Bulletin of the Archaeological Society of Delaware

Number Sixteen, New Series

Fall 1984

Bulletin of the Archaeological Society of Delaware

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AN ANALYSIS OF FLUTED POINTS AND PALEO-INDIAN SITE LOCATIONS FROM THE DELMARVA PENINSULA

by

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INTRODUCTION

The purpose of this paper is to describe and analyze data on fluted projectile points and Paleo-Indian site locations from the Delmarva Peninsula. Although several studies have provided summaries of fluted point finds for portions of the general Delmarva region (Mason 1959; Thomas 1966; Brown 1979; Marshall 1982; McCary 1983), as well as discussions of Paleo-Indian site distributions in the Delmarva region (Gardner 1979; Custer 1984:48-60; 1983:28-33; Custer, Cavallo, and Stewart 1983), no studies have systematically considered both the fluted point data and the Paleo-Indian site location data for all of the Delmarva Peninsula. This paper seeks to fill that gap in the literature and summarize the basic data used to develop regional models of Paleo-Indian settlement-subsistence systems (Custer, Cavallo, and Stewart 1983).

Before presenting the fluted point and Paleo-Indian site data, it is necessary to define the chronological scope of this paper. In recent years, Gardner (1974, 1977, 1979) has noted that there are many similarities in terms of general adaptations, tool kits exclusive of projectile points, lithic raw material preferences, and site distributions between the traditional Paleo-Indian (ca. 13,000 BC - 8500 BC) and Early Archaic (ca. 8500 BC - 6500 BC) periods. Although the hafting elements of projectile points change from flutes to notches between these two periods, Gardner notes that the similarities in other aspects of these cultures are more important. In his view, the traditional Early Archaic period should be a phase within the Paleo-Indian period and the end of the Paleo-Indian period should be dated at 6500 BC. Although the available Delmarva Peninsula archaeological data support Gardner's model (Custer 1983:28-33; 1984:48-60), only the fluted point phases of the Paleo-Indian period will be considered here, mainly because systematic attribute and collection data are not available for Early Archaic point types such as Palmer, Kirk, Amos, and Charleston (Coe 1964; Broyles 1971; Gardner 1974:38-40). Therefore, this paper will consider only the early portion of the Paleo-Indian period (ca. 13,000 BC - 8500 BC).

Three sub-phases are suggested for the fluted point phase of the Paleo-Indian period. From earliest to latest these sub-phases are Clovis, Mid-Paleo, and Dalton-Hardaway (Gardner 1974; Gardner and Verrey 1979). The absolute internal chronology among these three sub-phases is not clearly defined; however, the relative chronology is quite clear (Gardner 1974:36-38; Goodyear 1982). Figure 1 shows the typical diagnostic fluted point types associated with each sub-phase and these typical forms were used to evaluate the temporal placement of the fluted points examined in this study.

FLUTED POINT DATA

Sources for Delmarva fluted point data used here include Mason's (1959) survey of fluted points found in the Delaware drainage, Thomas' (1966) overview of fluted points from Delaware, the fluted point data file currently maintained at the Island Field Museum, Brown's (1979) survey of fluted points in Maryland, McCary's (1983, 1984) listing of fluted points which includes specimens from the Eastern Shore of Virginia, recent site reports on Paleo-Indian sites in Delaware (Custer 1980, Custer, Catts, and Bachman 1982), and my own notes on artifact collections at the Island Field Museum, the Virginia Research Center for Archaeology, the Maryland Geological Survey, and various private collections.

Appendix I lists all of the fluted point data used in this analysis. The main attributes recorded were site number, diagnostic type, raw material, length, width, thickness, length/width ratio, and width/thickness ratio. General comments on site location were also noted. It should be noted that quite often many more attributes related to basal grinding, flute length, and other variables are often recorded for fluted points. These variables were not recorded here because recent studies (Judge 1973:257-267; Gardner and Verrey 1979:34-39) have shown that length, width, thickness, and their related ratios form the main attributes which account for varied morphology within fluted point types. Also, many of the early fluted point surveys used to provide data for this study did not record metric attributes other than length, width, and thickness. Figure 2 shows some of the Delaware fluted points used in this study.

PALEO-INDIAN SITE DISTRIBUTION DATA

Appendix II provides a listing of all fluted point sites presently known from the Delmarva Peninsula. This listing was drawn from the Delmarva Archaeological Data System (DADS), a regional archaeological data base developed by the University of Delaware Center for Archaeological Research with funding from the University of Delaware Research Foundation. DADS is a

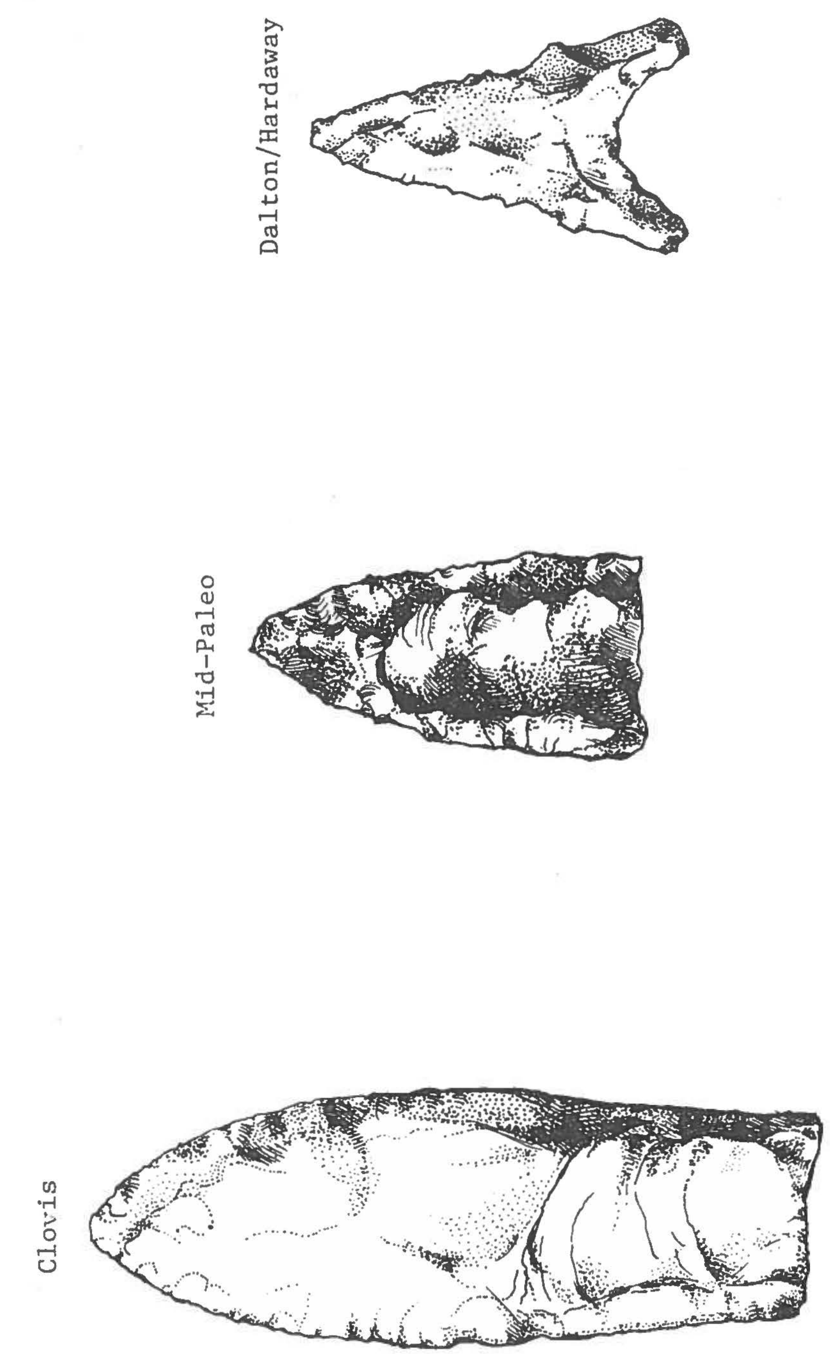


Figure 1: Typical Fluted Point Types

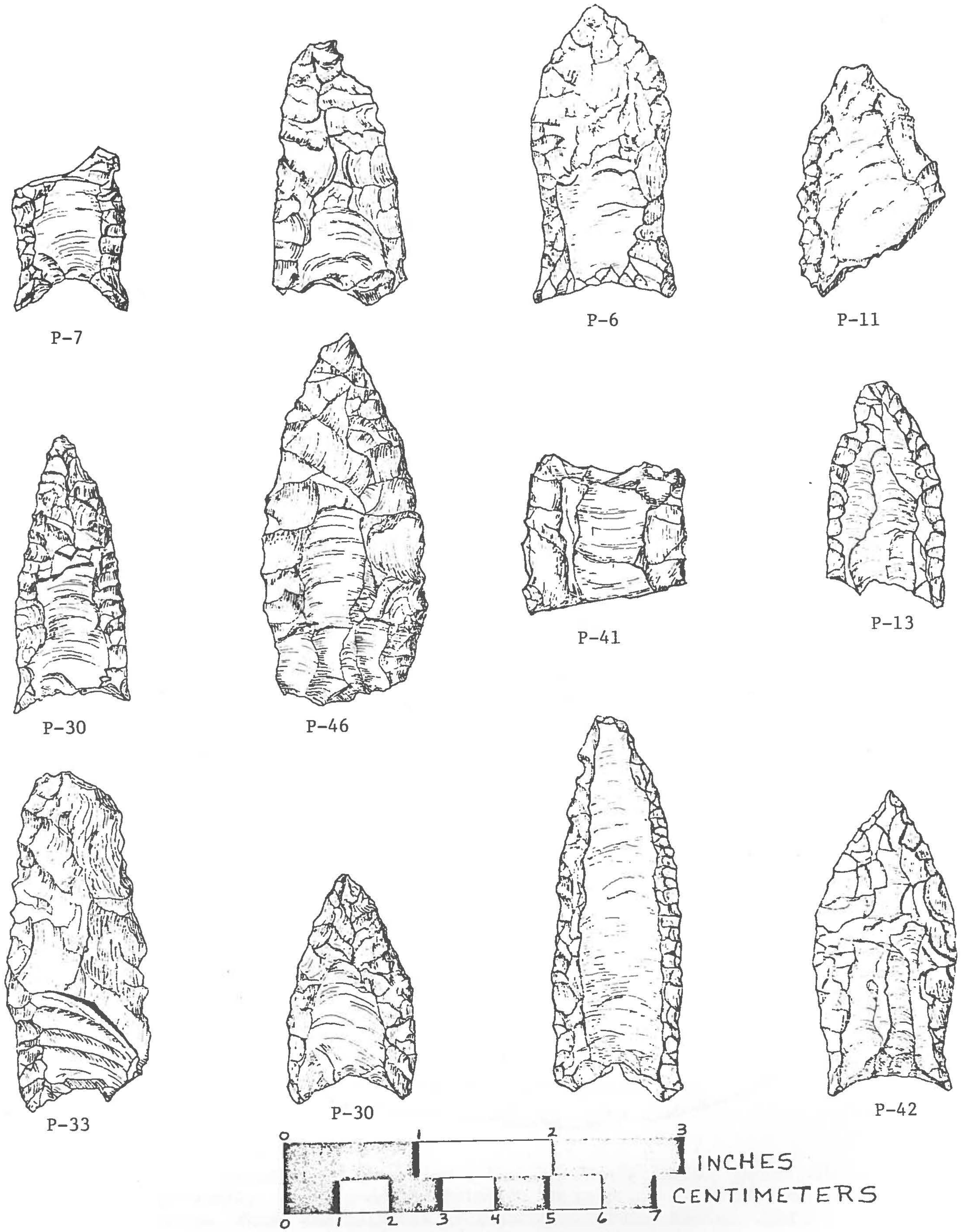


Figure 2: Delaware Fluted Points

computerized data bank of all of the prehistoric archaeological sites found on the Delmarva Peninsula and in southeastern Pennsylvania. Data on diagnostic artifacts present at each site and a wide series of locational variables were recorded. Appendix II lists all sites for which fluted points were recorded along with a series of locational variables which were thought to be important.

ANALYSIS

Rather than separately consider fluted point and site distribution data, these two data bases will be analyzed together. Two basic research issues will be considered: 1) general characteristics of the two data bases; and 2) variation among regional concentrations within the data bases. Additionally, Appendix III provides a more technical multivariate statistical analysis of the fluted point data with respect to research issues raised in a recent paper by Gardner and Verrey (1979).

General Characteristics - Morphological Variables

Table 1 shows the summary descriptive statistics for the total Delmarva fluted point data base. The large absolute values for variance, standard deviation, skewness coefficients, and kurtosis coefficients listed in Table 1 indicate that the distributions are not normally distributed and are generally skewed toward the smaller values and measurements. Figure 3 shows these features for the distribution of a single value, length. The non-normal distribution of these variables indicate that there are probably several sub-populations of data within the overall fluted point data base. These sub-populations may be related to regional variations in the data base as will be discussed later.

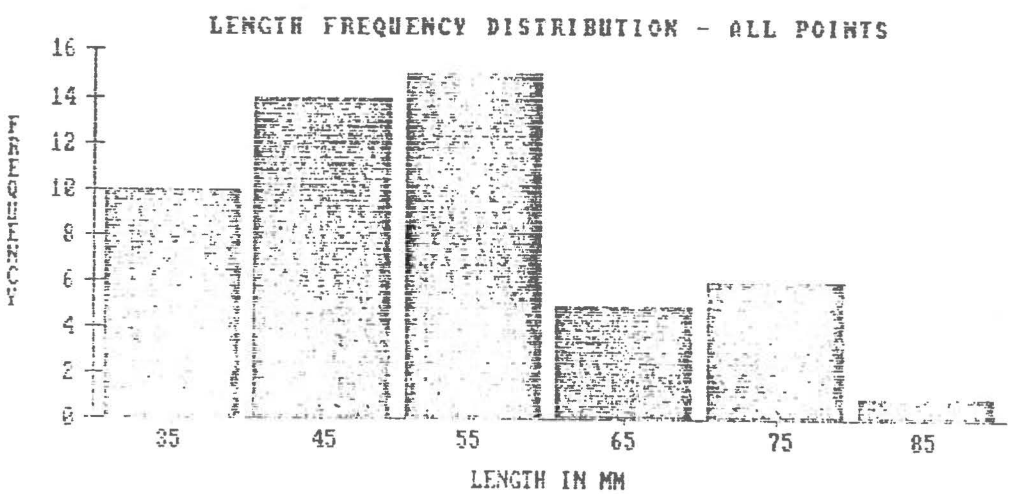
Examination of Appendix I underscores the various arguments that stress the Paleo-Indian focus on high quality cryptocrystalline raw materials (eg.- Goodyear 1979; Gardner 1974,1977,1979). Of the 87 points in the sample, only 3 points (3%) are manufactured from non-cryptocrystalline materials. Thus, Paleo-Indian groups manufacturing fluted points on the Delmarva Peninsula almost exclusively used high quality lithic materials. Consequently, the search for high quality lithic materials is an important variable to consider in discussions of Paleo-Indian settlement patterns and adaptations.

The importance of high quality materials also seems to be important for all time periods. A test for dependence of variables between chronological type and raw material generated a chi-square value of 4.55 with 6 degrees of freedom $(.50<p<.75)$,

Table 1: General Descriptive Statistics

	Length	Width	Thickness	L/W Ratio	W/T Ratio
Mean	38.11	23.84	5.55	1.55	3.69
Variance	687.29	44.37	5.83	1.02	2.76
Std. Dev.	26.22	6.66	2.41	1.01	1.66
Std. Error	2.81	.71	.26	.11	.18
Skewness	-.39	-1.77	-1.07	-.72	-.62
Kurtosis	1.89	8.49	3.86	1.87	4.32

Figure 3: Length Frequency Distribution



which indicates no relationship between the variables.

<u>General Characteristics - Site Distribution Data</u>

Figure 4 shows the location of fluted point sites on the Delmarva Peninsula. Earlier analyses (Custer 1984:49, Fig. 5; Custer, Cavallo, and Stewart 1983:264-266) noted three main concentrations of fluted point sites. These three concentrations are apparent in Figure 4 and include a concentration in northwestern Delaware and northeastern Maryland (Northern Concentration - No. 1, Figure 4), a concentration in the central portion of the Delmarva Peninsula (Drainage Divide Concentration - No. 2, Figure 4), and a concentration along the southern Maryland Eastern Shore (Southern Concentration - No. 3, Figure 4). These three concentrations have been correlated with the following natural environmental features (Custer 1984:55-60): 1) Northern Concentration - primary lithic outcrops of the Delaware Chalcedony Complex; 2) Drainage Divide Concentration - extensive Late Pleistocene-early Holocene swamps of the Mid-Peninsular Drainage Divide; and 3) Southern Concentration - large cobble deposits of the ancestral Susquehanna-Potomac-Nanticoke river confluence. These three concentrations can also be used as a basis to study variability in the fluted point and site location data bases.

<u>Regional Variation</u>

It is interesting to consider variation in fluted point attributes among the three regional concentrations noted above. Table 2 shows the distribution of chronological types among the three areas. The relatively small sample of fluted points which can be securely attributed to one of the three areas makes it difficult to ascertain any temporal differences in Paleo-Indian use of the three areas. Nonetheless, there are sufficient data to apply a chi-square test to see if there is a dependent relationship between the chronological periods and the Paleo-Indian use of the three areas. The chi-square test statistic is equal to 1.64 with 4 degrees-of-freedom ($.75<p<.90$) and shows that there is no dependent relationship between the two variables. Therefore, the currently available data indicate that the three areas of fluted point concentrations were used with similar frequencies during the fluted point phase of the Paleo-Indian period.

The fluted points from each of the three areas can be analyzed for differences in morphology to see if Paleo-Indian site utilization differed among the three areas. One attribute which can be analyzed is point length. In a study of fluted points from New Jersey, Marshall (1982:26-31) analyzed point length to identify differential tool utilization and Gardner and Verrey (1979:16-18, 41-44) have shown that point length is the attribute most sensitive to resharpening and tool reuse. As

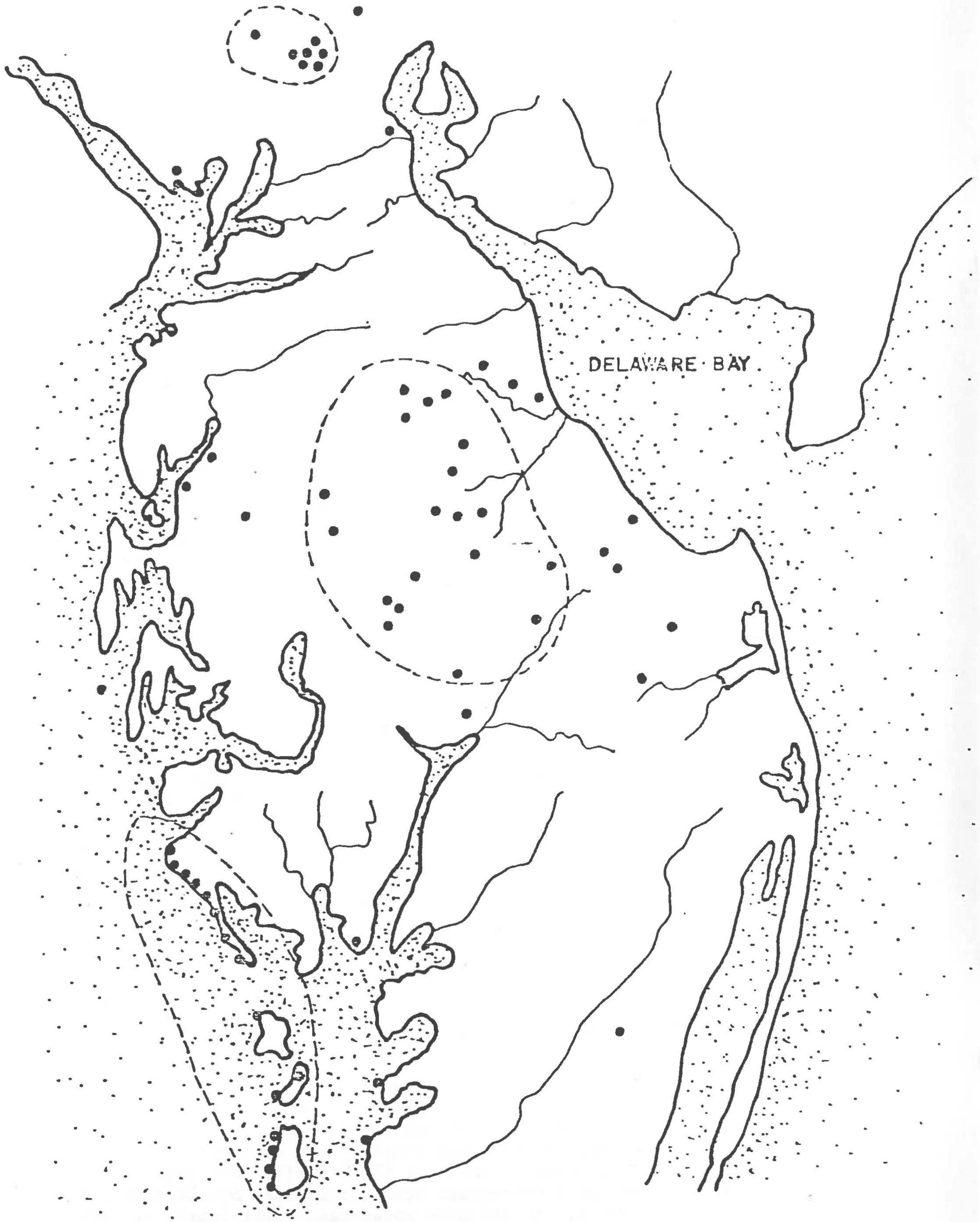


Figure 4: Fluted Point Locations

Table 2: Chronological Types and Regional Concentrations

Type	North	Divide	South	Total
Clovis	7	14	10	31
Mid-Paleo	8	11	8	27
Dalton	2	2	4	8
Total	17	27	22	66

(21 points cannot be assigned to a regional concentration)

newly manufactured fluted points are continually resharpened and reutilized, their length decreases. The varied frequencies of points of different lengths in collections can be indicative of differential tool kit use. For example, in an area where new points are being produced and used to replace old, highly resharpened points, one would expect to find numerous large points, which would be manufacturing rejects with little, if any, reworking, and numerous small, highly reworked points which would have been discarded from the tool kit. A different distribution might be found in an area where no new projectile points were being manufactured. In such an area, points of varied lengths would be broken and discarded. Consequently, an assemblage of points from such an area would include many smaller points, or a series of points of varying lengths. Trends similar to these have been noted by Custer, Cavallo, and Stewart (1983:266-269) using Marshall's (1982:27) fluted point data from New Jersey.

Similar analyses were undertaken using the Delmarva fluted point data. Figure 5 shows the length frequency distribution for each of the three regional concentrations. Table 3 shows a series of descriptive statistics for all points from each region. Comparison of the descriptive statistics in Table 3 and the frequency distributions in Figure 5 for the three regions shows that length measurements are normally distributed in the drainage divide and southern sub-areas. Length measurements from the northern area are clearly not normally distributed.

Although the northern sample is smaller (only 64%) than the other two regional samples, the difference in normality between the northern sample and the other two samples has significant meaning. Examination of the northern area frequency distribution shows that there are two main size classes of points in the northern area: a series of points (the majority of the sample)

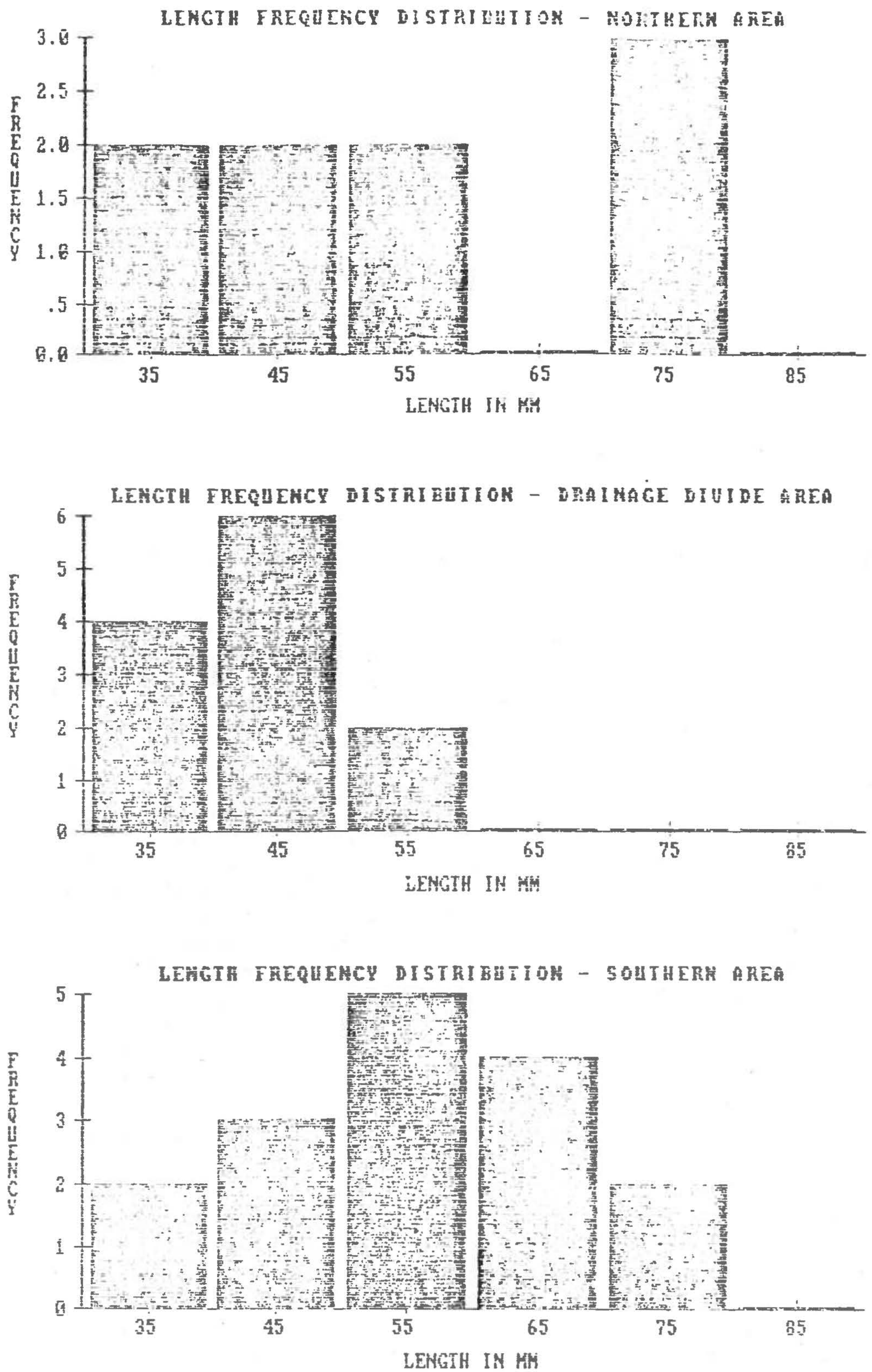


Figure 5: Regional Length Frequency Distributions

Table 3: Regional Descriptive Statistics

	Length	Width	Thickness	L/W Ratio	W/T Ratio
Northern Concentration (n=14)					
Mean	35.43	23.50	4.86	1.37	4.13
Variance	949.49	58.11	7.21	1.29	4.45
Std. Dev.	30.81	7.62	2.68	1.14	2.11
Std. Error	8.24	2.04	.72	.30	.56
Skewness	.02	-2.16	-.26	-.24	-.93
Kurtosis	1.55	7.65	3.08	1.41	2.80
Drainage Divide Concentration (n=25)					
Mean	43.60	24.76	5.24	1.75	3.28
Variance	703.25	46.61	8.19	1.06	3.21
Std. Dev.	26.52	6.83	2.86	1.03	1.79
Std. Error	5.30	1.37	.57	.21	.36
Skewness	-.86	-1.68	-1.02	-1.06	-1.02
Kurtosis	2.16	8.18	2.74	2.35	2.72
Southern Concentration (n=25)					
Mean	29.88	22.60	6.08	1.25	3.45
Variance	650.44	68.92	4.66	.97	1.41
Std. Dev.	25.50	8.30	2.16	.99	1.19
Std. Error	5.10	1.66	.43	.19	.24
Skewness	.17	-1.23	-1.53	-.41	-1.84
Kurtosis	2.30	5.69	6.06	1.39	6.45

that are between 35 mm and 55 mm in length and a series of points between 70 mm and 75 mm in length. In this case, the smaller points represent heavily reused discards found near the primary lithic quarry sources in northwestern Delaware and northeastern Maryland (Custer and Galasso 1980:4; Custer 1984:55-56; Custer and Ward n.d.). The larger points are early stage points rejected at the quarry sites as well due to manufacturing errors or material flaws. Thus, the frequency distribution of length measurements for the northern area is typical of the type of distribution expected close to a quarry source.

Because the drainage divide and southern area distributions are normally distributed, they can be statistically compared. Table 4 shows the comparative t-test statistics for length, width, thickness, length/width ratio, and width/thickness ratio. None of the test values have associated probability values less than .10 and this indicates that none of the differences between the southern and drainage divide areas are statistically significant. Following the logic presented earlier in this paper, the similarity of the attribute distributions between these areas would be interpreted as an indication that groups in the two areas shared similar tool production and use activities and similar lithic procurement strategies. However, other data suggest otherwise.

Table 4: Comparative Statistics for Drainage Divide and Southern Areas

Region	Length	Width	Thickness	L/W Ratio	W/T Ratio
Drainage Divide	43.60	24.76	5.24	1.75	3.28
South	29.88	22.60	6.08	1.25	3.45
Test Statistic	1.86	1.00	-1.17	1.75	-.40

When non-projectile point lithic tools are compared between the drainage divide and southern areas, important differences can be noted. Tool kits from the drainage divide area seem to be highly curated with many tools resharpened into multi-function tools. The best example of these highly reworked tool kits would be the assemblages from the Hughes Early Man Complex in Delaware (Custer 1984:57-59, Plate 2). Multiple tools are common and Paleo-Indian groups seem to be carefully husbanding their lithic resources. The low frequency of lithic resources in the drainage divide area makes this a necessary lithic maintenenace strategy (see discussion in Goodyear 1979).

A different pattern is seen in the non-point components of southern area tool kits, although the available data are more limited. In cases where large surface collections have been catalogued (eg. Gardner and Stewart 1977; Gardner and Haynes 1978; Gardner, Wall, Tolley, and Custer 1978), the presence of numerous early stage bifaces manufactured from cobbles is always noted. Also, the southern area is rich in secondary cobble lithic resources (Custer and Galasso 1980). Generally, the tool kits do not seem to be heavily curated and intensive reworking of tool kits does not seem to have taken place. Also, more early stage biface production apparently took place in the southern area than in the drainage divide area. To summarize to this point, the drainage divide area shows tool kits indicative of intensive resharpening, and careful curation (Binford 1979). These characteristics are indicative of tool kit maintenance strategies associated with areas of low lithic resource availability. In contrast, the southern area shows more

profligate lithic resource utilization in an area rich in secondary lithic resources.

In spite of these differences, the fluted point length frequency distributions of the two areas are not significantly different. The absence of a difference in the length frequency distributions between the two areas of quite different lithic utilization strategies would seem to contradict earlier arguments, presented here and elsewhere (Gardner and Verrey 1979:16-18, 41-44; Custer, Cavallo, and Stewart 1983:269-271), about point length reflecting lithic utilization patterns. However, when the northern area is also considered, some interesting patterns emerge. The northern area provides a length frequency distribution with a bimodal pattern consisting of small discarded, highly resharpened points and large points rejected late in the manufacturing process. This is the expected pattern for a lithic-rich area with quarrying and initial tool production activities. The unimodal distribution of the drainage divide area with its smaller values also fits with the expected pattern for a lithic-poor area. Furthermore, non-projectile point components of the tool assemblages from both areas also correspond to the expected patterns for lithic-rich and lithic-poor areas (see Custer 1984:56-60).

The southern area, however, represents something of an anomaly. The point length frequency distribution from this lithic-rich area is identical to that of the lithic-poor drainage divide area. Moreover, the frequency distributions of the northern and southern areas, both lithic rich, are quite different. The differences in distributions between the two lithic rich areas may be related to the type of lithic resources present in each area. The northern area lithic resources are large, primary sources localized in a relatively restricted area (Custer and Ward n.d.). The southern area, in contrast, is characterized by numerous widespread secondary cobble deposits (Custer and Galasso 1980). Size differences in available lithic materials may have made it difficult to manufacture larger points and bifaces from the secondary lithic resources of the southern area. It is also possible that the process of cobble reduction is different from that associated with the reduction of primary materials (see discussion in Cavallo 1981). Whatever the case, the Delmarva data show that more research on cobble reduction is needed and that there are differences in the ways primary and secondary lithic resources are utilized.

Up to now the discussion of regional variation has focused on the fluted point data. Some additional insights can be gained, nonetheless, by looking at regional variation in site location data. One variable which can be studied is the environmental setting of Paleo-Indian sites among the three regional sub-areas. Table 5 shows the different site settings among the three regions. Examination of Appendix II shows that there are two main categories of site settings: 1) poorly-drained swamp environments, which may be swampy frequent floodplains of major and minor drainage, bay/basin features, sinkholes, or drainage divide swamps; and 2) well-drained floodplains or terraces of the major drainages. Based on surface collections (see Custer 1984:56-60) and comparisons with other Paleo-Indian sites and collections in the Northeast and Middle Atlantic (Kraft 1973; 1977; Gardner 1974; 1977; 1979; Eisenberg 1978; Moeller 1980; 1982), the Paleo-Indian sites associated with poorly drained swampy settings are primarily hunting/processing sites and related base camps. Documented examples in Delaware include 7NC-A-2, 7NC-D-70, 7K-E-10, 7K-E-24, and 7K-E-33. On the other hand, the sites in well-drained settings are more often base camp sites associated with other outlying hunting sites or quarry-related activities. Thus, the two columns in Table 5 can be equated with the hunting/processing aspects of the Paleo-Indian settlement system (poorly drained swamps) and the more exclusively habitation and/or lithic procurement aspects of the settlement system (well-drained floodplains and terraces).

Table 5: Site Settings among Regions

	Site Settings	
Regions	Poorly-Drained Swamps	Well-Drained Floodplains and Terraces
North	4	3
Drainage Divide	14	5
South	2	10

Although the data presented in Table 5 are biased by numerous factors, such as sampling problems, analysis still shows some interesting patterns. Chi-square analysis of the crosstabulation in Table 5 yields a test statistic of 9.66 with two degrees-of-freedom ($p<.01$). This value indicates a strongly significant dependent relationship among the site types found in the three areas. There are many hunting related sites in the drainage divide area, including potential base camps associated with complexes of hunting/processing sites. Also, hunting sites and related base camps are under-represented in the southern area. It is my feeling that the preponderance of hunting/processing sites in the drainage divide area is a genuine pattern in the archaeological record, mainly because both hunting and base camp sites are present among the sites associated with swampy settings. On the other hand, the low number of hunting/processing sites in the southern area is probably a result of sampling bias because it is unreasonable to believe that there are very few hunting/processing sites in the southern area. The high number of hunting/processing sites located in

swampy settings in the drainage divide area is probably related to the high incidence of swampy settings in this section of the Delmarva Peninsula at the end of the Pleistocene (Custer 1984:26, 44-47; Custer and Griffith 1984). As such, the drainage divide area of the Delmarva Peninsula was most likely a rich hunting and gathering area that attracted Paleo-Indian groups, even though lithic resources were relatively scarce. This hypothesized use of the drainage divide area, which is based on site location data, is also congruent with the fluted point data which indicated that fluted points from the area were primarily small highly resharpened points.

CONCLUSIONS

The analysis of fluted points and Paleo-Indian site locations provides interesting insights about Paleo-Indian lifeways. To a certain extent, the Delmarva Peninsula presented Paleo-Indian groups with a problem of incongruent distributions of critical resources. The central section of the Delmarva Peninsula was an especially rich and productive hunting/gathering setting; however, it was characterized by a relatively low incidence of lithic materials suitable for the manufacturing of stone tools. The northern end of the peninsula had relatively abundant high quality cryptocrystalline lithic resources, but had a lower incidence of high quality hunting sites than did the central part of the peninsula. The southwestern coast of the peninsula was similar to the northern area. Thus, Paleo-Indian groups had to arrive at the hunting sites with a tool kit in place that could be easily manipulated into a wide variety of hunting and processing tools. Furthermore, as tool kits became depleted, Paleo-Indian groups had to procure suitable replacements.

These problems were solved by numerous strategies. One strategy was to remain mobile and move among the various incongruent areas of differential resource availability. Similar mobility is common to most hunters and gatherers (Binford 1983:Chapters 2 and 3; 1982). Another strategy was to intensively utilize cryptocrystalline lithic materials for most of their stone tools. High quality lithic materials are the easiest materials to manipulate into various bifacial and unifacial tool forms (Callahan 1979; Goodyear 1979). Use of these materials allowed Paleo-Indians to prepare a carefully planned tool kit while in areas of high lithic availability and then to transport these tools to areas with good hunting settings and low lithic resource availability. In other words, careful curation of tool kits manufactured from high quality materials was the Paleo-Indians' solution to the problem of incongruent resource distributions. Given the fact that there was little seasonal variation in plant and animal resource availability during the Late Pleistocene (Carbone 1976), the state of the tool kits probably played an important role in scheduling Paleo-Indian group movement.

In sum, analysis of fluted points and Paleo-Indian site distributions shows the importance of high quality lithic resources to Paleo-Indian adaptations and these analyses lead to insights about Paleo-Indian lifeways. Hopefully, further research will identify additional concentrations of Paleo-Indian sites. Analyses of these new data can then be used to test some of the ideas presented here.

APPENDIX I - DELMARVA FLUTED POINT DATA

SITE NUMBER	POINT TYPE	MATERIAL	LENGTH	WIDTH	THICKNESS
18WC	CLOVIS	JASPER	53	28	6
18WC	CLOVIS	CHERT	50	21	6
18SO	MID-PALEO	JASPER	34	21	5
44AC	MID-PALEO	CHERT	36	20	6
18SO	CLOVIS	CHERT	60	24	8
18SO	CLOVIS	CHERT	0	24	7
44AC	MID-PALEO	CHERT	41	26	6
18QU	CLOVIS	JASPER	71	31	8
18QU17	CLOVIS	JASPER	67	28	8
18QU	CLOVIS	JASPER	49	23	5
18QU	CLOVIS	JASPER	54	21	6
18DO1	CLOVIS	JASPER	54	23	6
18DO	CLOVIS	CHALCEDONY	90	39	10
18CA23	CLOVIS	CHERT	57	29	8
18CA25	CLOVIS	JASPER	65	23	7
18CA23	CLOVIS	JASPER	59	29	9
18CA18	MID-PALEO	CHALCEDONY	0	24	5
18CA26	CLOVIS	JASPER	53	23	5
18SO86	CLOVIS	JASPER	0	35	7
18SO32	MID-PALEO	CHERT	0	25	7
18SO119	CLOVIS	QUARTZ	44	20	7
18SO8	CLOVIS	QUARTZ	0	23	8
18SO		JASPER	0	0	0
18WO23	CLOVIS	QUARTZ	0	25	7
18DO	DALTON	JASPER	43	21	5
18DO34	MID-PALEO	JASPER	44	23	6
18DO	DALTON	JASPER	42	26	6
18DO	CLOVIS	CHERT	59	28	8
18DO	CLOVIS	JASPER	0	28	6
18DO71	CLOVIS	JASPER	0	25	8
18DO70	MID-PALEO	JASPER	39	25	6
18DO69	MID-PALEO	JASPER	35	20	6
18DO69	MID-PALEO	JASPER	46	22	6
18DO69	DALTON	JASPER	31	16	5
7NC-A-2	DALTON	CHERT	40	25	5
7NC-A-2	CLOVIS	JASPER	75	30	6
7NC-A-2	MID-PALEO	CHERT	34	21	4
7NC-D-70	MID-PALEO	CHERT	0	20	3
7NC-C	MID-PALEO	JASPER	40	18	5
7NC-C	MID-PALEO	CHERT	44	52	76
7NC-A-10	CLOVIS	CHERT	80	29	5
7NC-A-4	MID-PALEO	CHERT	51	22	6
7K	CLOVIS	CHERT	55	24	7
7S-F-3	CLOVIS	JASPER	54	26	0
7S-C-1	CLOVIS	JASPER	0	21	5
7NC-D-15	DALTON	JASPER	38	21	6
7S-B-27	MID-PALEO	JASPER	52	26	6
7NC-D-21	MID-PALEO	JASPER	0	25	4
7NC-E-10	MID-PALEO	CHERT	41	28	5

APPENDIX I - ctd.

7NC-E-62	CLOVIS	CHERT	57	23	0
7S	CLOVIS	CHERT	0	28	7
7K-F-14	MID-PALEO	CHERT	58	27	7
7K	DALTON	CHERT	31	22	4
7K-D-4	MID-PALEO	JASPER	60	23	5
7K-D	CLOVIS	JASPER	0	28	4
7K-D	CLOVIS	JASPER	72	25	5
7K-E-10	MID-PALEO	JASPER	64	27	0
7K	MID-PALEO	JASPER	0	26	3
7K-G-14	CLOVIS	CHERT	60	24	7
7K-E-50	MID-PALEO	JASPER	0	32	6
7K-E-24	MID-PALEO	CHERT	0	37	7
7K	CLOVIS	CHERT	70	29	8
7NC-D-23	CLOVIS	CHALCEDONY	65	25	0
7K-E-19	MID-PALEO	JASPER	0	31	6
7NC-D-18	MID-PALEO	CHERT	0	24	10
7NC-D-14	CLOVIS	CHERT	0	0	0
7K-F-14	CLOVIS	CHALCEDONY	65	28	9
7K-G	MID-PALEO	JASPER	0	22	0
7K-C-76	CLOVIS	JASPER	68	26	6
7K-E-11	DALTON	CHERT	38	20	6
7K	CLOVIS	JASPER	71	30	6
7NC-E	CLOVIS	JASPER	72	28	8
7K	CLOVIS	JASPER	51	21	8
7NC-J-10	MID-PALEO	JASPER	37	20	6
7NC-D-3	CLOVIS	JASPER	0	31	6
7K	CLOVIS	JASPER	60	27	6
7K-E	CLOVIS	JASPER	0	0	0
7K-E-8	CLOVIS	JASPER	70	30	8
7	CLOVIS	CHERT	57	24	8
7K-C-76	DALTON	JASPER	44	18	0
7NC	MID-PALEO	JASPER	43	23	5
7K	DALTON	JASPER	58	27	7
7S-J-11	MID-PALEO	CHERT	37	20	6
7	MID-PALEO	JASPER	41	21	5
7K-G-33	MID-PALEO	JASPER	41	22	6
44NH116	DALTON	CHERT	0	0	0

APPENDIX II - PALEO-INDIAN SITE DATA

SITE NUMBER	PHYSIOGRAPHIC PROVINCE	SECONDARY DRAINAGE	SURFACE WATER TYPE	GEOMORPHOLOGICAL SETTING
18-CA-18	LOW COASTAL PLAIN	TUCKAHOE	STREAM	HIGH TERRACE
18-CA-23	LOW COASTAL PLAIN	CHOPTANK	STREAM	FLOODPLAIN
18-CA-25	LOW COASTAL PLAIN	CHOPTANK	STREAM	FLOODPLAIN
18-CA-26	LOW COASTAL PLAIN	CHOPTANK	STREAM	LOW TERRACE
18-DO-1	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	FLOODPLAIN
18-DO-14	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	LOW TERRACE
18-DO-69	LOW COASTAL PLAIN	CHESAPEAKE	STREAM	FLOODPLAIN
18-DO-70	LOW COASTAL PLAIN	CHESAPEAKE	ESTUARINE BAY	FLOODPLAIN
18-QU-17	LOW COASTAL PLAIN	TUCKAHOE	STREAM	FLOODPLAIN
18-SO-32	LOW COASTAL PLAIN	MANOKIN	STREAM	FLOODPLAIN
18-SO-78	LOW COASTAL PLAIN	MONIE BAY	ESTUARINE BAY	FLOODPLAIN
18-SO-8	LOW COASTAL PLAIN	CHESAPEAKE	ESTUARINE BAY	FLOODPLAIN
44-NH-116	LOW COASTAL PLAIN	CHESAPEAKE	ESTUARINE BAY	LOW TERRACE
7K-C-76	LOW COASTAL PLAIN	CHOPTANK	STREAM	LOW TERRACE
7K-C-8	LOW COASTAL PLAIN	ST. JONES	CAROLINA BAY	LOW TERRACE
7K-E-10	LOW COASTAL PLAIN	INDIAN	STREAM	INTERIOR FLAT
7K-E-12	LOW COASTAL PLAIN	CHOPTANK	STREAM	HIGH TERRACE
7K-E-19	LOW COASTAL PLAIN	CHOPTANK	STREAM	LOW TERRACE
7K-E-24	LOW COASTAL PLAIN	CHOPTANK	STREAM	LOW TERRACE
7K-E-31	LOW COASTAL PLAIN	MURDERKILL	STREAM	FLOODPLAIN
7K-C-40	LOW COASTAL PLAIN	CHOPTANK	STREAM	SAND RIDGE
7K-E-50	LOW COASTAL PLAIN	CHOPTANK	STREAM	TERRACE
7K-C-62	LOW COASTAL PLAIN	CHOPTANK	STREAM	TERRACE
7K-C-8	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	LOW TERRACE
7K-F-14	LOW COASTAL PLAIN	MISPILLION	STREAM	LOW TERRACE
7K-G-14	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	LOW TERRACE
7K-G-33	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	LOW TERRACE
7K-G-6	LOW COASTAL PLAIN	MARSHYHOPE	STREAM	LOW TERRACE
7NC-A-10	PIEDMONT UPLANDS	UPPER DELAWARE	STREAM	UPLAND SLOPE
7NC-A-12	PIEDMONT UPLANDS	UPPER DELAWARE	STREAM	UPLAND SLOPE
7NC-A-2	PIEDMONT UPLANDS	MILL CREEK	STREAM	HOCKESSIN LOWLANDS
7NC-D-14	PIEDMONT UPLANDS	UPPER DELAWARE	STREAM	HIGH TERRACE
7NC-D-15	FALL LINE	UPPER DELAWARE	STREAM	UPLAND SLOPE
7NC-D-21	FALL LINE	UPPER DELAWARE	STREAM	TERRACE
7NC-D-3	HIGH COASTAL PLAIN	CHRISTINA	STREAM	INTERIOR FLAT
7NC-D-59	COASTAL PLAIN	UPPER DELAWARE	STREAM	HIGH TERRACE
7S-B-27	LOW COASTAL PLAIN	NANTICOKE	STREAM	LOW TERRACE
7S-C-1	LOW COASTAL PLAIN	SLAUGHTER	STREAM	LOW TERRACE
7S-F-3	LOW COASTAL PLAIN	BROADKILL	STREAM	SAND RIDGE
7S-J-11	.LOW COASTAL PLAIN	POCOMOKE	STREAM	INTERIOR FLAT

APPENDIX III - MULTIVARIATE STATISTICAL ANALYSIS

The purpose of this appendix is to provide a short presentation of the results of a factor analysis of the metric attributes of the Delmarva fluted point data base. In a recent paper, Gardner and Verrey (1979) carried out a similar factor analysis of fluted points from the Flint Run area of northwest Virginia and noted that there are two main underlying sources of variability measured by the commonly recorded matric attributes of fluted points. These two sources of variability were point size in terms of length/width ratios and point thickness in terms of width/thickness ratios (Gardner and Verrey 1979:37, Fig. 7). The factor analysis shows these results by noting the correlations of metric attributes with two or more factors of "super-attributes" (Rummel 1970:472-487). Table 6 shows varimax rotated factor matrix published by Gardner and Verrey.

Table 6: Factor Matrix - Virginia Fluted Point Data

Variable	Factor 1	Factor 2
Length	0.94935	0.07055
Width	0.90459	0.33041
Thickness	0.41545	0.86437
Basal Thickness	0.22451	0.26133
Basal Width	0.83254	0.21432
Hafting Width	0.90941	0.36252
Hafting Thickness	0.17000	0.89547
Width/Thickness	0.09485	-0.97321
Length/Width	0.77255	-0.02362

<u>Source:</u> Gardner and Verrey 1979:35, Table 6

An identical analysis was carried out for the Delmarva data using the oblique primary- and reference-factor analysis module of the STATPRO statistical package on an IBM-XT computer. Table 7 shows the primary attribute correlation matrix and Table 8 shows the factor matrix for the Delmarva fluted point data.

Table 7: Correlation Matrix - Delmarva Fluted Point Data

	Length	Width	Thickness	L/W Ratio	W/T Ratio
Length	1.0000				
Width	0.2999	1.0000			
Thickness	0.2502	0.5745	1.0000		
L/W Ratio	0.9602	0.1697	0.1828	1.0000	
W/T Ratio	-0.0516	0.5294	0.4385	-0.0942	1.0000

Table 8: Factor Matrix - Delmarva Fluted Point Data

Variable	Factor 1	Factor 2
Length	0.9900	0.2021
Width	0.2372	0.8529
Thickness	0.2187	0.8161
L/W Ratio	0.9900	0.1047
W/T Ratio	-0.0736	0.7978

Comparison of Tables 6 and 8 shows that the two factor analyses produced roughly similar results.* Although different variables were used in each factor analysis, the results are similar nonetheless. The analysis of the Delmarva points shows point length measures clustering with one factor and width/thickness measures clustering with another. The similarity of the two analyses' results underscores both the validity of the factor analysis technique and the validity of considering point length and associated ratios as special indicators of point reuse and life history (Gardner and Verrey 1979:17-18, 34-35).

*Gardner and Verrey used the SPSS statistical analysis package; however, the STATPRO factor analysis computations are comparable (National Evaluation Systems 1984:70-72; Overall and Klett 1972:157-179).

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