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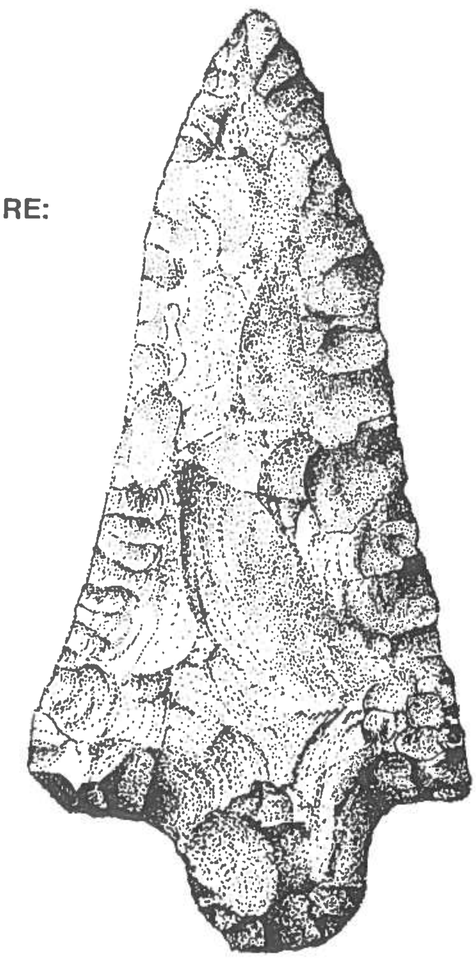

ANALYSIS OF "BROADSPEARS" FROM DELAWARE: FORM, FUNCTION, AND DISTRIBUTION

by

Jay F. Custer and Glen S. Mellin

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ANALYSIS OF "BROADSPEARS" FROM DELAWARE: FORM, FUNCTION, AND DISTRIBUTION

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Ever since the publication of John Witthoft's (1953) important article "Broad Spear Points and the Transitional Period Cultures", archaeologists have noted the distinctive nature of the broad-blade bifaces which were manufactured and used in the Middle Atlantic region between 2000 B.C. and 1200 B.C. Because these artifacts look so different from the chipped stone tools that came before and after them, they have attracted numerous varied archaeological interpretations. "Broadspears" have been part of hypotheses concerning migrations (Turnbaugh 1975), trade and exchange (Custer 1984a; Stewart 1984a), cultural "traditions" (Kinsey 1972:345-349), and specialized tool functions (Dunn 1984; Cook 1976; Staats 1986; Kraft 1986). Unfortunately, many of these hypotheses, and arguments among the archaeologists involved, have been based on little or no data. In this paper we will address the issues of broadspear form and function by analyzing a sample of 599 broadspears from throughout Delaware. The distribution of sites with broadspears will also be considered.

BIFACE FORM AND FUNCTION

A series of articles have addressed the issue of broadspear form and function for more than 30 years. Witthoft (1953) suggested initially that they were spearpoints and went as far as to suggest that they would have functioned as fish spears. Other researchers (Kinsey 1972:426) noted the high incidence of resharpening and suggested that many "broadspears" would have functioned as knives or cutting tools. Similar arguments have been advanced by other researchers (Cook 1976; Custer 1984b) without the benefit of original supporting data, although Dunn's (1984) analysis of a sample of 75 Perkiomen points clearly showed that edge wear indicative of knife use characterized a majority of the specimens. On the other hand, Staats (1986) and Kraft (1986) have tried to counter the arguments of Cook, Dunn, and Custer by citing specific counter examples to their data and analyses. However, neither Staats nor Kraft provide any comprehensive analyses to support their arguments.

Our purpose in this paper is to analyze a large sample of broadspears with regard to their form and function. A total of 599 broadspears were studied, and the sample represents all of the broadspears from Delaware curated at the Island Field Museum. In this manner, a variety of broadspear types (Figures 1-4) of various raw materials from several different areas were studied.

By far, this is the largest and most varied sample of broadspears analyzed to date. The specific broadspear varieties studied are Savannah River, Long, Lehigh/Koens-Crispin, Perkiomen, and Susquehanna. Figures 1-4 show samples of these broadspear varieties from Delaware. The dates of these artifacts would range between 2000 B.C. and 1200 B.C. (Custer 1984c:79-82; Kinsey 1972:345-349, 425-430) with Savannah River, Long, and Lehigh/Koens-Crispin varieties (Figures 1 and 2) predating the Perkiomen and Susquehanna varieties (Figures 3 and 4).

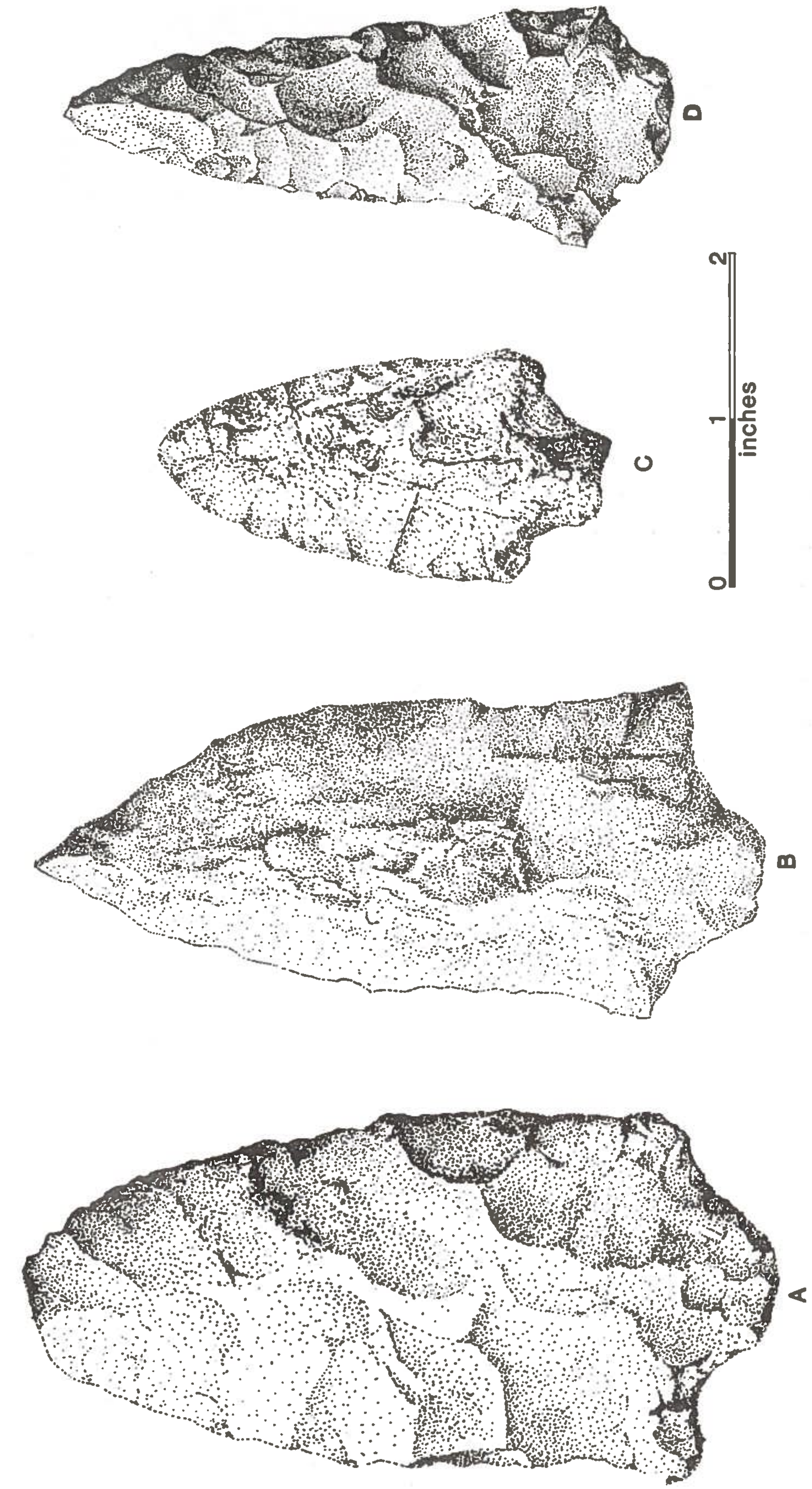
A series of attributes were recorded for each artifact and these attributes were chosen specifically to reflect tool function. Basic measurements of length, width, and thickness were recorded because experimental studies (Ahler 1971:89-90; Callahan 1979) and a large body of literature (eg. Thomas 1978) on modern hunting arrows have shown that measurements, such as maximum point width, are critical variables affecting penetration capacity. Furthermore, length/width ratios are good indicators of point resharpening and use patterns (Gardner and Verrey 1979).

Attributes of edge wear and resharpening were also recorded for each artifact. Because Staats (1986) has questioned the use of these attributes, we provide here a discussion of their use and note some of the supporting experimental literature. It is our contention here that experimental studies linking edge damage and function are a more useful approach to artifact studies than the so-called "common sense" approach advocated by Staats (1986). The presence of transverse medial fractures and impact fractures was recorded because each is indicative of specific tool use. Ahler (1971:84, 119-121) has shown that transverse fractures arise when bifaces are used in a twisting fashion, such as in prying or gouging associated with heavy cutting or butchering activities. Transverse fractures may also arise from prying activities such as those which may be associated with dismembering a large animal's leg joints (Ahler 1971:84). There are no experimental data to suggest that these cutting activities would lead to a break at the juncture of the blade and the stem as suggested by Staats (1986:37). Impact fractures have been produced experimentally when bifaces are used for projectile points (Ahler 1971:85-86; Callahan 1979). Again, there are no experimental studies to suggest that transverse fractures, rather than impact fractures, would be produced by projectile point use as suggested by Staats (1986:40).

The presence and location of rechipping, or reworking, of broadspear edges was also recorded. Contrary to statements made by Staats (1986:39,40), it is possible to distinguish edge wear and rechipping from intentional edge grinding associated with tool hafting (Callahan 1979; Semenov 1964; Ahler 1971; Odell 1980; Odell and Odell-Vereecken 1980) and in this study we did not mistake intentional edge grinding for wear or resharpening. The presence of bevelled resharpening was also noted because this kind of resharpening is especially closely linked to knife usage (Ahler 1971:83-84).

FIGURE 1

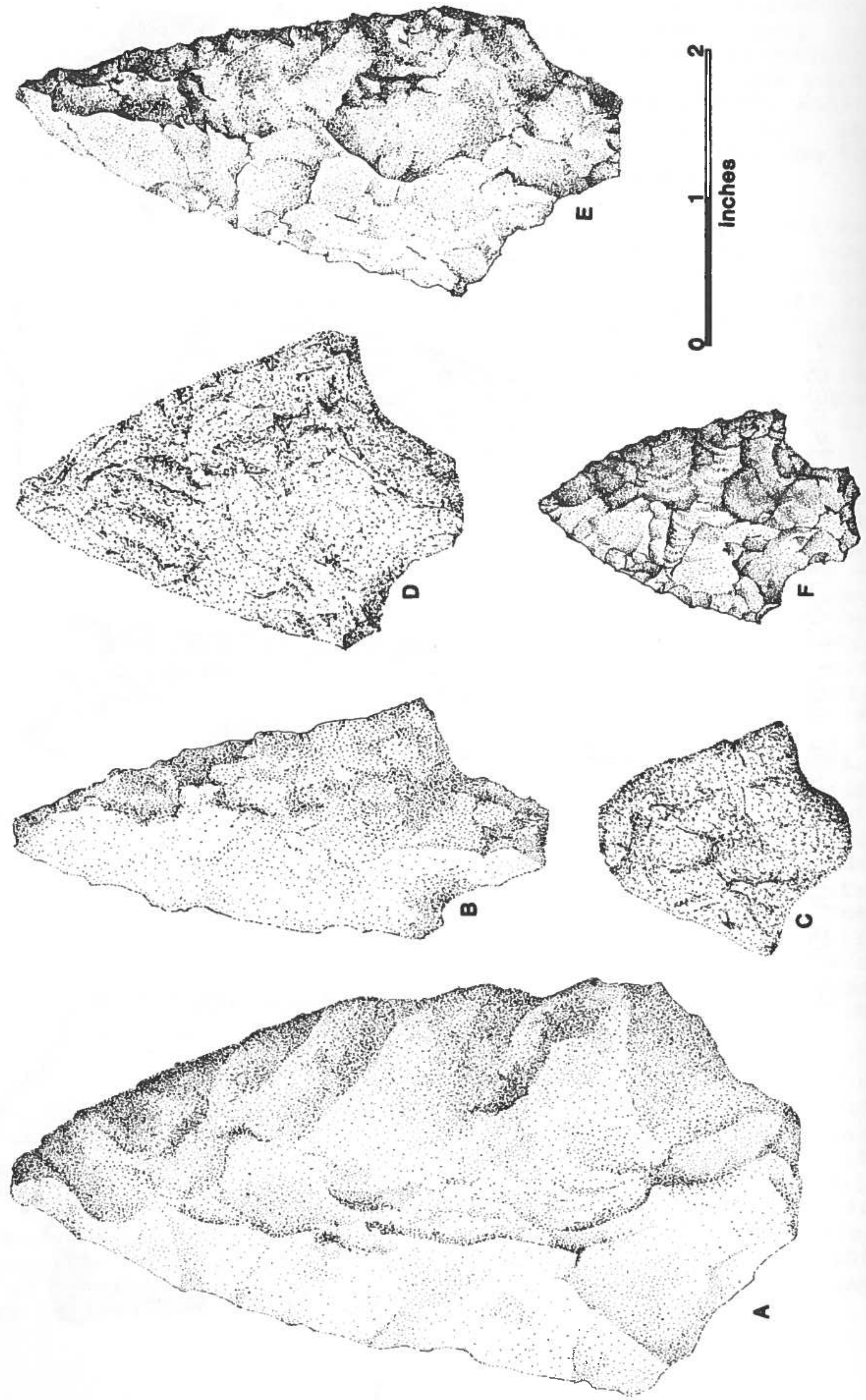
Savannah River and Long Broadspears



A. 7NC-A-2 (rhyolite) B-C. Nanticoke Drainage (quartzite) D. 7S-A-1 (rhyolite)

FIGURE 2

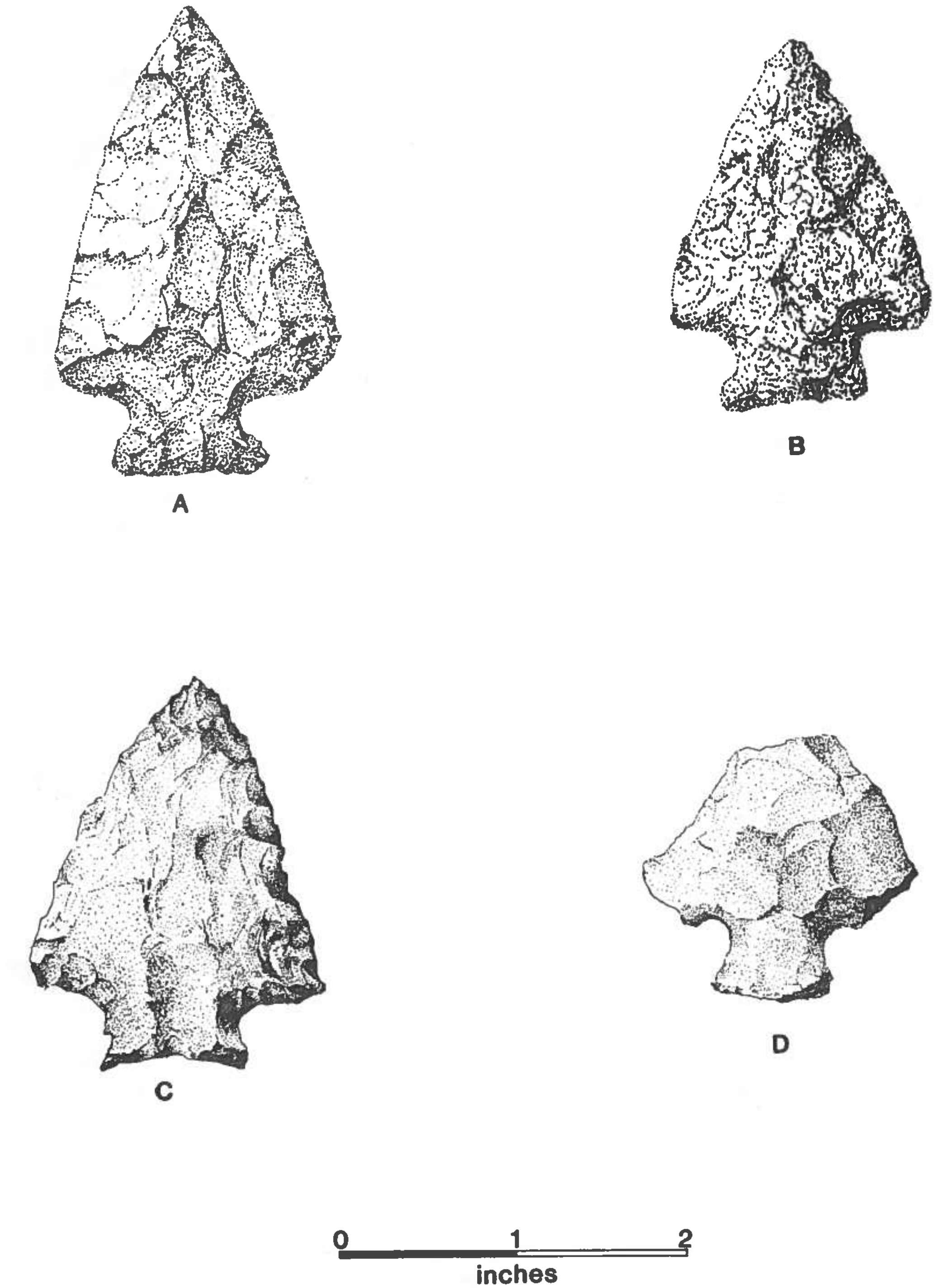
Lehigh/Koens–Crispin Broadspears



A–C Coverdale Collection, Kent Co. (argillite) D. 7K–D–31 (quartzite) E. 7K–D–21 (chert) F. 7S–C–22 (jasper)

FIGURE 3

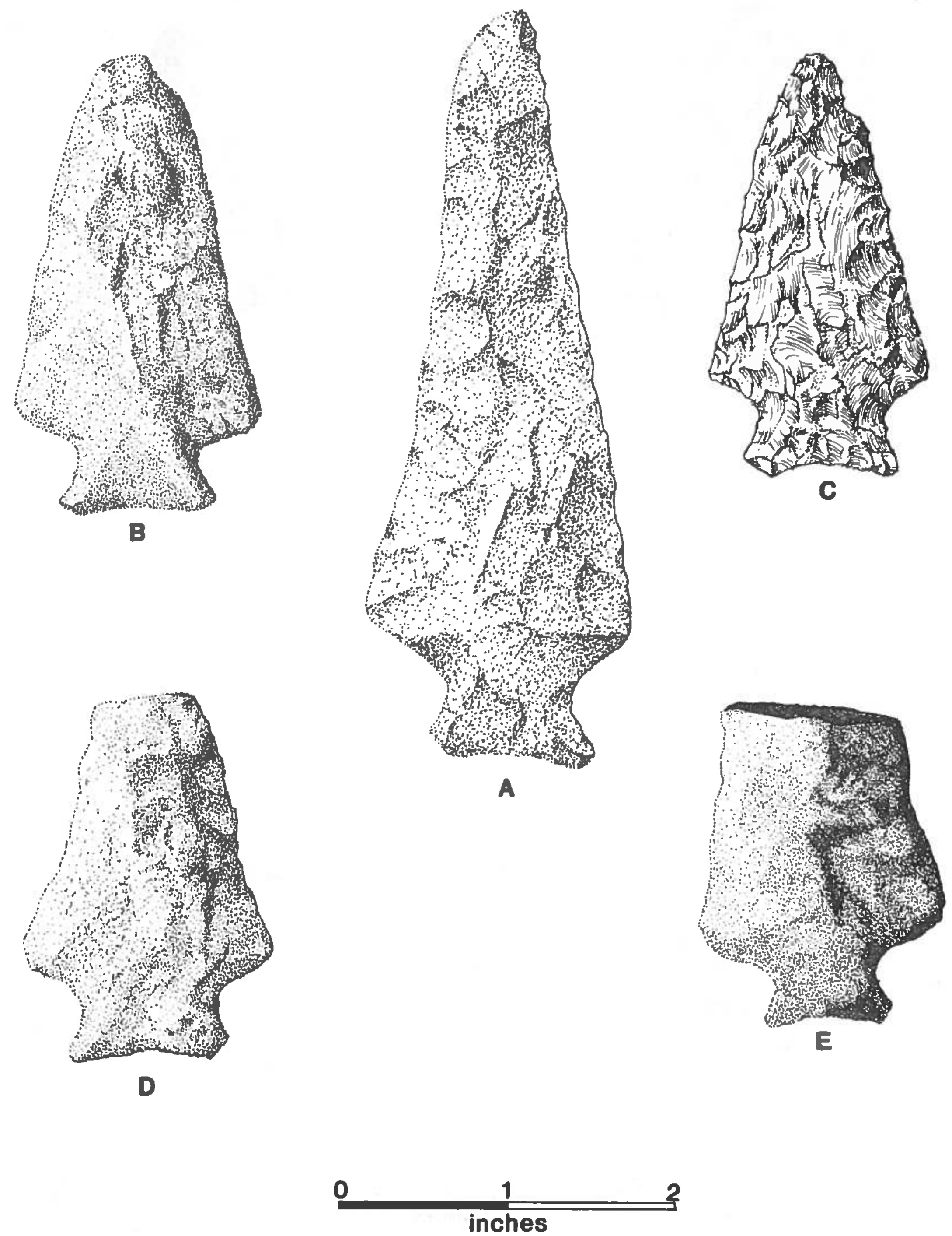
Perkiomen Broadspears



A. 7K–C–12 (jasper) B. 7S–E–1 (quartzite) C. 7K–D–31 (chert) D. 7K–D–1 (chert)

FIGURE 4

Susquehanna Broadspears



A. 7S-E-6 (rhyolite) B. 7S-E-6 (argillite) C. Nanticoke Drainage (jasper)
D-E. Coverdale Collection, Kent County (argillite)

ANALYSIS OF BROADSPEAR MORPHOLOGY

General Characteristics

The sample studied here consisted of 599 broad-blade bifaces, of which 551 could be placed into the five major typological categories (Long, Savannah River, Lehigh/Koens-Crispin, Susquehanna, Perkiomen). Table 1 shows a cross tabulation of the major types and the raw materials from which they were made. It can be seen that the sample is fairly evenly divided between the early broadspear types (Savannah River, Long, Lehigh/Koens-Crispin) which comprise 56% of the sample and the later types (Susquehanna and Perkiomen) which comprise the remaining 44%.

TABLE 1

Raw Materials and Broadspear Types

	Raw Materials							
Point Type	**Arg.**	**Rhy.**	**Quartz**	**Qtzite**	**Ironstone**	**Chert**	**Jas.**	**Other**
Long	22	5	7	9	1	0	4	4
Savannah River	13	14	10	11	0	0	8	0
Lehigh/K-C	108	35	11	23	4	5	12	1
Susquehanna	88	39	7	1	1	12	56	3
Perkiomen	7	8	3	2	0	6	9	2

It is interesting to note that in the entire assemblage, the major raw materials utilized are non-local argillites and rhyolites, which comprise 62% of the sample. Cryptocrystalline materials account for 20% of the sample and local quartz, quartzite, and ironstone comprise the remaining 18%. Numerous studies of the early Woodland I time period in Delaware (Custer 1982; 1984c:108-113), the Middle Atlantic (Stewart 1984a; Custer 1984a), and Eastern North America (Griffin 1967) have stressed emerging trade and exchange networks as important characteristics of this time period and the large proportion of non-local materials in this sample underscores these assertions.

When raw material utilization is considered among the major types, an interesting pattern is seen. Table 2 shows a crosstabulation of cryptocrystalline and non-cryptocrystalline utilization among the major point types. A chi-square test for independence was applied to these data and the test statistic is equal to 50.28 ($p<.001$). This value indicates that the degree of cryptocrystalline and non-cryptocrystalline utilization is

TABLE 2

Cryptocrystalline Utilization

Point Type	Cryptocrystalline	Non-Cryptocrystalline
Long/Savannah River	12 (22)	96 (86)
Lehigh	17 (40)	182 (159)
Susquehanna	68 (42)	139 (165)
Perkiomen	15 (8)	22 (29)

Numbers in parentheses represent espected values.

dependent on point type. In other words, given the overall pattern of cryptocrystalline use among all types, some types, namely Susquehanna and Perkiomen, show greater cryptocrystalline use than would be expected by chance alone. In all types, non-cryptocrystalline use is predominant. However, it is not as dominant as one might expect for the Susquehanna and Perkiomen varieties. Conversely, non-cryptocrystalline use is significantly high for Long, Savannah River, and Lehigh/Koens-Crispin varieties, even greater than what would be expected given the high level of non-cryptocrystalline usage among all broadspear types. The significance of these patterns of raw material use will be discussed later in conjunction with the data on functional attributes.

Descriptive Statistics and Penetration Capability

Table 3 lists descriptive statistics for broadspear length, width, and thickness measurements as well as for length/width and width/thickness ratios. The statistics were calculated for the entire sample as well as for the individual types. Table 4 shows frequency distributions for the length and width measurements and for the most part the frequencies are normally distributed. Therefore, parametric statistical analyses can be used.

Witthoft's (1953) initial description of these kinds of bifaces stressed the fact that they are distinctive because they are very wide compared to their length. Table 5 shows a comparison of broadspear widths with samples of other projectile points from other time periods. Broadspear measurements were compared to those of other point types using a difference-of-mean test and the cases where significant differences were present are noted. It can be seen that broadspears are significantly wider than any other point types.

Maximum biface width is of considerable importance in analyzing biface function, especially with regard to projectile functions, because it is the main determinant of penetration

TABLE 3

Descriptive Statistics

Data Set	Variable	n	Mean	Std.Dev.	Skewness	Kurtosis
Total	Length	375	59.69	24.59	1.28	4.15
	Width	599	36.26	12.93	.94	4.16
	Thick.	599	8.65	2.69	1.12	7.59
	L/W	375	1.72	.38	1.17	5.47
	W/T	595	4.35	1.43	.99	4.57
Long/S.R.	Length	62	65.50	21.12	.72	2.65
	Width	109	33.13	9.06	.12	3.79
	Thick.	109	9.64	2.46	-.11	4.46
	L/W	62	2.00	.47	1.04	4.34
	W/T	108	3.57	1.08	1.22	4.77
Lehigh/K-C	Length	128	71.17	29.14	.72	2.47
	Width	199	44.74	13.98	.73	2.84
	Thick.	199	9.56	2.78	1.05	4.09
	L/W	128	1.58	.30	1.03	5.93
	W/T	199	4.98	1.60	.81	3.95
Susquehanna	Length	140	47.23	13.57	1.34	6.84
	Width	208	28.69	7.49	.41	6.44
	Thick.	208	7.24	1.77	-.12	5.24
	L/W	140	1.72	.35	.85	4.51
	W/T	206	4.09	1.07	.44	3.17
Perkiomen	Length	25	49.64	11.35	.07	1.99
	Width	37	32.92	9.88	-.57	5.17
	Thick.	37	7.24	2.10	-.82	5.73
	L/W	25	1.56	.33	1.24	4.95
	W/T	36	4.78	1.62	1.20	5.34

TABLE 4

Measurement Frequency Distributions

Length Categories (cm)	Total	Long	S.R.	Lehigh/K-C	Susque.	Perk.
0-10	0	0	0	0	0	0
10-20	0	0	0	0	0	0
20-30	8	0	0	1	7	0
30-40	62	3	2	11	36	8
40-50	81	4	4	21	45	2
50-60	86	8	9	26	30	10
60-70	50	8	4	18	13	4
70-80	22	2	3	9	6	1
80-90	10	0	3	5	2	0
90-100	21	3	4	11	0	0
100-110	12	1	1	10	0	0
110-120	9	2	1	4	1	0
120-130	5	0	0	4	0	0
130-140	8	0	0	7	0	0
140-150	1	0	0	1	0	0
Width Categories (cm)						
0-10	0	0	0	0	0	0
10-20	10	2	1	0	7	0
20-30	187	15	19	24	110	11
30-40	210	25	20	64	75	16
40-50	93	10	10	46	10	8
50-60	57	1	5	33	3	1
60-70	25	0	0	19	1	0
70-80	10	0	0	10	0	0
80-90	3	0	0	3	0	0

TABLE 5

Comparative Measurement Data

Point Type	n	Width Mean	S.D.	Source
Fluted	87	23.84*	6.66	(1)
Early Notched	281	22.39*	8.00	(2)
Bifurcate	392	19.48*	5.86	(2)
Stemmed and Notched	3270	23.29*	7.65	(3)
Broadspears	599	36.26	12.93	
Fox Creek	270	27.50*	8.08	(3)
Triangles	203	17.00*	3.40	(4)

* - Significantly different from broadspear values

Sources:

1 - Custer 1984e:6
2 - Custer 1986:54
3 - These measurements are derived from a sample of all bifacial tools manufactured from argillite and rhyolite curated at the Island Field Museum (see Custer 1984a).
4 - Custer 1983

capacity. A narrow biface with a round cross section has the greatest penetration capacity; however, when considering a hunting weapon, other factors come into play. Binford (1983) has noted that there are two major hunting techniques and each has implications for hunting weapons. One technique is termed "impalement hunting" and has as its goal the complete penetration of the game animal, which is then held on the spear or arrow shaft. Projectiles used in this hunting technique, which is commonly used for fish, sea mammals, and birds, tend to be narrow with a round cross section (Oswalt 1976:89, 93). The second technique is "shock hunting" in which the goal is to put a good-sized hole in the game animal and cause damage, or shock, to its circulatory system. If this technique is successful, the animal either dies immediately or is followed until it dies. For the most part, shock hunting is used on land mammals with large body weights (Oswalt 1976:84) although an interesting exception is kangaroo hunting by Australian aborigines, which is done by impalement hunting (Binford 1983). In shock hunting, penetration is important, although complete penetration is not necessary. Even more important is the size of the hole, or wound, inflicted on the animal. The bigger the hole, the more critical the wound will be. However, if the projectile is too wide, the required penetration will be inhibited. Thus, design of a projectile for shock hunting must be narrow enough to insure penetration, yet wide enough to inflict a fatal wound.

Consideration of a variety of projectile points from ethnographic and archaeological contexts indicates an optimum solution to this problem. Thomas (1978:469) analyzed an ethnographic sample of arrow and spearpoint specimens and found the mean width of each to be 14.7cm and 22.9cm respectively. The ethnographic sample of spears is probably most applicable to the prehistoric projectiles of the Middle Atlantic because the bow and arrow are thought to be a late (post - A.D. 1000) cultural innovation associated with the use of triangular projectile points during the Woodland II Period (Custer 1984c:148-149). The mean width of the ethnographic sample of spears was compared to the values for different prehistoric point types noted in Table 5. There are no significant differences between the various point types and the ethnographic spears, <u>except</u> for the broadspears which are significantly wider.

Figure 5 shows a plot of mean point widths for the various types of points noted in Table 5. The similarity of the widths of all point types, except broadspears, is apparent. A similar plot is shown in Figure 6, which is based upon a series of measurements presented by Kinsey (1972:Appendix) in his typology of Upper Delaware River Valley projectile points. Again the broadspear varieties fall well outside the range of the other archaeological and ethnographic samples.

It should also be noted that modern bow hunting laws provide some relevant data on penetration capacity. In Delaware, a hunting arrow must be at least 7/8" wide (22.9mm) in order to ensure that a fatal wound is inflicted. Figures 5 and 6 show this value and it can be seen that the ranges of broadspear widths do not include this minimum value.

To summarize the analysis of broadspear width and penetration capacity, it can be seen that broadspears are all significantly wider than other bifaces which are commonly thought of as projectile points used in shock hunting. Because biface width is associated directly with penetration, and because broadspears fall well outside the width range associated with optimum penetration, it is unlikely that all broadspears were manufactured for use as projectiles. A small proportion (28%) are less than 30mm wide, and may have functioned as projectiles, nonetheless. However, the vast majority of the broadspears analysed here are too wide to have functioned effectively as projectiles. At this point it is pertinent to note that some researchers (Witthoft 1953; Kinsey 1972) have suggested that broadspears functioned as fish spears with their wide "shoulders" acting as toggles. Given the fact that fish spearing is done via impalement hunting and given the fact that maximum penetration is required in impalement hunting, the wide configuration of broadspears renders them virtually useless for such an activity.

FIGURE 5

Biface Width Through Time– Central Middle Atlantic Data

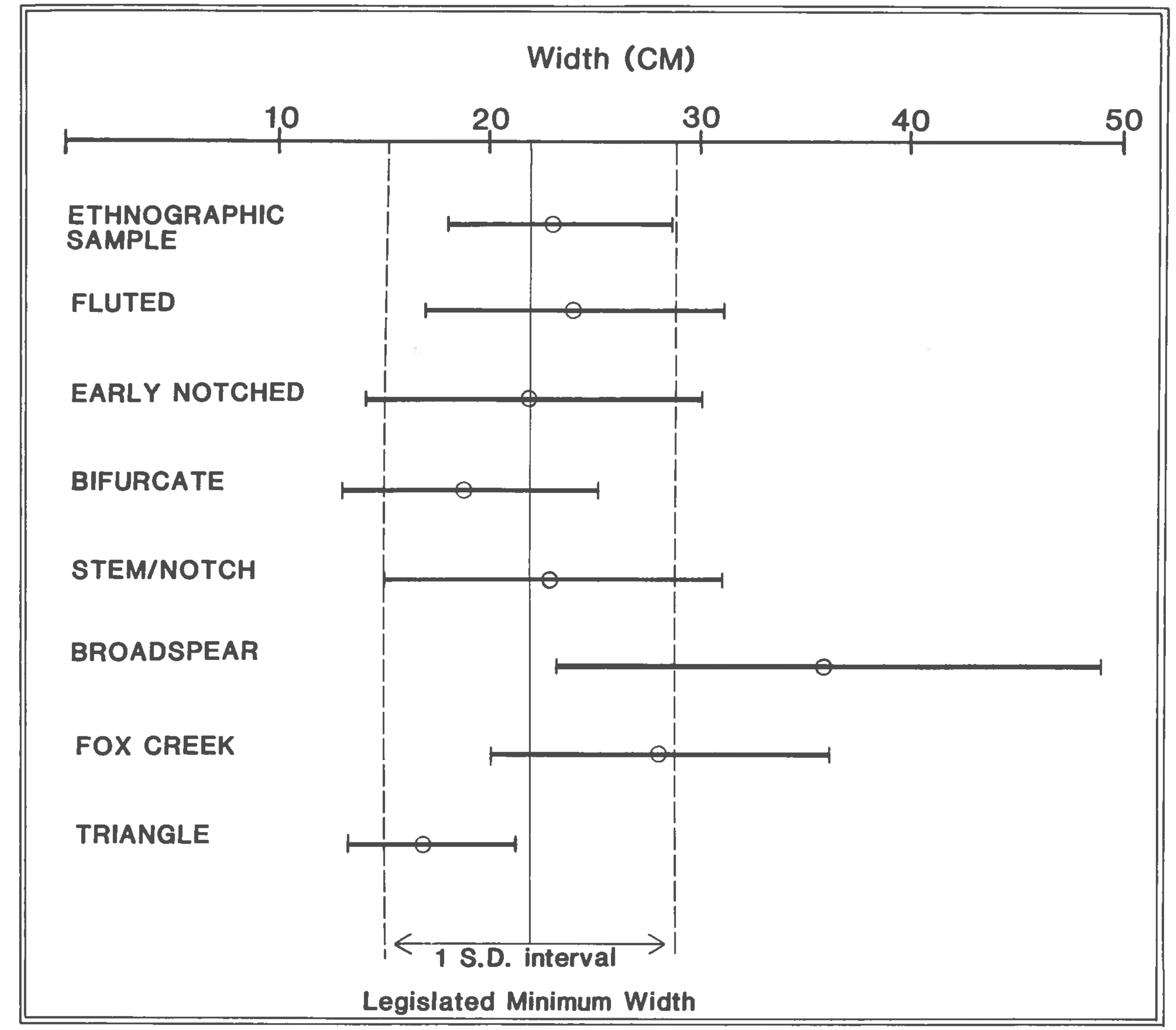
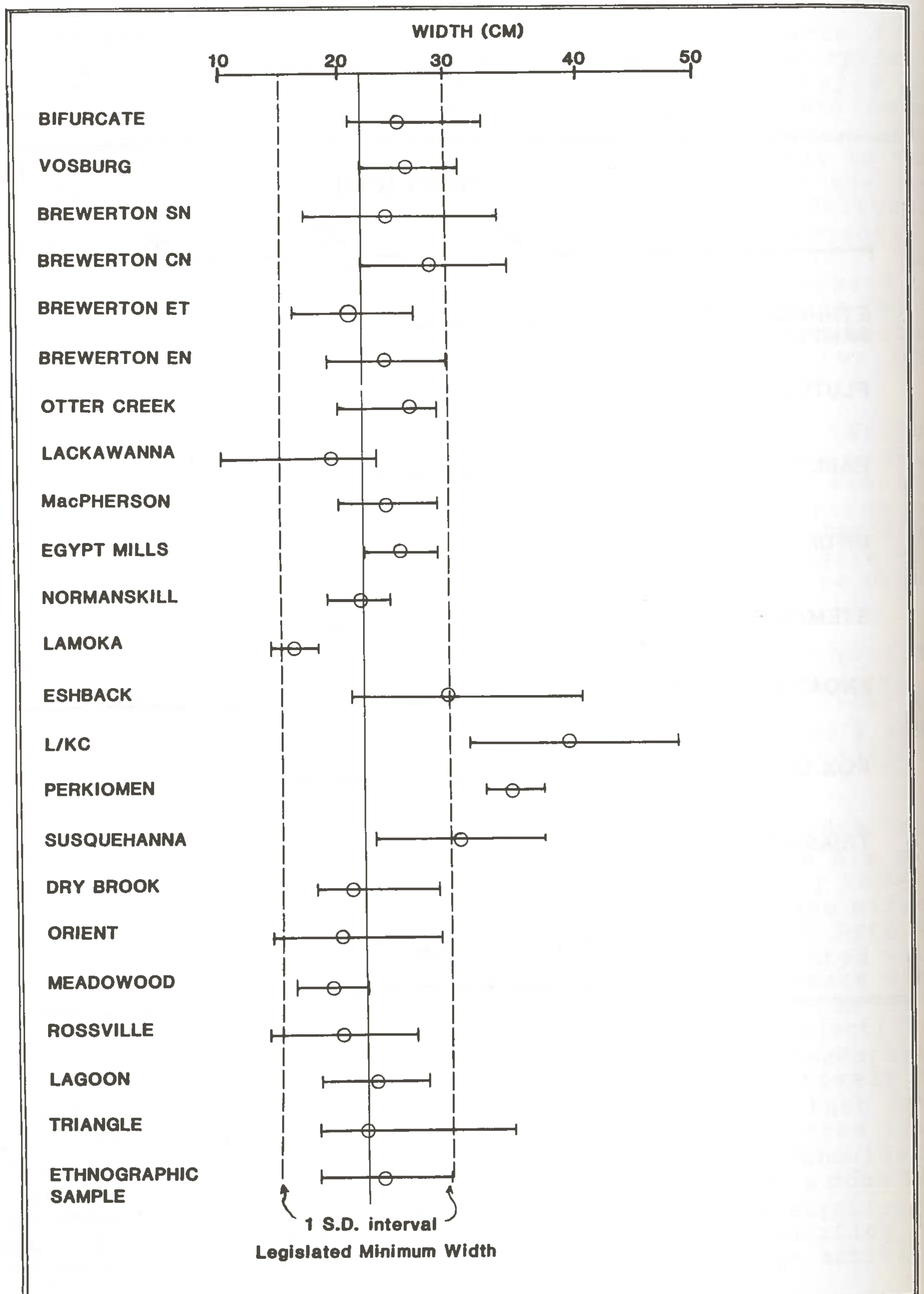


FIGURE 6

Biface Width through Time– Upper Delaware Valley Data



Wear Patterns and Breakage

Although the analysis of broadspear size and configuration can provide insights about the potential, or possible, use of these bifaces as penetrating weapons, analysis of wear patterns and breakage can provide direct empirical data on broadspear functions. A discussion of the wear and breakage patterns used in this study was provided earlier in the paper and the frequency of varied wear and breakage patterns are noted below. Table 6 shows the frequency of the varied wear and breakage patterns for small broadspears, those less than 30mm wide, and larger specimens which are greater than 30mm wide. Percentage values for each size class were compared using a difference of proportion test and the test statistics are also noted in Table 6. There is no difference in the frequency of impact fractures between the two size classes indicating that small broadspears were not used more frequently as projectiles than the larger broadspears.

TABLE 6

Wear and Breakage Pattern Frequency by Size Categories

Wear/Breakage	Small Size (<30mm)	LargeSize (>30mm)	Test Statistic
Impact Fracture	7(4)	14(3)	.51
Transverse Fracture	42(25)	182(42)	4.04*
Reworked	116(98)	304(71)	7.19*
Asymmetrical	111(65)	212(49)	3.51*
Distal Reworking	105(62)	173(40)	4.74*
Medial Reworking	128(75)	257(60)	3.54*
Proximal Reworking	123(72)	246(57)	3.40*
Alternate Beveling	54(32)	93(22)	2.59*
Double Beveling	35(20)	36(8)	4.16*
All 3 Reworking	88(52)	134(31)	4.69*

( ) = Percentage value   * = Statistically significant difference

The larger broadspears show a significantly higher proportion of transverse fractures than the smaller specimens indicating that the larger bifaces were used more frequently for heavy cutting activities with twisting and prying motions compared to the smaller varieties. On the other hand, the smaller specimens showed significantly more instances of resharpening and bevelling than larger specimens. In fact, the smaller specimens probably are smaller because they <u>are</u> resharpened. Frequent resharpening among the smaller specimens tends to indicate that the small specimens are <u>not</u> merely small and complete versions of the larger broadspears. Rather, they are small because they are at the end of the resharpening sequence. Thus, small broadspears lack wear patterns associated with projectile point use. And, they are small, i.e. within the width range where penetration was possible, not due to design, but due to repeated resharpening. Consequently, it is unlikely that many of the smaller broadspears functioned as projectile points. Rather, they functioned as cutting tools not associated with the heavy cutting motions which produced the transverse fractures seen among the larger specimens.

Table 7 shows the frequency of wear and breakage patterns between cryptocrystalline and the non-local argillite and rhyolite raw materials. The low frequency of impact fractures is similar between both raw material categories. However, the frequency of transverse fractures among argillite and rhyolite specimens is double that among the cryptocrystalline broadspears. The indication is that the argillite and rhyolite tools were used more frequently for heavy cutting activities involving twisting and prying motions. For all indicators of resharpening, cryptocrystalline broadspears showed significantly higher frequencies. This higher frequency of resharpening may indicate either a higher degree of curation of cryptocrystalline broadspears, or uses of cryptocrystalline broadspears for cutting activities which caused edge dulling and consequent resharpening (but not transverse fractures), or both. The high proportion (79%) of medial blade resharpening among cryptocrystalline broadspears is consistent with the idea that a specialized cutting function was favored. Such a placement of damage and resharpening has been associated with sawing motions and slicing cutting activities (Ahler 1971:82-85). It should be noted that the varied wear and resharpening patterns on broadspears of different raw materials are ones of proportion and degree. Although rhyolite and argillite broadspears have a significantly

TABLE 7

Wear and Breakage Pattern Frequency by Raw Material

Wear/Breakage	Argillite & Rhyolite	Crypto-crystalline	Test Statistic
Impact Fracture	12(3)	5(4)	.56
Transverse Fracture	157(42)	24(21)	4.17*
Reworked	259(69)	112(97)	5.96*
Asymmetrical	165(44)	87(75)	5.79*
Distal Reworking	143(38)	70(60)	4.17*
Medial Reworking	212(56)	92(79)	4.36*
Proximal Reworking	207(55)	85(73)	3.41*
Alternate Beveling	77(21)	36(31)	2.32*
Double Beveling	33(8)	20(17)	2.54*
All 3 Reworking	111(30)	59(51)	4.17*

( ) = Percentage value   * = Statistically significant difference

higher percentage of transverse fractures, 21% of cryptocrystalline broadspears show these fractures as well. Likewise, although cryptocrystalline broadspears show a higher proportion of medial resharpening, more than half (56%) of the argillite and rhyolite broadspears still show this kind of resharpening.

The variable use and resharpening of broadspears of different raw materials is most likely related to the availability of the raw materials. As one moves south through the Delmarva Peninsula, lithic materials become increasingly scarce and the size of usable cobbles also decreases (Custer and Galasso 1980). Consequently, most large broadspears were manufactured from non-local materials transported to the Delamarva Peninsula via trade and exchange or direct procurement. Although cryptocrystalline materials are available in the Delaware Fall Line area as part of the Delaware Chalcedony Complex, the data presented earlier showed that argillites and rhyolites, the nearest sources of which are more than 100 km distant, were more commonly used for manufacturing broadspears. Thus, the majority of broadspears in this sample are manufactured from distantly-available raw materials and broadspears manufactured from these materials were used more frequently for heavy-duty cutting activities. This association of wear patterns and raw materials suggests that argillite and rhyolite procurement was directed to a large degree for the procurement of raw materials suitable for the manufacture of large, heavy-duty cutting tools. The presence of early stage bifaces and manufacturing debris of argillite and rhyolite, especially in central Delaware (Custer 1984a; 1984c:109; 1984d) indicates that these tools were not imported in finished form. Rather, they were manufactured here. The resulting picture is one of a highly focused lithic exchange and tool production industry. The fact that rhyolites and argillites produce a cutting edge which is not as sharp as, but less brittle than, cryptocrystalline materials (Stewart 1984b; Callahan 1979) explains the preference for their use in manufacturing heavy-duty cutting tools. In contrast, the sharp, yet brittle, cryptocrystalline broadspears were more suitable for slicing and cutting of softer materials. However, these brittle edges would have required more frequent resharpening as is the case for the tools in this sample. It can also be noted that the cutting activities associated with cryptocrystalline broadspears produced edge damage which could be corrected via resharpening. On the other hand, transverse medial fractures, associated with the non-cryptocrystalline materials, are more dramatic damage which cannot be so easily corrected. Therefore, the varied raw materials and varied cutting uses of broadspears conditioned the frequency and degree of their resharpening and curation.

Table 8 shows the frequency of the varied wear and breakage patterns among the recognized point types (Long/Savannah River, Lehigh/Koens-Crispin, Susquehanna, and Perkiomen). Table 9 summarizes the results of paired comparisons of the breakage and wear patterns among the types and Table 10 notes the frequencies

TABLE 8

Wear Breakage Pattern Frequency by Point Type

Wear/Breakage	**Point Types** L/S R	L/K-C	S	P
Impact Fracture	4(3)	5(2)	8(3)	4(11)
Transverse Fracture	47(43)	71(36)	68(33)	12(32)
Reworked	98(90)	121(61)	198(95)	32(86)
Asymmetrical	61(56)	89(45)	132(63)	23(62)
Distal Reworking	53(49)	73(37)	116(56)	21(57)
Medial Reworking	77(71)	100(50)	164(79)	25(68)
Proximal Reworking	71(65)	98(49)	160(77)	27(73)
Alternate Beveling	29(27)	37(19)	57(27)	16(43)
Double Beveling	18(17)	19(9)	29(14)	4(11)
All 3 Reworking	42(39)	57(29)	97(47)	16(43)

(   ) = Percentage Value
L/S R = Long/Savannah River   S = Susquehanna
L/K C = Lehigh/Koens-Crispin   P = Perkiomen

of significant differences among the paired comparisons. For the most part, there were no differences among any of the types with regard to impact and transverse fractures. It can be seen, however, that the comparisons involving Lehigh/Koens-Crispin points produced the greatest number of significant differences, especially with regard to resharpening and wear attributes. Lehigh/Koens-Crispin specimens showed significantly fewer instances of edge modifications compared to all other types. It is suggested here that this difference may be related to raw material availability. A large proportion (53%) of the Lehigh/Koens-Crispin bifaces are manufactured from argillite (Table 1), and although this is a non-local material, the available data for some parts of Delaware indicate that argillite was imported in bulk and formed the basis of the bifacial stone tool technology (Custer 1984a). Therefore, the ready availability of argillite may have precluded the need for elaborate curation of argillite Lehigh/Koens-Cripin points.

A final comparison of wear and breakage pattern frequency was carried out for the early (Long/Savannah River and Lehigh/Koens-Crispin) and late (Susquehanna and Perkiomen) broadspear varieties (Table 11). The same patterns noted previously are underscored with the early varieties showing less edge resharpening than the later varieties.

TABLE 9

Summary of Paired Comparisons of Wear and Breakage Frequency by Point Type

Wear/Breakage	**L/SR vs L/KC**	**L/SR vs Sus**	**L/SR vs Perk**	**L/KC vs Sus**	**L/KC vs Perk**	**Sus vs Perk**
Impact Fracture	------	------	------	------	>	------
Transverse Fracture	------	------	------	------	------	------
Reworked	>	------	------	<	<	>
Asymmetrical	------	------	------	<	<	>
Distal Reworking	>	------	------	<	<	------
Medial Reworking	>	------	------	<	------	------
Proximal Reworking	>	<	------	<	<	------
Alternate Beveling	------	------	------	<	<	------
Double Beveling	------	------	------	------	------	------
All 3 Reworking	------	------	------	<	------	------

------ = No Significant Difference
< = 1st Value Significantly Smaller Than Second
> = 1st Value Significantly Larger Than Second

TABLE 10

Frequency of Significant Differences Among Paired Type Comparisons

Long/Savannah River	-----			
Lehigh/Koens-Crispin	4	-----		
Susquehanna	1	7	-----	
Perkiomen	0	6	2	-----
	L/SR	L/K-C	Sus	Perk

TABLE 11

Wear and Breakage Pattern Frequency by Early and Late Types

Wear/Breakage	L/SR & L/K-C	P&S	Test Statistic
Impact Fracture	9(3)	12(5)	1.21
Transverse Fracture	118(38)	80(33)	1.38
Reworked	219(71)	230(94)	6.81*
Asymmetrical	150(49)	155(63)	3.42*
Distal Reworking	126(41)	137(56)	3.51*
Medial Reworking	177(57)	189(77)	4.86*
Proximal Reworking	169(55)	187(76)	5.23*
Alternate Beveling	66(21)	73(30)	2.25*
Double Beveling	37(12)	33(13)	.51
All 3 Reworking	99(32)	113(46)	3.36*

( ) = Percentage Value   * = Statistically Significant Difference

L/S R & L/K-C = Long/Savannah River & Lehigh/Koens-Crispin
P & S = Perkiomen & Susquehanna

Summary of Morphological Analysis

Analysis of the sample of broadspears from Delaware clearly indicates that broadspears are simply not well suited to use as penetrating weapons due to their wide blades. The range of widths of broadspears in this sample falls well outside the width ranges of bifaces which are clearly projectile points, and is significantly larger than the observed sizes of ethnographic specimens. Furthermore, the wear and breakage patterns present on broadspears show only a very small incidence (3.5%) of impact

fractures, which can be associated with projectile point usage. In contrast, there are overwhelming proportions of transverse fractures and edge maintenance and these are associated with knife usage. Therefore, most of the bifaces identified as broadspears by archaeologists are <u>not</u> spears, rather, they are generalized cutting tools.

Identification of broadspears as generalized cutting tools raises a number of questions concerning interpretations of the archaeological record. First, if most broadspears were generalized cutting tools, then what did people living at that time use for projectile points? It has been suggested (Custer 1984c:78-82) that generalized narrow stemmed points were used as projectile points contemporaneously with broadspears and further data are needed to test this hypothesis. However, the important point is that some kind of projectile point, other than broadspears, needs to be identified for the time period between 2000 and 1200 B.C.

A second question is why are so many specially configured generalized cutting tools produced during the 2000 B.C. and 1200 B.C.? Also, why do many sites from this time period contain so-called "pure" broadspear components? If one accepts the data presented here, then the "pure" broadspear components represent functionally specific sites. Similar interpretations of these sites have been suggested by Kinsey (1972). The proliferation of generalized cutting tools may be related to shifts in adaptations which occurred ca. 2000 - 1200 B.C. (Custer 1984b). Although broadspears are found throughout the varied environments of the Middle Atlantic, including upland settings (Tolley and Barber 1984), it is suggested here that the proliferation of broad-blade cutting tools is related to increased sedentism and emerging generalized estuarine and riverine adaptations in the Delmarva region. The analysis of site locations presented later in this paper will show how site distributions for this time period reveal these patterns of adaptations.

The identification of broadspears as knives also has implications for archaeological interpretations which use concepts such as "broadspear people" or "broadspear traditions". The linking of a specific tool form with a sociocultural entity is not a useful heuristic device and theories of migrations of "broadspear people" are most likely not based on firm empirical grounds.

Before considering site distributions, one final point concerning raw material utilization and trade and exchange should be made. The data on broadspears indicate that non-local raw materials formed the basis of the bifacial technology and were the preferred raw materials for manufacturing of broad-blade cutting tools. As such, the availability of suitable raw materials had to be assured over distances of more than 100 km. Importation of raw materials, rather than solely finished tools, would help to assure lithic resource availability, as would caching, and instances of both have been identified in the

Delmarva archaeological record (Custer 1984d). However, it is difficult to imagine that hand-to-hand exchange systems could provide sufficient quantities of raw materials with regularity and predictability. Even highly ritualized and sanctified exchange systems would probably not assure sufficient quantities of materials. Therefore, it is suggested here that at least some of the large quantities of argillite and rhyolite which were used to manufacture broadspears were procured by direct trips to the middle Delaware Valley quarries by Delmarva groups. Intensive trade systems have been identified as indicators of increasingly complex social systems for this time period (Custer 1984b); however, extensive procurement trips over distances of more than 100 km are even better indicators of complex social systems.

BROADSPEAR SITE DISTRIBUTIONS

The remainder of this paper provides an analysis of the distribution of sites which have produced broadspears throughout the Delmarva Peninsula. Figure 7 shows the locations of sites which produced broadspears and is based upon the Delmarva Archaeological Data System (DADS). DADS is a regional archaeological data base of more than 4600 sites maintained by the University of Delaware Center for Archaeological Research and provided the data used in the analysis of broadspear site locations presented below. It can be seen that sites producing broadspears are found throughout Delaware and the Delmarva Peninsula. For the most part, the distribution map reflects survey and cataloging activities, not patterns of prehistoric settlement. However, attributes of broadspear site locations can be compared to the total site sample in DADS to see if any special trends in site location patterns can be associated with cultures who made and used broadspears.

Table 12 shows the varied geomorphological settings of sites with broadspears and the total DADS sample. The majority of the sites are associated with riverine floodplain and terrace settings for both samples. A chi-square test was applied to these data and the result (chi-square = 4.79, df = 3, p = .18) indicates that there are no significant differences between the two samples. Therefore, there are no special locational characteristics of broadspear sites with respect to geomorphological settings.

The varied surface water settings are noted in Table 13. Flowing stream settings predominate and the chi-square test results (chi-square = .51, df = 2, p = .78) indicate that broadspear sites have no special locational characteristics with respect to surface water settings. Table 14 shows the frequency with which broadspear sites are associated with stream confluences. Chi-square test results (chi-square = 9.50, df = 1, p = .002) indicate that there are significantly more broadspear sites associated with stream confluences than is the case in the total sample. Water distance frequencies are shown in Table 15 and the chi-square test results (chi-square = 5.51, df = 10,

FIGURE 7

Broadspear Point Site Distribution

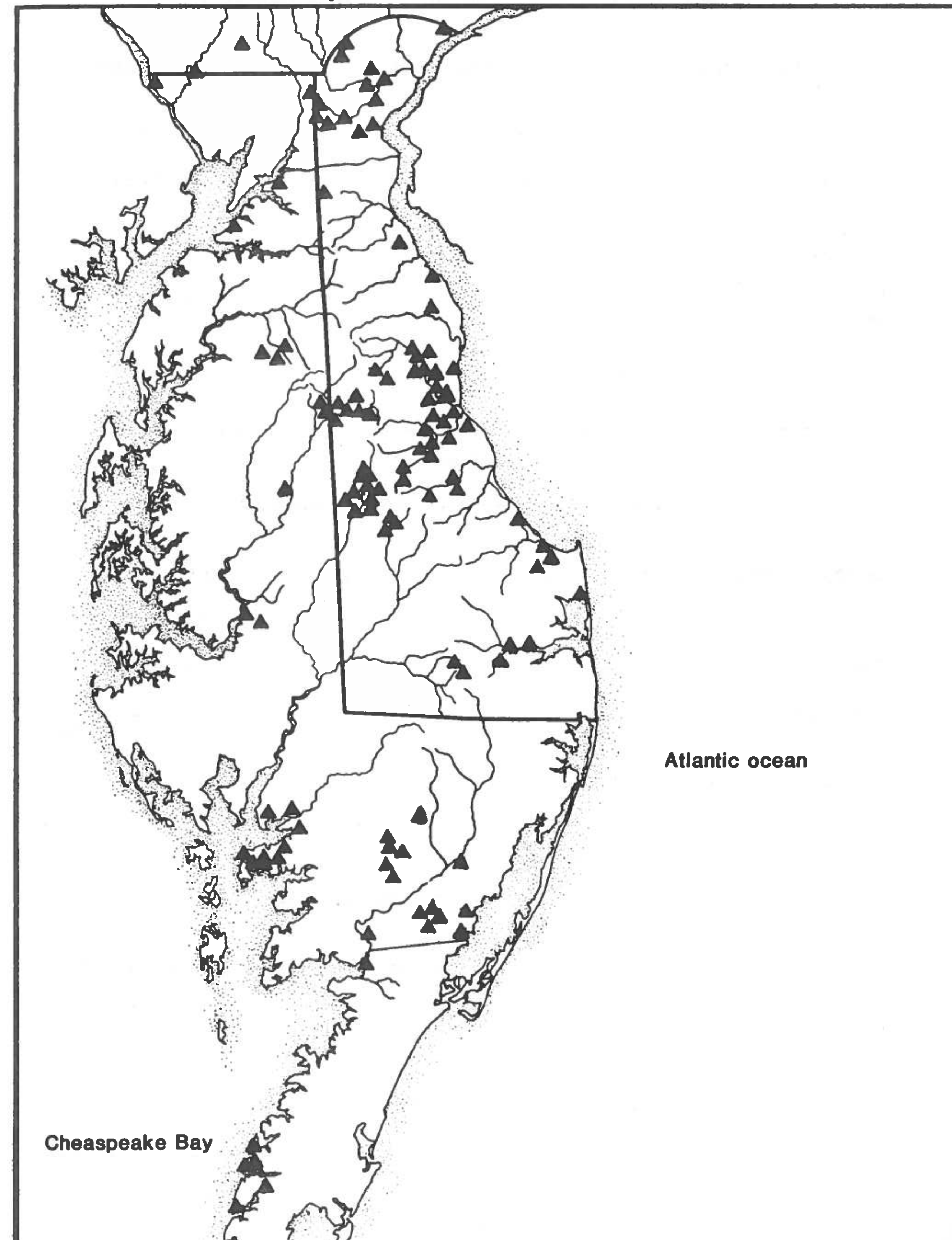


TABLE 12

Geomorphological Setting of Broadspear Sites

Geomorphological Setting	Broadspear Sites	Total Sites
Terrace	79(48)	1965(48)
Floodplain	67(41)	1712(42)
Interior-Low Relief	15(9)	240(6)
Interior-High Relief	3(2)	165(4)

(   ) = Percentage Value

TABLE 13

Surface Water Setting of Broadspear Sites

Surface Water Setting	Broadspear Sites	Total Sites
Flowing Stream	143(87)	3748(87)
Estuary	11(7)	262(6)
Bay/Basin	11(6)	233(5)

(   ) = Percentage Value

TABLE 14

Stream Confluences at Broadspear Sites

Confluence	Broadspear Sites	Total Sites
Present	46(28)	790(18)
Absent	118(72)	3551(82)

(   ) = Percentage Value

TABLE 15

Water Distance Frequencies for Broadspear Sites

Water Distance (m)	Broadspear Sites	Total Sites
0-100	69(51)	1919(53)
101-200	39(29)	912(25)
201-300	12(9)	323(9)
301-400	9(7)	200(5)
401-500	3(2)	76(2)
501-600	1(1)	72(2)
601-700	2(1)	28(1)
701-800	0 -	33(1)
801-900	0 -	15 < 1
901-1000	1(4)	13 < 1
> 1000	0 -	9 < 1

(   ) = Percentage Value

p = .85) indicate that broadspear sites show no special tendencies for distance to surface water. Because the chi-square test is only marginally applicable, a series of difference-of-proportion tests were applied and no significant differences were noted. Table 16 shows the aspects of broadspear and other sites. Chi-square test results (chi-square = 8.52, df = 7, p = .29) show that broadspear sites show no special location trends with respect to aspect.

The locational data indicate that there are no special trends in broadspear site locations when they are compared to the total sample of sites. The riverine focus of broadspear sites is, thus, not significantly different from that of other time periods. The common focus of broadspear sites and other sites in the sample is underscored by the fact that sites with broadspear components also often contain other components as well. Table 17 shows the frequency with which other archaeological components are found at broadspear sites and it can be seen that only 12% of the time are broadspears the single component of archaeological sites. Broadspear components are most commonly associated with other Woodland I components, as would be expected given definitions of Woodland I settlement patterns (Custer 1984c), and Woodland II components. One reason for the common occurrence of broadspear and other components is the fact that 89% of the sites with broadspears are base camps (Table 18). Because many of the base camp sites in the Delmarva region tend to be multicomponent sites, and because the chi-square test results (chi-square = 12.07, df = 1, p < .001) indicate that broadspears occur significantly more frequently at base camp sites, it is not surprising that broadspears are frequently found in association with artifacts of other cultural complexes.

TABLE 16

Aspect of Broadspear Sites

Aspect	Broadspear Sites	Total Sites
North	25(75)	550(13)
Northeast	8(5)	366(9)
East	25(15)	712(17)
Southeast	15(9)	501(12)
South	20(12)	634(15)
Southwest	21(13)	424(10)
West	28(17)	713(17)
Northwest	19(12)	354(8)

( ) = Percentage Value

TABLE 17

Co-occurence of Broadspear Components and Other Occupations

Co-occurring Occupation	Broadspear Sites
Paleo-Indian	30(18)
Archaic	41(25)
Other Woodland I	127(77)
Woodland II	76(46)
Only Broadspears	20(12)

( ) = Percentage Value

TABLE 18

Broadspear Site Types

Site Type	Broadspear Sites	Total Sites
Procurement	4(11)	72(42)
Base Camps	34(89)	99(58)

In conclusion, "broadspears" are an interesting and important part of the Delmarva archaeological record. The data presented here shows that the broad-blade bifaces were most commonly used as knives and generalized cutting tools at base camp sites. Understanding why such special tool forms, which were linked with very distinctive lithic raw material procurement systems, proliferated between 2000 B.C. and 1200 B.C. will be a major goal for future research in Delmarva archaeology.

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