SECTION 13.0 STONE PROCUREMENT AND TOOL MANUFACTURE AND USE

Lithic artifacts are the most durable and commonly found artifact class on archaeological sites, therefore, providing a large data set with which to interpret cultural behavior. Lithic analyses may provide information on a variety of behavioral levels including procurement of lithic materials and raw material selection, tool making technology (both initial manufacture and subsequent maintenance), hafting technologies and resharpening episodes for weapons, general tool use and function, mobility of groups, and trade or exchange practices. Lithic assemblages often represent both intentional discard as well as lost items and lithic patterning may contribute information to understanding activity areas, discard behavior and site formation processes.

The Hickory Bluff stone tool assemblage provided diverse information with which to examine lithic procurement strategies, and stone tool manufacture and use. As a result of the observation of numerous pebble and cobble tools recovered during excavation, a local gravel study was conducted to identify the range of types and sizes of river pebble and cobble clasts available along the St. Jones River. This study sought to define the parameters of this type of local procurement and its effect on tool manufacture at Hickory Bluff. A series of analyses were conducted that consciously ignored temporal periods, seeking patterns that might have been dictated by material types regardless of chronology. Lithic reduction sequences were examined for each material type to define differences or similarities in strategies. Projectile point attribute analysis was conducted to examine the variability in form using both qualitative and quantitative variables and to identify an approach for establishing consistent type traits. Tool function was based on macroscopic use wear analysis with an emphasis on edge modification (micro use wear patterns) and edge angle. Multiple tool edges on a single artifact were identified suggesting extensive reuse (i.e., curation) or perhaps, closely related tasks with multiple tool edges on a single artifact. In addition to macroscopic analysis, microscopic use wear and residue analysis was conducted for 50 unifacially retouched artifacts. A comparison of the two methodologies and results demonstrated contrasting data sets. Trade and mobility issues were addressed through a lithic mineralogy study, conducted for projectile points, bifaces and unifaces. Regional sources were suggested for the raw materials and served to define the range of interaction of the Hickory Bluff occupants.

LOCAL GRAVEL STUDY

The large number of tested pebbles and cobbles recovered from Hickory Bluff, along with the presence of cortical material found on lithic artifacts suggested that the site inhabitants of Hickory Bluff utilized locally available gravel.

Geological and geomorphological studies of Hickory Bluff and the surrounding area (Section 4.0) reveal that the parent material, or substrate, that underlies Hickory Bluff is composed of unconsolidated Pleistocene sands and gravels known as the Columbia Formation (Fm.) (Jordan 1962, 1964; McGee 1886, 1887, 1888; Shattuck 1901, 1906). The Columbia Fm. forms a nearly continuous mantle located unconformably over the older Miocene rocks of the coastal plain (Jordan 1964). The contemporary landscape, stratigraphy and archaeological assemblage observed at Hickory Bluff are the products of a number of factors including soil formation and fluvial, eolian and cultural processes that have modified Columbia Fm. deposits through time. In essence, it is from Columbia Fm. deposits that raw materials for the production of stone tools were drawn. Thus it follows that examination of the size, weight, and lithologic characteristics of Columbia Fm. deposits at Hickory Bluff is important in understanding the Native American lithic selection and procurement process.

The Hickory Bluff gravel study was initiated to systematically analyze the lithologic and size characteristics of locally available raw materials. The descriptive information provided the context to compare artifacts recovered from Hickory Bluff.

Sample Attributes

To ensure a representative sample of available gravel, samples were taken from different settings. A series of backhoe trenches were excavated from west to east across the site to locate buried deposits and gravels which were not exploited or selected from by Native inhabitants. A total of eight standardized (5-gallon) samples were collected from gravel bearing strata identified within each trench. Previously excavated test units were also utilized as sample locations. Samples were collected in columnar sections from trenches or units with grid coordinates N405.7 E586, N394 E655, N337 E690, and N309 E658.

In addition to samples obtained from the backhoe trenches, two 5-gallon samples were collected from an exposed gravel bar along Puncheon Run (Dover Quadrangle, UTM Zone 17 Coordinates N4332359: E455400), which enters the St. Jones River opposite Hickory Bluff. The spatial distribution of sample locations is shown in Figure 13.1.

Samples 1, 2, 3, 4 and 9 were all taken from a backhoe trench with coordinates N405.7 E586. This trench was oriented west to east, perpendicular to the St. Jones River. The trench was positioned with its western end nearest the St. Jones River and sloped upwards and to the east. The eastern end of the trench terminated on the flat, elevated surface of the bluff (Figure 13.1), exposing a cross section of the landform in profile.

Samples 3 and 4 were taken from a graded (fining upward) bed of gravel that occurred across the entire length of the trench and had a maximum thickness of approximately 60 centimeters (cm). The bed tapered to the east. This same bed was exposed in test units south of the trench at roughly the same elevation along the arcuate lower surface of the bluff. The gravel deposit was interpreted as a buried point bar because of its tendency to taper to the east and its presence along the arcuate lower surface of the bluff.

Samples 1 and 2 were taken from a deposit immediately overlaying the bed from which Samples 3 and 4 were extracted. This deposit was composed of unsorted silts, sands and small pebbles. This deposit also tapered to the east up the slope of the bluff, but terminated as the slope became gentle. At this point, the deposit graded laterally into B horizon soils that had developed on the upper surface of the bluff. The lateral grading into the B horizon as the slope of the landform suggested that this was a colluvial deposit derived from material eroding off the upper surface of the bluff. The steeper portion of the slope was not stable enough for a B horizon to develop.

Sample 9 was taken from a concave lens that cut the point bar deposit at a right angle, indicating a stream had incised this deposit and the resulting channel eventually infilled. Sample 10 was taken from a similar geologic feature to the south (N309 E658). Pertinent sample information is summarized in Table 13.1.

Table 13.1 Gravel Sample Summary

Sample #	Provenience	Depth Above Mean Sea Level (amsl) and Centimeters Below Surface (cmbs)	Geologic Setting
1	N405.7 E587	3.85-3.48 amsl / 28-60 cmbs	colluvial deposit
2	N405.7 E588	4.15-3.70 amsl / 25-70 cmbs	colluvial deposit
3	N405.7 E586	3.55-3.10 amsl / 45-90 cmbs	buried point bar
4	N405.7 E587	3.6-3.05 amsl / 65-120 cmbs	buried point bar
5	Dover Quadrangle UTM N4332359 E455400	.50- 0.0 amsl / 0 –50 cmbs	exposed point bar
6	Dover Quadrangle UTM N4332359 E455400	50- 0.0 amsl 0 –50 cmbs	exposed point bar
7	N337 E690	3.5-2.64 amsl 290 – 384 cmbs	D horizon unweathered Columbia Fm.
8	N394 E655	3.71-3.05 amsl 295-360 cmbs	D horizon unweathered Columbia Fm.
9	N405.7 E593	4.04-3.39 amsl / 115-180 cmbs	buried fluvial cut and fill feature
10	N309 E658	4.98-4.64 amsl 116-150 cmbs	buried fluvial cut and fill feature

Percent by Weight

The percent by weight composition of each particle size within the sample was calculated based on the Wentworth scale. The Wentworth particle size scale classifies rock fragments based on the diameter of their longest axis. A rock fragment with a diameter between 1/16 and 2 millimeters (mm) is classified as a sand, between 2 and 4 mm a granule, between 4 and 64 mm a pebble, between 64 and 256 mm a cobble and greater than 256 mm a boulder. Since this study is concerned with raw materials large enough for the production of stone tools, rock fragments with a diameter of <6 mm are treated as one category. Included in the <6 mm category are granules, small pebbles, silts and clays.

Each sample was weighed to determine its total weight. The sample was then screened through 6 mm (¼ inch) steel mesh to separate the smaller clasts from the remaining sample. This fraction of the sample was then weighed and divided by the total weight, giving the percent by weight of that size category. This procedure was repeated for each size category. The percent by weight composition of each particle size for individual samples is summarized in Table 13.2.

Table 13.2 shows that overall size categories in the samples are skewed toward the smaller size categories. Table 13.2 indicates that the faction <6 mm is the dominant size category in Samples 1, 2, 6, 8, 9, and 10. In Samples 3, 4, 5, and 7 the percent by weight of pebbles (6-64 mm) is slightly greater than the < 6mm category.

There were no boulder sized clasts (>256 mm) in any of the samples (although very rare examples were present in one deep backhoe trench). Cobbles, or clasts, with a diameter between 64 and 256, were also relatively scarce with the highest percentage by weight (16.757 percent) occurring in Sample 7. Since clasts <6 mm in diameter are unsuitable for the production of stone tools based on their size, pebbles (6-64 mm) became the dominant size category. Even with the <6 mm fraction of the sample eliminated, several of the samples still contained a large number of clasts that were unsuitable as raw material for the production of stone tools based on their size (Figure 13.2).

Table 13.2 Percent by Weight According to Wentworth Scale

Sample No.	Total Weight (kg)	%weight < 6mm Silts, Sands and Clays	% weight 6-64mm Pebbles	% weight 64-256mm Cobbles	% weight > 256mm Boulders
1	30.390	80.948	16.782	1.502	0.00
2	29.140	87.577	11.187	0.000	0.000
3	33.680	44.448	45.101	10.451	0.000
4	36.170	40.752	46.696	12.541	0.000
5	40.940	38.227	49.023	12.750	0.000
6	39.000	54.949	34.000	11.05	0.00
7	35.150	39.687	43.556	16.757	0.000
8	27.220	68.736	19.177	12.087	0.000
9	29.940	78.791	21.209	0.000	0.000
10	32.540	63.706	33.805	2.484	0.000

Figure 13.2 Sorted Gravel Sample

A lower limit of 30 mm was set as the cutoff point for usable clasts. Clasts smaller than this were included in the percent by weight according to particle size calculations, but were discarded as candidates for lithic reduction. It should be noted that the 30 mm limit is arbitrary, and that clasts below this size may still have been utilized in crushed form as pottery temper.

In order to facilitate comparisons with the archaeological assemblage, data for each clast were compiled in a database. Each clast was visually classified according to mineralogy, weighed on a triple beam balance, and measured on three mutually perpendicular axes to determine length, width, and thickness. The database fields contained identification number, provenience, depth (amsl), depth (cmbs), weight (g), length (mm), width (mm), thickness (mm), and lithologic type.

Size Breakdown

The database was queried to display the number of clasts in successive 5 mm intervals. Figure 13.3 shows that the most commonly occurring clasts are those between 35 and 40 mm. The curve in Figure 13.3 is severely skewed to the left, supporting the percent by weight calculation by showing that pebbles are indeed the most commonly occurring size category and within the pebble range, the 35-40 mm interval is dominant. A total of 91.38 percent of the usable sample (that part of the sample composed of clasts greater than or equal to 30 mm in diameter*)* is composed of clasts between 30 and 64 mm in diameter.

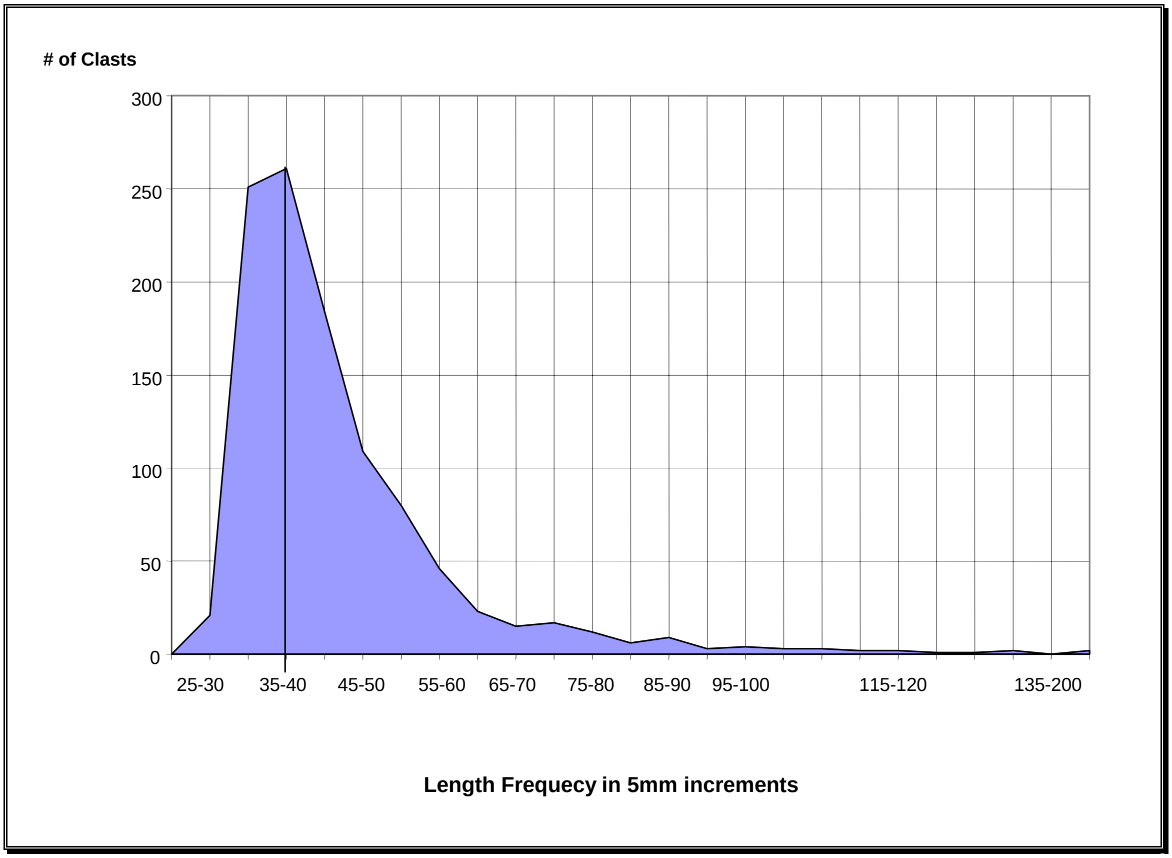


Figure 13.3 Number of Clasts in Successive 5-mm Intervals

Lithologic Composition

The frequency of lithologic type within the entire sample is determined by dividing the number of clasts of a particular lithology by the total number of clasts. The same formula was employed to determine the lithologic composition within individual samples allowing variations within the whole to be isolated. The lithologic frequency of the entire sample is illustrated in Figure 13.4.

Figure 13.4 reveals 12 separate lithologic types present in the global sample. The majority of the sample (96.4 percent) is composed of four lithologic types, quartz (45.74 percent), quartzite (18.56 percent), sandstone (18.37 percent) and jasper (13.73 percent), with other types occurring in small amounts. The high percentage of quartz and quartz derivative clasts is not surprising as quartz is the second most commonly occurring mineral in the earth's crust and, due to its internal arrangement of silicon and oxygen atoms, is very resistant to both chemical and physical weathering processes. Thus by the time sediments from the interior of a continent reach a coastal environment it is common for them to contain a high percentage of quartz relative to other mineralogical types. The sandstone encountered in the sample is composed mainly of quartz grains held together with a ferruginous cement, and the quartzite is simply a metamorphosed quartz sandstone. Jasper, formed by the deposition of silica by precipitation from water (in this case iron rich) is probably the most significant component of the sample. The compact microfibrous texture of jasper causes a splintery conchoidal fracture, which lends itself nicely to the production of stone tools. Quartz and some varieties of quartzite also exhibit conchoidal fracture and are utilized in the production of stone tools, but the fine grained compact texture of jasper makes it a preferred candidate for lithic reduction. Chert, which is another cryptocrystalline mineral similar to jasper commonly used for the production of stone tools, is only present in very small amounts. Only eight chert pebbles were found in the entire sample. Also, rhyolite or argillite pebbles were absent from the sample. The scarcity of these materials in the sample suggests that chert, rhyolite, and argillite tools recovered from Hickory Bluff were manufactured from imported raw material.

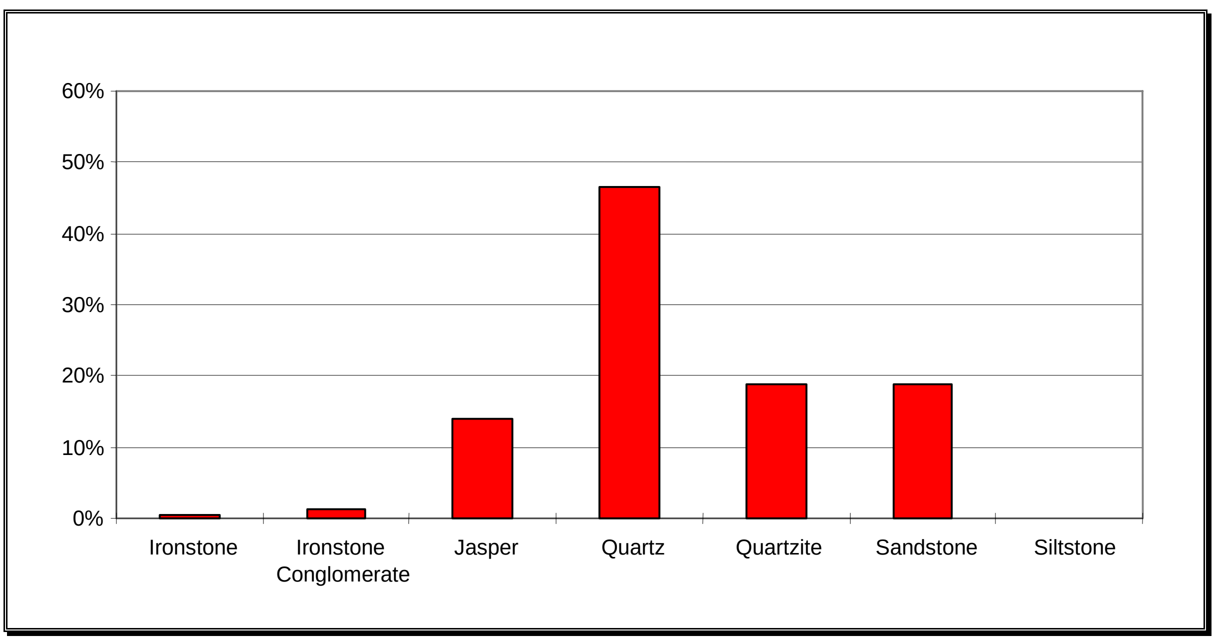


Figure 13.4 Global Frequency of Lithological Type

Table 13.3 shows variations in the major lithologic components within individual samples compared to the entire sample.

Table 13.3 Lithologic Frequency by Sample

	Total Sample %	1	2	3	4	5	6	7	8	9	10
Jasper	13.73	18.52	13.16	11.18	12.77	13.1	15.38	10.96	3.17	18.29	24.39
Quartz	45.74	35.19	65.79	51.76	37.23	46.43	47.69	47.95	46.03	43.9	46.34
Quartzite	18.56	27.78	10.53	15.88	27.66	9.52	17.69	16.44	33.3	24.39	4.88
Sandstone	18.37	12.96	0	12.94	20.21	27.38	17.69	23.29	17.46	13.41	18.29
other	0.60	5.55	10.52	8.32	2.13	3.57	1.55	1.36	0.04	0	6.1

It should be noted that while some variations in frequency probably reflect different depositional environments, misidentification of clasts also must be factored in. Nearly all the clasts have significant iron rich weathering rinds, which makes identification by visual inspection difficult. While jasper is relatively easy to identify, distinguishing between quartz, quartzite, and sandstone is more difficult. There seems to be a progression with crystal quartz as one end member and fine grained quartz sandstone as the other, the intermediate members being sugary textured quartz and quartzite clasts that have undergone varying degrees of metamorphism. To accurately identify a clast it is necessary to remove some cortical material so that the unweathered interior of the clast can be examined. In point of fact this could be the reason for the large number of tested pebbles recovered from Hickory Bluff. The removal of cortical material was kept to a minimum in this study so that the accuracy of visual identification could be checked in subsequent lithic reduction experiments. Figure 13.5 shows a graphical representation of the data contained in Table 13.3.

In a comprehensive study of Columbia Fm. sediments, 100 pebbles from six different sample locations were examined in order to determine the gross lithology of the gravels (Jordan 1964). All pebbles examined were between 1-2 inches in diameter along their intermediate axes. Jordan (1964) found that his average sample composition consisted of 46 percent vein quartz, 36 percent sandstone, 14 percent chert, 2 percent crystalline rock, and 2 percent shale. This compares nicely with the data compiled for the current study (Table 13.3). It is unclear if Jordan made an attempt to distinguish between jasper and chert or simply lumped all micro-crystalline forms of quartz into the chert category. If the latter is assumed, the correlation matches even more closely.

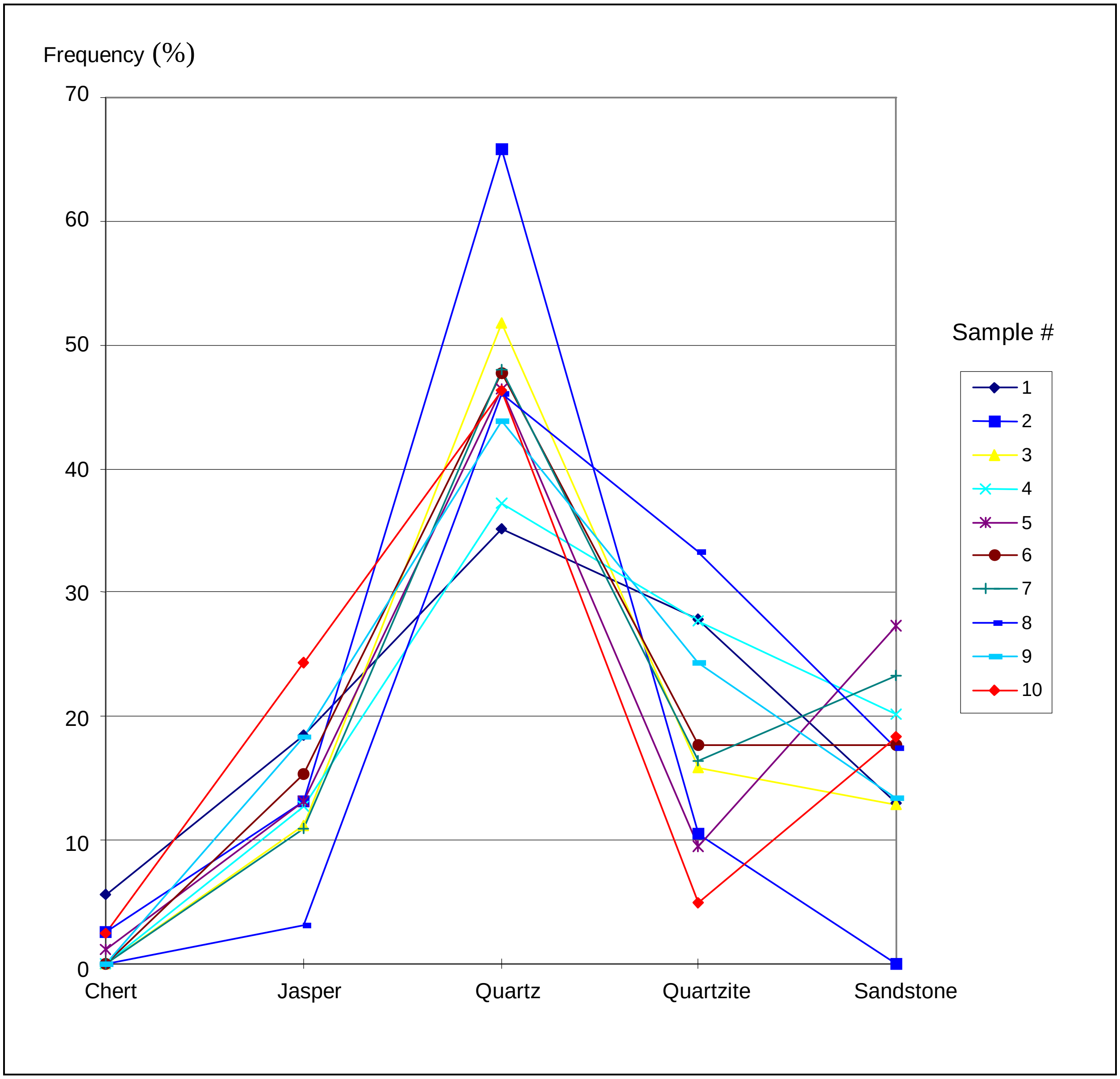


Figure 13.5 Frequency of Lithologic Type by Sample

Lithology Versus Size

The previous database queries, which broke down the sample into 5-mm intervals, can be expanded to determine what the most frequently occurring lithologic type is within each size category. Table 13.4 summarizes the results of these queries. Quartz, quartzite and sandstone occur most frequently in the 35-40 mm interval, while jasper occurs most frequently in the 30-35 mm range. This result is predictable from Figure 13.3, which showed 30-35 and 35-40 mm to be the most frequently occurring size intervals.

Table 13.4 Lithologic Distribution by Size Interval

Interval in mm	# of clasts global	Chert	Jasper	Quartz	Quartzite	Sandstone	Other
25-30	21	0	4	11	4	2	0
30-35	251	2	48	130	47	23	1
35-40	260	3	34	121	59	40	2
40-45	184	2	28	81	32	35	5
45-50	109	0	14	49	15	28	3
50-55	80	0	8	40	15	15	2
55-60	46	0	3	18	6	12	7
60-65	23	1	2	10	3	6	1
65-70	15	0	0	4	2	7	2
70-75	17	0	1	5	6	3	2
75-80	12	0	2	2	2	5	1
80-85	6	0	1	3	0	2	0
85-90	9	0	0	2	2	4	1
90-95	3	0	0	0	1	2	0
95-100	4	0	0	3	0	1	0
100-105	3	0	0	2	0	1	0
105-110	3	0	0	0	0	3	0
110-115	2	0	0	1	0	1	0
115-120	2	0	0	0	0	1	1
120-125	1	0	0	1	0	0	0
125-130	1	0	0	0	1	0	0
130-135	2	0	0	0	0	2	0
135-200	0	0	0	0	0	0	0
200-205	2	0	0	0	1	0	0

Variations in the lithological composition by size interval within each individual sample are depicted graphically in Figure 13.6.

Summary of Findings

Gravel clasts from different geologic settings and proveniences were sampled from Hickory Bluff. These clasts were analyzed according to lithologic type and size. Twelve different lithologic types were classified. Listed alphabetically, these include basalt, carbonate (limestone), chert, claystone, conglomerate, ironstone, ironstone conglomerate, jasper, quartz, quartzite, sandstone and siltstone. Only four of these types were present in all samples: jasper, quartz, quartzite and sandstone. These four lithologic types comprised 96.4 percent of the entire sample and were present in the following proportions: jasper (13.73 percent), quartz (45.74 percent), quartzite (18.57 percent) and sandstone (18.37 percent).

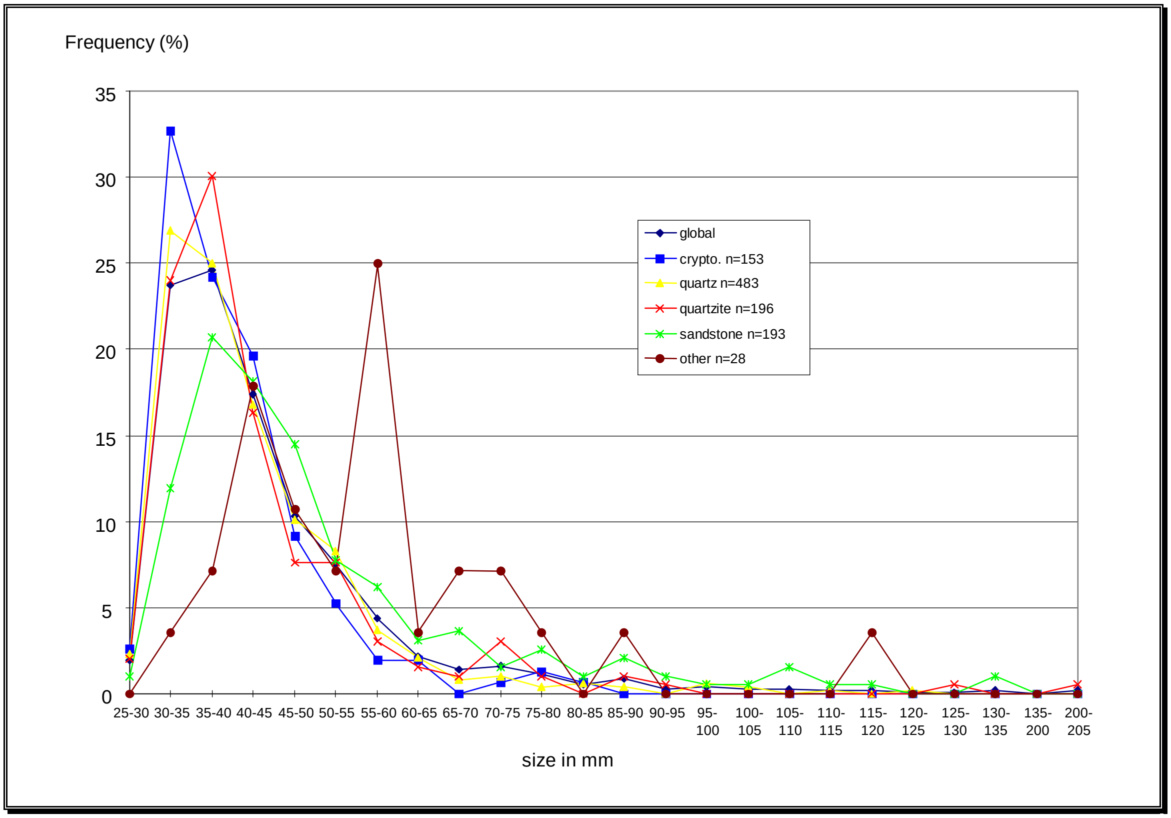


Figure 13.6 Lithological Composition by Size Interval

Percent by weight by particle size calculations indicate that the sample as a whole is composed largely of silts, sands and clays, with pebbles occurring slightly less frequently. Cobble sized clasts were rare, with the largest clasts in this size range (64-256 mm) occurring in deep test locations (Samples 7 and 8). No clasts in the boulder size range were recovered.

Size analysis supported the percent by weight by particle size calculations. Within the usable sample (that part of the sample composed of clasts greater than or equal to 30 mm in diameter) the 35-40 mm range was dominant with the 30-35 mm range occurred only slightly less frequently. In fact, 91.38 percent of the usable sample is composed of clasts between 30 and 64 mm in diameter.

Combining size and lithologic analyses showed that quartz, quartzite, and sandstone occur most frequently in the 35-40 mm range while jasper occurs most frequently in the 30-35 mm range. The global frequency distribution by size interval curve is mimicked by the individual lithologic frequency by size interval curves except in the “other” category. Since the lithologic category “other” accounts for only 0.60 percent of the total sample, small fluctuations in the curve are amplified.

No direct relationship is evident between geologic setting (Table 13.1) and the lithologic composition of samples (Table 13.3). Comparing the percent by weight by particle size (Table 13.2) with the geologic setting (Table 13.1) it can be observed that samples taken from point bars are composed of higher percentages of pebbles than sands and silts. This holds true for all point bar samples except Sample 6, which is composed of a slightly higher percentage of silts and sands than pebbles. Finally, it should be noted that while the lithologic and size characteristics referred to in this study are representative of Columbia Fm. deposits at or in the immediate vicinity of Hickory Bluff they can not be said to be characteristic of all Columbia Fm. deposits.

REDUCTION SEQUENCES

Lithic tool manufacture is a reductive process, involving the removal of material until a desired or appropriate form is reached. For analytical purposes, lithic reduction is often viewed as a staged process. Two types of reduction processes may occur: lithic reduction of cores to produce bifacial tools or to produce usable flakes or flake edges for tools. Reduction strategies may vary based on the type of raw material and the type of end product anticipated. The recovery of a variety of raw materials provided information for an examination of differences in reduction technologies. Among raw materials used for stone tools, materials included quartz, quartzite, chert, jasper, ironstone, rhyolite, argillite, sandstone, and siltstone. Raw material variation among tool types and debitage was analyzed for an understanding of differences in reduction strategies and material selection based on material type.

Reduction strategies were examined through three artifact categories: bifaces (n=150), cores (n=488) and debitage (n=32,243). Early and late stage bifaces were defined by overall appearance, the degree of shaping, thickness, and sinuosity of edge profiles. Variations in raw material selection and stage of biface reduction were analyzed using the width: thickness ratio. Core reduction strategies (i.e., multidirectional and bipolar reduction techniques) were examined by material type and size grade. Debitage was examined using a flake aggregate analysis. Frequency of lithic raw material usage was examined to define differential selection for and reduction strategies based on material traits and availability.

Flake aggregate analysis or mass analysis considers group characteristics of an archaeological assemblage; in this case, size distribution of flake debris as measured on an interval scale. Mass analysis involves quantifying several intuitive concepts associated with lithic reduction. The primary notion is that because lithic tool manufacture is a reductive process, both the tool and the debitage produced become smaller as the process continues. In short, debitage from later reduction stages should be smaller than that resulting from earlier stages, reflecting the diminishing size of the tool. Several simple count and weight measurements were thus taken for each graded sample, and relative counts within and between size grades were determined. Weight variation within a size grade becomes a measure of artifact shape (i.e., heavier flakes of the same size grade will tend to be thicker). The data may then be used in differentiating between types of load application such as the amount of force applied, its location relative to the edge of the tool, and the angle of attack. By implication, the manufacturing technique may be inferred; thin, marginal flakes imply biface thinning, while relatively thick, nonmarginal flakes imply core reduction. In addition to flake size, there should be an observable progression during the reduction sequence in the removal of cortex, with later reduction stages producing on average less cortical material. Thus, the frequency of cortex is recorded within each size grade.

Biface Reduction

Width to thickness ratios, often recorded as a direct indication of reduction stage, were recorded for 66 early stage bifaces and 84 late stage bifaces (Figure 13.7). For the early stage bifaces, the range of width:thickness was 1.1-4.3 with a mean of 2.14; for late stage bifaces, the range was 0.72-5.5 with a mean of 2.50. The lack of distinctiveness in the biface types from Hickory Bluff may indicate a problem with the paradigm (i.e., relative thickness may not be as closely related to reduction stage as assumed), or it may relate to raw material characteristics.

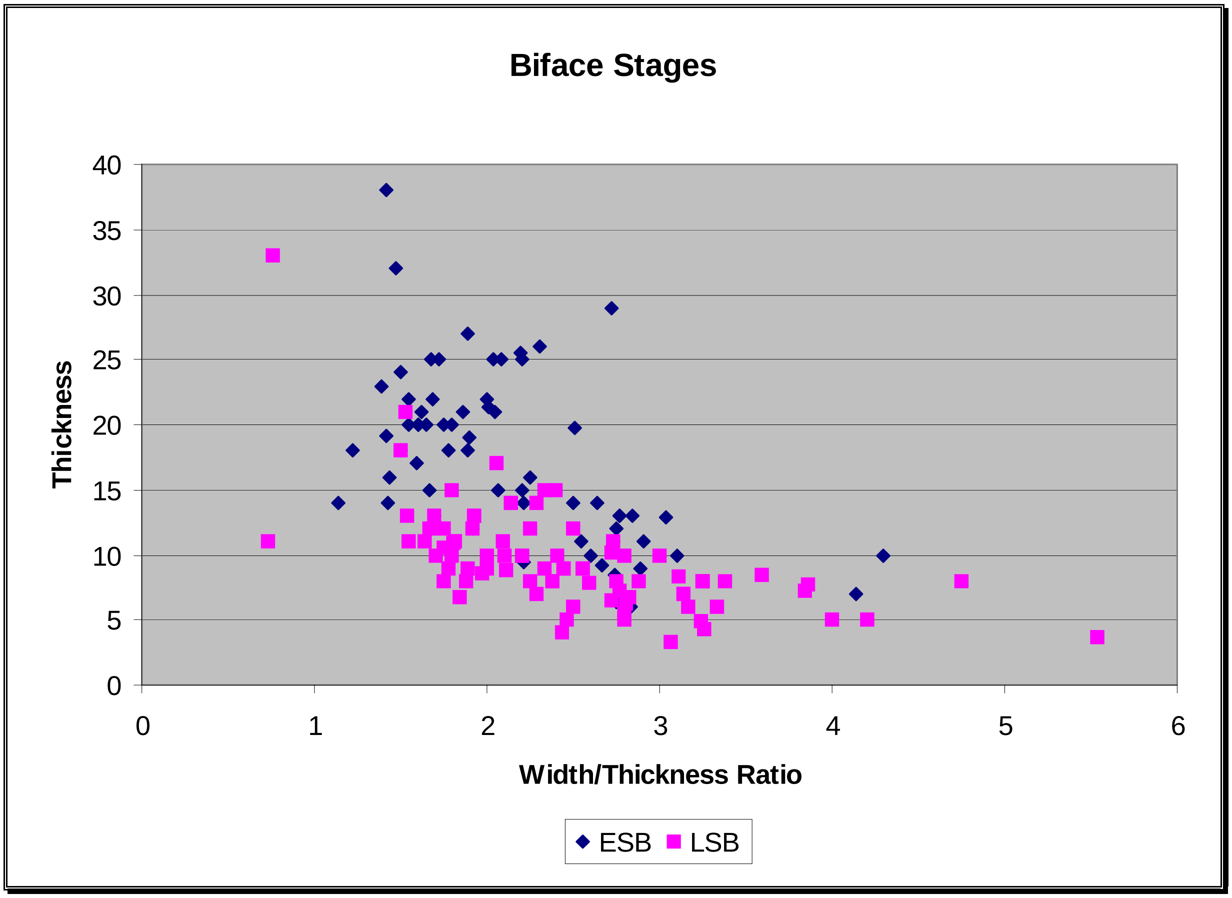


Figure 13.7 Width/Thickness Ratios for Bifaces

Width:thickness ratios were examined for chert, jasper, and quartz early and late stage bifaces to evaluate variability in raw material. Chert bifaces demonstrate a similar range of width:thickness ratios between early and late stages; however, the late stage chert bifaces are thinner overall (5-15 mm). Early and late stage jasper bifaces displayed similar ratios and thicknesses with no distinct separation (Figure 13.8). Width:thickness ratios for quartz bifaces were similar; however, early stage bifaces were generally thicker (> 15 mm).

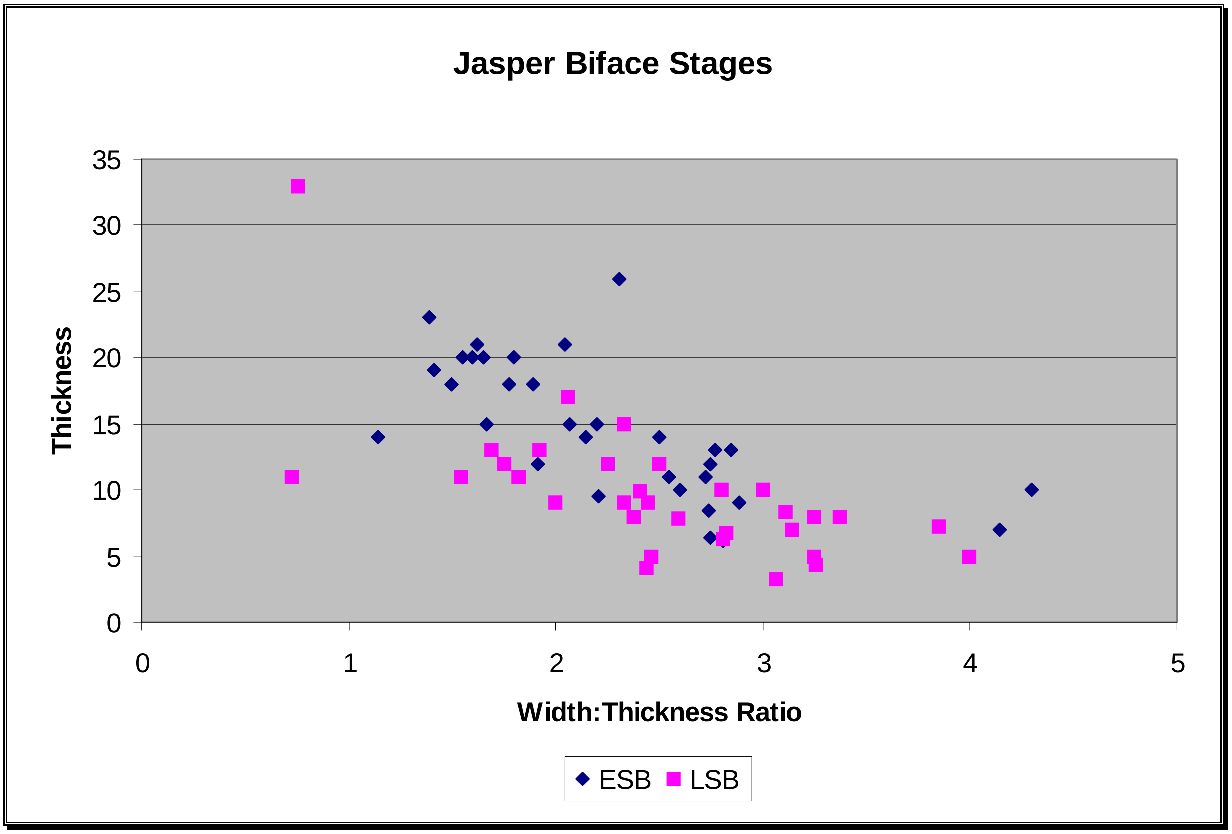


Figure 13.8 Width/Thickness Ratios for Jasper Bifaces

Analysis of raw material distribution among bifaces indicated that early stage bifaces were primarily of jasper, quartz, and quartzite (Figure 13.9), while the majority of late stage bifaces were of jasper, chert, and quartz. The late stage biface distribution was almost identical to the projectile point distribution. The presence of more argillite, rhyolite, and chert projectile points and late stage bifaces than early stage bifaces suggested that these materials were introduced at Hickory Bluff in a relatively late stage or completed stage of manufacture and that little early stage knapping of these materials was conducted at the site. Quartz and quartzite early stage bifaces represent the higher percentage of these materials and may have been reduced for flake tools, implying that the early stage bifaces were actually flake cores. Jasper accounted for the highest percentage of early and late stage bifaces and projectile points.

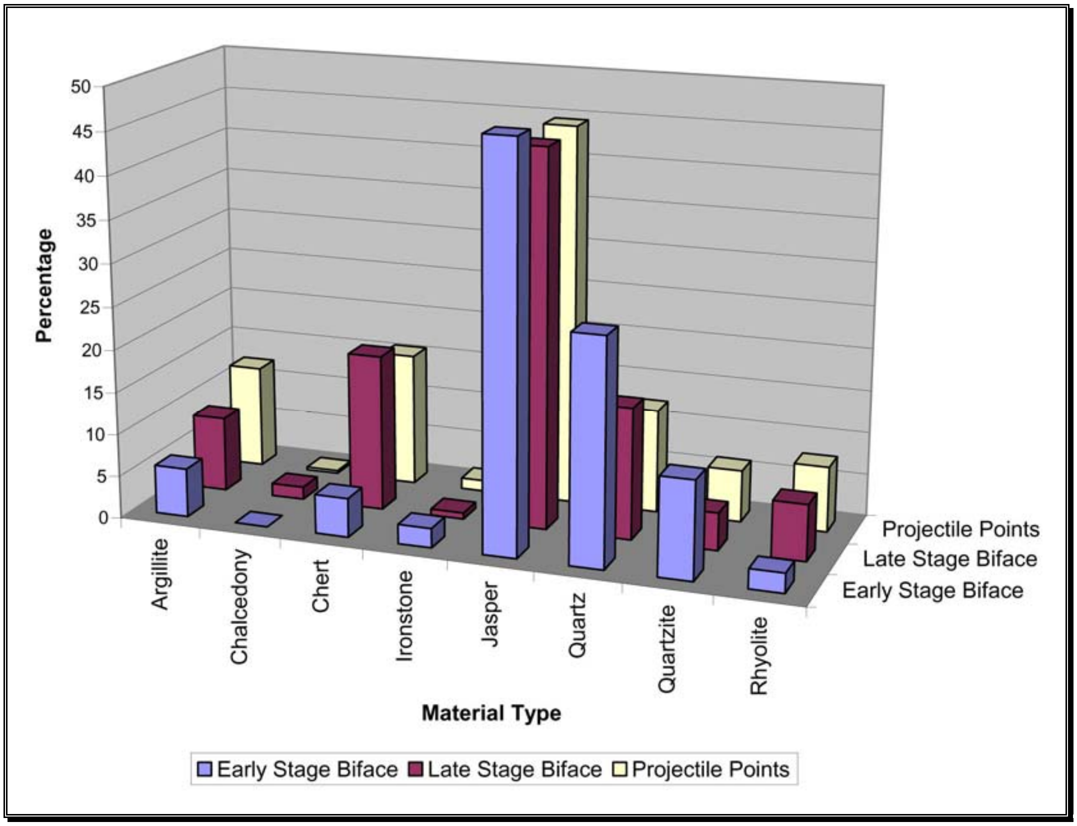


Figure 13.9 Biface and Projectile Point Raw Materials Percentages

A comparison of the availability and types of local lithic materials in the Columbia Fm. gravels, and the percentages of bifaces made of similar materials suggests cultural selection. Cherts and jaspers represent about 14.0 percent of the local gravels whereas 58.3 percent of the bifaces are cherts and jaspers (Table 13.5). Over 64 percent of the local gravels are quartz and quartzite; however, only 26.9 percent of the bifaces are made from these materials (Figure 13.10).

Table 13.5 Percentages of Lithic Material Types for Local Gravels, Bifaces and Cores

Type	Chert	Jasper	Quartz	Quartzite	Sandstone	Other
Gravels	0.00	13.73	45.74	18.56	18.37	0.60
Bifaces	13.00	45.29	19.73	7.17	0	14.79
Cores	16.49	50.00	25.85	6.97	0	0.68

Core Reduction

Both multidirectional and bipolar techniques were used for core reduction at Hickory Bluff. Multidirectional techniques were employed for all material types (Figure 13.11); bipolar reduction was evident for chert, jasper, quartz, and quartzite. Similar percentages of chert and jasper cores were reduced using both multidirectional and bipolar techniques. Quartz and quartzite cores were reduced mainly with a multidirectional approach; however, some bipolar reduction was employed.

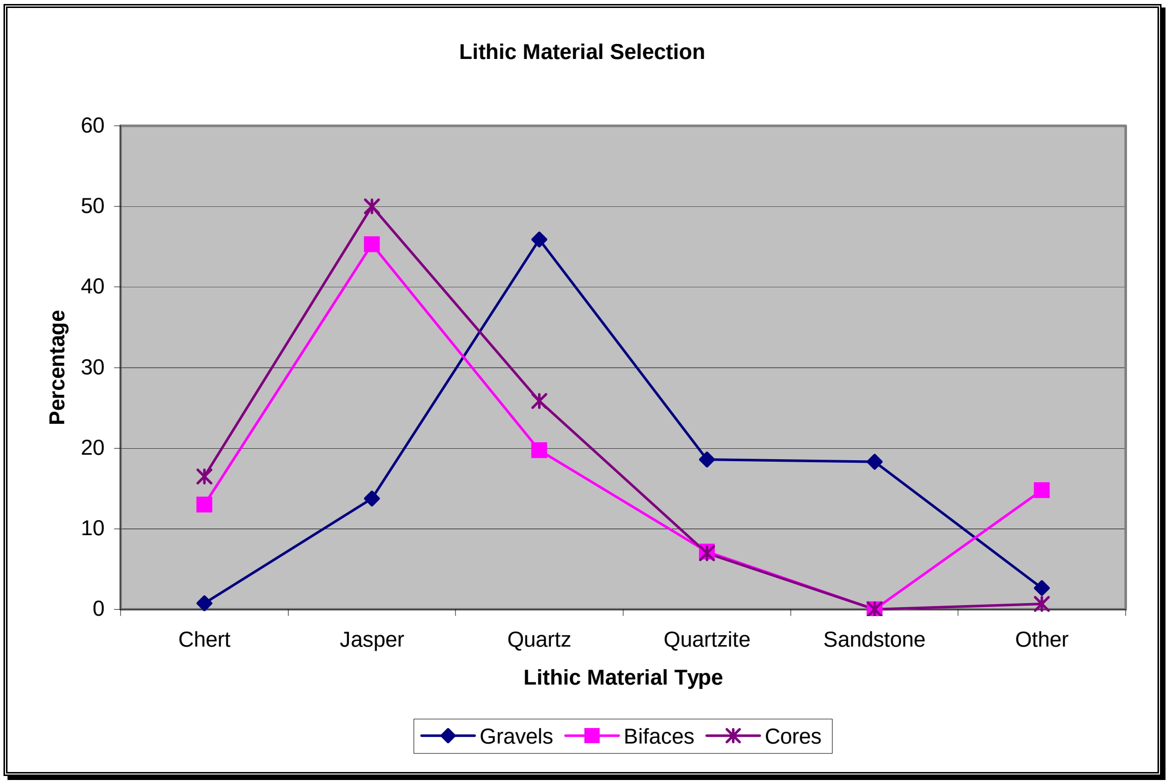


Figure 13.10 Lithic Material Selection for Gravels, Bifaces and Cores

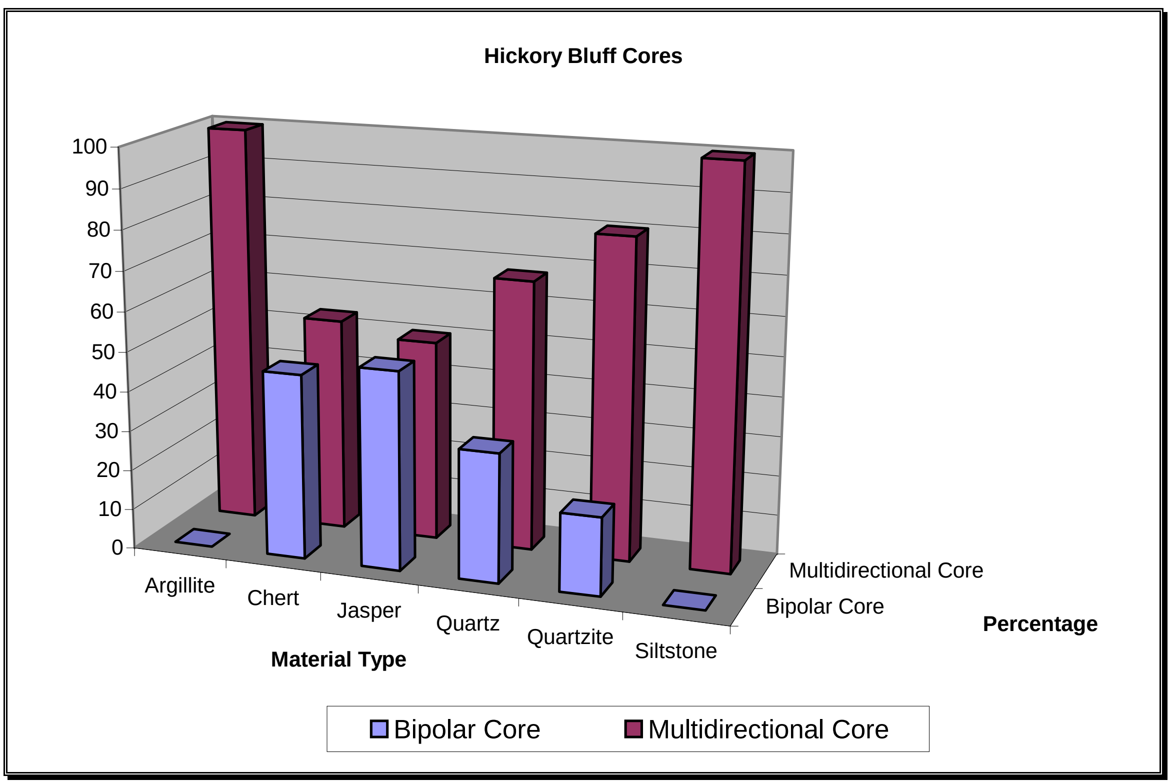


Figure 13.11 Multidirectional and Bipolar Core Raw Material Percentages

Size grade was recorded for 488 cores (288 multidirectional cores and 200 bipolar cores). General core size ranged from 10-20 mm to over 50 mm (maximum length) (Figure 13.12). Most of the chert and jasper multidirectional cores were 30-50 mm in size (Figure 13.13) whereas most of the quartz and quartzite multidirectional cores were over 50 mm in size. Bipolar cores displayed a similar pattern, with most quartz and quartzite cores measuring 50 mm or greater (Figure 13.14). Bipolar chert and jasper cores varied in size with higher percentages of chert cores measuring 30-50 mm and the majority of jasper cores measuring between 40 and 50 mm.

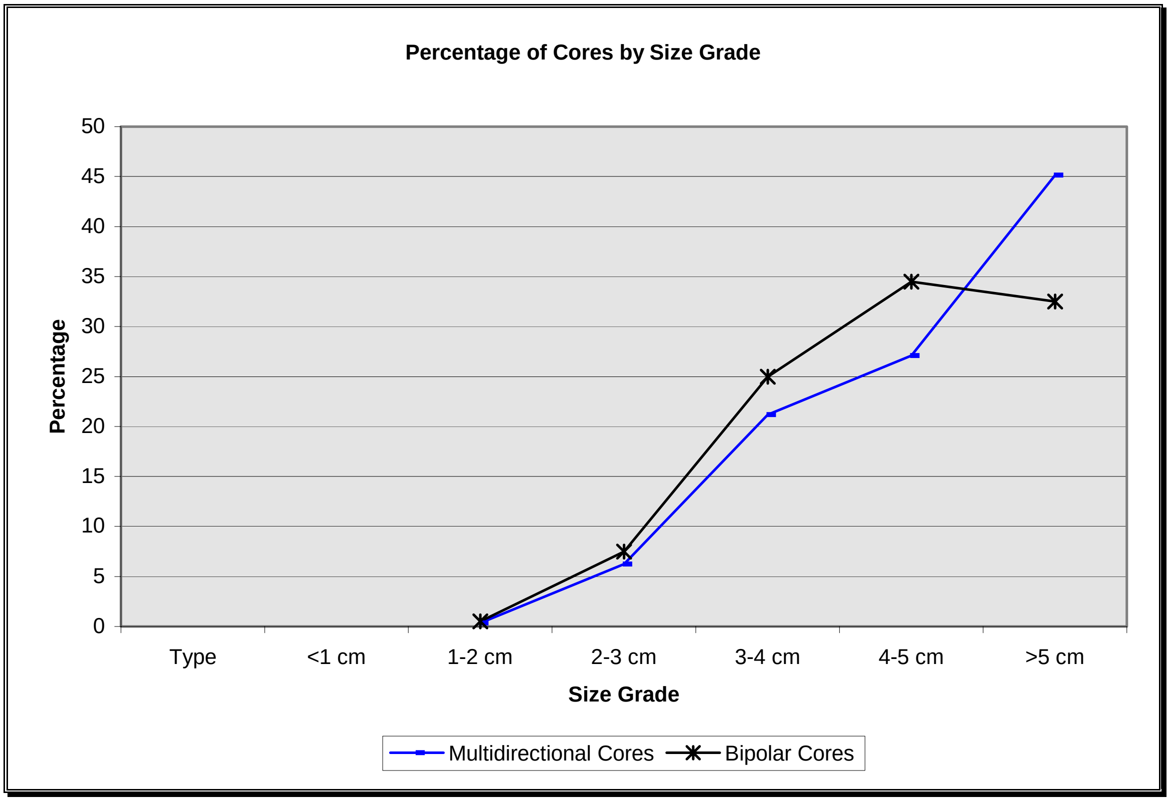


Figure 13.12 Percentage of Cores by Size Grade

A higher percentage of smaller cores (i.e., 30-40 mm and 40-50 mm) were reduced using bipolar techniques, whereas larger cores (>50 mm) exhibited a higher percentage of multidirectional reduction. The difference in reduction strategies was most likely the result of the material size. Smaller cobbles were being maximized using bipolar techniques. Larger cobbles provide more material and were reduced using multidirectional techniques.

Material type and size grade between the two core reduction strategies were similar. Overall, smaller cores were cherts and jaspers; larger cores were quartz and quartzite. The variation in raw material size was the result of availability of local lithic materials and reflects the natural environment rather than intentional cultural selection based on size.

A comparison of the local lithic materials in the Columbia Fm. gravels and the percentages of cores also suggest cultural selection. Cherts and jaspers represent 14.5 percent of the local gravels whereas 66.5 percent of the cores are cherts and jaspers (Table 13.5). Over 64 percent of the local gravels are quartz and quartzite; however, only 32.8 percent of the cores are made from these materials (Figure 13.10).

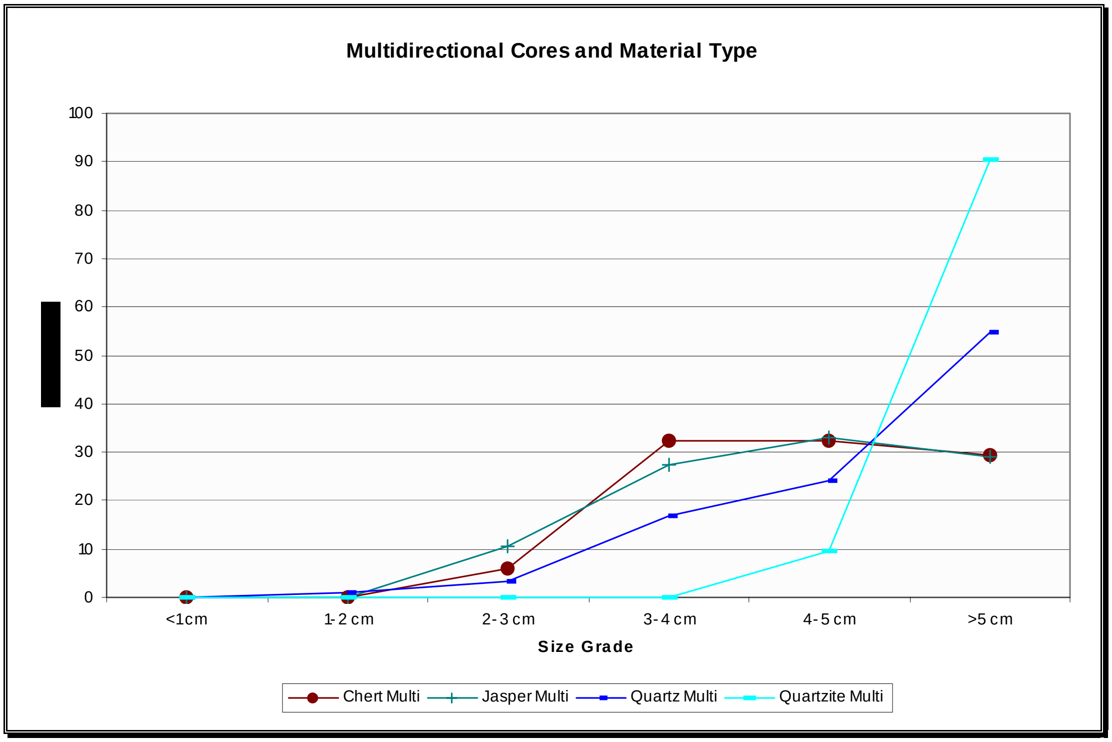


Figure 13.13 Raw Material types for Multidirectional Cores

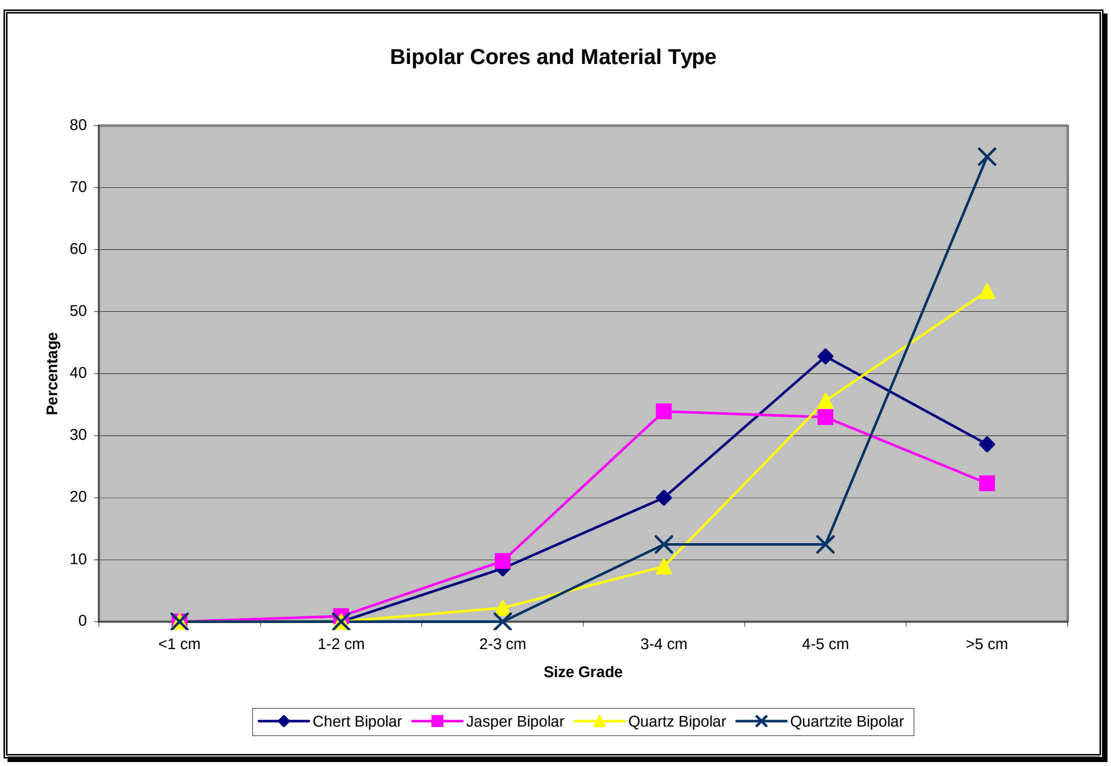


Figure 13.14 Raw Material Types for Bipolar Cores

Debitage Analysis

Jasper flaking debris represents the highest frequency (n=16,384 or 50.8 percent) of chipped stone materials at Hickory Bluff (Figure 13.15). Some of the minority raw material types (i.e., andesite, sandstone, schist, and steatite) provided sample sizes that were too small for meaningful statistical analysis. Quartz represented the most abundant raw material after jasper representing 21.6 percent of the assemblage (n=6,977). Chert and rhyolite contributed 11.9 percent and 6.6 percent of the total debitage assemblage respectively.

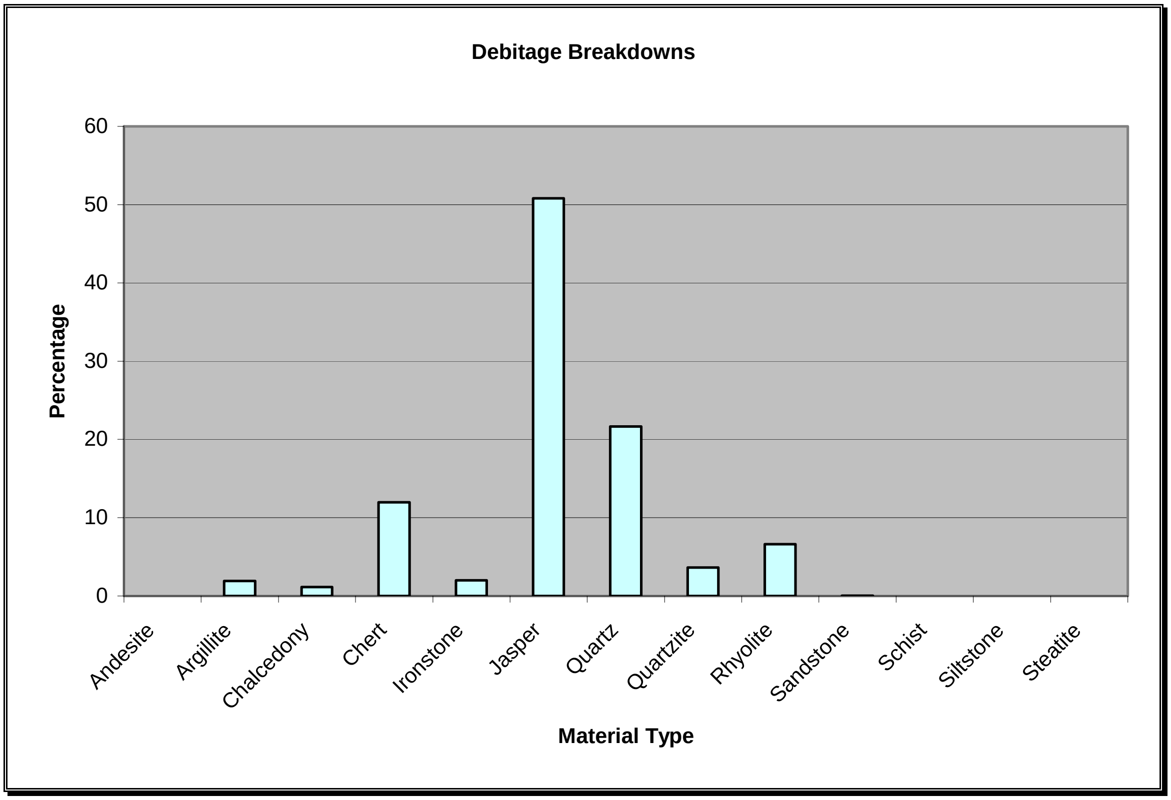


Figure 13.15 Raw Material Types of Debitage

Size grade 1 consisted of the smallest debitage in the assemblage, defined as 10 mm or less (.39 inch or less). Most of the debitage in this size grade was smaller than the 1/4-inch mesh wire opening on the screens and was most likely not recovered during excavation. Since the 1/4-inch mesh was the smallest screening fabric used in the field, the size grade 1 material does not represent a systematic or complete sample. A similar fall-off for size grade 1 debitage is indicated for all selected data sets (Figure 13.16). Size grade percentages for chert, jasper, and quartz debitage were similar. Quartzite debitage exhibited slightly lower percentages of smaller flakes (size grade 2) and higher percentages of larger flakes (size grades 3-5).

Based on mean flake weights for each size grade (Table 13.6), smaller quartz and quartzite flakes (size grades 2-3) were slightly heavier than chert or jasper debitage in the same size grade. Larger quartz flakes (size grades 4-5) were heavier than chert, jasper, or quartzite debris in the same size grade.

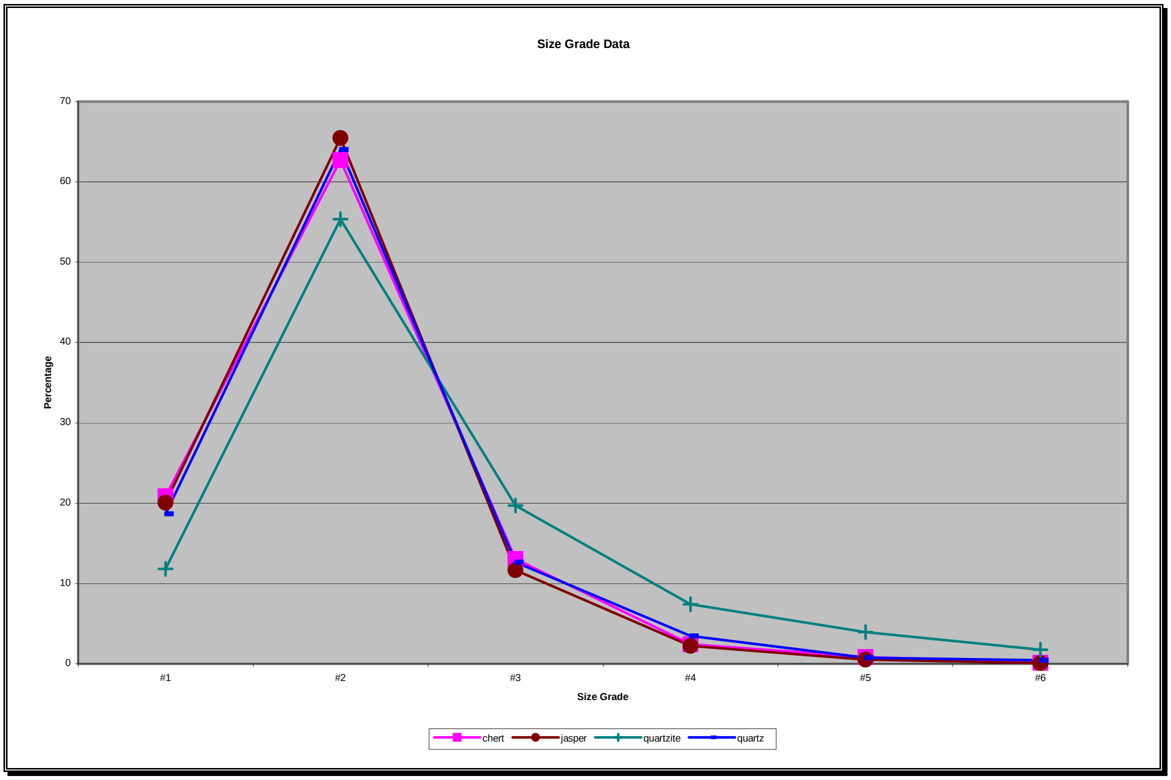


Figure 13.16 Size Grade of Debitage by Material Type

Table 13.6 Mean Flake Weight per Size Grade for Selected Hickory Bluff Material Types

Size Grade	Chert	Jasper	Quartz	Quartzite
1 (<10 mm)	0.11	0.11	0.15	0.13
2 (10-20 mm)	0.35	0.35	0.53	0.50
3 (20-30 mm)	1.76	1.81	2.37	2.19
4 (30-40 mm)	6.58	5.46	8.25	6.24
5 (40-50 mm)	14.27	14.33	21.16	14.73
6 (> 50 mm)	28.1	42.04	39.69	59.20

The presence of remnant cortex was used as an indicator of core/flake reduction strategies occurring onsite. Bifacial reduction and tool maintenance activities would provide fewer flakes with remnant cortex. The percentage of occurrence of remnant cortex on argillite and rhyolite flakes (Table 13.7) was lower than most other materials indicating that argillite and rhyolite artifacts were transported to the site in relatively finished forms. In contrast, higher percentages of cortical flakes would be expected from local raw materials such as the adjacent pebble sources in the Columbia Fm. gravels. Over 30 percent of ironstone, jasper, quartzite, and sandstone debitage exhibited cortex (schist debitage also contained a high percentage of cortex but the sample was a total of 3 artifacts).

The ratio of flakes to chips, the latter defined as flaking debris without recognizable flake attributes, showed some variation (Table 13.7) including a ratio of 5.4 for quartz. This ratio for quartz indicated more chips in relation to flakes among the quartz debris, whereas argillite, rhyolite, and ironstone displayed high ratios indicating fewer chips and more flakes. The lower ratio of flakes to chips suggest less control during flintknapping (i.e. generating more incidental chips) and may reflect the quality of the lithic material (e.g., non-conchoidal fracturing of quartz) or the skill of the flintknapper.

Table 13.7 Percentage of Remnant Cortex and Flake/Chip Ratio for Hickory Bluff Debitage

Material Type	Cortex	Flake/Chip Ratio
Andesite	0	0
Argillite	0.81	616
Chalcedony	19.72	59.8
Chert	23.83	16.5
Ironstone	34.00	212.6
Jasper	33.61	23.7
Quartz	24.89	5.4
Quartzite	33.07	21.0
Rhyolite	0.51	709
Sandstone	46.66	0
Schist	33.33	2
Siltstone	16.88	18.2
Steatite	0	0

PROJECTILE POINT ATTRIBUTE ANALYSIS

Variability in Form and Dimensional Attributes within the Collection

The analyses were designed to describe the morphological variability in the Hickory Bluff points using summary charts of attribute combinations. The goal was to identify characteristic patterning within a range of dimensional and associated properties that might be significant in developing standardized replicable type definitions. The initial breakdowns were categorical: by gross morphology (specifically, the general design of hafting elements) and by raw material. Following that, combinations of attributes were examined. While patterning in these areas was noted, the results of the study suggested that there were effects other than style operating on the form of the artifacts. Finally, two of the non-stylistic variables indicated by the analysis, raw material form and the effects of resharpening, were considered.

General Attributes – Haft Shape and Raw Material Distributions

Figure 13.17 illustrates the frequency of hafting element types in the collection, as an indicator of the range of morphological forms present. Notably, there were relatively few notched points. Nearly two-thirds of the points were stemmed, while unstemmed forms accounted for the smallest proportion of the hafting element types.

In terms of raw material types, cryptocrystallines—specifically jasper and chert—dominated the collection (Table 13.8). Jasper was chief among all materials, accounting for over 40 percent of the points. Crystalline (quartz) and coarse-grained metamorphic (quartzite, argillite) or volcanic material (rhyolite) comprised the remainder of the raw materials represented.

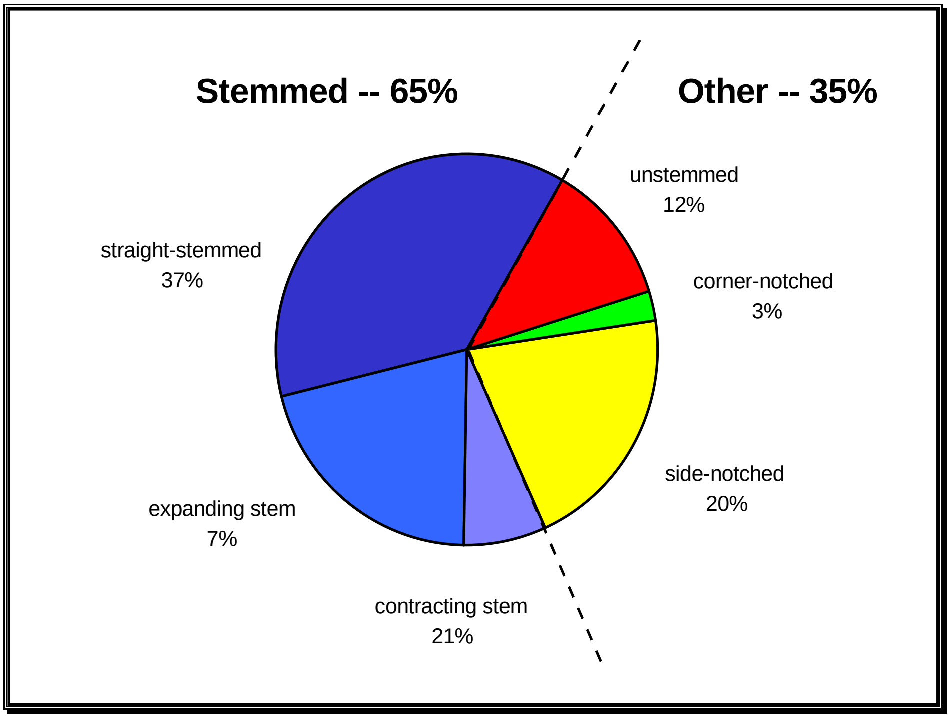
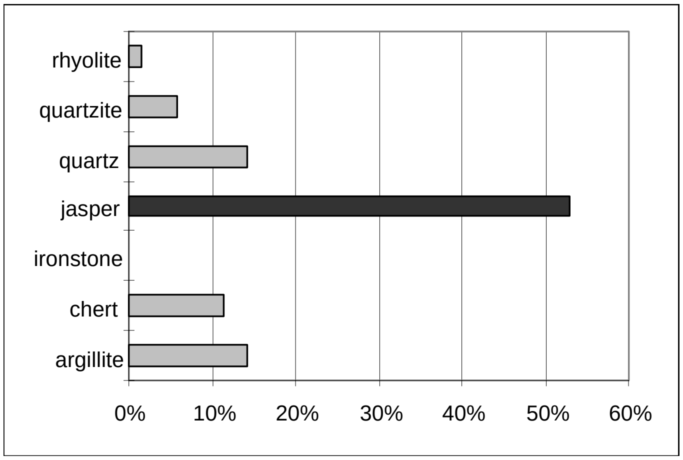


Figure 13.17 Distribution of Hafting Element Types

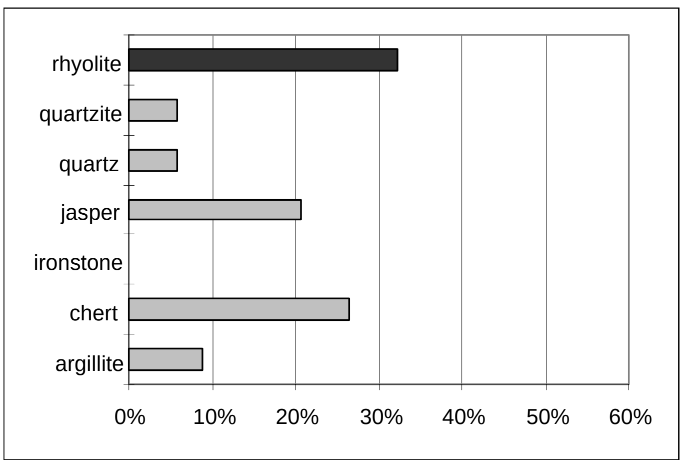
Table 13.8 Lithic Raw Material Distribution among Points in the Collection

	Material	Frequency
	jasper	42%
cryptocrystalline	chert	12%
other	argillite	16%
	quartz	12%
	rhyolite	9%
	quartzite	8%
	ironstone	2%

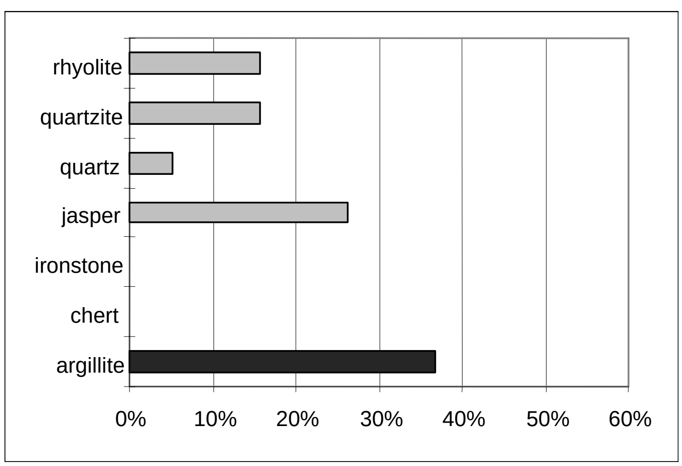
Raw material variation graphed by hafting element (Figure 13.18) reflects the general prevalence of jasper throughout the collection: it accounted for 40-60 percent of the points in most haft groups. Straight-stemmed points (Figure 13.18a) are a typical example; 53 percent of this form were made of jasper, while the next highest frequencies were quartz and argillite, at 14 percent each. Exceptions to the dominance of jasper were seen among side-notched and expanding stemmed points. Among side-notched points (Figure 13.18b), rhyolite was the most frequently occurring material at 32 percent, with jasper and chert comprising 26 and 22 percent, respectively. Coarse-grained materials were even more prevalent among expanding stemmed points (Figure 13.18c), where argillite comprised 37 percent of the total, jasper 26 percent, and quartzite and rhyolite 16 percent each.



a) Straight -Stemmed Points n=70



b) Side-Notched Points n=34



c) Expanding-Stemmed Points n=19

Figure 13.18 Frequency of Raw Materials for Selected Hafting Element Types

Base shapes among points in the collection were primarily convex or straight, with the former typically occurring twice as often as the latter on all hafting element types. Expanding stemmed points were an exception. Straight, convex, and concave bases occurred in equal proportions on this stem type, but the sample size was small and, thus, the significance of the variation was difficult to interpret. No other correlation was observed between base morphology and haft shape, and none with raw material.

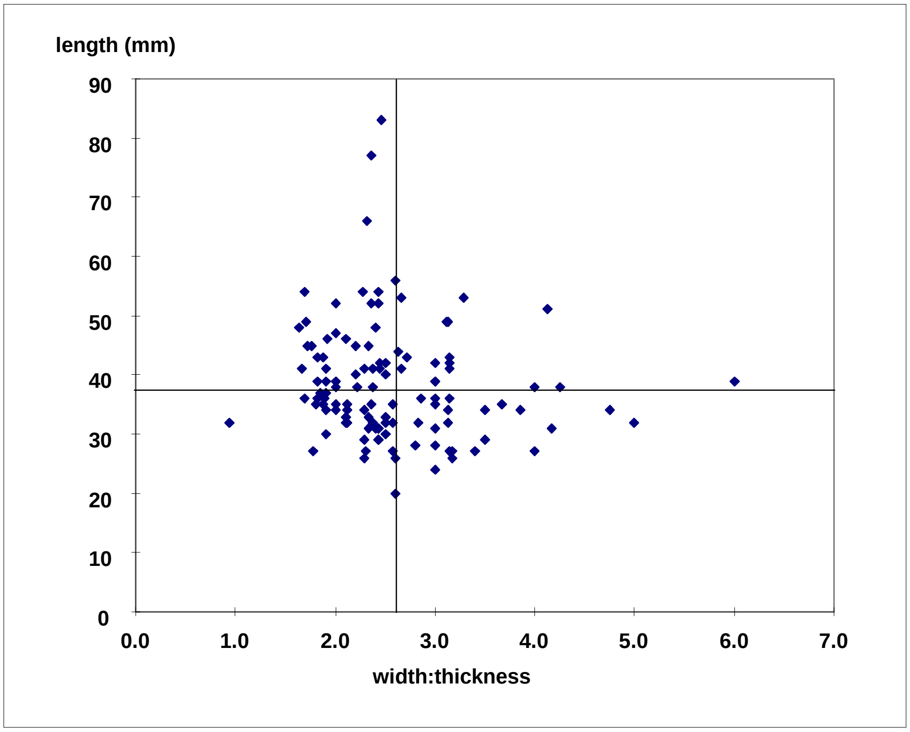
Dimensional Variables

The relationships between a variety of dimensional attributes were analyzed to investigate the potential for patterned variation applicable to type definition. For the analyses, the data were grouped on the basis of haft shape and raw material. A sample of the results of these analyses is included here. In general, the investigation demonstrated that a large amount of variability was present in the points in the collection, which made type delineation problematical. For example, to assess the overall range of artifact sizes, a scatterplot was constructed using a combination of three attributes—length, width, and thickness—in a measure that generally describes artifact size as a function of volume (Figure 13.19a). Length was plotted against relative thinness (the width:thickness ratio).

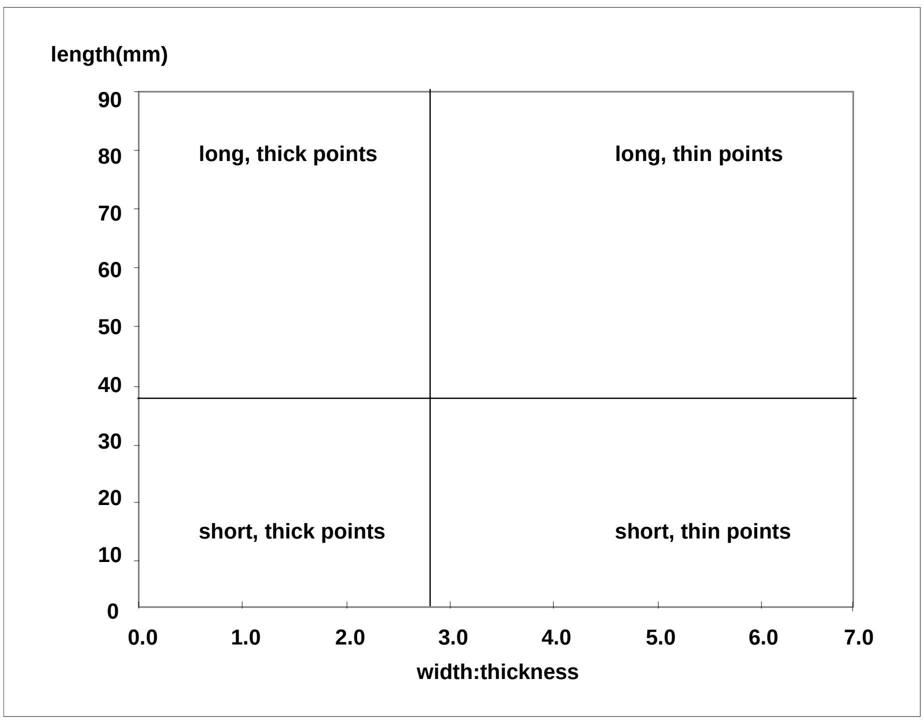
The cross-hairs on the chart denote mean measures specific to the Hickory Bluff collection (mean length = 38.6 mm, mean width:thickness = 2.6), while the extremes describe long, thin points, or short, thick points, and so on, as indicated in Figure 13.19b). The graph shows the general lack of correlation between the variables: that is, long points did not tend to be thicker or thinner than average, and vice versa. Most of the artifacts clustered around the mean values, with several outliers describing points that were long, but of average thinness, or thin but of average length.

Artifact length may in fact be one of the most variable and least consistent measures of artifact morphology, as it is subject not only to original design concerns (including notions of style and function), but also to the constraints of raw material and the effects of use and retooling. Indeed, most researchers agree that the hafting element of a point typically sees less wear or damage over time than the blade. Thus, the dimensions of the haft may be considerably more stable and subject to fewer influences than overall dimensions such as artifact length.

Based on this assumption, several haft dimensions were examined, with measurements tabulated and plotted in various combinations. For example, the frequency distributions of haft length and haft width were plotted by haft type (Figure 13.17), seeking modes as evidence of internal grouping. Relatively complex modalities (multiple peaks) were displayed for most of the variables across the different hafting element types, implying little patterning relevant to type groups. Straight-stemmed forms were a notable exception (Figure 13.20), in which normal, unimodal distributions of haft length and haft width occurred. As an aside, the pattern seen in haft element length for these points was slightly different from that of their overall length. This suggested different or differently weighted factors influencing the lengths of hafts and blades, possibly indicating that the size of the hafting element remains more stable than that of the blade over time.

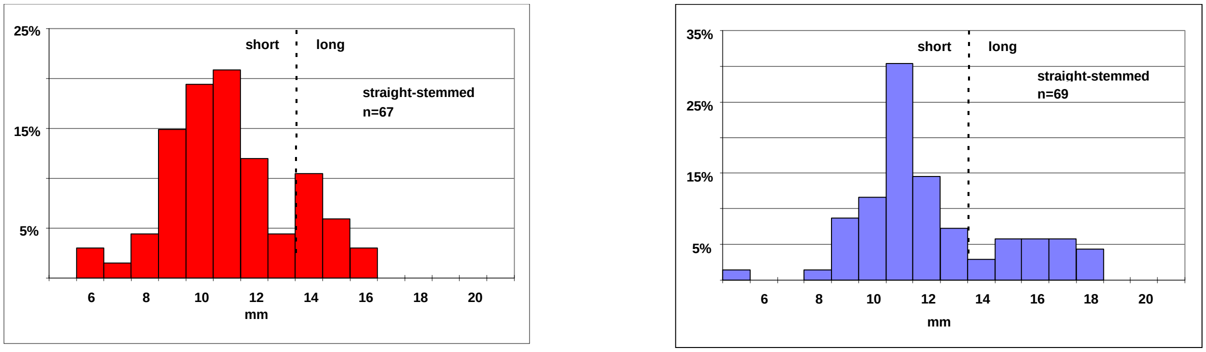


a) Scatterplot of Artifact Length vs. Width-Thickness Ratio (cross-hairs indicate mean measurements in the collection: length = 38.6 mm, width:thickness = 2.6)



b) Schematic Interpretation of the Chart Extremes

Figure 13.19 Results of the Analysis of Artifact Size as Measured by Length vs. Width:Thickness.



a) haft length b) haft width

Figure 13.20 Frequency Distributions of Haft Lengths and Widths of Straight Stemmed Points

A further dimension was added to the analysis by grouping haft attribute data by raw material type. When thus tabulated (Table 13.9), side-notched and straight-stemmed points showed patterning that suggested at least some correlations between material and haft form. Side-notched points of cryptocrystalline material, for example, tended to have short hafts, while those of rhyolite tended to have long hafts (note that the short-long thresholds were determined on the basis of bimodal frequency distributions). There was a similar variation between cryptocrystalline and argillite in straight-stemmed points, with cryptocrystalline points bearing short hafts, and argillite points long hafts.

Raw material correlations with haft width were less clear (Table 13.10). Again using breaks in the frequency distributions as size thresholds, there was virtually no difference among side-notched points grouped by raw material. Straight-stemmed points did show some variation, however. The proportion of cryptocrystalline points dropped off sharply among longer hafted points, while both argillite and quartz frequencies increased. Contracting and expanding stem points showed little similar variation correlated with either haft length or width.

Table 13.9 Raw Material Proportions among Selected Haft Types, Grouped by Length
(cells contain the proportion represented by each material as a total of all the materials in that size interval; note that only the significant material types are displayed).

	Haft Length	**Cryptocrystalline (chert/jasper)**	**Rhyolite**
Side-notched	<14 mm	54%	21%
n=39	≥14 mm	26%	50%

	Haft Length	**Cryptocrystalline (chert/jasper)**	**Argillite**
Straight-stemmed	<13 mm	83%	4%
n=68	≥13 mm	19%	44%

Table 13.10 Raw Material Proportions among Selected Haft Types, Grouped by Width
(cells contain the proportion represented by each material as a total of all the materials in that size interval, with only the significant materials displayed).

	Haft Width	Cryptocrystalline (chert/jasper)	Rhyolite
Side-notched	<16 mm	50%	25%
n=39	≥16 mm	42%	31%

	Haft Width	Cryptocrystalline (chert/jasper)	Argillite	Quartz
Straight-Stemmed	<14 mm	76%	9%	9%
n=68	≥14 mm	27%	27%	27%

Both of these measurements, haft length and haft width, tend to describe the overall size of a point, matters of style notwithstanding: in general, large points tend to have large hafts. The correlations between haft size and raw material among several haft forms, straight stems in particular, suggests that there may be a demonstrable link between raw material type or form and artifact morphology. A similar set of plots was constructed using the ratio of haft length-to-haft width, measuring the surface area of the hafting element. Frequency distributions by haft type showed a wide amount of variability in haft size as measured by area within each of the various types. The only discernable pattern was that, not unexpectedly, expanding stem points tended to have the largest surface areas.

A number of other attributes of basal morphology, particularly such things as notch width, angle, etc., have been used frequently in dimensional analyses, but were not examined in the present study. While other investigations have concluded that certain of these attributes are good discriminators of type, the small number of notched points present in the collection made such analyses impractical.

Initial Conclusions

A variety of simple dimensional attribute combinations were investigated in the foregoing analyses, providing similar results in terms of patterned variability. That is, while there were non-random appearing correlations noted between certain variables, the overall results of the study emphasized the degree of morphological variation that characterized the collection. As noted at the outset of this investigation, it was hoped that some of this variability could be summarized and reduced to manageable form through the detailed description of artifact morphology irrespective of temporal periods. But the results of the analyses suggested that such natural or inherent typology is too complex a phenomenon to describe solely through an array of dimensional attributes, at least in the present collection of artifacts.

The reasons for the complexity in the Hickory Bluff collection may be multiple, including the variety of morphological types that appear to be present (encompassing a large proportion of the haft forms that are recognized in the region), the amount of temporal variability represented in the depositional contexts at the site, the variety of raw material types present, the influence of raw material on the shape that an artifact can assume, and certain aspects of artifact use and curation, which can alter original form.

And yet, because of the variability in the Hickory Bluff points, the database lends itself to more generalized studies of point morphology, and in particular, the potential influences operating on the forms that we document archaeologically. The site is located on the Coastal Plain, well away from outcrops of primary lithic material that occur in the Piedmont. Yet secondary lithic deposits were available at various times in the form of Pleistocene age outwash gravels of the Columbia Fm. that underlie the surface mantle of eolian silty loam at the site. In addition, the site appears to have been an intensively occupied habitation at which artifacts were manufactured, used and discarded. Thus, the points from Hickory Bluff provide the basis for a study of raw material selection, artifact use and repair, and the effects of each of these activities on artifact morphology.

The Constraints of Raw Material on Point Morphology

Dimensional attribute analyses conducted on the basis of raw material groups suggested that some aspects of the variability in the Hickory Bluff point collection may best be explained as a function of raw material type or form. Whereas, for example, width:thickness ratios of points grouped by haft element appeared to overlap (Figure 13.21), in similar plots grouped by raw material some materials displayed relatively distinct separation (Figures 13.22 and 13.23). In each of these example scatterplots, 80 percent confidence ellipses have been drawn around the mean values to emphasize the spread of each distribution; that is, there is an 80 percent probability that the mean value for each group falls within its respective ellipse. The analyses indicated that, while contracting stem and side-notched points tended to have the same range of relative thinness, jasper points tended to be both narrower and thinner than quartz points.

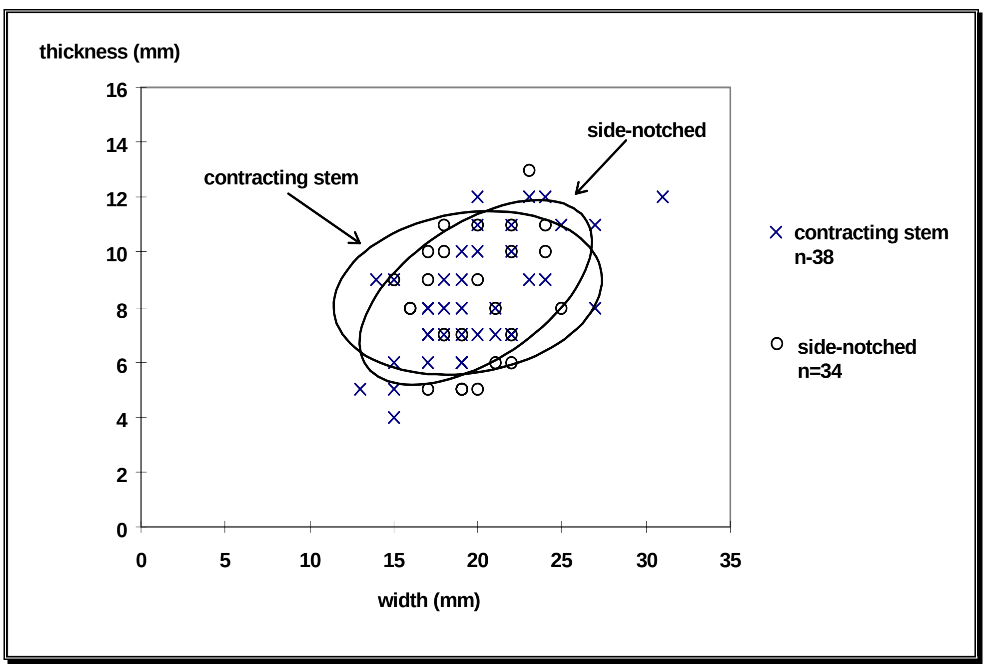


Figure 13.21 Scatterplot of Width:Thickness Ratios of Contracting Stem and Side-Notched Points

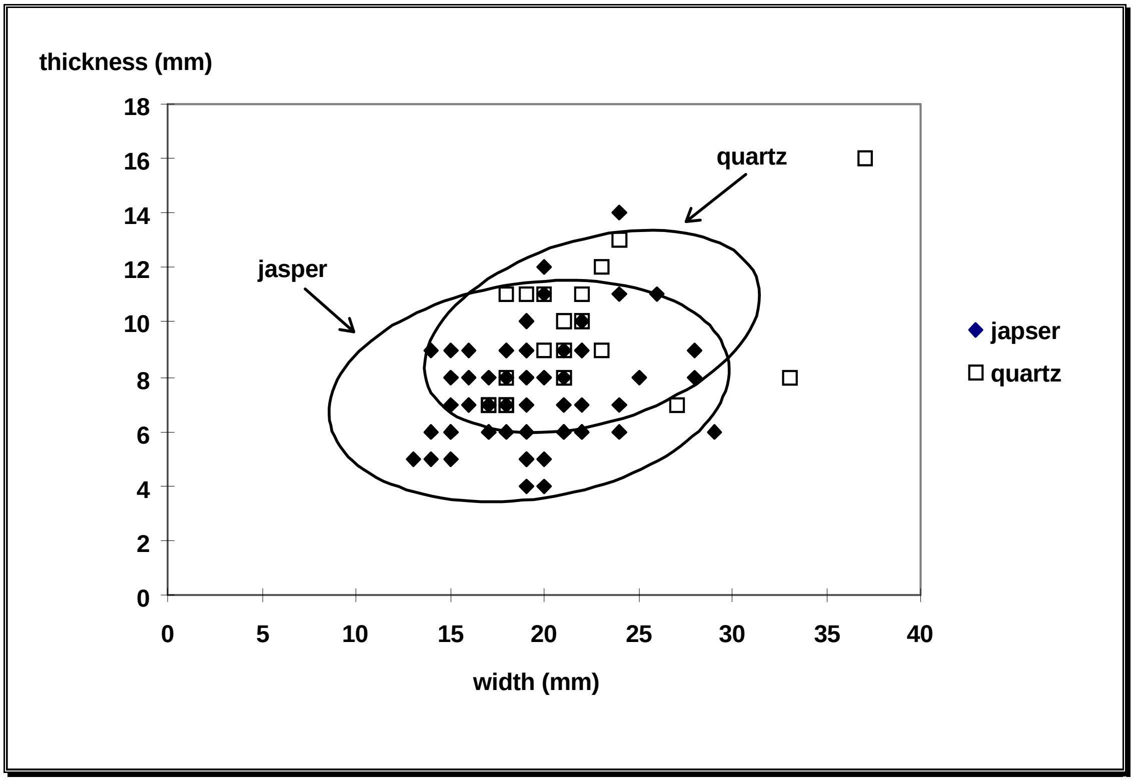


Figure 13.22 Scatterplot of Width:Thickness Ratios of Jasper and Quartz Points

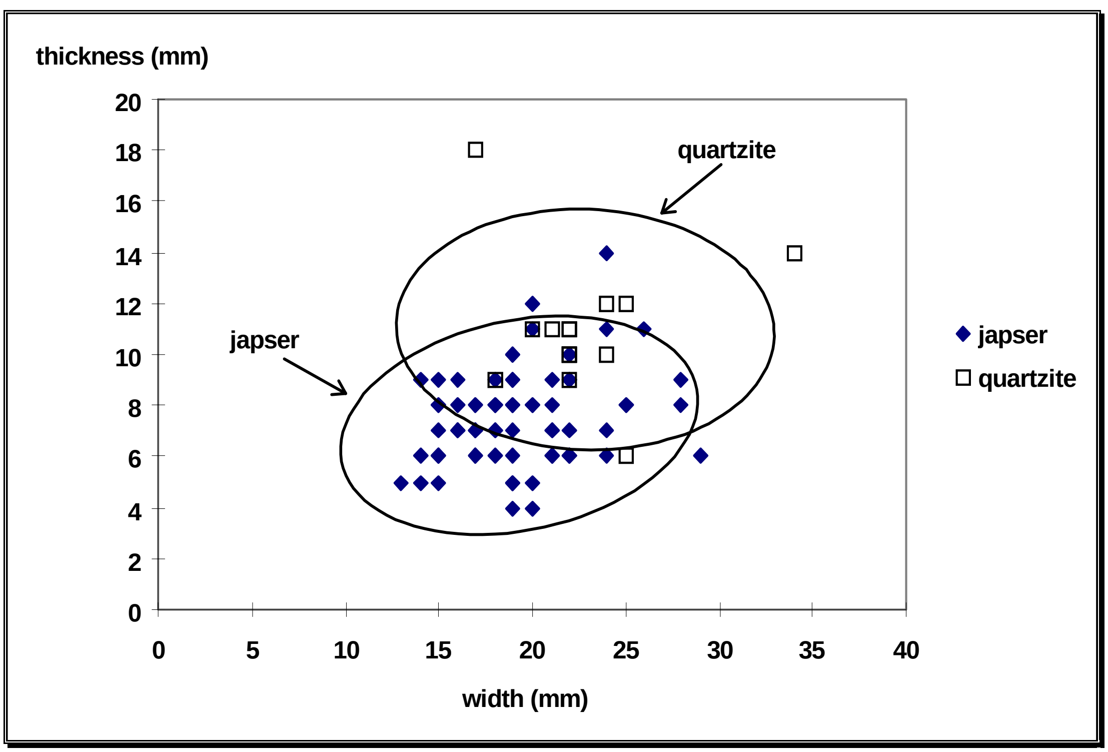


Figure 13.23 Scatterplot of Width:Thickness Ratios of Jasper and Quartzite Points

The same was true for jasper points in comparison with quartzite points: the jasper artifacts tended to be both narrower and thinner than those of quartzite (Figure 13.23). This will come as no surprise to those who have examined points from regional collections, since quartz and quartzite points are usually thicker than jasper or chert points. Similarly, flintknappers from the region will recognize that quartz and quartzite tend to be more difficult to thin than cryptocrystalline materials. This information is important because it highlights a pattern that will recur in the data. That is, raw material—the petrological type, as well as the form of the nodule (pebble, cobble, outcrop blank, etc.)—influences the final form of an artifact.

The mean width:thickness ratios for various pairs of raw material types were compared and the differences appeared to be fairly significant in some cases (Table 13.11). Petrological characteristics may be a factor in these observed differences, since, as noted above, cryptocrystalline jasper can be more easily thinned than hard or resistant materials such as quartz or quartzite. Raw material form may also be a determinant, assuming, for example, that quartzite was present in larger clast sizes than jasper, and thus would require more extensive reduction to achieve the same relative thinness. In contrast, there was no apparent differentiation in width:thickness ratios between jasper and argillite (Figure 13.24, Table 13.11). Raw material form may be the important element in this case as well, assuming that jasper occurred predominantly in pebble or cobble form, while argillite was introduced to the site as large flakes, blanks, or preforms that could easily be thinned to the same proportionate degree as the cryptocrystalline material.

Table 13.11 Pair-Wise Comparison of Width: Thickness Ratios for Selected Raw Material Types
(significant results, implying different means, are shown in bold).

	Mean Width:Thickness Ratio	Sample Size	T-test Results
Jasper	2.67	n=73	
Quartz	2.38	n=20	t=1.60, df=91, p=0.11
Jasper	2.67	n=73	
Argillite	2.82	n=29	t=0.94, df=100, p=0.35
Jasper	2.67	n=73	
Rhyolite	2.27	n=15	t=1.95, df=86, p=0.06
Jasper	2.67	n=73	
Quartzite	2.19	n=15	**t=2.36, df=86, p=0.02**

Gravel Database

To further investigate the effects of raw material form on point morphology in the Hickory Bluff collection, a study was conducted of the gravels present in the Columbia Fm. deposits underlying the site. A full report of the study and the results of descriptive analyses are contained in the preceding sections of this chapter. Further comparative analysis with artifacts from the site has indicated that significant parallels can be documented between the size and form of points and gravels of certain raw materials.

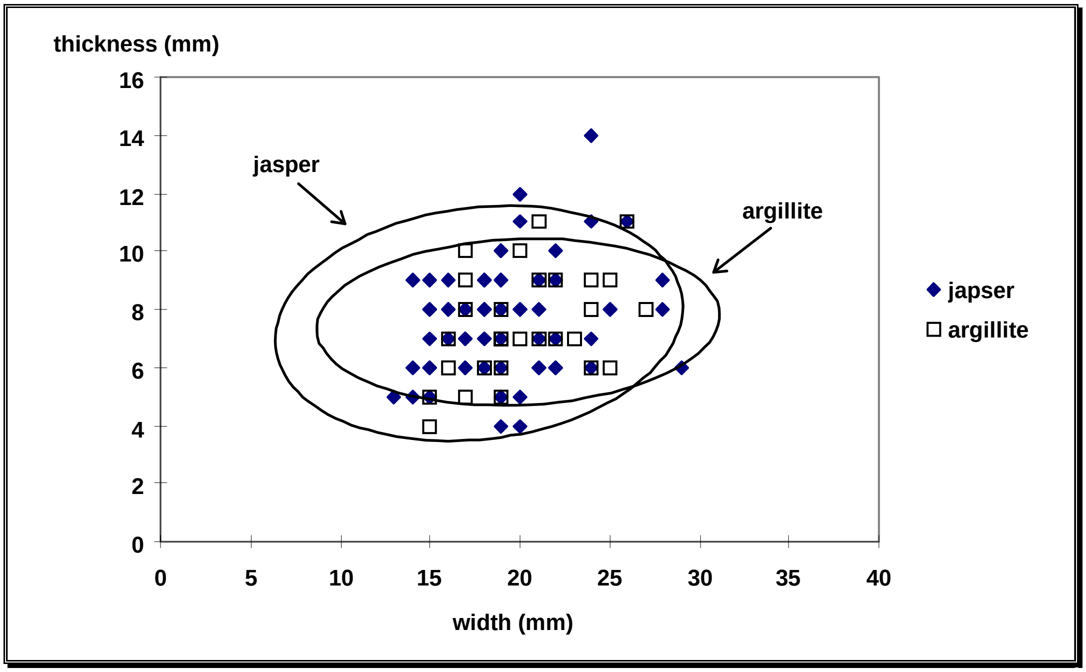


Figure 13.24 Scatterplot of Width:Thickness Ratios of Jasper and Argillite Points

Table 13.12 displays the distribution of the major types of workable stone among gravels and points in the Hickory Bluff collection. Jasper accounts for 14 percent of the gravels, but 42 percent of the points, while in contrast, quartz accounts for 46 percent of the gravels, but 12 percent of the points. Quartzite and chert show similar, if less dramatic, variations. (Minor inconsistencies occurred in the identification of chert in the gravel and point samples, but they were of little consequence in the following analyses. Moreover, the difference in knapping quality between chert and jasper is small in comparison with non-cryptocrystalline materials, and so jasper is the focus of comparative analysis.) No argillite or rhyolite was identified in the gravels. Assuming that the samples are representative, we can infer that neither of these materials was readily available from the local gravel sources, which further implies that argillite and rhyolite entered the site in different size and form than much of the other material used for artifact manufacture. Indirect evidence of this was seen in the width:thickness plot (Figure 13.24).

Table 13.12 Frequency of Occurrence of Lithic Raw Materials among Gravel and Points

Raw Material	Gravel	Points
Chert	<1%	12%
Jasper	14%	42%
Quartz	46%	12%
Quartzite	19%	8%
Argillite	--	16%
Rhyolite	--	9%
Other*	21%	2%
***N*=**	1,056	186

*for gravel: sandstone; for points: ironstone and siltstone

Comparative analysis focused on the three major forms of workable stone occurring in the gravels: jasper, quartz, and quartzite. The dimensional attributes of these gravels were examined prior to comparing them with the projectile points. The gravels were sorted by size on a 5-mm interval scale. In general, most fell between 30 and 45 mm in length, the same length exhibited by the majority of the projectile points (Table 13.4). The individual frequency distributions by petrological type showed peaks at 30-35 mm for jasper and quartz, while quartzite peaked at a slightly higher interval, 35-40 mm. The differences were not statistically significant (the data were not normally distributed, and thus nonparametric tests were used to assess the distributions: quartz and quartzite clasts (Mann-Whitney U=333.5, p=0.34); jasper and quartzite (Mann-Whitney U=242.5, p=0.32); jasper and quartz (Mann-Whitney U=202.0, p=0.07).

The length distributions were heavily skewed toward smaller sized gravels, with several large outliers present in most cases. Due to potential questions about the reliability of mean calculations on these data, bullet charts were constructed to provide a graphic depiction of the confidence intervals (error ranges) associated with the estimated means for each group (Figure 13.25). The intervals are drawn as a series of vertical lines indicating the range within which each mean is likely to fall, with calculated levels of confidence. Quartz shows the narrowest range (shortest lines), implying that it has the tightest distribution, while quartzite shows the widest range. The mean for jasper lies outside (below) the 80 percent confidence level for either of the other materials, indicating a less than 20 percent chance that the quartz or quartzite gravels in the samples have mean lengths as small as that of the jasper gravels. In contrast, the means of the quartz and quartzite gravels overlap.

The implication to be drawn from these figures is that it is likely that the jasper pebbles available along the banks of the St. Jones River were smaller than either the quartz or quartzite pebbles found there. Quartzite pebbles were likely to have been the largest of the three. It is true that gravels would have been selected for size, just as they were for petrological type, the latter indicated by the fact that jasper far outranks other materials in terms of frequency in the point collection. Yet these data describe the likelihood of finding large jasper clasts vs. large quartz or quartzite clasts. And here outliers in the data may be significant. While the mean statistics describe the general run of available material, or the likelihood of finding appropriately sized pieces for selection, the largest end of the size distributions put effective limits on the size ranges of the artifacts that can be manufactured from them. Since the material was being selected, not randomly chosen as were the gravel samples, the range statistics imply that the potential maximum size of quartz and quartzite artifacts was greater than that of jasper.

When the gravel dimensions were compared with point dimensions, the means appeared to be shifted by roughly the same amount for each of the three raw material types. That is, the mean length of quartzite points was roughly the same proportion less than the mean length quartzite gravels as compared with the same measurements for jasper. Nonetheless, the amounts do vary. This can be seen graphically in a series of bullet graphs showing the confidence intervals for both length and width measurements of points and gravels for the three raw materials (Figure 13.26).

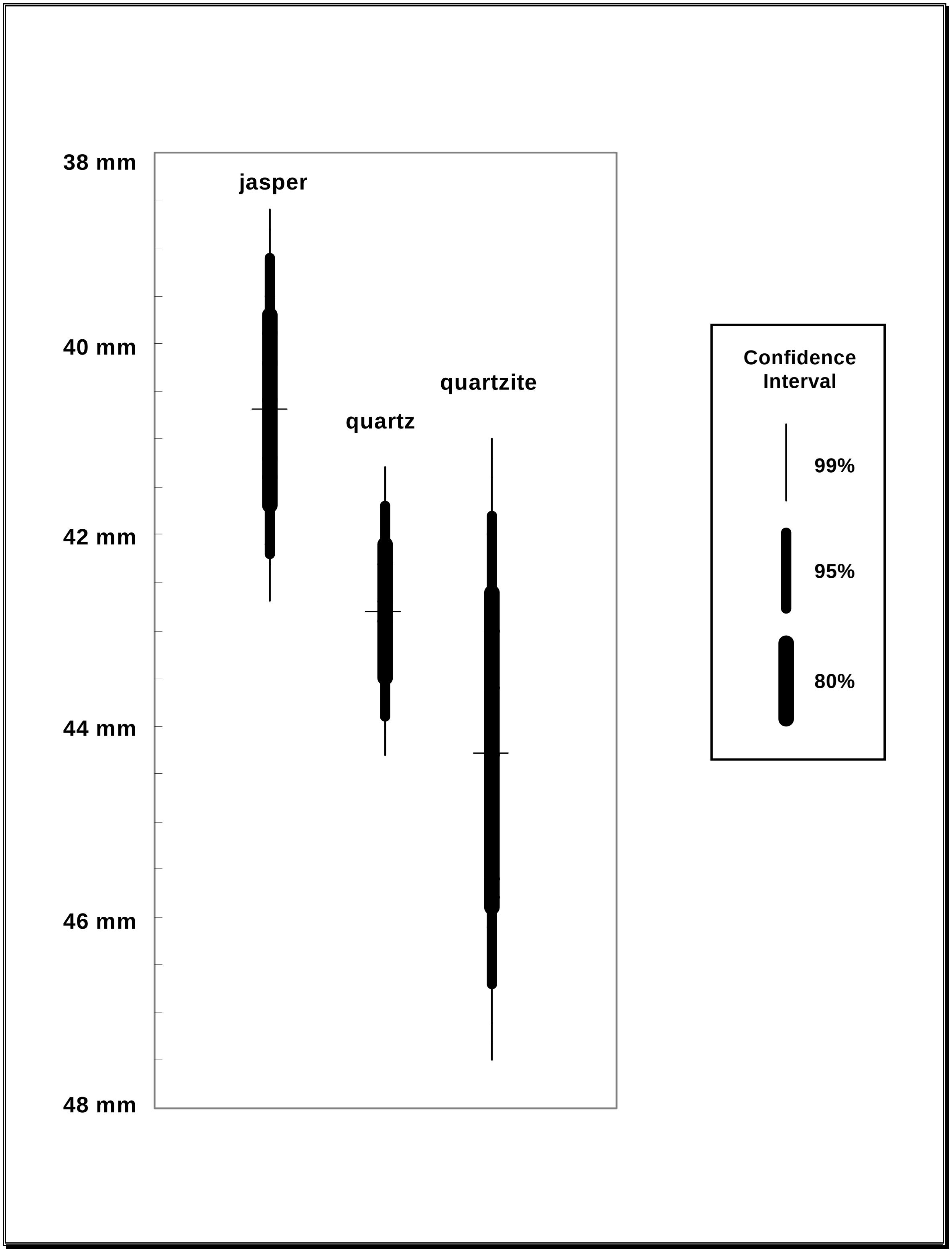
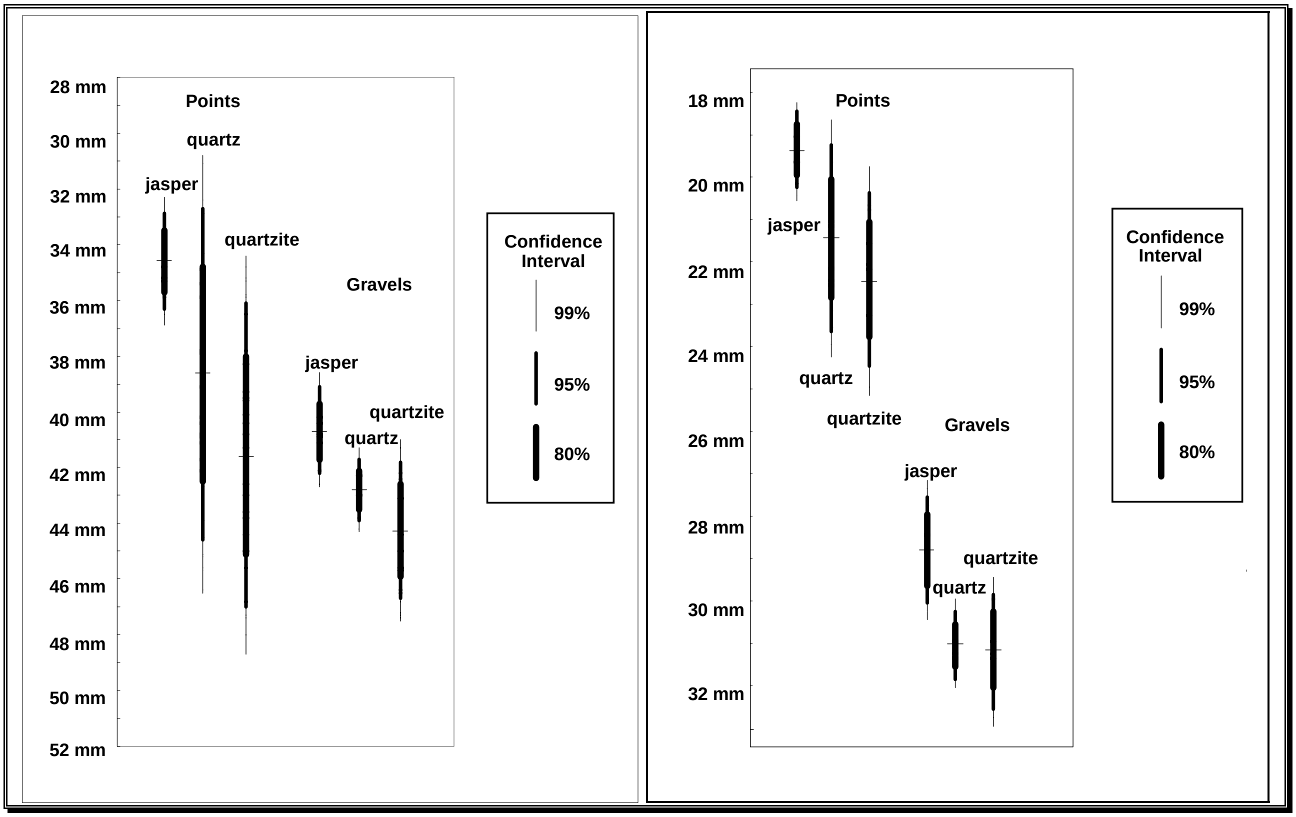


Figure 13.25 Bullet Graphs Showing Confidence Intervals for the Mean Estimates of Gravel Sizes



a) Mean Length Estimates b) Mean Width Estimates

Figure 13.26 Confidence Limits for Mean Length and Width Estimates of Gravels and Points

The differences in the means were charted in Tables 13.13 and 13.14. The greatest variation was seen in the data for jasper, where gravels were on average 15 percent larger than points. The least variation occurred in quartzite gravels, which were only 6 percent larger than quartzite points. While certain processes such as resharpening may greatly influence variations in artifact length, an overall pattern was present in the data suggesting that the majority of points were of a size range consistent with the local gravel sources.

Table 13.13 Variation in Mean Lengths of Gravels and Points

	Jasper	Quartz	Quartzite
Gravels	40.6 mm	42.8 mm	44.3 mm
Points	34.6 mm	38.6 mm	41.6 mm
Difference	6.0 mm	4.2 mm	2.7 mm

The size relationship between gravels and points was equally evident when width was measured in the same way, illustrated in Table 13.14. As noted earlier, the maximum width of a point typically occurs at the shoulder, in association with the hafting element and in an area that is less likely to be altered substantially by systematic rejuvenation of the blade. As anticipated, the proportional variation in mean width measurements between gravels and points was closer for all three raw materials than the same variation for length, ranging from 33 percent for jasper to 28 percent for quartzite. Again, this suggests a similar source for the points, and that the points are of a size range consistent with the locally available gravels. The data further imply that, assuming there is no overarching design attribute that dictates the production of points of similar width across all types and materials, some of the variation observed in length measurements was due to blade resharpening

Table 13.14 Variation in Mean Widths of Gravels and Points

	Jasper	**Quartz**	**Quartzite**
Gravels	28.9 mm	31.1 mm	31.2 mm
Points	19.4 mm	21.5 mm	22.5 mm
Difference	9.5 mm	9.6 mm	8.7 mm

Data from unhafted bifaces were also examined to determine how they were related to the process of gravel reduction. Table 13.15 tabulates of the frequency distribution of all bifaces, whole or fragmentary (n=210), by raw material type. For comparative purposes, the corresponding frequencies of gravels and projectile points are included.

Table 13.15 Frequency Distribution of Bifaces, Points and Gravel
(disproportionately high frequencies are highlighted).

Material	**Bifaces**	**Points**	**Gravel**
Chert	14%	12%	<1%
Jasper	47%	42%	14%
Quartz	20%	12%	46%
Quartzite	8%	8%	19%
Argillite	6%	16%	--
Rhyolite	5%	9%	--
Ironstone	1%	2%	--
Sandstone	--	--	18%
Other	--	--	3%
N=	210	186	1,056

Comparing point frequency with biface frequency, most materials show similar numbers. An initial inference from these data is that the majority of the bifaces were indeed related to point manufacture, and that reduction activity was common at the site, particularly focused on the local pebble and gravel sources.

The greatest differences between biface and point frequencies were in the quartz, argillite, and rhyolite categories. There was, for example, a higher frequency of quartz bifaces in relation to quartz points, contrasting with a lower relative frequency of argillite and rhyolite bifaces. Assuming that bifaces represent intermediate stages in a reduction sequence, this suggests that there was less manufacture of points on site from the latter materials. Among the gravels, cryptocrystalline materials (jasper and chert) were considerably less frequent than either points or bifaces of those materials, while quartz and quartzite were more frequent. Thus it appeared that the process of procurement from the local gravels involved specific selection criteria in terms of material type. The functional, technological, and socio-religious implications of these selection criteria will be addressed in a later report section. For the present discussion, the relative dimensions of the bifaces are of greatest interest, and descriptive statistics for whole bifaces of the majority raw materials—jasper, quartz and quartzite—are listed in Tables 13.16 and 13.17.

Table 13.16 Variation in Mean Lengths of Gravels, Points and Bifaces

	Jasper	Quartz	Quartzite
Gravels	40.6 mm	42.8 mm	44.3 mm
Bifaces	45.0 mm	52.7 mm	69.9 mm
Points	34.6 mm	38.6 mm	41.6 mm

Table 13.17 Variation in Mean Widths of Gravels, Points and Bifaces

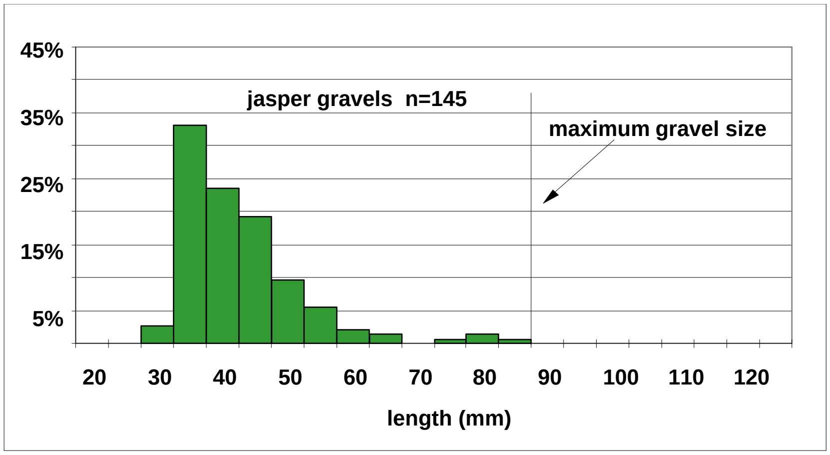
	Jasper	Quartz	Quartzite
Gravels	28.9 mm	31.1 mm	31.2 mm
Bifaces	28.5 mm	34.9 mm	44.4 mm
Points	19.4 mm	21.5 mm	22.5 mm

The mean dimensional measures of bifaces were typically larger than those of gravels. This is also seen in histograms of the frequency data, which are illustrated for jasper and quartzite (Figures 13.27 and 13.28). The peaks in biface frequencies lie to the right of the peaks in the gravel distributions, indicating that the average biface was larger than the average gravel clast. This implies that not only were specific raw materials selected from the available gravels, but the largest appropriate clasts, larger than the typical gravel size, were selected as well.

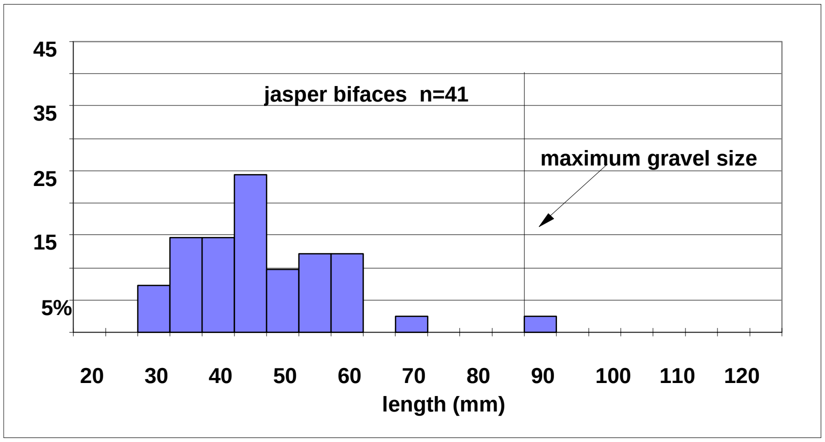
Jasper, shown in Figure 13.27, represents the most common material used in the manufacture of points and bifaces. The length ranges of both of the artifact types fit well within the dimensional range of the gravels, with the exception of one biface. On inspection, the biface did not appear to have been made from material of exotic origin, implying that the material was collected from the local gravel deposits. The artifact, then, serves as a reminder of the nature of sampling (i.e., a sample does not necessarily include the entire range of items that may exist). There are larger clasts in the Columbia Fm. than those included in the gravel samples in this study, but they are atypical, and none were captured in the current analysis.

Jasper points were consistently shorter than bifaces, conforming to the notion of a generalized reduction sequence culminating in finely finished projectile points. Quartzite was the extreme case. While the bifaces did include long specimens, the gravel sample contained cobble sized examples well beyond the length range of the largest bifaces.

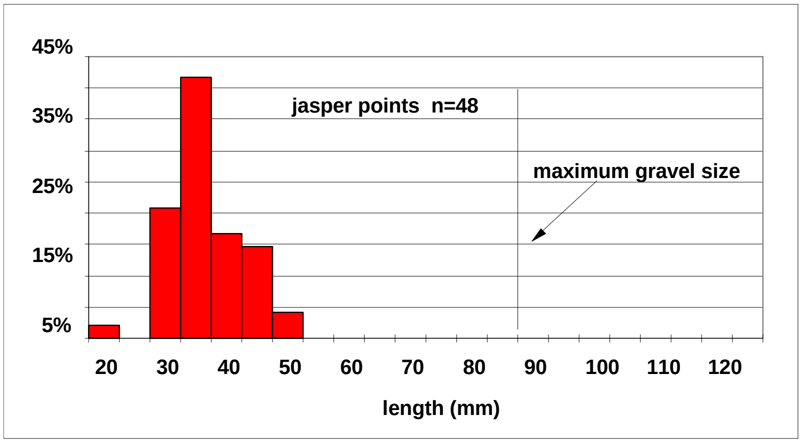
Again, the bifaces were consistently longer than the finished points. In spite of the small sample sizes, the reduction trend is evident.



a) Gravel Distribution

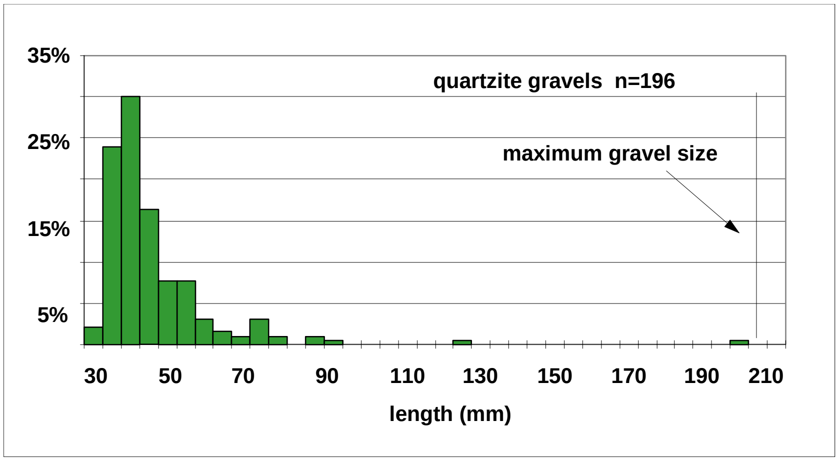


b) Biface Distribution

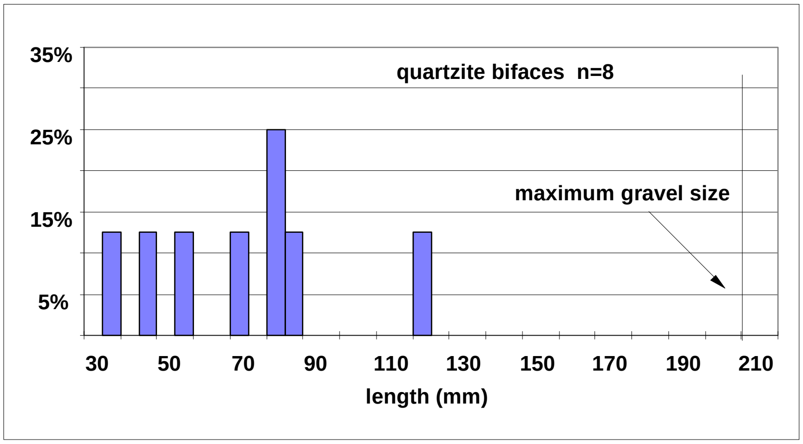


c) Point Distribution

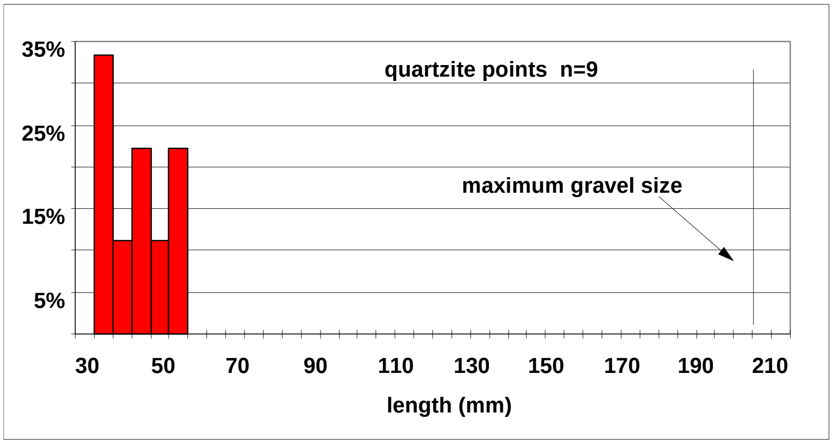
Figure 13.27 Frequency Distributions of the Lengths of Jasper Gravels, Bifaces and Points



a) Gravel Distribution



b) Biface Distribution



c) Point Distribution

Figure 13.28 Frequency Distribution of the Lengths of Quartzite Gravel, Bifaces and Points

The foregoing analyses demonstrate, at some length, is that no substantial variation was apparent in the sizes of the jasper, quartz or quartzite points from the size ranges of gravels of those materials. The differences in the sizes of the gravels of the three materials, as described by central tendency statistics, were reflected in a proportional variation in the dimensions of the points. While this does not prove that the points were made from the gravels, it does offer an objective, quantitative demonstration that the majority of the points were of a size range consistent with that expected if they were manufactured from the local gravels.

Resharpening: Measuring Artifact Re-use and Its Effects on Morphology

A major factor in the life-cycle of a projectile point, and one which can significantly affect the form of the artifact as seen archaeologically, is edge wear arising from use and resharpening. This alteration of form can result from slow processes of attrition through constant use, or from quicker, more catastrophic effects, such as a snap break or impact fracture and ensuing efforts to reproduce a usable edge. As noted earlier, some researchers feel that many of the forms recognized in archaeological contexts are actually the result of tool refurbishing, not original design (Frison 1968; Dibble 1995). To investigate the effects of resharpening on the projectile points from Hickory Bluff, several approaches were taken that focused on description of the shape and relative size of the blade. Note again that the study consciously disregarded temporal periodization, investigating instead the overarching effects of use on artifact shape and the subsequent implications for point typology in general.

Tip Angle

One of the assumptions made at the outset of the analysis was that the original intent of the artisan in crafting a point was to produce a symmetrical piece, one in which both the blade and hafting element would exhibit bilateral symmetry. The notion of symmetry is in part functional—as their general name implies, many of these artifacts were in fact used as projectile tips, and their flight characteristics and piercing capabilities would have been enhanced by symmetrical form. But symmetry is also a matter of less techno-functional concerns such as aesthetics or style. In addition, there may be metaphysical or symbolic aspects behind symmetrical form. The notion of balance is a universal cultural phenomenon, seen in belief systems as diverse as the Navajo philosophy of harmony, the Taoist principle of yin and yang, the Greek idea of moderation, and our own concepts of even-handed justice and the balance of nature. We are, after all, bilaterally symmetrical ourselves, as are almost all higher life forms. Thus the idea of symmetry of form is deeply ingrained in the structure of human symbolism.

In contrast to the symmetry of original form, morphology resulting from the resharpening of lithic artifacts may be somewhat less rigidly prescribed. The rejuvenation of a lithic blade edge can be a relatively expedient measure, carried out in a more opportunistic or practical manner than was original manufacture. And thus, style may often figure less importantly in the process. Assuming the preceding to be valid, blade asymmetry may be one of the hallmarks of reworking.

To quantify blade symmetry in the Hickory Bluff points, the angle formed by the tip of each complete point was measured in two halves, and the difference between the angles was tabulated as a proportion of the whole (Figure 13.29). The reference plane for measuring the angles was assumed to be a bisection line drawn along the main orientation of the hafting element. In choosing the hafting element as the reference plane, we are recognizing the haft as the most important part of the artifact in terms of its detail and complexity of form. And as noted above, the hafting element tends to sustain less wear or damage through use, and thus undergoes less reshaping over time. And so for the present study, unless there was obvious damage or reworking in this area, the hafting element was assumed to approximate the original orientation of the artifact, and measurements were taken relative to its centerline. Figure 13.30 shows a range of proportional variations, beginning with a nearly symmetrical blade, exhibiting a tip angle variation of 5 percent, and extending to a blade with more than 20 percent angle variation. As is apparent, asymmetry becomes discernible as the proportional difference approaches 15 to 20 percent.

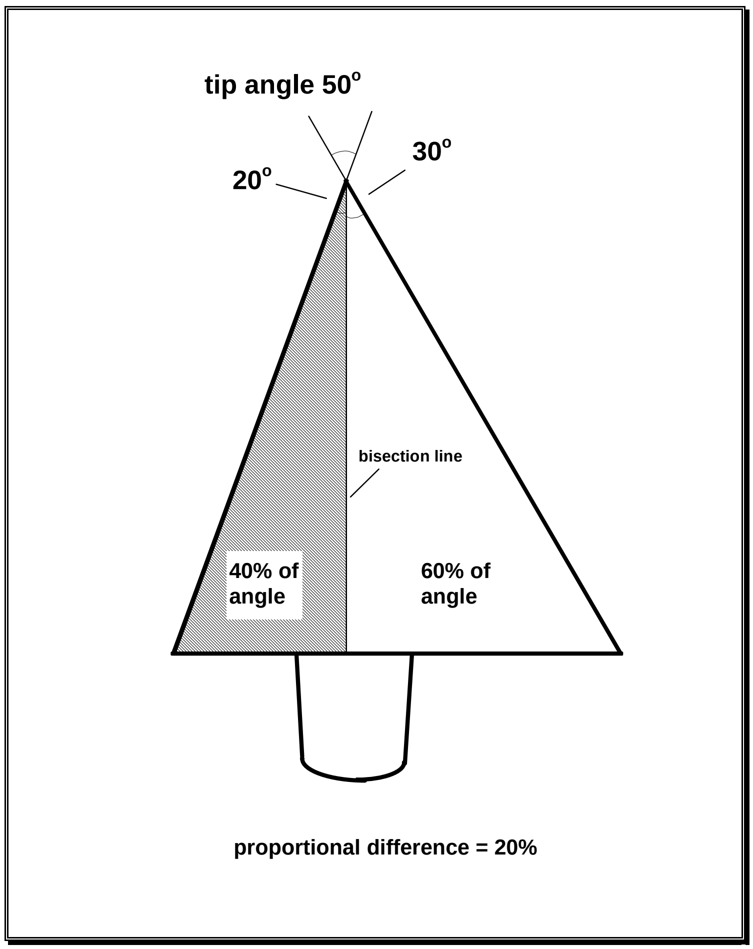


Figure 13.29 Determination of Proportional Difference in Tip Angle Halves

Figure 13.31 is a histogram of the frequency distribution of tip angle proportions for all of the points in the Hickory Bluff collection that were sufficiently complete for the measurements to be taken (n=169). Based on analysis of the previous illustration, showing the shapes of blades with increasing angle variations, the first three intervals in the histogram, left of the leftmost

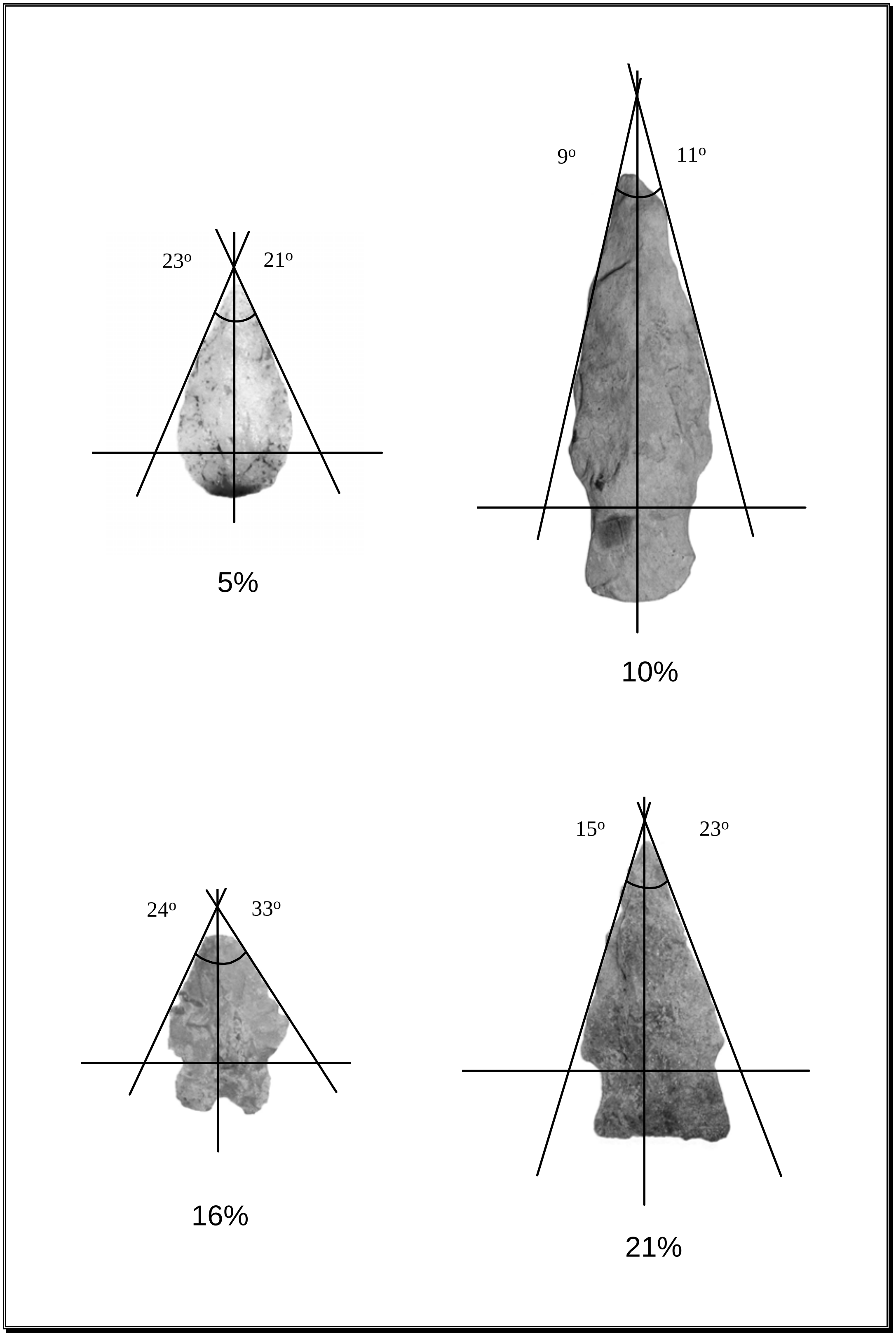


Figure 13.30 Proportional Differences Between Tip Angle Halves

dotted line and representing differences of 5, 10 and 15 percent, were considered to describe points that generally appear symmetrical. To the right of the second line, where proportional differences are greater than 30 percent, points appear distinctly asymmetrical. As noted, symmetrical points probably represent a design effect—artifacts purposely formed in a balanced, regular shape. Asymmetrical points may, conversely, represent extensive rejuvenation, with little regard to form other than in its most practical aspect—i.e., the most efficient maintenance of a long, sharp cutting edge. The intermediate area on the chart, between 15 and 30 percent, is more ambiguous, and likely represents both incompletely or possibly, inexpertly crafted points, along with points showing relatively little expedient edge rejuvenation.

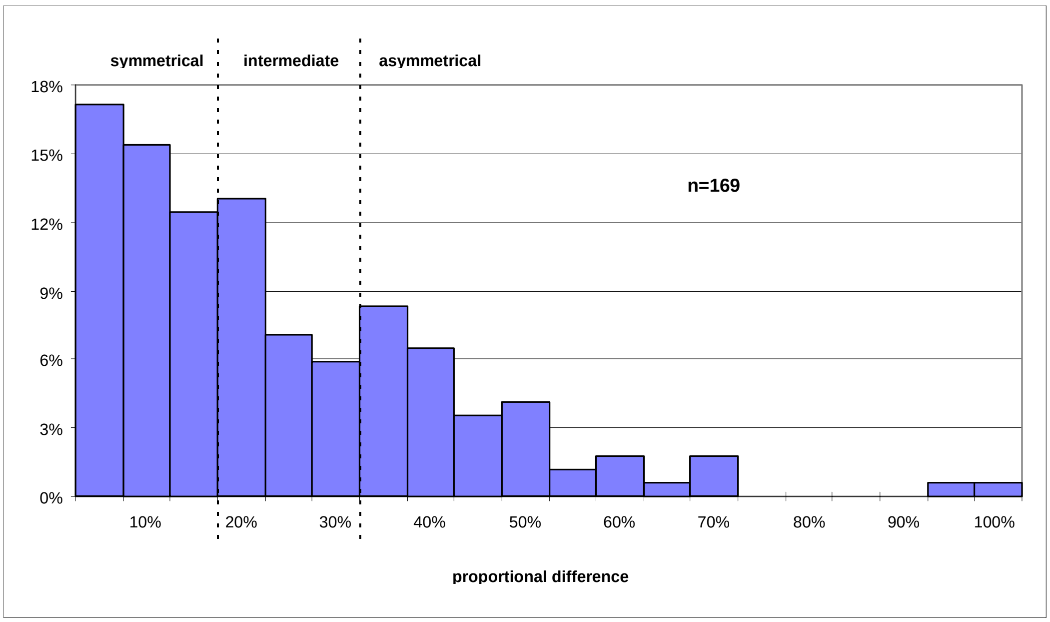


Figure 13.31 Difference in Tip Angle Proportions as a Description of Symmetry

The purpose of this analysis, using the entire measurable collection without controls for variables such as raw material or haft type, was to observe the overall trend in the database in terms of the validity of the symmetry measurement. It was expected that artifact refurbishing would be common at an extensive occupation site such as Hickory Bluff, and that blade asymmetry would likewise be common. And in fact this appears to have been the case, since over one-half of the points (55 percent) bear blades with tip angle differences of more than 15 percent, suggesting increasingly prominent degrees of asymmetry.

Blade Edge Shape

Additional attributes were recorded on the points in the collection for potential correlations between blade form and artifact reworking. On the assumption that the shape of the blade edge in plan, or silhouette, may provide further information about the amount of use and resharpening that a tool has withstood, a series of blade shape attributes was recorded for each artifact. Four general blade edge shapes were recognized in the study: straight; convex; concave; and complex; the latter being an edge that shows variation along its length, implying more than one episode of shaping. Several of these edge shapes are illustrated in Figure 13.32, arranged in two groups: simple, those showing the same shape along both edges; and complex, showing combinations of edge shapes.

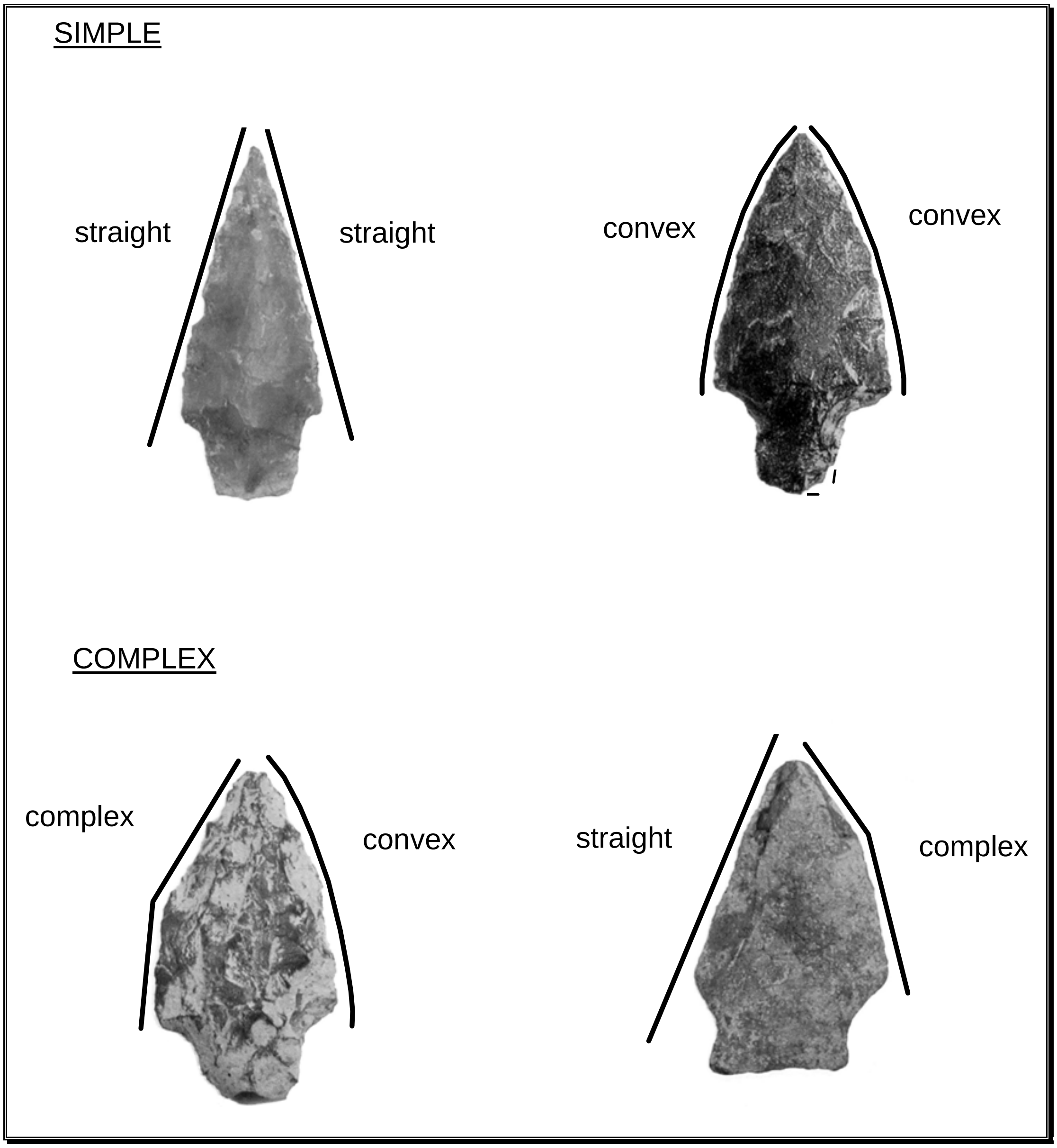
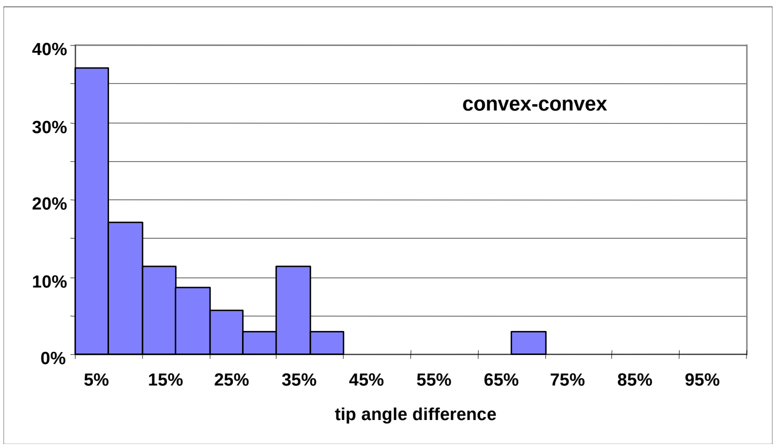


Figure 13.32 Blade Edge Shape Combinations

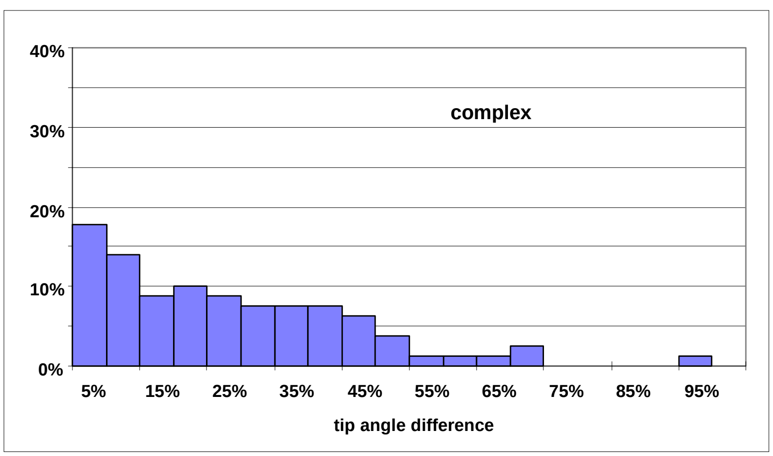
Again assuming that the original intent of the artisan was to produce a symmetrical tool form, it was proposed that specific combinations of blade edge shape would indicate the presence or absence of resharpening. For example, a balanced combination of convex/convex edges or straight/straight edges might be more likely the result of original design and thus be associated with symmetrical blades, while combinations that include at least one complex edge might indicate reworking and be associated with asymmetrical blades. To investigate this notion in the Hickory Bluff collection, blade edge shapes were tabulated and the results compared with tip angle data. It was assumed that there would be a positive correlation between symmetry and edge shape—the more asymmetry exhibited in the angle of the blade tip (i.e., the greater the proportional difference between the halves of the blade), the more likely the blade would exhibit mixed edge shapes.

When graphed as proportional variations in tip angle, the simple edge combinations – convex-convex, for example (Figure 13.33a) – showed frequency distributions heavily skewed to the left. This distribution indicates that most of the tip angles on these points bore little proportional difference (i.e., the blades appeared roughly symmetrical).

In contrast, the distribution of points with complex blade combinations (Figure 13.33b) is flatter and weighted more heavily to the right, due to a considerably lower frequency of occurrence of balanced tip shapes (and in particular, those with a proportional variation of 5 percent or less), as well as a higher incidence of markedly asymmetrical shapes (with a proportional variation of 3 percent or greater).



a) Simple, Convex-Convex Blade Edge Combinations



b) Complex Blade Combinations

Figure 13.33 Frequency Distributions of Blade Angle Proportions for Selected Blade Edge Shape Combinations

The difference in the two distributions was found to be statistically significant (Kolmogorov-Smirnov Two Sample results, p=0.03). Assuming that the preceding data on blade shape are valid, we can state that the complexity of blade edges does correlate with blade symmetry in the present collection of points. That is, both of these variables suggest deviation from a planned, balanced artifact design that is presumed to be the original state of an artifact immediately following manufacture. This deviation is further assumed to be the result of use and the retooling or rejuvenation of the working edge of the artifact.

Blade Length versus Haft Length

Having reasoned that there is an apparent relationship between blade symmetry and blade edge shape that may indicate reworking, a set of dimensional variables against which to measure the observed correlations, the ratio of blade length to haft length, may be introduced. The assumption behind recording this ratio again involves the relative amount of wear that the two parts of the artifact receive. As noted previously, the hafting element of a point typically experiences little wear, thus, it requires comparatively little refurbishing. In contrast, the blade may receive extensive wear, and so becomes the focus of resharpening activity. As the use-life of the artifact is extended, and edge attrition or damage and subsequent resharpening continue, the length of the blade in relation to the hafting element should decrease. This decrease should be measurable in a reduction in the blade-to-haft-length ratio.

The ratios of blade length-to-haft-length for all points in the collection for which both measurements could be taken are displayed in Figure 13.34, as an indication of the overall variability in the database. The range is 0.93 to 6.40, indicating points in which the blade is slightly shorter than the hafting element to blades over 6 times as long as the haft. Except for a single outlier, the distribution is close to normal. That is, for most of the points (over 50 percent of the collection) the blade is two-to-three times as long as the hafting element, and there are roughly equal numbers with blades proportionately longer and shorter than the average.

This distribution implies variation in the blade:hafting element ratio that is statistically random throughout the collection. This type of unpatterned diversity suggests that a variety of influences may affect blade length, primary among which are presumably style, raw material effects, and resharpening processes.

To examine the amount of correlation present between point size and the degree of reworking indicated by the proportional blade length, scatterplots of haft length against the blade:haft-length ratio were constructed. Were large points in the collection, for example, more likely to have short blades than small points? In this case, artifact size was expressed by haft length. It is assumed that the length of the haft more closely approximates the original size of the artifact, ignoring as previously the effects of style on the blade:haft ratio. Overall artifact length would be an inappropriate measure, since it is presumably affected by the phenomenon being investigated, the change in blade length due to resharpening.

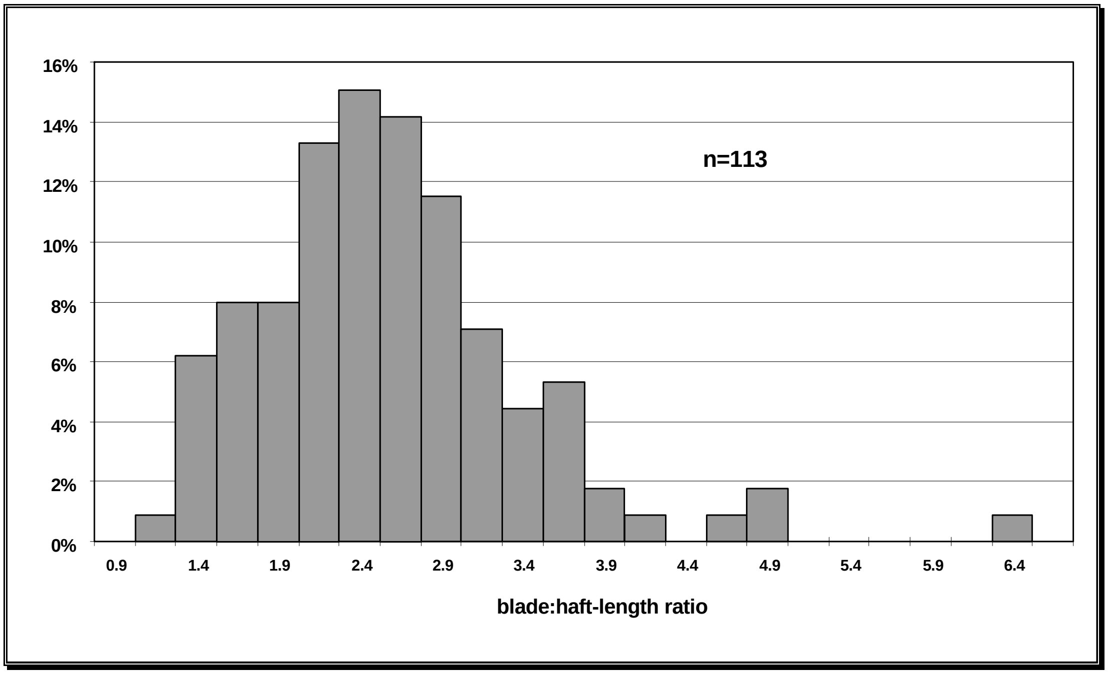


Figure 13.34 Frequency Distribution of Blade: Haft-Length Ratios for All Measurable Points

In advance of plotting the data, several expected outcomes for different type/reworking scenarios were listed for comparison against the results of the analysis:

- if a single type were present and none of the artifacts were reworked, the group would exhibit a relatively narrow range of haft lengths and a narrow range of blade:haft ratios (all the points should generally look the same).

  – expect little correlation and a tight cluster on the scatterplot

- if a single type were present and the artifacts were extensively reworked, the group would display the same narrow range of haft lengths, indicative of a single type, but a wider range of blade:haft ratios

  – expect a vertically dilated cluster (assuming the ratio is graphed on the y-axis), with the distance along the axis corresponding to the degree of reworking

- if single type were present, not reworked, but with raw material variation important in determining size, the points would be proportional within the size range variation of the raw material nodules or clasts, thus, there would be a range of haft lengths with the blade:haft ratios remaining fairly constant

  – expect a horizontal cluster (assuming haft length is graphed on the x-axis)

- if multiple types were present, none reworked, a potentially wide range of haft lengths would be expected, corresponding to a range of types and a similarly wide range of blade:haft ratios

  – expect a dispersed cloud plot with no correlations

- if multiple types and extensive reworking were present, the same range of haft lengths would be expected as above, dependent on the range of types, but with a more limited range of blade:haft ratios

  - expect a cloud plot, but less dispersed and lower on the y-axis, depending on the amount of reworking

Figure 13.35 illustrates the plot for the entire Hickory Bluff collection, and it represents the type of cloud plot anticipated from a range of influences on the blade:haft ratio—multiple types, a range of raw material forms, and variation in the amount of reworking. As a regression line calculated for the data indicates, there is no linear relationship between haft length and the ratio of blade and haft length. That is, points with longer hafts do not necessarily have longer or shorter blades in relation to the hafting element. The chart, then, reinforces the notion of general, seemingly random diversity in blade and haft proportions, thus implying a variety of influences on artifact shape.

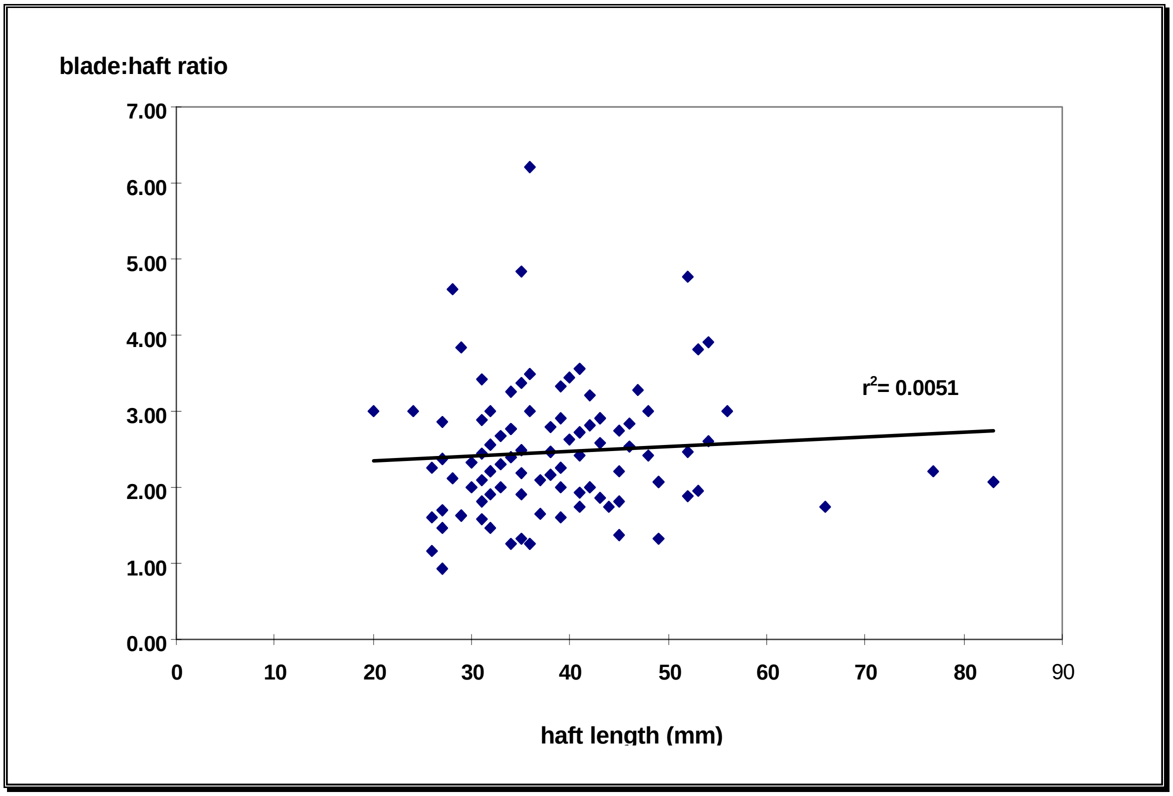


Figure 13.35 Scatterplot of Haft Length vs. Blade:Haft Ratio Showing the Lack of Linear Correlation

The scatterplots for specific haft forms also emerge as cloud plots that, on the basis of the scenarios listed above, suggest wide variation in the charted variables. Yet most of the plots are elongated and directional, with distinct slopes indicating correlations between artifact size (haft length) and relative blade length (blade:haft ratio). This type of result suggests less random patterning in the data. Contracting stemmed points, for example (Figure 13.36), showed a moderate degree of correlation. With two outliers removed (n=21), the correlation coefficient was relatively large: r=0.69, with F=17.75, p=0.00, a finding of significant (non-random) results. Approximately one-half of the variability in the blade:haft ratio (r^2 =0.48) is explained by or associated with haft length.

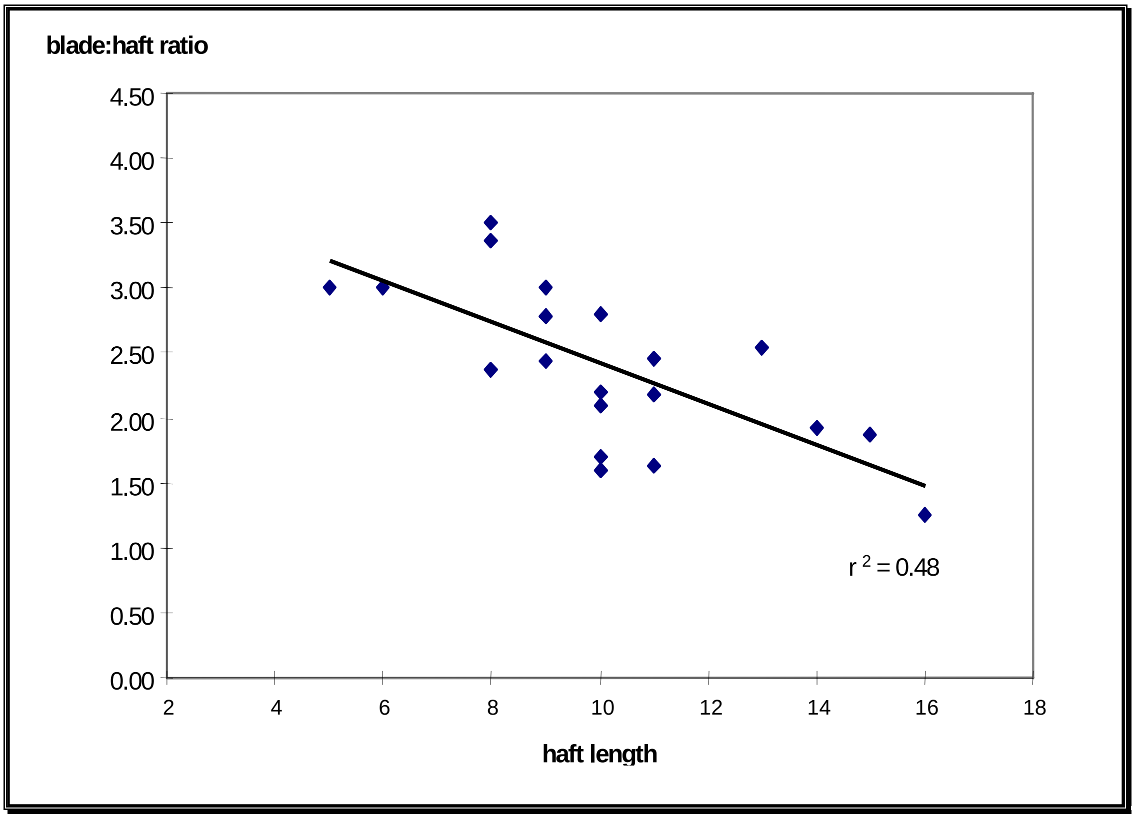


Figure 13.36 Relative Haft Length for Contracting Stemmed Points

Similar results were obtained for straight-stemmed points (Figure 13.37) with n=45, r=0.66, F=34.06, p=0.00. The results are significant with 44 percent of the variability in the relative length of the blade explained by haft length or overall artifact size (r^2 =0.44).

The relationship for side-notched points was similar (Figure 13.38). With a single, unrepresentative outlier removed (n=22), a moderate correlation is demonstrated, r=0.75, F=26.27, p=0.00. Again, these are significant results, with almost 60 percent of the variability explained (r^2 =0. 57).

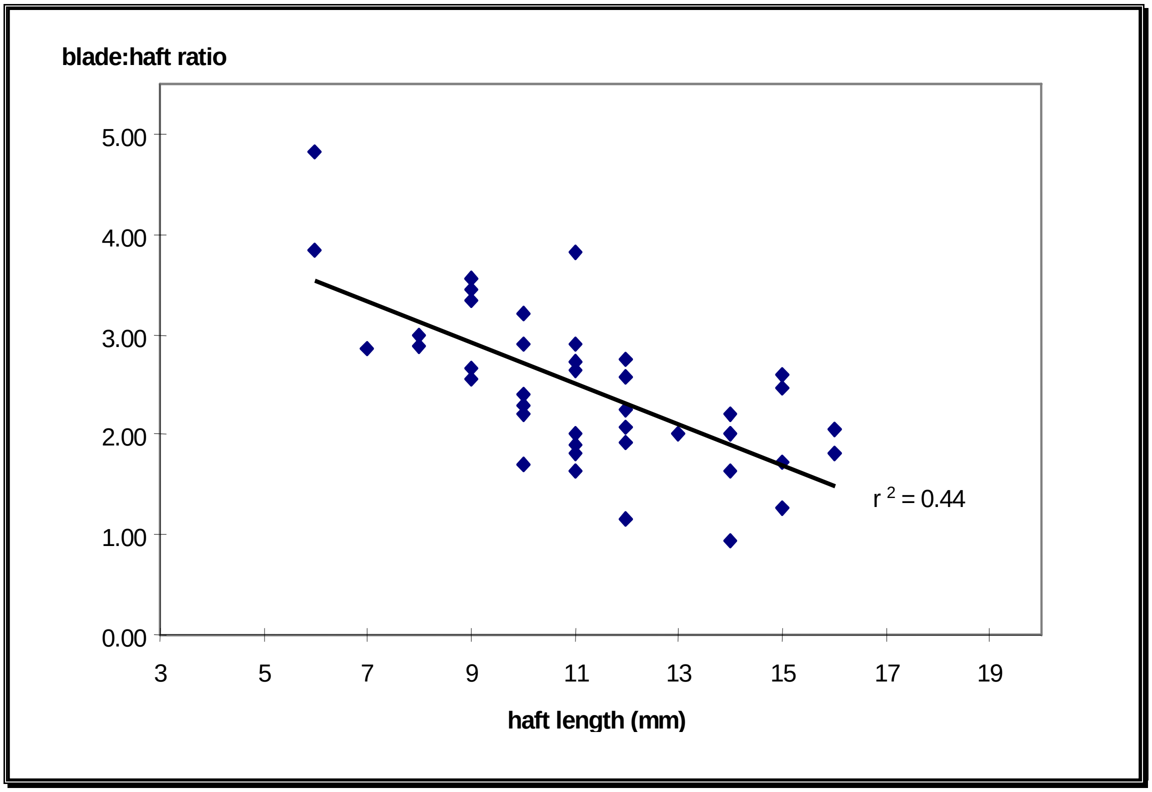


Figure 13.37 Relative Haft Length for Straight-Stemmed Points

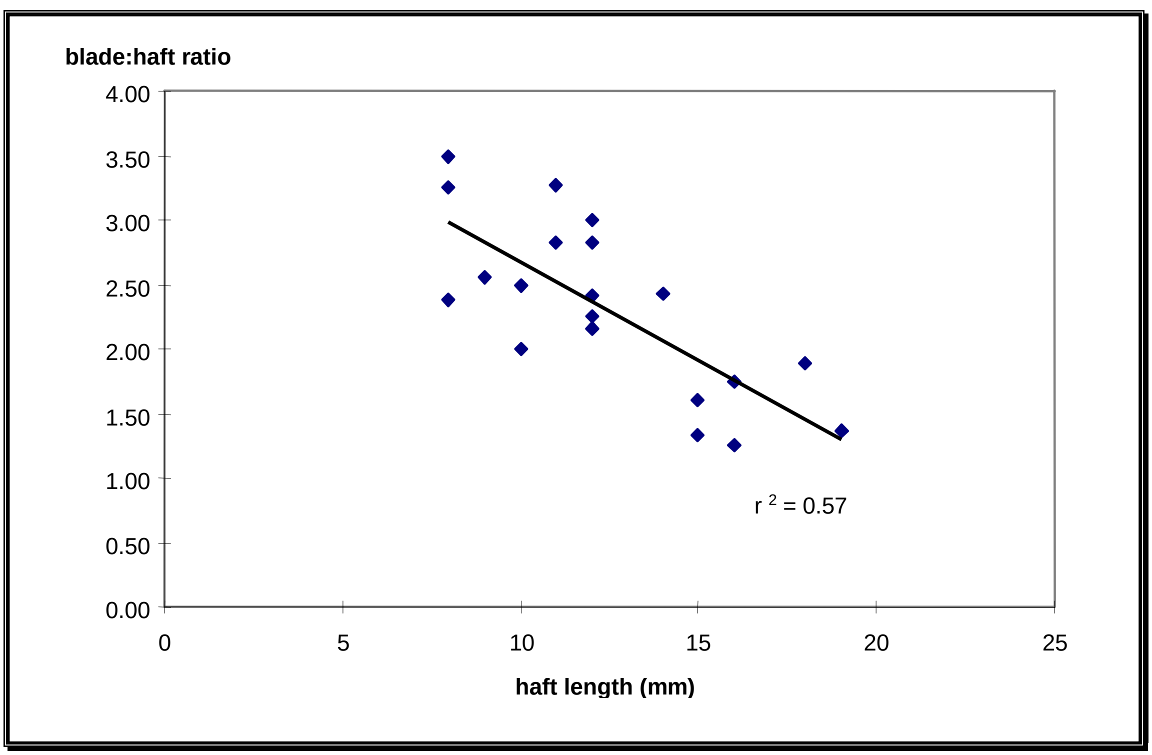


Figure 13.38 Relative Haft Length for Side-Notched Points

Of particular interest here is the fact that in all cases, the correlation was negative. While the strength of the relationship was not overwhelming in any instance, the data do describe a trend in which, as haft length increases, the ratio of blade length to the length of the haft decreases. That is, larger points (or those with longer hafts) tended to have shorter blades in relation to the haft, regardless of haft type. Such a proportion could be an original design characteristic of the artifacts, yet because the effect is seen across all haft types, the data suggest that reworking was a major influence on point length throughout the collection. Where the blade:haft ratio is low (short blade in relation to haft), the likelihood of reworking is presumably greatest. The opposite ends of the trendlines (long blade in relation to haft) would by implication represent relatively unatrophied tool forms (i.e., closer to original form). Incidentally, this evidence of reworking across the various haft types supports a major hypothesis about site use: that it was a large, intensively occupied habitation site at which a large number of exhausted tools would be expected.

Blade Symmetry and Blade:Haft Ratios

Assuming that the patterns seen in the relationship of artifact size and blade:haft ratios are indeed associated with reworking, correlations should be present with the blade shape attributes that were proposed earlier as indicators of resharpening. To test this notion, the haft length vs. blade:haft ratio plots were redrawn with the artifacts grouped by blade symmetry and blade edge shape variables.

First, the data were grouped by the degree of asymmetry measured in the blades. Were the correlation between relative blade size and blade symmetry positive, the artifacts with the most symmetrical blades (the smallest proportional differences in tip angle, <15 degrees) should lie highest on the chart (indicating long blades), these variables together providing evidence of little or no reworking. Conversely, artifacts with the largest tip angle differences (>31 percent) should lie low on the chart, indicating shortened and asymmetrically reworked blades.

Only among contracting stemmed points was there evidence of patterning appropriate to this hypothesis. The distribution (Figure 13.39) in fact showed some separation between points with large and small tip angle differences, as 80 percent confidence ellipses drawn around the clusters help to demonstrate. But the pattern was opposite to that expected—the points with the least apparent asymmetry (lowest tip angle differences) tended to have shorter blades in proportion to the hafting element (lying lowest on the y-axis). Little or no separation was noted among side-notched points or straight-stemmed points, similarly grouped by the proportional difference in tip angles (Figures 13.40 and 13.41). There are several possible explanations for the lack of anticipated correlation. For example, more than one stylistic or morphological type may be present among the plotted artifacts, each with a different original blade:haft ratio. Alternatively, the blade attributes may have been affected by more than one resharpening pattern, based on variations in functional or stylistic criteria. Both of the attributes examined here—blade

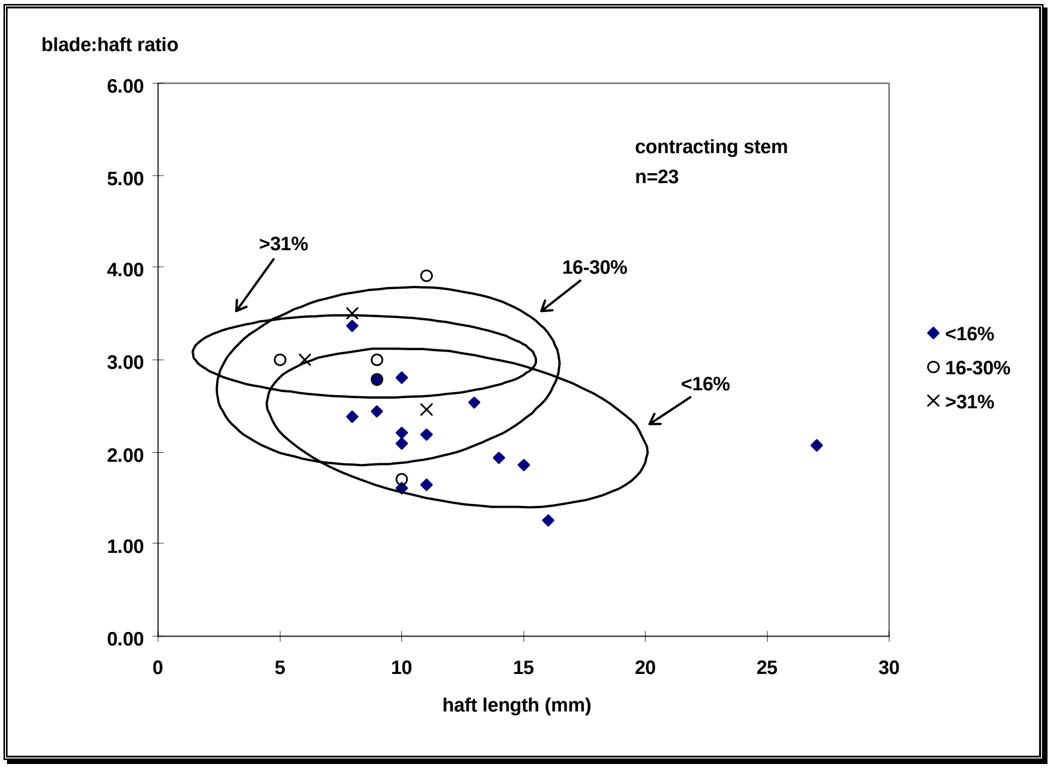


Figure 13.39 Relative Haft Length for Contracting Stemmed Points Grouped by Tip Angle Proportion

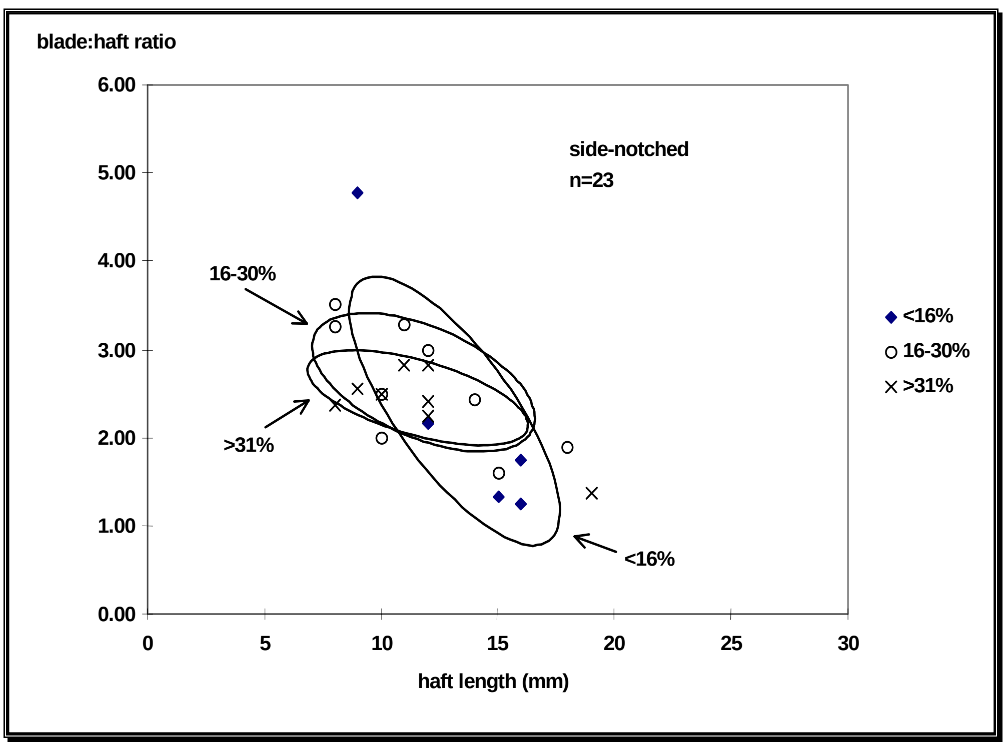


Figure 13.40 Relative Haft Length for Side-Notched Points Grouped by Tip Angle Proportion

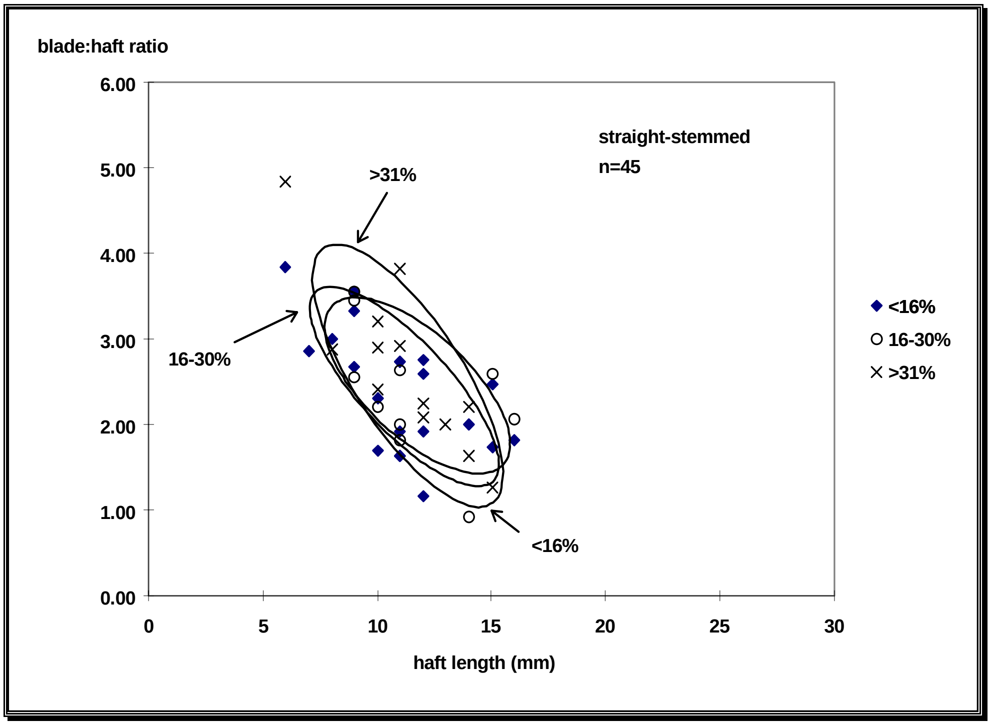


Figure 13.41 Relative Haft Length for Straight-Stemmed Points Grouped by Tip Angle Proportion

asymmetry and a small blade:haft-length ratio—are, in fact, probably valid indicators of resharpening to some extent. Yet the lack of clear correlations in the data studied may indicate that the complexity of the relationship between the two attributes is too great to be displayed in simple graphs.

While not strong, the blade symmetry results implied the opposite to predictions about the relationship between the length of the blade relative to the haft and evidence of reworking. They suggested that points with short hafting elements had been reworked less than those with long hafting elements. This may make some sense, if shorter hafting elements imply smaller points, which can be resharpened less frequently, because there is less blade present to refurbish. Smaller blades may thus tend to show less asymmetry from reworking. An alternative inference is that the smaller points were symmetrically resharpened, either due to functional or stylistic reasons.

Blade Edge Shape and Blade:Haft Ratios

Taking the relationship between function and the amount and form of blade resharpening a step further, blade edge shape was considered in relation to artifact size. Part of the difficulty in discovering evidence of a correlation between asymmetry and blade rejuvenation may lie in the fact that there were probably differences in the manner in which artifacts were reworked depending on their function. That is, for a cutting implement, maintenance of a long cutting edge is important. Assuming that style and other non-technological considerations allow deformation of the blade shape to occur, a cutting tool may more often be sharpened along one edge, resulting in an asymmetrical appearance. In contrast, a piercing tool, such as a projectile tip, will be more useful with a bilaterally symmetrical form, and thus dulled or broken points may more often be reworked on both blade edges, relatively symmetrically. In this latter case, edge complexity may be a better indicator of resharpening.

The plots of haft length vs. blade:haft-length ratio were redrawn with the data grouped by blade edge shape. The results were similar to the tip angle plots, in that for each haft type—contracting stem, side-notched, and straight-stemmed—there was considerable overlap in the scatterplot clouds. In only one case, straight-stemmed points, was there partial separation, as rendered by 80 percent confidence ellipses in Figure 13.42.

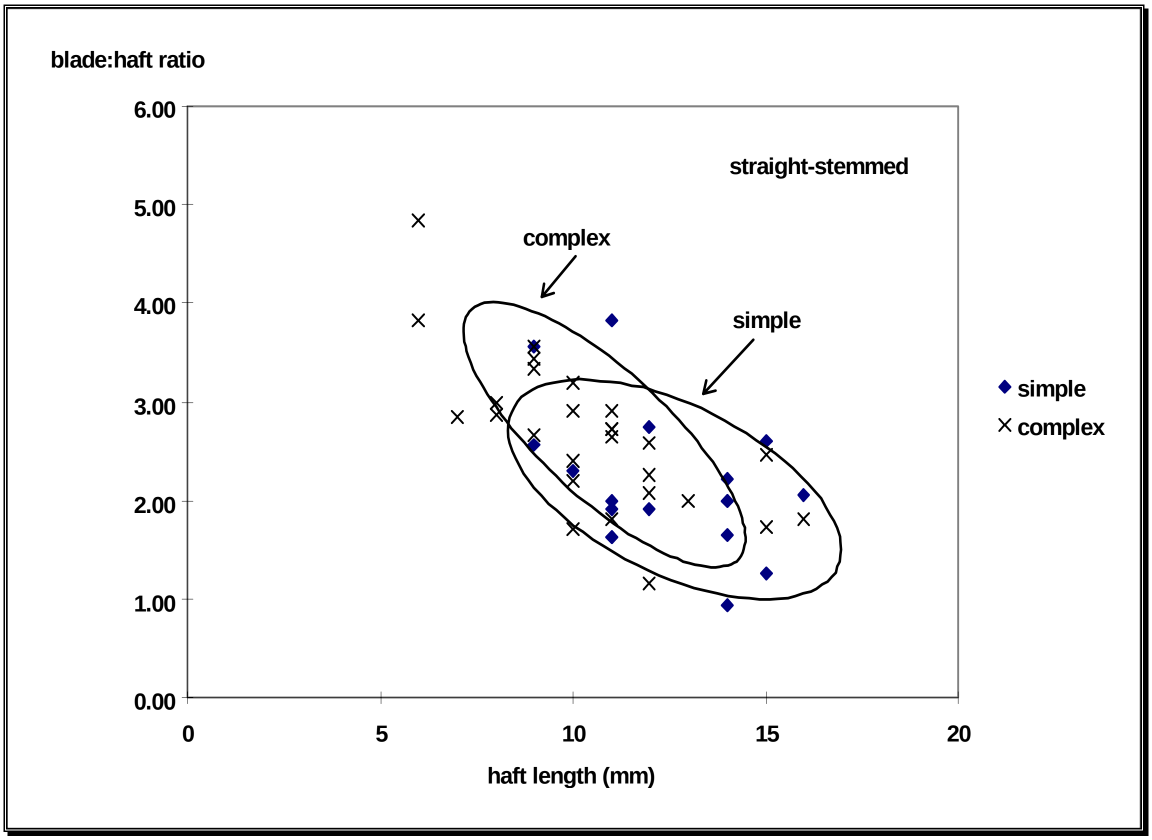


Figure 13.42 Relative Haft Length for Straight-Stemmed Points Grouped by Blade Edge Shape

As an additional test of the data, a slightly different measure of relative blade size—the length-to-width ratio of the blade—was examined using a similar set of scatterplots grouped by blade morphology (tip angle and edge shape). This ratio was chosen on the assumption that as the blade of a point is resharpened, it will tend to grow shorter more quickly that it becomes narrow. That is, the maximum width of a point typically occurs at the shoulders, an area which usually undergoes little reworking. As resharpening continues, the length-to-width ratio of most points should decrease. But when plotted, no correlation could be demonstrated between haft length (as an indication of overall artifact size) and the length:width ratio of the blade. Figure 13.43 illustrates the results of a sample scatterplot—of straight stemmed points with the data grouped by tip angle proportion, which depicts blade symmetry. The overlap among the confidence ellipses is nearly complete. Neither were there correlations with blade edge shape. It seems, then, that the influences on the proportional width of these points was not related to the attributes assumed to be indices of reworking in this study.

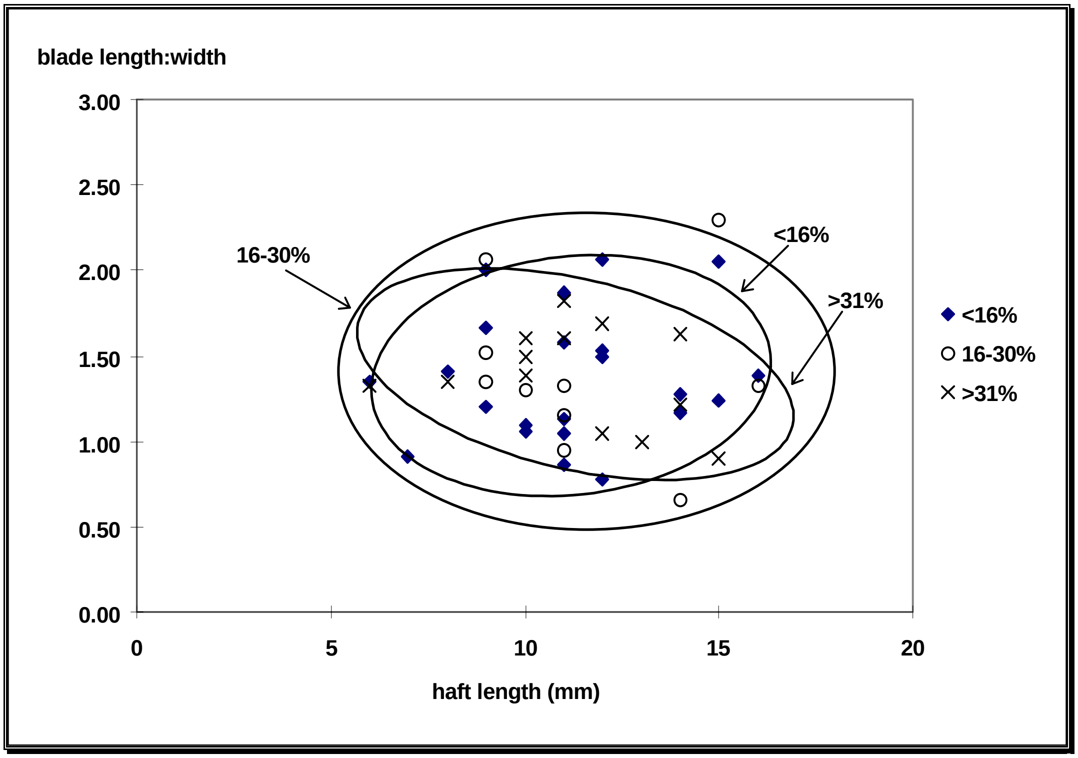


Figure 13. 43 Relative Blade Width for Straight-Stemmed Points Grouped by Tip Angle Proportion

Summary

Overall, the patterns anticipated at the start of this investigation, in terms of correlations between artifact shape and reworking, were not present in the data. It was expected, for example, that points exhibiting greater asymmetry and edge shape complexity would also exhibit smaller blade:haft ratios, all implying changes in original morphology due to use and reworking of the blade. In the event, the various analyses indicated that both of the blade shape attributes tended to be, if anything, negatively correlated with blade:haft ratios. This suggests that the relationship between the variables is more complex than supposed in the preliminary hypotheses.

Several lines of evidence suggested that the smaller points in the collection and in particular, small straight-stemmed points bore less evidence of reworking. Points with large hafting elements tended to exhibit proportionately smaller blades. Ignoring design criteria as a factor, this suggested that the larger points had been resharpened more heavily than the small points in the collection. In addition, smaller points tended to have more symmetrical blades and simpler blade edge shapes. Together, the findings suggested different functional and rejuvenation scenarios for large and small points. Large points, for example, may have been more frequently used as cutting tools, as noted above. Relative ease of replacement, i.e., easy access to the gravels from which smaller points were made, may have been a factor in the decision to resharpen or replace worn or broken items. The lessened ability to work down the blade of smaller points also may have been a factor. And finally, there may have been symbolic or metaphysical aspects involved that cannot be detected directly through archaeological analysis: small points may have been single-use artifacts that simply were not resharpened.

Analysis Using Conventional Types

Since the analyses described above appeared to discriminate between large and small stemmed points, several plots were redrawn using specific conventional type groups, as developed on the basis of subjective criteria and described in Section 12.0. Comparing data from two very different looking point types—large, relatively thin Lackawaxen stemmed points and smaller Woodland I stemmed points—potentially significant patterns were observed. Although the data in scatterplots of haft length vs. tip angle proportion for both types are widely distributed, points typed as Lackawaxen tended to have longer hafting elements and more asymmetrical blades than points typed as small stemmed points (Figure 13.44).

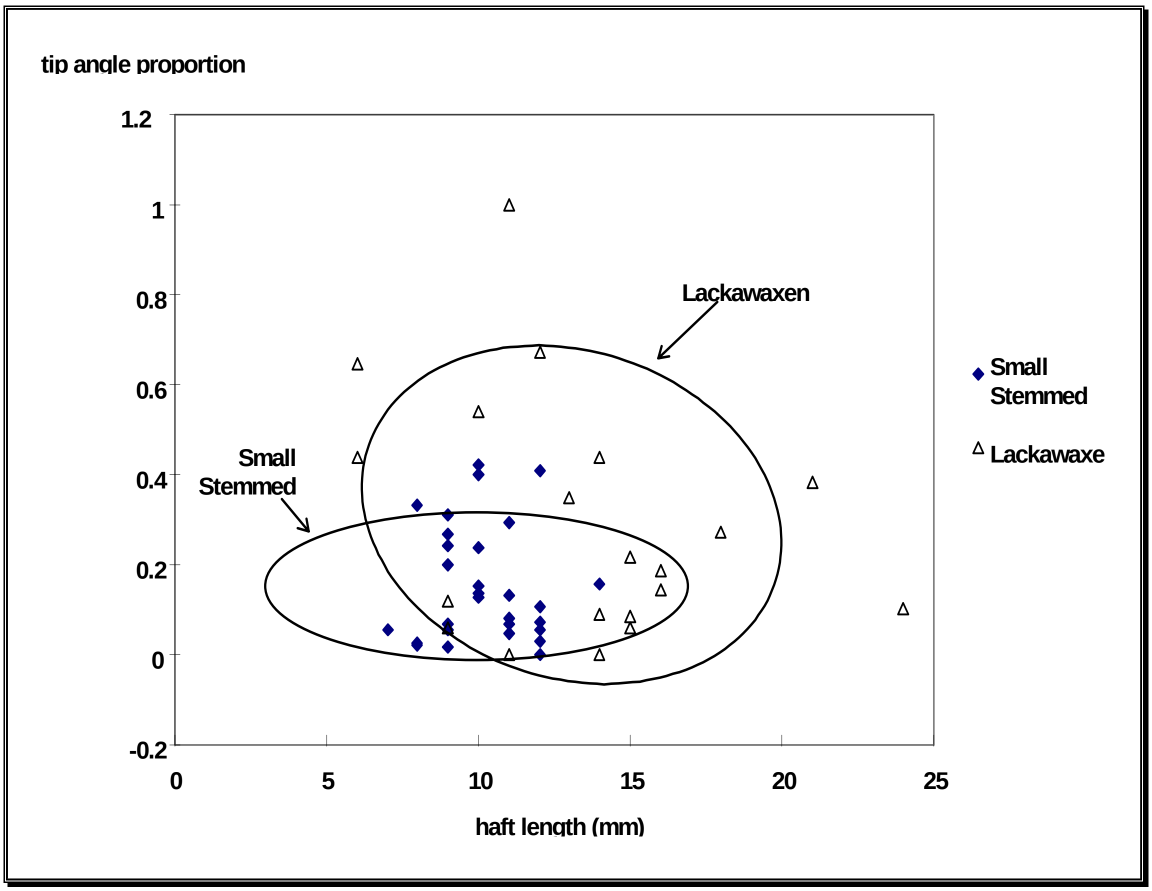


Figure 13.44 Haft Length vs. Tip Angle Proportion for Small-Stemmed and Lackawaxen Points