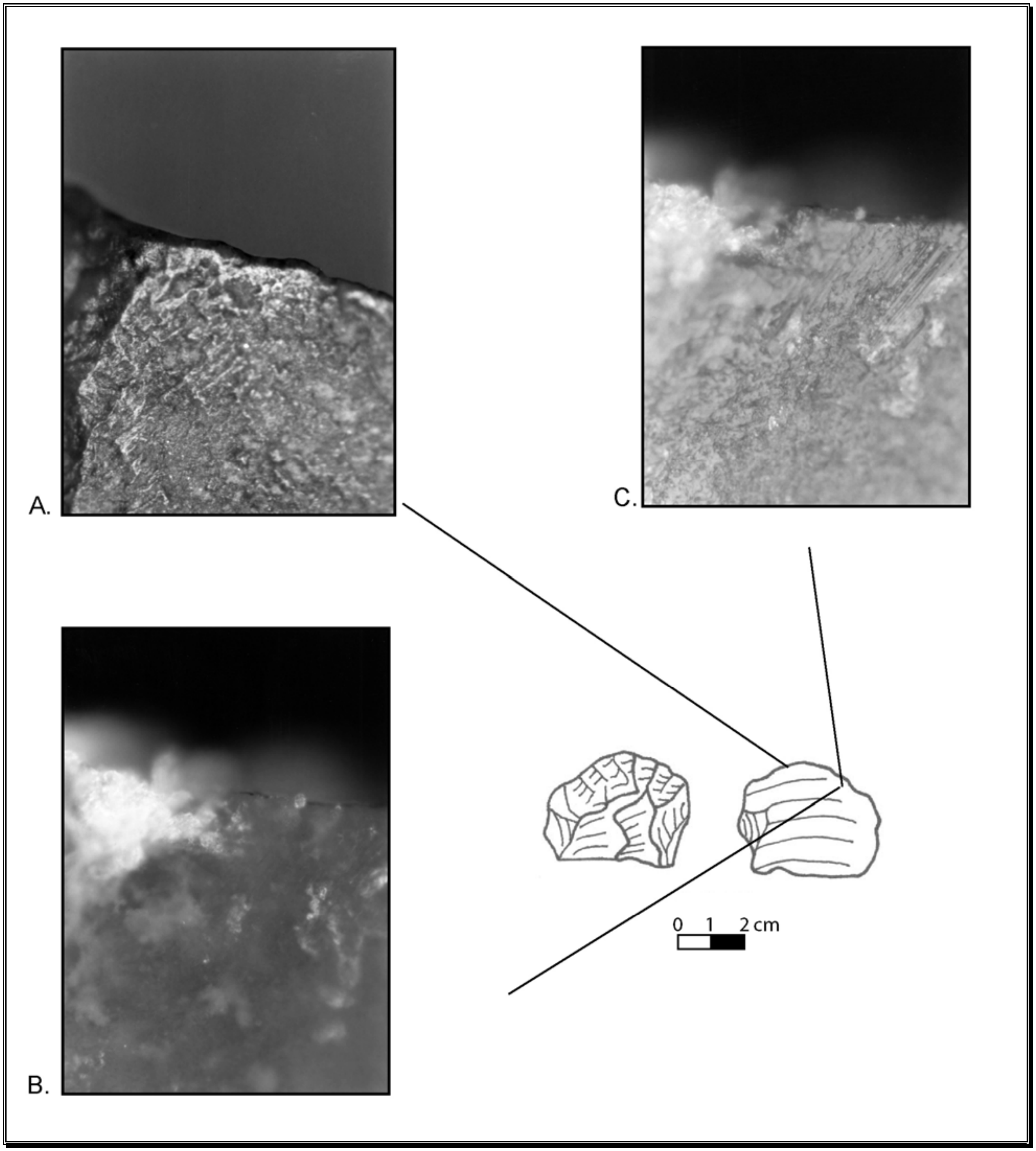

Figure 13.67 Microscopic Evidence of Putative Skin Tissue Residues on Artifact 132-3

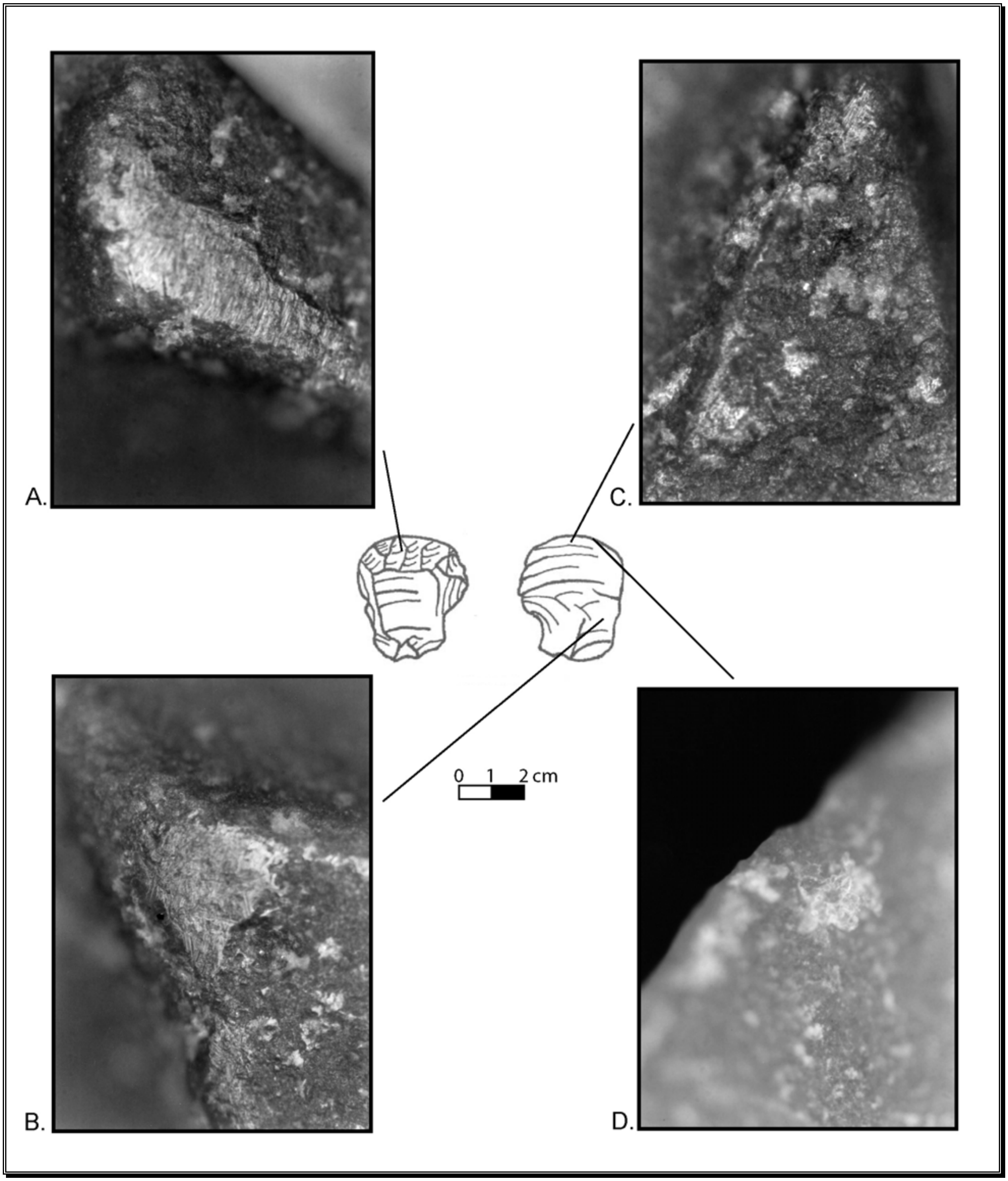

Figure 13.68 Microscopic Evidence of Putative Skin Tissue Residues on Artifact 602-1

Bone or antler residues consist of fine white particles and are often associated with striae due to the hardness of the material. Experimentally, it is difficult to accurately differentiate between bone and antler residue (Hardy 1994). On both tools with bone or antler contact (1141-7 and 1169-1), the residues are confined to the distal working edge.

Plant residues are found on five artifacts: one artifact with starch grains (Figure 13.69, 2725-1), one artifact with woody plant tissue (1002-1), and three artifacts (114-5, 676-11 and 3728-5) with plant tissue for which more specific identification was not possible. Three artifacts (114-5, 676-11 and 3728-5) have plant tissue confined to the proximal portion suggesting that they are related to hafting. The wood residue on artifact 1002-1 is also located on the proximal portion of the tool and is most likely related to hafting. One further artifact (2290-2) has shiny black patches on its proximal, ventral surface that may be the remains of a mastic. Chemical tests would be necessary in order to confirm this hypothesis.

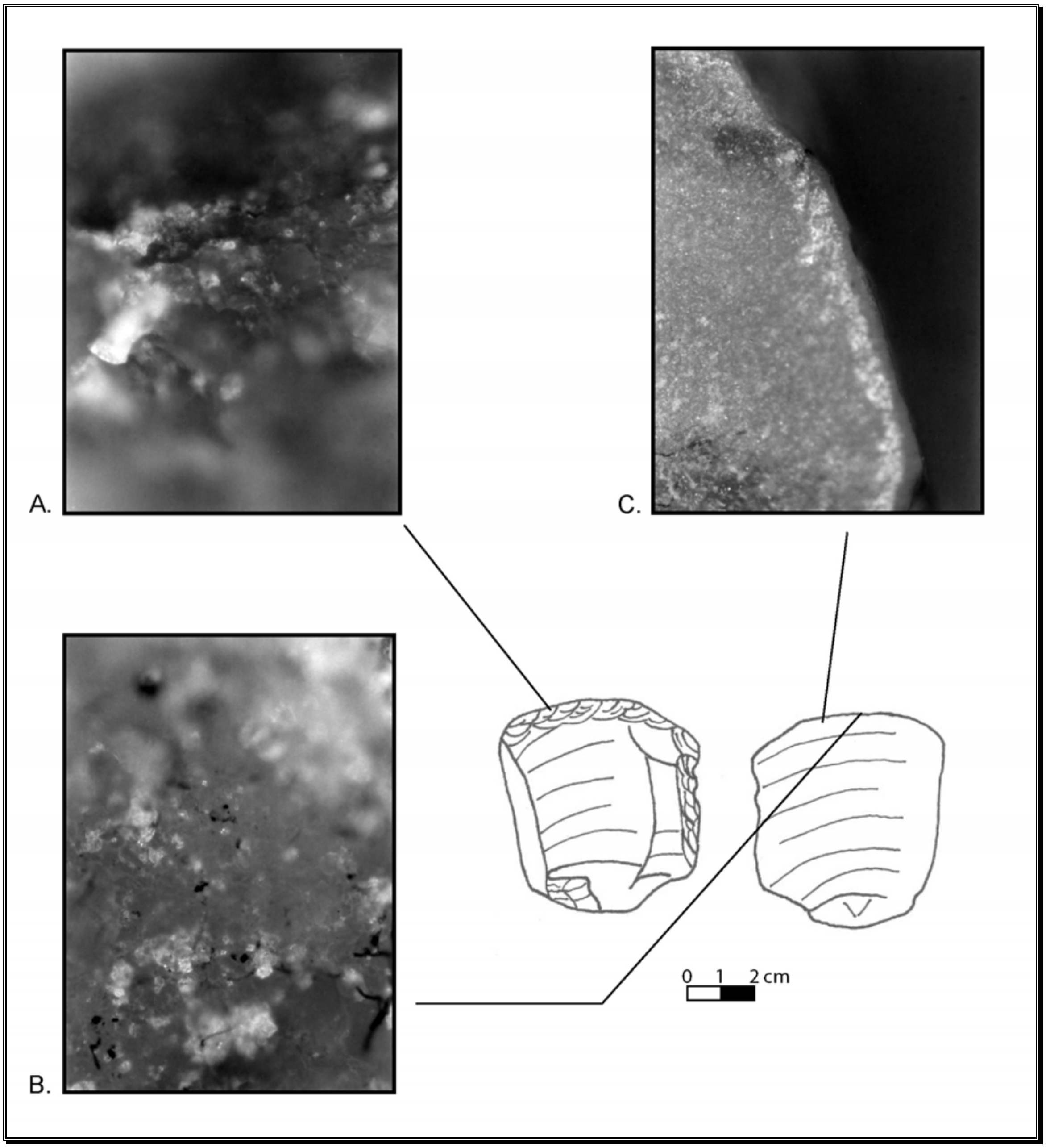

Figure 13.69 Microscopic Evidence of Starch Grains on Artifact 2725-1

Use wear. The positioning and orientation of wear patterns suggests that the most common use-action was scraping. A scraping use-action is typically indicated by the presence of striations that are perpendicular or oblique to the working edge of the tool (Mansur-Franchomme 1986). The wear indicative of scraping was typically confined to small areas along the working edge with striations perpendicular or oblique to that edge. While edge rounding was observed on some working edges, edge damage in the form of microflake scars was not common. One artifact showed wear patterns suggesting that it was used as a borer and two were used for slicing or cutting. A boring use-action is inferred when a pointed artifact exhibits striations near the tip that are perpendicular to the long axis of the point. Cutting or slicing use actions result in an area of striations that run parallel to the working edge of the tool and are confined to a small zone near the edge (Keeley 1980; Mansur-Franchomme 1986).

Hafting. Twenty-nine of fifty artifacts (58 percent) demonstrated some evidence of hafting. Hafting traces included striations or polish confined to the proximal 1/3 to 1/2 of the artifact. Hafting traces consisted of striations either perpendicular or parallel to the long axis of the artifact (Beyries 1987). Striations were often accompanied by abraded ridges and highly reflective polish. Striations were more common on the ventral surfaces and abraded ridges on the dorsal. On four artifacts, plant tissue was also found confined to the proximal portion and may be the remains of the haft itself. Only one artifact exhibited possible mastic.

Sediment and non-artifactual samples. Microscopic examination of four sediment samples taken from different levels at the site (N309/E657, Stratum I, Level 1, Feature 70; N402 E624, Stratum I, Level 5, Feature 90; N350 E651, Stratum II, Feature 233; N368 E630, Feature 169) revealed no material morphologically similar to the residues found on the artifacts. Three unmodified lithic samples consisting of rounded pebbles (Bag 2910, N350 E651, Stratum B-1; Bag 2131, N308 E657, Stratum B-1; Bag 3598, N368 E630, Stratum B-1) showed no wear or residues similar to that seen on the artifacts. A fourth non-artifactual sample of tabular flint (Bag 2292, N402 E624, Feature 90, Level 1) had no residues but did have randomly oriented striations scattered over the rock surface on both sides. Unlike use-related striations on artifacts, these striations were not localized or patterned.

Individual Examples

Hide processing. A total of eight artifacts showed evidence of slicing or scraping hides.

Artifact 1161-1 (Figure 13.66): Striations were found both parallel and perpendicular to one edge of the tool. Confined along this edge were a series of skin fragments found in association with both orientations of striations. Identification of skin fragments was based on comparison with modern samples used for hide processing (Figure 13.66d).

Artifact 132-3 (Figure 13.67): Edge rounding and polish were found along the retouched edge, particularly on the ventral surface. Figure 13.54b and 13.54c show the juxtaposition of striations perpendicular to the working edge and skin fragments.

Artifact 602-1 (Figure 13.68): Striations confined to the distal 1/3 of the tool occurred perpendicular to the working edge on both the dorsal and ventral surfaces (Figure 13.68a and 13.68c). Skin fragments were also found along the working edge on the ventral surface (Figure

13.68d). The proximal 1/3 of the tool was characterized by complex sets of striations caused by movement under a haft.

Starchy plant processing. One artifact showed evidence of processing starchy material, possibly roots or tubers.

Artifact 2725-1 (Figure 13.69): Starch grains viewed under cross-polarized light exhibit a black extinction cross (Loy et al. 1992; Fullagar and Field 1997; Barton et al. 1998). This artifact showed starch grains scattered over the dorsal surface and confined to the distal margin near the working edge on the ventral surface. The starch grains were accompanied on the ventral surface by striations parallel and perpendicular to the working edge. This patterning suggested that the ventral surface was in contact with a starchy substance during use and that the scraped or sliced material accumulated on the dorsal surface. The presence of a large number of starch grains suggested that their source may be a starchy storage organ such as a root or a tuber. This identification is not definitive, however, as starch grains can occur in various parts of plants (Fahn 1982).

Bone/antler processing. Three artifacts had particles identified as bone or antler fragments along their working edges.

Artifact 1169-1 (Figure 13.70): On the ventral surface, three different zones were distinguished. The distal 1/3 of the tool was characterized by edge rounding, polish and striations with multiple orientations (Figure 13.70a and 13.70b). Bone or antler particles were found along the working edge. The middle 1/3 of the tool was an area of unmodified stone surface (Figure 13.70c). The proximal 1/3 of the tool was polished with striations running perpendicular to the long axis of the tool that are caused by movement of the tool in a haft.

Artifact 1141-7 (Figure 13.71): A projecting point on the tool had striations perpendicular to the edge on both the dorsal and ventral surface. These striations were accompanied by bone/antler residue (Figure 13.71a and 13.71d). Further along the same edge were a series of multiply-oriented striations (Figure 13.71c) related to a complex scraping motion. The proximal 1/3 of the tool showed abraded ridges and striations related to hafting (Figure 13.71b).

Hafting. A total of 29 artifacts showed some evidence of hafting.

Artifact 114-5 (Figure 13.72): hafted with striations and plant tissue. The proximal 1/2 of the tool had multiply-oriented striations due to movement within a haft (Figure 13.72b) and scattered plant tissue in the same area (Figure 13.72a). The distal end of the tool had striations parallel to the long axis suggesting the tool was used for scraping. The use material is unknown.

Artifact 2290-2 (Figure 13.73): The proximal 2/3 of the tool was characterized by striations primarily parallel to the long axis of the tool in association with highly reflective black patches (Figure 13.73b). The black patches were morphologically similar to a mastic such as some kind of resin. Chemical analysis would be necessary to confirm this identification. The distal end showed evidence of scraping an unknown material (Figure 13.73a).

Artifact 1002-1 (Figure 13.74): The retouched edge of the tool exhibited edge rounding and striations perpendicular to the edge indicative of scraping a relatively hard material (Figure 13.74a). The proximal 1/3 of the tool had striations parallel to the long axis from movement within a haft (Figure 13.74c). A fragment of wood tissue (Figure 13.74b) was preserved on the ventral surface and may be a remnant of the haft itself.

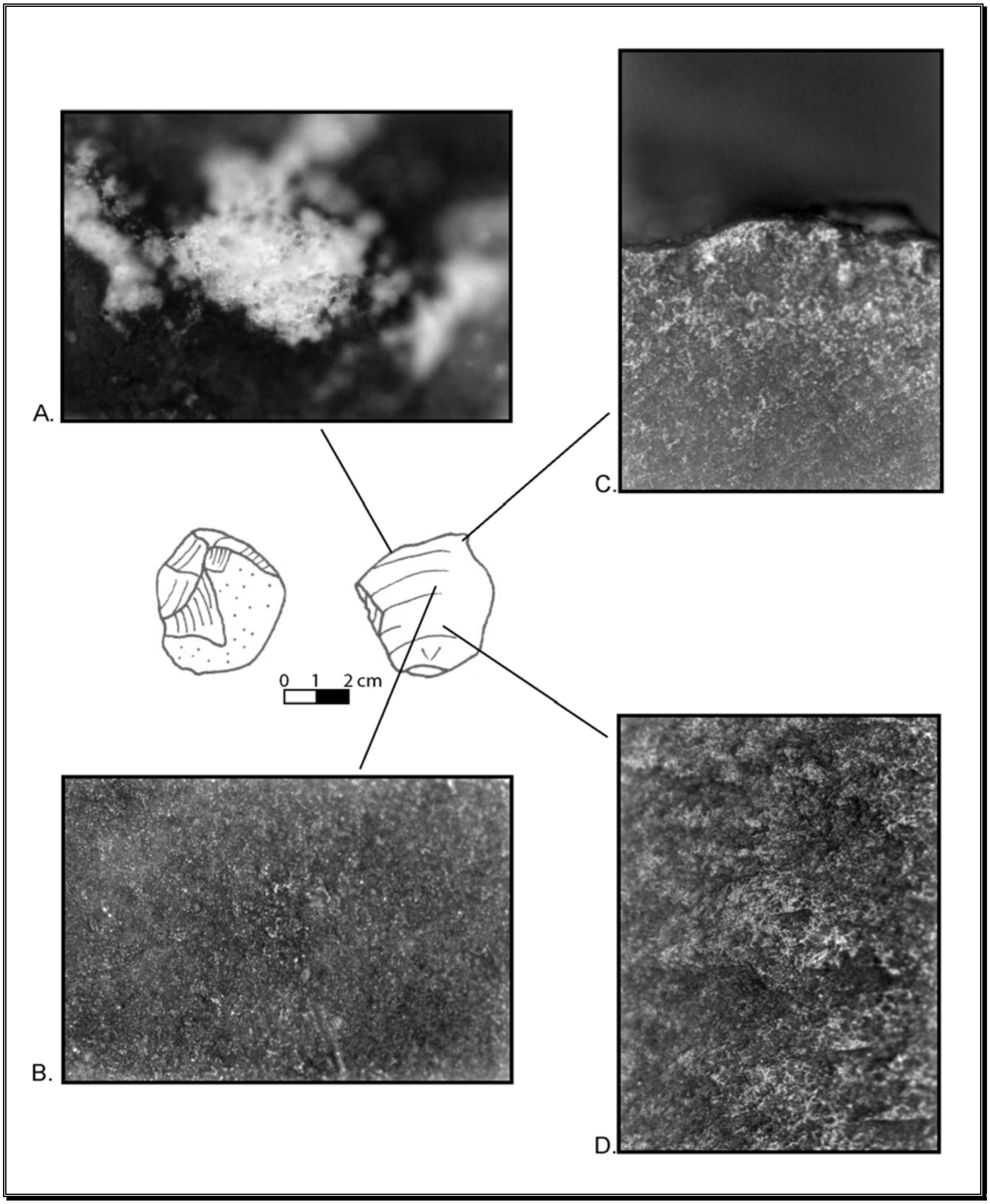

Figure 13.70 Microscopic Evidence of Bone or Antler Processing on Artifact 1169-1

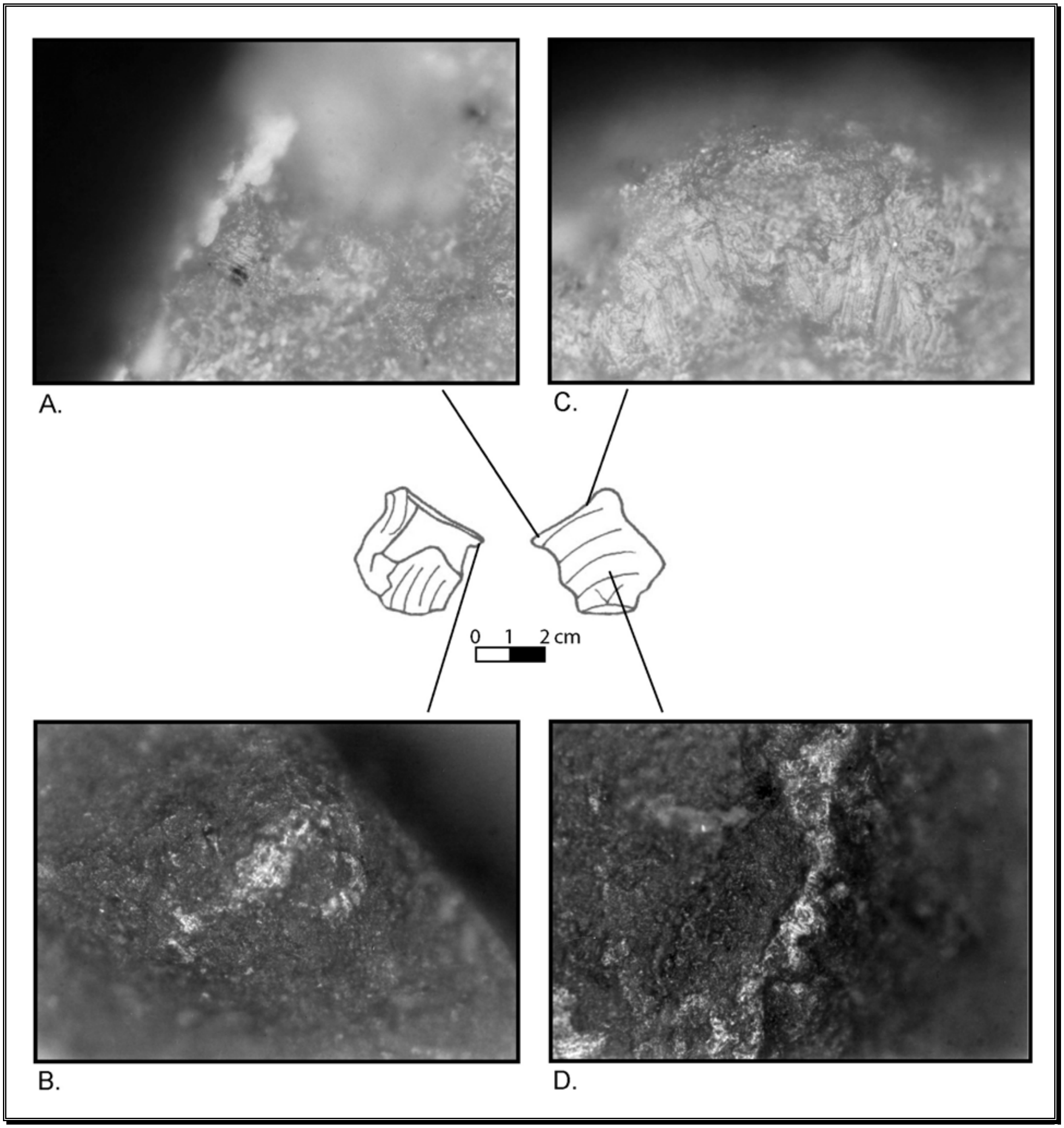

Figure 13.71 Microscopic Evidence of Bone or Antler Processing on Artifact 1141-7

Discussion

The majority of the unifaces from Hickory Bluff were used as hafted scrapers. The materials scraped included dry hide, bone or antler, and starchy or woody plants. No hair fragments were found on the artifacts interpreted as hide scrapers, making more specific identification (e.g. species) difficult. The presence of starch grains along the working edge on one artifact suggests the processing of a starchy storage organ such as a root or a tuber (Figure 13.68). At present, more specific identification has not been possible.

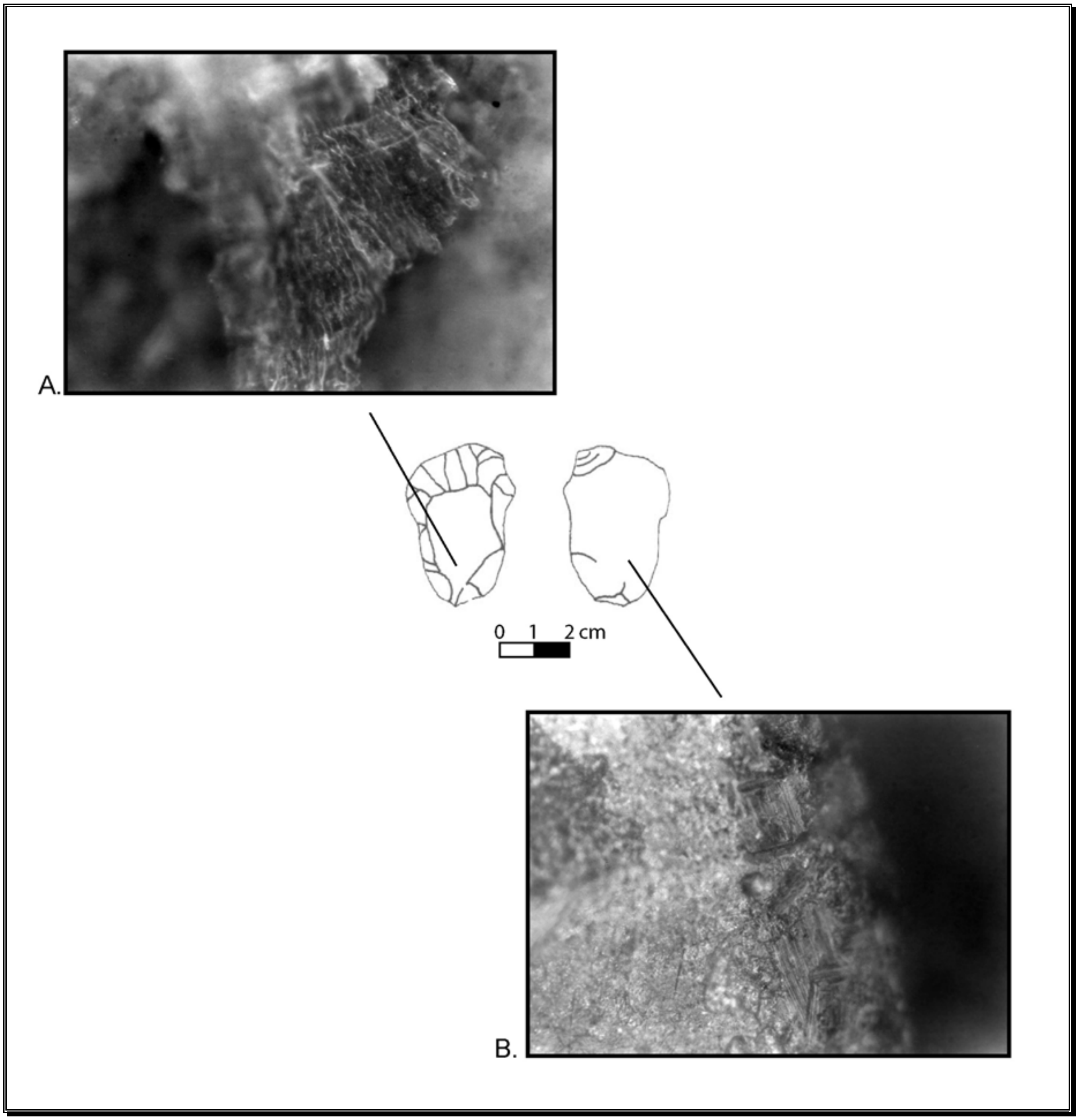

Figure 13.72 Microscopic Evidence of Hafting on Artifact 114-5

Table 13.46 summarizes the frequency of use wear and residue evidence for both hafting and use. Of the 29 artifacts that show evidence for hafting, all 29 artifacts have use wear related to hafting while only 5 have residues related to hafting. Of the 40 artifacts with evidence of use, 29 have use wear only, 10 have both use wear and residues, and 1 has residue only. The bulk of the evidence for both hafting and use comes from use wear. However, the residues are complementary, providing a cross-check of the use wear evidence and often a more specific identification of the use-material. The use of multiple analytical techniques provides more precise information than either would alone (Hardy and Kay 1998).

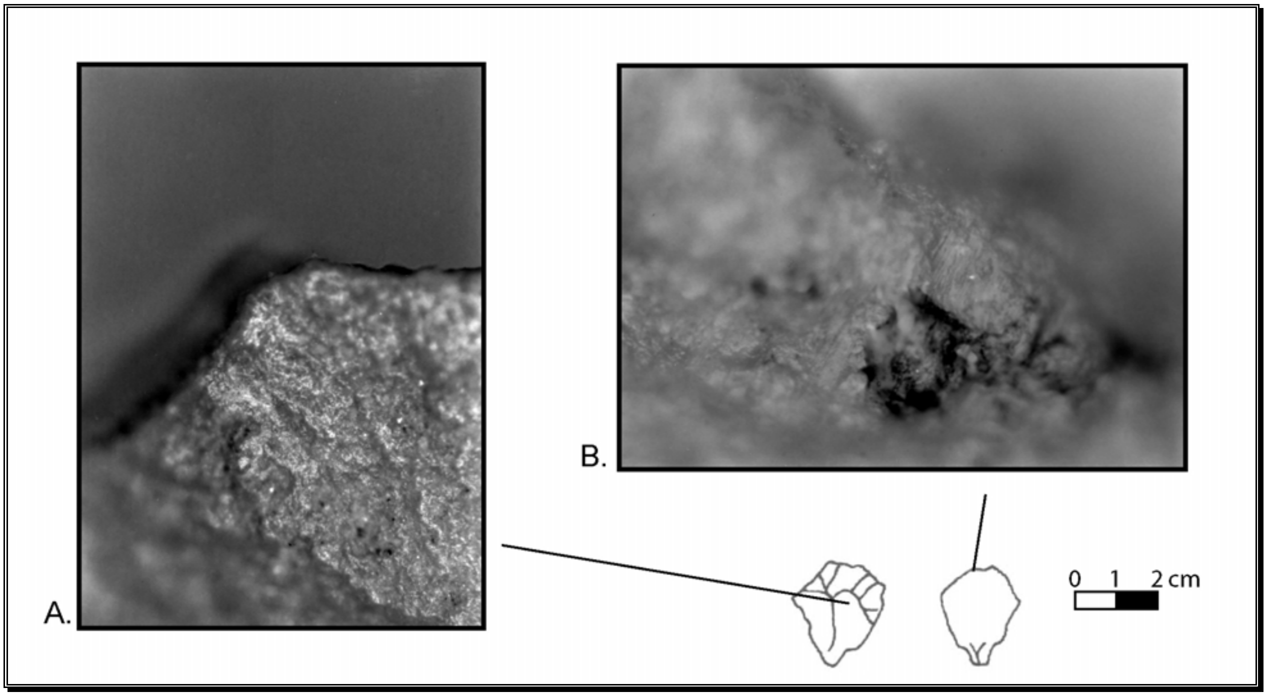

Figure 13.73 Microscopic Evidence of Hafting on Artifact 2290-2

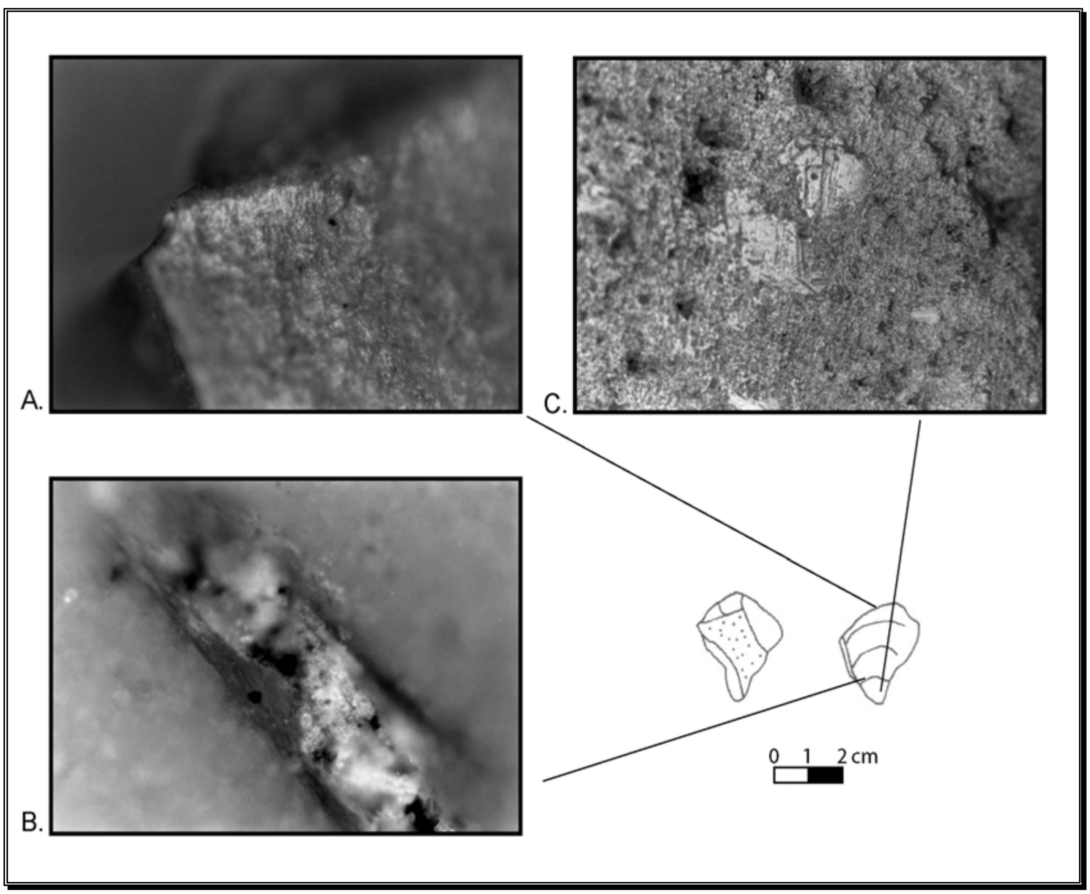

Figure 13.74 Microscopic Evidence of Hafting on Artifact 1002-1

Table 13.46 Frequency of Use wear and Residue Evidence for Hafting and Use (n=50)

	Residues only	Use wear only	Residues and Use wear	Total with any combination
Hafting	0 (0%)	24 (48%)	5 (10%)	29 (58%)
Use	1 (2%)	29 (58%)	10 (20%)	40 (80%)

The higher frequency of use wear evidence relative to residues has several possible explanations. Previous investigations (Hardy and Kay 1998) suggest that relatively hard materials are less likely to leave identifiable use wear. Several of the unifaces appear to have been used on bone or antler. It is possible that some of the artifacts with signs of use but no specific identification of use-material were used on similar hard materials that left no identifiable residues. Although most of the artifacts were unwashed prior to examination, some were cleaned for display as part of a public outreach program. This cleaning could have removed some residues. Finally, the taphonomy of residues is relatively poorly understood and a variety of unknown factors such as pH, groundwater, elemental composition of the flint, intensity of use, etc., could have contributed to loss or lack of residues.

Unifaces from Hickory Bluff appear to have been used, both hafted and unhafted, to scrape and cut hide as well as starchy plants and bone or antler. This evidence suggests that the common assumption of unifaces as specialized hide-scraping tools is not correct at Hickory Bluff. This research also underscores the importance of using multiple analytical techniques in the investigation of stone tool function.

Microscopic versus Macroscopic Use Wear Analysis

Two independent methodological approaches were employed to examine a selected sample of fifty unifacial tools. Macroscopic analysis using a 10x lens was the standard process for all tool examination for the Hickory Bluff assemblage. Macroscopic analysis for the fifty selected unifacial tools identified edge modification in terms of unifacial and bifacial microflakes, edge rounding, edge polish, grinding and presence of striations. Microflake removal was categorized as serial, random, or nibbling. Most of the microflake edges exhibited sequential and overlapping flake scars (i.e., serial flake scars along the edge). Some edges showed adjacent microflakes that were not overlapping and seemed random in placement. Nibbling was evidenced by isolated flake scars along the edge and may represent incidental flake removal along material edge flaws during knapping or use, or may indicate post-depositional activity. Microscopic analysis was focused on identification of abraded edges and possible organic residue under 100-500x. Evidence of hafting and use wear in the form of polish, rounding, and striations were documented.

Based on the macroscopic analysis, 127 EUs were defined for this uniface sample. Agreement on the presence of use wear and/or residue occurred for 58 EUs or about 46 percent (Table 13.47). Polish was recognized during both macroscopic (n=60) and microscopic (n=36) analyses. Identification of rounding and striations varied by approach: rounding was visibly observed during macroscopic analysis (n=56) whereas striations were documented more frequently during microscopic analysis (n=41). It is likely that rounding and striations are two manifestations of the same type of wear, simply viewed at varying levels of detail.

Polish was observed during both analytical techniques on the same 21 EUs. Edge rounding was noted on 4 EUs and both artifacts with observable macroscopic striations were documented during microscopic analysis.

Table 13.47 Summary Data from Unifacial Tool Edge Analyses

Observation	Macroscopic Analysis	Microscopic Analysis
Polish	29	10
Residue	0	4
Rounding	25	0
Striations	0	9
Polish / Residue	0	1
Polish / Rounding	31	1
Polish / Rounding / Residue	0	1
Polish / Rounding / Striations	0	1
Striations / Polish	0	18
Striations / Polish / Residue	0	4
Striations / Residue	0	7
Striations / Rounding	2	2
Total	87	58

Hafting indicators varied between approaches; primary characteristics identified during macroscopic analysis consisted of microflake removal along the lateral edges, either as retouch or use wear (Table 13.48). Polish, rounding, and grinding were also observed and only two incidences of visible striations perpendicular to the edge were noted macroscopically. Microscopic hafting indicators included the presence of residue, striations on the lateral edges as well as the dorsal and ventral faces, polish, and abraded dorsal ridges (Table 13.48). About half of the sample exhibited hafting according to each of the approaches (macroscopic n=21; microscopic n=28); however, specific tools with hafting varied between the two approaches (n= 11) resulting in a 22 percent agreement.

Use-action (type and intensity of use) was expectedly consistent for both types of analyses as a result of the data set (Table 13.49). Multiple use-actions indicated either multiple use along one edge or use of multiple edges. Although scraping use-action was predominant (Table 13.49), cutting/slicing and boring activities were also identified. Based on the macroscopic analysis, 98 percent (n=49) of the selected tools exhibited scraping use-action; in the microscopic analysis, only 68 percent (n=34) demonstrated scraping use-action. Comparison of scraping use-action based on individual unifacial tools indicates agreement between the two types of analysis for 34 tools (68 percent). One tool exhibiting boring use-action was also similarly identified between the two techniques.

Table 13.48 Hafting Indicators on Selected Unifacial Tools

Hafting Indicators	**Macroscopic Analysis**	**Microscopic Analysis**
Lateral Edges	**30**	**5**
Polish	14	
Residue		1
Rounding	11	
Striations		2
Polish/Rounding	5	
Striations/Residue		2
Dorsal Surface	**0**	**7**
Polish		2
Residue		1
Rounding		
Striations		2
Polish/Striations		1
Striations/Abrasion		1
Ventral Surface	**0**	**14**
Polish		1
Residue		
Rounding		
Striations		4
Polish/Striations		5
Striations/Abrasion		2
Striations/Residue		1
Hafting Traces (unidentified)		1

Table 13.49 Summary of Use-Action for Selected Unifacial Tools

Use- Action	**Macroscopic Analysis**	**Microscopic Analysis**
Boring	**0**	**1**
Cutting/ slicing	**1**	**2**
Scraping	**49**	**34**
Complex scraping	13	4
Complex scraping/cutting	1	0
Scraping	33	29
Scraping/boring	2	0
Scraping/slicing	0	1
Unknown	**0**	**13**

Functional interpretation between the two techniques was based on the corresponding level of detail and definition. Macroscopic analysis provided broader functional categories (i.e., scraping hide) whereas microscopic analysis identified function based on the type of media on which the tools were used (i.e., antler, bone, hide, plant, and wood)(Table 13.50). Most of the macroscopic analysis functional interpretation was scraping hide (56 percent; n=28). The primary functional determinations using the microscopic analysis were scraping unknown material (36 percent; n=18) and unknown function (22 percent; n=11). Functional interpretation for only six tools was agreed upon in both techniques (only 12 percent).

Table 13.50 Summary of Function for Selected Unifacial Tools

Function	Macroscopic Analysis	Microscopic Analysis
Boring hard material (bone/antler)		1
Cutting wood/hide/grasses	1	
General scraping	5	
Scraping bone/antler		1
Scraping hard material		5
Scraping hard material/high silica material		2
Scraping hide	28	4
Scraping hide or bone		1
Scraping hide/boring	2	
Scraping hide and hard materials; cutting vegetal materials	1	
Scraping plant		3
Scraping unknown material		18
Scraping wood	1	
Scraping wood/hide/grasses	11	
Scraping/ slicing hide	1	1
Slicing soft material		1
Unknown		11
Unused		2

REGIONAL LITHIC SOURCES AND PROCUREMENT STRATEGIES

Lithic Mineralogy

A lithic mineralogy study was conducted for selected artifacts from Hickory Bluff to identify material types and possible source locations. Selected artifact types for this study consisted of bifaces, projectile points, and unifaces. This identification was conducted by Phillip LaPorta, geologist, and compiled by Parsons from data tables provided.

The mineralogy study consisted of a macroscopic assessment of each artifact using a 10x lens. Visual observations included color, diapheneity (translucency), texture/luster, internal and external structures, and heat treatment. Using extensive comparative collections, each artifact was identified by petrological grouping and geological age and, if possible, by formation, member, and quarry. General comments were also provided. Detailed analytical tables are located in Appendix J.

Of the 575 artifacts in this study, lithic sources were identified for 62 percent (Table 13.51). Pinpointing quarry, county, and/or state sources locations was problematic because of the extensive nature of some formations; however, locational information was recorded for 47.1 percent of the artifacts.

Table 13.51 Artifact Type and Frequency in the Mineralogy Study

Artifact Type	Total Frequency	Source Identified		Location Identified	
		#	%	#	%
Projectile Points	298	240	80.5	207	69.5
Bifaces	218	91	41.7	38	17.4
Unifaces	59	26	44.0	26	44.0
Total	575	357	62.0	271	47.1

Lithic materials procured for the Hickory Bluff projectile point, biface, and uniface assemblages represent nineteen different geological formations from eight states (Table 13.52). These formations were identified as primary source locations for argillites, cherts, dacites, felsites, hornfels, jaspers, quartz, and quartzites. The different formations are associated with various Mid-Atlantic topographic features including the Coastal Plain, the Piedmont, the Ridge and Valley, and the Great Valley, and extend beyond state boundaries. Different source or quarry locations may occur along the extent of the geological formation. Lithic materials from different locations along the same geological formation may exhibit slightly different visual and mineralogical characteristics. Although mineralogical characteristics from specific formations were identified for the Hickory Bluff artifacts, this does not necessarily indicate that lithic materials were obtained at a specific quarry. Procurement behavior may include quarrying activities at the primary outcrops, procurement through exchange and trade, or collection of local cobbles and pebbles from secondary sources, such as Pleistocene and Holocene gravels (e.g., Pennsauken gravels, New Jersey and Taconic quartz and quartzites, Delmarva) (Appendix J). As a result, the distributions reflect the maximum spatial extent of identified sources.

A wide range of potential lithic sources representing seven states was associated with the Hickory Bluff projectile points (Table 13.53). Most of the lithic materials were from geological formations in the Delmarva Piedmont, including Cecil County and Heath Farm source locations in Maryland and Iron Hill in Delaware (part of the Delaware Chalcedony Complex). Additional Delmarva lithic sources comprise materials from Talbot County and along the Choptank River (Figure 13.75). Lithic material was also obtained from Cumberland County, New Jersey across Delaware Bay. Approximately 25 percent of the projectile point lithic materials were identified as cherts and ironstone obtained on the Coastal Plain; these materials may represent stream and terrace gravels that may have been procured locally.

Northern lithic sources represented by the projectile point assemblage include argillite from the Delaware River valley in New Jersey and Pennsylvania and cherts from the Pennsylvania Reading Prong area (Figure 13.75). Western lithic sources include materials from the Ridge and Valley, and Great Valley regions in Maryland; the Ridge and Valley area in

Virginia; and the Ohio River Valley (Figure 13.75). Four projectile point fragments were identified as Flint Ridge chert from the Vanport Fm. in Ohio. Some rhyolite was identified as characteristic of lithic materials associated with the Carolina Ridge and Valley area in North Carolina (Figure 13.75).

Table 13.52 Geological Formations Associated with the Hickory Bluff Assemblage

Formation	Geological Age	Material Type	State
Aquia	Cenozoic	Sandstone	MD, VA
Austin Glen	Ordovician	Turbidite/Graywacke	NY
Axeman	Cambro-Ordovician	Chert	MD
Beekmantown	Cambro-Ordovician	Chert	MD, NJ, PA, VA
Calvert	Miocene	Chert	MD, VA
Calvert	Miocene	Orthoquartzite	NJ
Carolina Slate Belt	Precambrian	Dacite	NC, VA
Catoctin	Precambrian	Dacite	MD, NC, PA
Catoctin	Precambrian	Metarhyolite	MD, PA
Conococheague	Cambro-Ordovician	Chert	MD, PA
Elbrook	Cambro-Ordovician	Chert	MD
Greenbrier	Mississippian	Chert	VA
Hardyston	Cambrian	Jasper	PA, VA
Hardyston	Cambrian	Metaquartzite	VA
Hardyston	Cambrian	Quartzite	PA, VA
Helderberg	Lower Devonian	Chert	MD, NJ, PA, VA, WV
Iron Hill	Cretaceous	Jasper	DE
James Run Volcanics	Cambro-Ordovician	Felsite	MD
James Run Volcanics	Cambro-Ordovician	Jasper	MD
Lockatong	Triassic	Argillite	NJ, PA
Lockatong	Triassic	Hornfels	NJ
Onondaga	Devonian	Chert	MD, NJ, NY, PA
Rickenbach	Cambro-Ordovician	Chert	MD, PA
Taconic	Cambro-Ordovician	Quartz	DE, MD, PA, VA
Taconic	Cambro-Ordovician	Quartzite	MD, PA, VA
Vanport	Pennsylvanian	Chert	OH

Lithic sources identified for bifaces exhibited a slightly different distribution than for projectile points; most of the materials were from the Delmarva Piedmont (Cecil County and Heath Farm, Maryland; and Iron Hill, Delaware) and from the Pennsylvania Reading Prong area (Table 13.54; Figure 13.76). Lithic materials from the Virginia Ridge and Valley area (Flint Run jaspers) were also present in the Hickory Bluff biface assemblage. Isolated bifaces were identified from northern source locations such as argillite from the Delaware River valley and New Jersey Coastal Plain, graywacke from the Hudson River valley in New York, orthoquartzite from the Choptank River on the Delmarva, metarhyolite from the Maryland Ridge and Valley area, chert from the Great Valley area of Maryland, and dacite from the Carolina Ridge and Valley area in North Carolina (Figure 13.76).

Table 13.53 Hickory Bluff Projectile Point Lithic Sources

Location	State	Quarries (if identified)	Material Types	Frequency
Carolina Ridge and Valley	NC	Morrow Mountain	Dacite; porphyritic rhyolite	7
Coastal Plain	DE-MD		Chert; ironstone	52
Delaware River Valley	NJ-PA		Argillite	17
Delmarva Choptank River	MD	Choptank River; Talbot County	orthoquartzite; sandstone	11
Delmarva Piedmont	DE	Iron Hill	Chert/jasper; quartz	4
Delmarva Piedmont	DE-MD		Chert; quartz	8
Delmarva Piedmont	MD	Cecil County	Chert/jasper; felsite/metafelsite;	64
Delmarva Piedmont	MD-VA		quartz	5
Maryland Great Valley	MD	Great Valley	Chert	4
Maryland Ridge and Valley	MD	Ridge and Valley; South Mountain	Chert/jasper; dacite	5
New Jersey Coastal Plain	NJ	Cumberland	Argillite; chert; hornfels; orthoquartzite	11
Ohio River Valley	OH		Flint Ridge chert	4
Pennsylvania Reading Prong	PA	Schuylkill; Vera Cruz	Dacite; jasper; mylonite quartzite	5
Ridge and Valley	MD or NC		Porphyritic rhyolite	2
Virginia Ridge and Valley	VA	Flint Run; Front Royal	Chert; jasper; metaquartzite; quartzite	8
Total				207

Identification of lithic sources for unifaces was limited (Table 13.55). Most of the lithic materials were designated similar to the Pennsauken gravels from New Jersey; lithic materials from the Delmarva Piedmont (Cecil County, Maryland and Iron Hill, Delaware) were also represented (Figure 13.77). Isolated unifaces were identified from the Pennsylvania Reading Prong area, the Maryland Ridge and Valley, and the Virginia Ridge and Valley area (Figure 13.77). The unifaces identified as similar to the Pennsauken type, a gravel formation in central New Jersey, may in fact indicate similar gravel sources closer to Hickory Bluff.

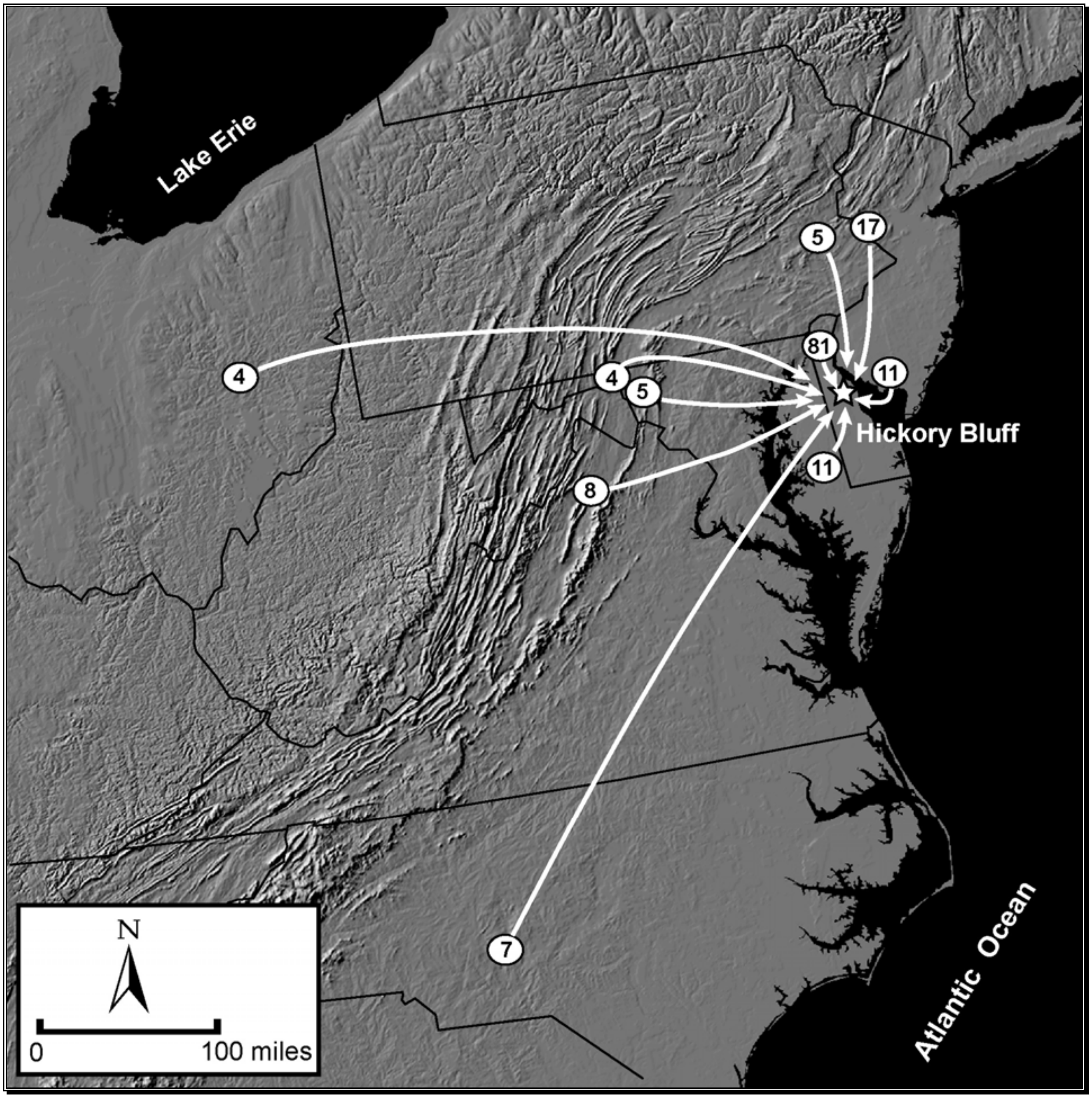

Figure 13.75 Lithic Sources Represented by the Hickory Bluff Projectile Point Assemblage

Lithic source distributions for projectile points were examined by time period (Table 13.56). The Early to Middle Archaic period was represented by only one Palmer and one LeCroy projectile point. The lithic source for the Palmer point was identified as chert from the Choptank River in the Maryland portion of the Delmarva; the LeCroy point material was designated Coastal Plain.

Source locations were identified for fifty-eight projectile points were dated to the Late Archaic period (Table 13.56). The majority of the Late Archaic projectile point materials were procured from the Delmarva Piedmont and from the Delaware River valley to the north (Figure 13.78). Additional materials were obtained from the New Jersey Coastal Plain and the Choptank

Table 13.54 Hickory Bluff Biface Lithic Sources

Location	State	Quarries (if identified)	Material Types	Frequency
Carolina Ridge and Valley	NC	Morrow Mountain	dacite	1
Coastal Plain	DE-MD		chert	2
Delaware River Valley	NJ-PA		argillite	2
Delmarva-Choptank River	MD	Choptank River	orthoquartzite	1
Delmarva Piedmont	DE	Iron Hill	chert	2
Delmarva Piedmont	MD	Cecil County; Heath Farm	chert/ jasper; dacite; felsite; quartzite	9
Hudson River Valley	NY		graywacke	1
Maryland Great Valley	MD	Great Valley	chert	2
Maryland Ridge and Valley	MD	South Mountain	metarhyolite	1
New Jersey Coastal Plain	NJ	Cumberland County	argillite	1
Pennsylvania Reading Prong	PA	Macungie	chert	10
Virginia Ridge and Valley	VA	Front Royal	chert	6
Total				38

River area on the Delmarva (Figure 13.78). Isolated projectile points were identified from sources north in the Pennsylvania Reading Prong area; to the west in the Maryland and Virginia Ridge and Valley areas; and to the south from the Carolina Ridge and Valley area, North Carolina (Figure 13.78).

The Early-Middle Woodland period was represented by 56 projectile points; over 46 percent of those were designated as from Coastal Plain sources that may be assumed to reflect local sources. The major lithic source for the Early-Middle Woodland projectile points was the Delmarva Piedmont area (Cecil County, Maryland and Iron Hill, Delaware) (Figure 13.79). Other minor lithic source areas included the Pennsylvania Reading Prong area to the north, the Choptank River area in the Delmarva, southwest of the site; and the Maryland Ridge and Valley area (Figure 13.79). The Adena projectile points in the Hickory Bluff assemblage were made of local materials rather than Flint Ridge chert from Ohio.The Middle Woodland period was represented by 11 projectile points. Lithic sources included the Delmarva Piedmont and the Choptank River area; the Delaware River valley; the Ridge and Valley area in Virginia; and the Carolina Ridge and Valley, North Carolina (Figure 13.80).

Table 13.55 Hickory Bluff Uniface Lithic Sources

Location	State	Quarries (if identified)	Material Types	Frequency
Delaware River Valley	NJ	Mercer/Middlesex Counties	chert	12
Delmarva Piedmont	DE	Iron Hill	chert/jasper	2
Delmarva Piedmont	MD	Cecil County	Chert/jasper; felsite	7
Maryland Ridge and Valley	MD		chert	1
Pennsylvania Reading Prong	PA		jasper	2
Virginia Ridge and Valley	VA	Front Royal	chert; metaquartzite	2
Total				26

Changes in lithic source utilization through time (Figures 13.78 through 13.80) suggests subtle shifts in selection and procurement. Lithic procurement in the Late Archaic period seems relatively confined to the Delmarva Peninsula for cherts, jaspers, and quartzites; argillite was obtained from farther north in the Delaware River valley. The Early-Middle Woodland lithic material sources are tightly focused in the Delmarva Piedmont area with limited materials obtained from other areas in the Mid-Atlantic area. The Middle Woodland period lithic material sources remain focused on use of the Delmarva Piedmont.

Table 13.56 Lithic Source Locations and Temporally Diagnostic Projectile Points

Location	State	Early-Middle Archaic	Late Archaic	Early-Middle Woodland	Middle Woodland
Carolina Ridge and Valley	NC		2		2
Coastal Plain	DE-MD	1	6	26	
Delaware River Valley	NJ-PA		16		1
Delmarva Choptank River	MD	1	6	1	1
Delmarva Piedmont	DE			2	
Delmarva Piedmont	DE-MD		1	1	
Delmarva Piedmont	MD		7	3	
Delmarva Piedmont	DE-MD		6	16	5
Delmarva Piedmont	MD-VA		1	3	
Maryland Ridge and Valley	MD		1	3	
New Jersey Coastal Plain	NJ		8		
Pennsylvania Reading Prong	PA		1	1	
Ridge and Valley	MD or NC		2		
Virginia Ridge and Valley	VA		1		2
Total		2	58	56	11

Procurement Strategies

The diversity and distribution of lithic material types may indicate social organization and/or mobility of prehistoric populations. Two types of lithic procurement were implemented by prehistoric groups: direct access, and trade and exchange. Direct procurement involved the groups traveling to the source location to obtain the needed lithic materials. Direct procurement may have been undertaken by special task groups whose sole purpose was to obtain lithic material, or, more likely, procurement occurred as an embedded strategy during the seasonal round of the group (Custer 1994). Trade and exchange systems may reflect broad-based networks or focused networks (Stewart 1989). Broad-based networks represent widespread "down-the-line" trading and are evidenced by decreases in artifact frequency as distance increases from the source location (Stewart 1989). Hoarding of materials obtained through a broad-based trade system occurred and indicated social or political territories exercising control over material goods (Stewart 1989:54). Hoarding or caching behavior may also be viewed as insurance against a decrease in argillite availability (Custer 1994). Hoarding behavior can be defined by higher frequencies of selected materials located at a distance from the source locations, with lower frequencies between the two areas (Stewart 1989). Focused exchange is defined as sporadic trade conducted by individuals or small groups and is characterized by isolated pockets of exchange goods in geographically distinct areas (Stewart 1989).

An existing Late Archaic lithic use and procurement model was based on the Barker's Landing assemblage (also from the St. Jones River) and on statewide lithic distributions (Custer 1989, 1994). A predominant use of argillite and rhyolite for projectile point manufacture was recorded at the Barker's Landing site with few projectile points made from other materials (Custer 1989:225). Statewide distributions of argillite demonstrated a discrete distribution in central Delaware (Custer 1989: 193) with lower frequencies in the northern Delmarva Piedmont, closer to the New Jersey source location. Based on this information, a procurement model was proposed consisting of argillite procurement and tool reduction in New Jersey, transport to the Delmarva, and caching behavior in central Delaware sites (Custer 1994: 140) (Figure 13.81). Hypothetical band territories were also defined based on the lack of argillite in the Delmarva Piedmont and the lack of non-argillite artifacts at selected sites in central Delaware (Figure 13.82).

Lithic materials and source locations were identified for the Hickory Bluff projectile point assemblage. Lithic procurement associated with the Late Archaic projectile point assemblage indicates direct procurement and possible embedded strategies for lithic sources in the Delmarva Piedmont, the Choptank River, and New Jersey Coastal Plain. Argillite from central New Jersey was also obtained either directly or through broad-based exchange. Lithic materials from distant sources, such as western Maryland, western Virginia and North Carolina, most likely suggest broad-based trade and exchange, based on the distance from the Hickory Bluff site and the relatively low frequency of projectile points made from those materials. The use of lithic materials for Late Archaic projectile points at the Hickory Bluff site demonstrates access to a variety of local sources in the Delmarva Peninsula including the Piedmont area as well as to argillite sources. The Hickory Bluff data suggest differential access to lithic material sources than exhibited at the Barker's Landing site and provides a slightly different view of group boundaries and possible territories.

Lithic materials associated with Early Woodland projectile points at the Hickory Bluff site indicates predominant use of the Delmarva Piedmont lithic sources. Broad-based exchange may be suggested for sources in surrounding Mid-Atlantic States.

SUMMARY

Lithic studies for Hickory Bluff included a variety of research issues aimed at examining cultural behavior as well as evaluating archaeological methods. These studies encompassed both local and regional raw material procurement and usage, possible mobility and/or trade behavior, projectile point typology as manifestations of manufacturing and maintenance constraints, and tool use wear as indicators of function.

A study of local Columbia Fm. gravels from the St. Jones River and comparison with selected artifacts from the Hickory Bluff lithic assemblage indicated that local procurement of

cobbles occurred. The majority of the projectile point measurements were within a size range consistent with local gravel source usage (mean dimensional measurements were smaller). However, biface measurements were typically larger than the local gravels suggesting either a variation in the cobble sample in the past (larger clasts present) or that bifaces may represent curated items procured and manufactured elsewhere. The presence of both bipolar and multidirectional cobble cores also indicated local gravel procurement.

Lithic mineralogy was also conducted to identify regional sources of lithic raw materials. Cobble sources along the St. Jones River are similar to cobble sources in other parts of the Mid-Atlantic (i.e., cherts from the Coastal Plain or the Delaware River valley) as well as to original geological formations upstream; exact source locations for these materials were difficult to differentiate. The primary source of raw materials for Hickory Bluff was the Delmarva Piedmont (Cecil County, Maryland and Iron Hill, Delaware). The predominance of locally obtained raw materials from the Delmarva suggests that for the most part the Hickory Bluff populations maintained a relatively discrete geographical area. The lack of debitage associated with artifacts of raw materials with sources located at a distance (i.e., Flint Ridge, Ohio and the Reading Prong area, Pennsylvania) suggests curated artifacts transported to the site. Procurement strategies at Hickory Bluff represent primarily direct procurement of Delmarva materials with broad-based trade and exchange for lithic materials from distant sources.

Projectile point typology was examined in terms of manufacturing constraints and the analyses demonstrated that the type and size of raw material clasts, and artifact use and curation combined to create the complexities of projectile point form. Aspects of projectile point maintenance (i.e., resharpening evidenced by tip angle, blade edge shape, blade length/haft length, blade symmetry and blade:haft ratios, and blade edge shape and blade:haft ratios) were examined to determine how resharpening episodes contributed to different projectile point forms. Different functional and rejuvenation scenarios were identified for large and small projectile points. Large projectile points may have served frequently as cutting tools exhibiting different resharpening parameters; small points may have been easily replaceable with access to local gravel sources and were not re-used or resharpened as often.

Examination of tool edge angle and use wear for the Hickory Bluff assemblage provided information on a wide range of possible tool functions. Basic functional tasks for chipped stone tools included general scraping and cutting, cutting of vegetal materials, cutting of soft materials, scraping of wood, grasses or hides, and scraping of soft hide. Specialized tool edges exhibited use wear consistent with piercing or boring on soft materials (awls), chopping or processing bone marrow (choppers), scraping or planing wood or soft materials (concave scrapers and gravers), and drilling hard materials (drills). Consistent use wear on hammerstones provided evidence of extensive use as flintknapping tools or pounding implements for opening nuts, bone or other materials. Activities associated with polishing or resharpening groundstone tools, preparing striking platforms during flintknapping, and smoothing wooden implements were evidenced through use wear observed on abrading tools. Most pitted stones exhibited evidence for high impact activities such as use as hammerstones or anvils to open nuts or to create and reduce bipolar cores. Ritual activity was suggested by the heavily ground recesses on two double pitted stones and the presence of small pestles. These tools were most likely associated with grinding small amounts of materials such as plants or herbs for medicinal use or pigments for ritual use.