DISCUSSION AND CONCLUSIONS

This final section of the report will discuss some of the implications of the interpretations of archaeological data recovered from the Leipsic Site. A summary of the data from the site is presented along with discussions of paleoenvironments, artifact chronologies, cordage twist data, regional lithic technologies, subsistence systems, regional migrations, community settlement patterns, and regional settlement patterns. Future research directions are also noted.

Site Summary

The sloping terrain upon which the Leipsic Site is located was an attractive locale for human settlement for more than 10,000 years. A variety of projectile points spanning the period between 8,000 B.C. and A.D. 1500 were recovered from the site and testify to the intermittent and repeated reoccupation of the site. Up until ca. 2500 B.C., the occupations were rather ephemeral, and the only signs of their presence are projectile points and waste flakes from the manufacture of stone tools. These artifacts are mixed with the remains of later occupations and diagnostic projectile points are the only certain signs of the early occupations.

Some time after 3000 B.C., prehistoric groups began to spend more time at the Leipsic Site. These later inhabitants built circular to oval houses with bent saplings as supports for roofs of bark, hides, or rushes. The houses also had interior fireplaces, an excavated "basement" like depression almost as large as the house itself, and a "sub-basement" storage pit. Storage pits and large outdoor fireplaces that may have been communal resource processing areas are also present.

All of the houses are relatively small and would have housed individual families. In one area of the site it is possible that up to six of the these houses were occupied at once. However, in all other areas of the site, the houses seem to indicate individual family occupations. At any given time in the past, there was probably only one household living at the site. Lithic and ceramic debris were found in some of the pits inside the houses indicating that the pits were used as refuse receptacles after they were no longer used as storage pits. The occupations probably lasted less than one year, and the presence of interior fireplaces in some of the houses suggests that the occupation spanned the cold-weather months. There seems to be little change in the way the site was used, and the households who used it, from approximately 2500 B.C. to A.D. 1500.

Lithic technologies at the site included core and biface reduction which relied heavily on cobbles and pebbles that are present near the site. Projectile points found at the site are sometimes made from materials not readily available in the immediate vicinity of the site, such as argillite and rhyolite. These artifacts may have been brought to the site as part of the tool kit transported by prehistoric groups, used, broken, discarded, and replaced with new tools manufactured at the site from local cobbles and pebbles.

In sum, the Leipsic Site was the home to numerous prehistoric groups over a long period of time. The initial use of the site was sporadic, but through time, the occupations became more substantial and there was little change in the way that the site was used. Nevertheless, the populations using the site were never large at any point in the history of its use.

Paleoenvironments

The extensive program of geologic coring in the vicinity of the Leipsic Site allowed for the development of a variety of paleoenvironmental information including the sedimentary data described in Appendix I and an earlier study of pollen from the initial geologic cores associated with the Phase II site research (Brush 1994). The sedimentary data reveal the development of the marshes of the Leipsic River environs over time and the pollen data reveal both vegetation and climatic changes in the local area. Past studies (Custer 1989; Mouer 1991) have suggested that one of the major causes of culture change during the Woodland Period, the time period of the major occupations of the Leipsic Site, was the interplay of changing estuarine environments and climatic change. The data from the geologic cores allows for these two factors to be studied at the Leipsic Site.

The data in Appendix I indicate that three main riverine environments were present in the vicinity of the Leipsic Site over time: alluvial valley, tidal river valley, and estuary. Each of these wetland environments would have had rich resources for prehistoric hunters and gatherers (Daiber et al. 1976). Detailed analyses of these environments in terms of relative productivity for hunting and gathering (Griffith 1974; Thomas et al. 1975) reveal that in general, the estuary would have been the richest environment followed by the tidal river valley and the alluvial valley in order of decreasing productivity. Water salinity also plays a role in estuarine environmental productivity in that the appearance of somewhat brackish water in the local estuarine marshes allows for the presence of a mix of plants and animals adapted to both fresh water and brackish water conditions. Thus, a somewhat brackish water tidal river valley environment at the freshwater/saltwater interface, or oligohaline, would be more productive than an estuary.

Table 41 shows a correlation of environmental data and settlement intensity. The first two columns summarize the data on riverine environments and water salinity over time from Appendix I. The combination of riverine environmental types and salinity produce a situation where environmental productivity for hunters and gatherers increased through time. The biggest changes would have occurred as there were shifts from alluvial valley to tidal river valley to estuary settings. The change from estuary to tidal river valley settings ca. A.D. 1100 was not as great, but probably did entail an increase in riverine productivity.

Local climatic data are also included in Table 41 based on Brush's (1994) earlier analysis of pollen from Leipsic River cores. Trends in local precipitation are specifically noted because studies of local prehistoric settlement patterns have stressed the role of availability of surface water as a determinant of prehistoric adaptations (Custer 1989). Prior to 1000 B.C., dry climates were present and availability of surface water was especially critical. At this time, there is good evidence of regional reductions in vegetation and aeolian erosion and deposition (Custer 1989:177-180). Between 1000 B.C. and A.D. 0 there are a series of cyclic changes between wet and dry environments. The wet environments would have entailed greater levels of precipitation compared to modern conditions and the dry intervals would have been as dry as those seen prior to 1000 B.C., which were dryer than modern climates. The intermediate climates seen between A.D. 0 and A.D. 1600 were similar to modern climates in the area. There were no dramatic shifts in precipitation during that time interval comparable to those seen earlier.

TABLE 41

Correlation of Environmental Data and Settlement Intensity

	RIVERINE ENVIRON-MENT	SALINITY	CLIMATE (PRECIPITATION)	SETTLEMENT INTENSITY
1600 – 1400 – 1200	Tidal River Valley	Oligohaline	Intermediate	Interval = 4 Index = 1 Highest
1000 – 800 – 600 – 400 – 200	Estuary	Oligohaline		Interval = 10 Index = .4 High
AD 0 – BC 200 – 400 – 600 – 800	Tidal River Valley	Fresh/ Oligohaline	Dry Wet Dry Wet	Interval = 90 Index = .04 Low
1000 – 1200 – 1400 – 1600	Alluvial Valley	Fresh	Dry	Interval = 250 Index = .02 Lowest

There is no real causal link between developing riverine environments and changing climatic conditions. Changing riverine environments were caused by sea level rise and the climatic changes were caused by changing air mass circulation patterns (Wendland and Bryson 1974). In general, these two sets of environmental changes can be viewed as independent factors operating concurrently to affect the lifeways of prehistoric hunters and gatherers.

The final column of Table 41 provides a measure of settlement intensity at the Leipsic Site based on the data in Table 20. These data estimated the time interval between successive occupations of the Leipsic Site. It was noted previously that the time intervals in Table 20 probably over-estimate the settlement intensity; however, because the estimates for each time interval were all based on the same assumptions and methods, they can be used as accurate relative measures of settlement intensity. The "Settlement Intensity" column of Table 41 notes the estimated time interval between occupations of the site from Table 20, an index of settlement intensity, and a qualitative assessment of the relative settlement intensity. The index was computed by dividing the smallest time interval, which was seen between ca. A.D. 1000 and A.D. 1600, into the other time intervals.

There is a continual increase in settlement intensity through time and there is a big difference, on the order of one degree of magnitude, between the index values pre-dating A.D. 0 and those post-dating A.D. 0. The A.D. 0 time period marks the appearance of true oligohaline conditions in this section of the Leipsic River Valley and the increase in settlement intensity at the Leipsic Site is probably related to the increase in local environmental productivity. It is important to note, however, that the increase in settlement intensity in the excavated section of the Leipsic Site at this time is not an isolated phenomenon. Rather, it is part of a overall trend in prehistoric settlement throughout the Leipsic Valley.

Settlement pattern studies of the St. Jones and Murderkill (Custer 1989; Galasso 1983; Gelburd 1988), Nanticoke (Custer and Mellin 1989), and Indian River (Custer and Mellin 1987) drainages have shown that as the oligohaline zone moved up the drainages with sea level rise, areas of intensive prehistoric settlement moved with it. The oldest examples of the largest sites with the most intensive

settlement are located in the lower reaches of the valleys and the younger examples are located increasingly farther up the valleys. The oligohaline zone seems to have been the preferred settlement location and prehistoric groups shifted their campsites as that zone moved up the drainages through time. The result of this kind of intensive, yet shifting, riverine settlement was the creation of vast archaeological sites which line the river shores.

Similar large sites clearly exist in the Leipsic River Valley (Plate 1) and the Leipsic Site described in this report is only a small section of these sites. Therefore, the changing settlement intensity noted in Table 41 is a small part of the larger process of shifting settlement up the drainage over time. The fact that the settlement intensity at the Leipsic Site increases dramatically at the time of the appearance of oligohaline conditions supports the underlying assumptions of the basic model of links between environmental change and changes in settlement noted above.

The ideas about settlement intensity and its links to local environmental change could easily be tested with further research. If the model is correct, then the time periods of the most intense settlement downstream from the Leipsic Site should be earlier than those of the Leipsic Site. Likewise, the time periods of the most intensive settlement upstream of the Leipsic Site should be later in time. Finally, the most intensive settlement in similar portions of the Leipsic River valley, such as the areas on the opposite side of the river from the site area described in this report, should date to the same periods as those noted in Table 41.

For the most part, climate change does not seem to be closely related to the trends in settlement at the Leipsic Site based on the data in Table 41. The riverine environmental conditions seem to be much more important. However, if we take a perspective on environmental change and site use that has a longer time frame than that shown in Table 41, then the importance of the environmental change is apparent. Prior to 3000 B.C., warm and wet climates characterized the local area as shown in the environmental summary in Table 42. By 3000 B.C., climates became warm and dry and these conditions lasted up until 1000 B.C. As noted previously, the Leipsic River environs were used to some extent during the entire time frame of Delaware prehistory. However, the first appearance of pit houses, storage features, and other indications of at least semi-sedentary settlement occurred ca. 3000 B.C.

The initial intensification of use of the site, in terms of settlement stability, therefore occurred at a time of dry climates. Other studies (Custer 1989) have suggested that during the drier climatic interludes, availability of surface water became critical for prehistoric groups. The major rivers, such as the Leipsic River, were dependable sources of fresh water and prehistoric settlement began to concentrate there ca. 3000 B.C.

In sum, the archaeological and paleoenvironmental data show that climatic changes initially drew prehistoric groups into the major river valleys for somewhat stable settlement beginning at ca. 3000 B.C. These initial settlements were focused on the oligohaline settings. As sea level rose, and the oligohaline setting moved inland, settlements shifted in that direction as well and became more intensive as the environmental productivity rose. This process of settlement intensification lasted through the Woodland I Period and into the Woodland II Period.

TABLE 42

Environmental Reconstructions--Coastal Plain

Episode	Interior, Well-Drained	Interior, Poorly-Drained	Major Drainages	Coastal Zone
Late Glacial (12,000 BC to 8,000 BC)	Boreal forest, limited grasslands	Bogs and swamps with deciduous gallery forest	Deciduous gallery forest with some grasslands in floodplains	Few estuarine settings, scrubby boreal woodlands, low productivity
Pre-Boreal/Boreal (8,000 BC to 6,500 BC)	Boreal forest	Bogs and swamps with deciduous gallery forest	Deciduous gallery forest and boreal forest	Boreal forest, few estuarine settings, low productivity
Atlantic (6,500 BC to 3,000 BC)	Oak-Hemlock, mesic deciduous forests	Extensive bogs and swamps with deciduous gallery forest	Mesic deciduous forests	Mesic deciduous forests, some estuarine settings, low productivity
Sub-Boreal (3,000 BC to 800 BC)	Oak-Hickory, xeric forests and grasslands	Few bogs and swamps	Deciduous gallery forests with some fringing salt marshes, xeric forests and grasslands in floodplains	Extensive salt marshes with scrubby xeric vegetation and fringing xeric deciduous forests, high productivity
Sub-Atlantic/Recent (800 BC to Recent)	Oak-Pine-Hickory, forests with mixed mesophytic communities	Bogs and swamps with deciduous gallery forest	Deciduous gallery forests (Oak-Chestnut) with extensive fringing salt marshes	Extensive salt marsh, Oak-Pine woodlands with some scrubby xeric vegetation, high productivity

Artifact Chronologies

The features at the Leipsic Site contain some interesting associations of projectile points, ceramics, and radiocarbon dates that have some implications for the study of regional artifact chronologies. For example, Feature 229 (Table 10) contained an association of Woodland II Killens ceramics and a stemmed point (Figure 45U) that would usually be associated with the Woodland I Period. Although it is possible that the stemmed point is an older artifact accidentally mixed in the fill of a younger, it is also possible that the point and the pottery do indeed date to the same time period. Stewart (1986) has also noted the possible presence of stemmed point in late prehistoric contexts in the middle Delaware River Valley that are younger than the age usually ascribed to these points.

Although the hypothesis of accidental mixing is more likely to be the correct interpretation of this association, the hypothesis that there are associations of artifacts that seem to be somewhat unexpected must also be considered. The Leipsic Site association from Feature 229 can serve as a

warning that we should be aware that our preconceptions about the clear-cut nature of artifact associations may not be accurate. The associations of Woodland II ceramics and a basal notched point in Feature 354 (Table 10) are a similar example.

The Woodland II radiocarbon date from Feature 255/256 (Beta- 42882, Table 11) is associated with Killens ceramics and is important because it is the first clear-cut date on these ceramics. Killens ceramics had been assigned a Woodland II date based on the similarities of its designs to other Woodland II wares (Custer 1989:308) and this date conforms that assignment. Furthermore, the dates on Mockley ceramics (Beta 42883 - Table 11) and Hell Island ceramics (Beta 42881, 42884) confirm the known date ranges for those ceramics and underscore the validity of the basic central Delaware ceramic sequence.

The assemblage of stemmed points (Plate 14) found in association with Hell Island ceramics is also important. Data from further north in the Delaware Valley (Kinsey 1972) indicate that similar stemmed points are characteristic of the A.D. 700-1000 time period, and the points shown in Plate 14 are probably equivalent types for the Lower Delaware River Valley and Delmarva Peninsula. Using the Delaware chronology (Figure 8), these points would date to the Webb Complex and would also be associated with Jack's Reef points.

The presence of these stemmed points at the end of the Woodland I Period has some bearing on the previously discussed issue of the presence of stemmed points in Woodland II contexts. If, indeed, stemmed points were in use at the end of the Woodland I Period, then the probability of their use during Woodland II times is increased.

Cordage Twist Data

The earlier discussion of cordage twist data in this report noted a number of problems in the compilation and use of these data to identify prehistoric ethnic groups. However, in spite of these problems, cordage twist data for ceramics from Delaware have been compiled and are presented in Table 43. Both sherd counts and vessel counts are included and only one example, the Minguannan ceramic assemblage from Lewden Green, does not include vessel counts. The data set is very small and includes only 18 total vessels. Therefore, no interpretations of the compiled data are offered. Nevertheless, these data are available for other researchers. A concerted effort to record vessel-based cordage data from the Island Field Museum collections could be a useful project for future research.

TABLE 43

Delaware Cordage Twist Data

CERAMIC TYPE	SITE	SHERD COUNT		VESSEL COUNT	
		S-twist	Z-twist	S-twist	Z-twist
Dames Quarter	Leipsic	5	0	1	0
Wolfe Neck	Snapp*	54	0	1	0
Mockley	Leipsic	1	8	1	1
Hell Island	Leipsic	10	0	2	0
Hell Island	Paradise Lane--Area A**	0	73	0	1
Hell Island	Paradise Lane--Area B**	16	0	1	0
Clemson Island	Leipsic	98	0	2	0
Killens	Leipsic	9	1	4	1
Townsend	Leipsic	10	3	2	1
Minguannan	Lewden Green***	9	25	?	?

* - Custer & Silber 1994
** - Riley, Custer, Hoseth, & Coleman 1994
*** - Custer, Catts, Hodny, & Leithren 1990

Regional Lithic Technologies

Various aspects of the Leipsic Site lithic technology data can be compared to data from other sites to further our understanding of regional lithic technologies. The issues discussed in this section of the report include comparative tool kit composition and general trends in the use of varied primary and secondary lithic raw materials.

The system of lithic tool types used to describe the Leipsic Site assemblage in Table 30, which was taken from the work of Lowery and Custer (1990), can be used to systematically compare the Leipsic Site assemblage with those of other sites where the data were organized and gathered in a similar fashion. Only the Woodland II assemblage from the Leipsic Site was used because the total site assemblage contains a variety of occupations and the Webb Complex assemblage is too small (Table 30). Unfortunately, comparable data are not available from a wide range of sites. Nevertheless, Table 44 shows comparable data from six other sites in the central Middle Atlantic region. The Slackwater Site is a Shenks Ferry village of the Woodland II Period from Lancaster County (Custer, Hoseth, Cheshaek, Guttman, and Iplenski 1993). The Crane Point Site (Lowery and Custer 1990) and the Paw Paw Cove Site (Lowery 1989) are Paleo-Indian Period sites from Talbot County on the Eastern Shore of Maryland. Site 36LA336 (Smoker and Custer 1986) is a Paleo-Indian site from the Triassic Lowlands of northern Lancaster County, Pennsylvania. The tool assemblages from the Hawthorn Site (Custer and Bachman 1983) and the Snapp Site (Custer and Silber 1994) date to the initial portion of the Woodland I Period. Both of these sites are located in northern Delaware.

Figure 70 shows the plot of the cumulative percentages shown in Tables 30 and 44. The Snapp, Hawthorn, Slackwater, and Site 36LA336 assemblages are the most similar and all are different from Paw Paw Cove, Crane Point, and the Leipsic Site Woodland II assemblage. In general, the Paw Paw Cove, Crane Point, and Leipsic assemblages have fewer formalized tool forms and cores than the other assemblages. Numerous studies (e.g. - Gardner 1989) have suggested that Paleo-Indian groups relied heavily on bifaces as core sources for flakes, and the relatively low proportion of cores in the Paw Paw Cove and Crane Point assemblages provides support for this observation. It is interesting that the assemblage from Site 36LA336 is not grouped with the other Paleo-Indian sites. Instead, it is grouped with the other later sites with its larger number of cores and formalized tools. Site 36LA336 may end up grouped with the later sites because all of the later sites and Site 36LA336 share the characteristic of being located rather close to either primary or secondary lithic outcrop sources. In contrast, Paw Paw Cove, Crane Point, and Leipsic are located fairly far from lithic resources, and only very small pebble and cobble outcrops are available at these locations. Thus, groupings shown in Figure 70 may reflect proximity to lithic resources along with relative reliance on bifaces as core sources of flakes.

The Leipsic Site Woodland II assemblage can be compared to assemblages from other sites using a variety of techniques applied in other reports in this report series. These techniques focus on the analysis of percentages of artifacts with cortex and varied lithic raw material use (e.g. - Riley, Custer, Hoseth, and Coleman 1994; Riley, Watson, and Custer 1994). Table 45 lists the data used in these comparisons and Figure 71 shows the locations of the sites used in the analyses. Tables 46 - 49

TABLE 44

Comparative Tool Kit Data - Miscellaneous Sites

	Slackwater			Crane Point			Paw Paw Cove			36 LA 336		
	Count	%	Cum.%	Count	%	Cum.%	Count	%	Cum.%	Count	%	Cum.%
Points/ knives	48	9	9	78	18	18	19	19	19	2	10	10
Late stage bifaces	91	17	26	20	5	23	6	6	25	4	20	30
Early stage bifaces	81	15	41	5	1	24	0	0	25	1	5	35
Drills	1	1	42	4	1	25	0	0	25	0	0	35
Concave/ biconcave scrapers	48	9	51	3	1	26	2	2	27	0	0	35
Bifacial side scrapers	0	0	51	9	2	28	5	5	32	1	5	40
Unifacial side scrapers	3	1	52	7	2	30	9	9	41	3	15	55
Trianguloid end scrapers	65	12	64	12	3	33	6	6	47	3	15	70
Slug- shaped unifaces	0	0	64	4	1	34	1	1	48	0	0	70
Wedges	4	1	65	5	1	35	1	1	49	0	0	70
Primary cores	55	10	75	0	0	35	0	0	49	0	0	70
Secondary cores	0	0	75	9	2	37	5	5	54	0	0	70
Denticulates	11	2	77	3	1	38	2	2	56	0	0	70
Gravers	14	3	80	5	1	39	7	7	63	0	0	70
Regular utilized flakes	106	20	100	197	45	84	24	24	87	6	3	100
Blade-like utilized flakes	0	0	100	73	16	100	12	13	100	0	0	100
Total	527	--	--	434	--	--	99	--	--	20	--	--

	Hawthorn			Snapp-Clyde Farm		
	Count	**%**	**Comparative %**	**Count**	**%**	**Comparative %**
Point/knives	61	31	31	16	17	17
Late stage bifaces	29	15	46	7	7	24
Early stage bifaces	6	3	49	6	6	30
Drills	0	0	49	0	0	30
Concave-biconcave scrapers	2	1	50	0	0	30
Bifacial side scrapers	3	2	52	5	5	35
Unifacial side scrapers	14	7	59	17	18	53
Trianguloid end scrapers	8	4	63	3	3	56
Slug-shaped unifaces	0	0	63	3	3	59
Wedges	0	0	63	2	2	61
Primary cores	21	11	74	4	4	65
Secondary cores	20	10	84	4	4	69
Denticulates	0	0	84	0	0	69
Gravers	3	2	86	0	0	69
Regular utilized flakes	25	13	99	24	25	94
Blade-like flakes	2	1	100	4	4	100
Total	**194**			**95**		

FIGURE 70

Comparison of Tool Kits

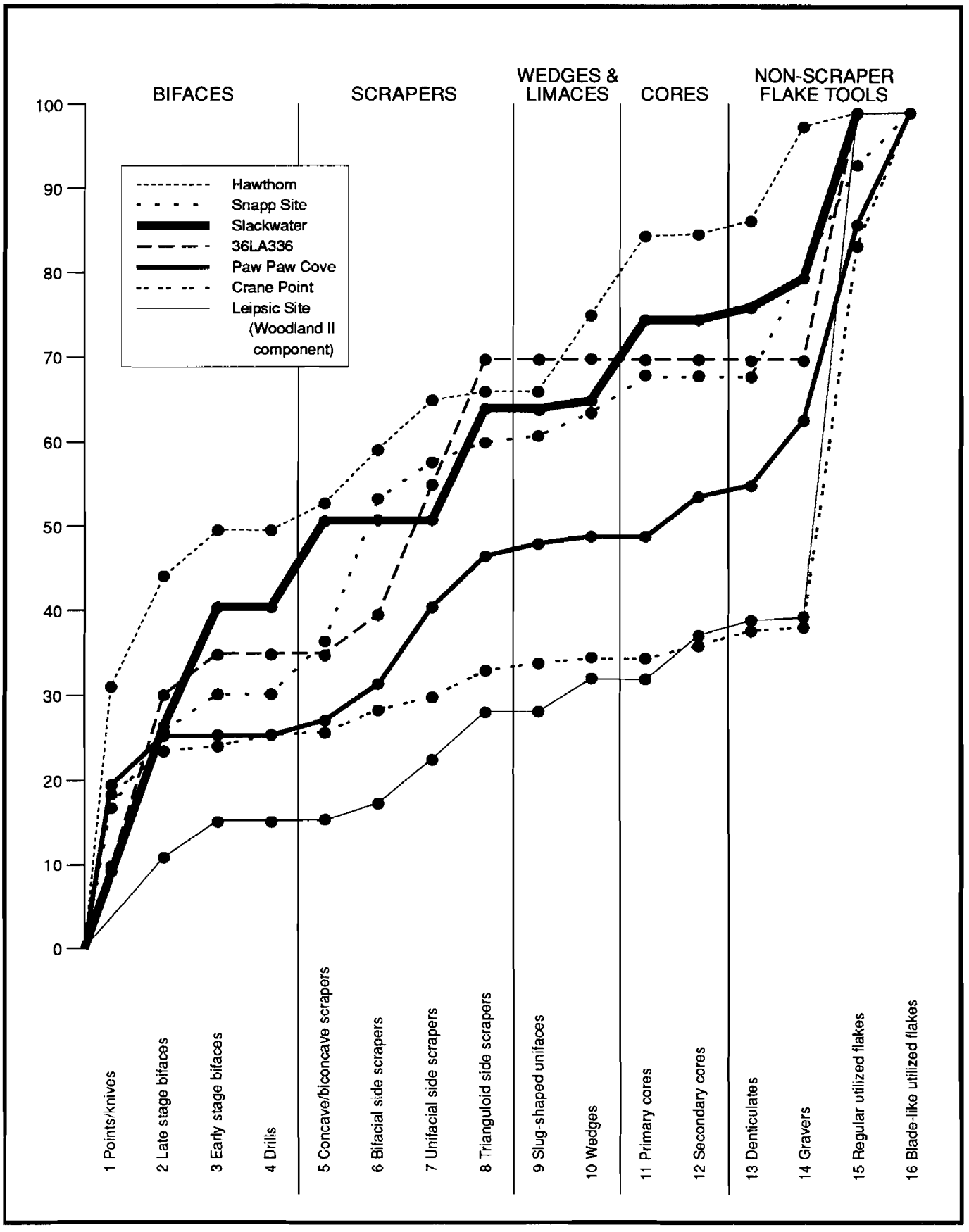


TABLE 45
Comparative Lithic Resource Use Data

Site	Function (Complex)	Total Artifacts	Cortex %	Crypto-crystalline %	Quartz/ Quartzite %	Reference
7K-C-194A	Base camp (Woodland II)	1,230	28	63	35	—
7K-C-360	Hunting/ staging	2,287	30	56	41	Riley, Watson, & Custer (1994)
7K-C-365A	Hunting/ staging	2,537	38	51	46	Riley, Watson, & Custer (1994)
7K-C-365B	Lithic reduction	8,130	4	5	94	Riley, Watson, & Custer (1994)
7S-G-123	Cobble reduction	164	54	65	23	Custer and Mellin (1991)
7K-C-204	Macro-band base camp	124	27	54	37	Riley, Bachman, et al. (1994)
7K-C-359	Micro-band base camp	160	26	63	33	Riley, Bachman, et al. (1994)
7K-C-363	Procurement	133	21	76	19	Riley, Bachman, et al. (1994)
7K-C-364	Staging/ processing	1,742	32	56	39	Riley, Bachman, et al. (1994)
7NC-D-100	Procurement	293	41	51	46	Shaffer et al. (1988)
7NC-D-3	Quarry reduction	368	0	51	38	Custer, Ward, & Watson (1986)
7NC-D-5	Quarry reduction	94	0	60	32	Custer, Ward, & Watson (1986)
7NC-E-9	Micro-band base camp	4,090	14	79	18	Custer, Catts, Hodny, & Leithren (1990)
7NC-E-46	Hunting/ staging	10,512	20	22	69	Custer and Bachman (1983)
7NC-D-54	Cobble reduction base camp	1,288	28	32	59	Custer, Sprinkle, Flora, & Stiner (1981)
7NC-D-55A	Cobble reduction base camp	132	45	16	59	Custer, Sprinkle, Flora, & Stiner (1981)
7NC-D-55B	Cobble reduction base camp	2,304	29	8	88	Custer, Sprinkle, Flora, & Stiner (1981)
7NC-A-17	Hunting/ staging	279	9	23	71	Custer and Hodny (1989)
7NC-A-2	Base camp	845	38	18	67	Custer and De Santis (1985)
36LE4	Lithic reduction	306	0	1	97	Custer (1992)
7NC-D-125						
Area A	Staging/ processing	10,576	1	98	2	Riley, Custer, Hoseth, & Coleman 1994
Area B	Staging/ processing	1,931	2	92	8	Riley, Custer, Hoseth, & Coleman 1994
Area C	Staging/ processing	1,096	13	54	45	Riley, Custer, Hoseth, & Coleman 1994
7NC-D-129	Procurement	2,207	7	74	26	Custer, Watson, Hoseth, & Coleman 1988
7NC-D-140	Procurement	133	21	75	25	Catts, Hodny, & Custer 1989
7NC-E-6A						
Area 2A	Macro-band base camp	5,515	9	60	34	Custer 1982
Area 2B	Macro-band base camp	6,206	9	71	23	Custer 1982
7NC-D-19	Quarry reduction base camp	653	0	74	26	Custer, Ward, & Watson 1986
7NC-F-61A	Quarry reduction base camp	1,922	1	99	1	Watson and Riley 1994
7NC-G-101	Base camp (Clyde Farm)	2,388	28	79	17	Custer and Silber 1994
	Base camp (Webb)	153	37	73	25	Custer and Silber 1994
	Base camp (Woodland II)	329	23	80	14	Custer and Silber 1994

show rankings of the sites listed in Table 45 with respect to cortex percentages, cryptocrystalline raw material percentages, and quartzite/quartz percentages. In these tables, sites are listed in order from lowest to highest by percentage frequency. Pairwise comparisons of site percentages using difference-of-proportion tests (Parsons 1974) were undertaken for all sites. Sites with similar percentage values are linked by brackets in these tables.

Table 46 shows the site rankings by cortex percentages and the Leipsic Site Woodland II assemblage falls among a group of sites with relatively high percentages of cortex. However, it is not among the sites with the highest cortex percentages. The grouping of sites including the Leipsic Site Woodland II assemblage mainly includes sites that are not located close to primary lithic outcrops and

TABLE 46
Cortex Percentage Ranking

SITE	SITE TYPE (COMPLEX)	CORTEX %
7NC-D-5	Quarry Reduction Base Camp	0
7NC-D-3	Quarry Reduction Base Camp	0
36LE4	Lithic Reduction	0
7NC-D-19	Quarry Reduction Base Camp	0
7NC-F-61A	Quarry Reduction Base Camp	1
7NC-D-125A	Staging/Processing	1
7NC-D-125B	Staging/Processing	2
7NC-A-2	Base Camp	2
7K-C-365B	Lithic Reduction	4
7NC-D-129	Procurement	7
7NC-E-6A		
Area 2A	Base Camp	9
Area 2B	Base Camp	9
7NC-A-17	Staging/Processing	9
7NC-D-125C	Staging/Processing	13
7NC-E-9	Base Camp	14
7NC-E-46	Processing/Staging	20
7NC-D-140	Procurement	21
7K-C-363	Procurement	21
7NC-G-101	Base Camp (Woodland II)	23
7K-C-359	Base Camp	26
7K-C-204	Base Camp	27
★ 7K-C-194A	Base Camp (Woodland II)	28
7NC-D-54	Cobble Reduction Base Camp	28
7NC-G-101	Base Camp (Clyde Farm)	28
7NC-D-55B	Cobble Reduction Base Camp	29
7K-C-360	Processing/Staging	30
7K-C-364	Processing/Staging	32
7NC-G-101	Base Camp (Webb)	37
7NC-A-2	Base Camp	38
7K-C-365A	Processing/Staging	38
7NC-D-100	Procurement	41
7NC-D-55A	Cobble Reduction Base Camp	45
7S-G-123	Cobble Reduction Base Camp	54

which have access to cobble and pebble resources. A variety of different site types is included in this grouping, and in the other site groupings seen in Table 46, indicates that access to raw material types was more important than site functions in determining use of primary and secondary materials.

Table 47 shows a ranking of sites by cryptocrystalline raw material percentages. The Leipsic Site Woodland II assemblage falls in a group of sites with moderate cryptocrystalline percentages, although it has one of the higher percentages in its group. As was the case for cortex percentages, the site groupings contain a variety of site types and this variety implies that resource availability was more important that specialized site activities in determining the kinds of lithic resources used at a site. The Leipsic Site Woodland II assemblage falls in a group of sites with low quartzite/quartz percentages (Table 48). Quartzite, quartz, and cryptocrystalline materials are all available as secondary cobble resources in the vicinity of the Leipsic Site and the data in Tables 47 and 48 indicate that the site's Woodland II inhabitants preferred cryptocrystalline materials.

TABLE 47
Cryptocrystalline Percentage Ranking

SITE	SITE TYPE (COMPLEX)	CRYPTO - CRYSTALLINE
36LE4	Lithic Reduction	1
7K-C-365B	Lithic Reduction	5
7NC-D-55B	Cobble Reduction Base Camp	8
7NC-D-55A	Cobble Reduction Base Camp	16
7NC-A-2	Base Camp	18
7NC-E-46	Staging/Processing	22
7NC-A-17	Staging/Processing	23
7NC-D-54	Cobble Reduction Base Camp	32
7NC-D-100	Procurement	51
7NC-D-3	Quarry Reduction	51
7K-C-365A	Staging/Processing	51
7K-C-204	Base Camp	54
7NC-D-125C	Staging/Processing	54
7K-C-364	Staging/Processing	56
7K-C-360	Staging/Processing	58
7NC-E-6A Area 2A	Base Camp	60
7NC-D-5	Quarry Reduction	60
7K-C-359	Base Camp	63
★ 7K-C-194A	Base Camp (Woodland II)	63
7S-G-123	Cobble Reduction Base Camp	65
7NC-E-6A Area 2B	Base Camp	71
7NC-G-101	Base Camp (Webb)	73
7NC-D-19	Quarry Reduction Base Camp	74
7NC-D-129	Procurement	74
7NC-D-140	Procurement	75
7K-C-363	Procurement	76
7NC-E-9	Base Camp	79
7NC-G-101	Base Camp (Clyde Farm)	79
7NC-G-101	Base Camp (Woodland II)	80
7NC-D-125B	Staging/Processing	92
7NC-D-125A	Staging/Processing	98
7NC-F-61A	Quarry Reduction Base Camp	99

TABLE 48
Quartzite/Quartz Percentage Ranking

SITE	SITE TYPE (COMPLEX)	QUARTZITE / QUARTZ %
7NC-F-61A	Quarry Reduction Base Camp	1
7NC-D-125A	Staging/Processing	2
7NC-D-125B	Staging/Processing	8
7NC-G-101	Base Camp (Woodland I)	14
7NC-G-101	Base Camp (Clyde Farm)	17
7NC-E-9	Base Camp	18
7K-C-363	Procurement	19
7NC-E-6A Area 2A	Base Camp	23
7S-G-123	Cobble Reduction Base Camp	23
7NC-D-140	Procurement	25
7NC-G-101	Base Camp (Webb)	25
7NC-D-129	Procurement	26
7NC-D-19	Quarry Reduction Base Camp	26
7NC-D-5	Quarry Reduction Base Camp	32
7K-C-359	Base Camp	33
7NC-E-6A Area 2B	Base Camp	34
★ 7K-C-194A	Base Camp (Woodland II)	35
7K-C-204	Base Camp	37
7NC-D-3	Quarry Reduction	38
7K-C-364	Staging/Processing	39
7K-C-360	Staging/Processing	41
7NC-D-125C	Staging/Processing	45
7NC-D-100	Procurement	46
7K-C-365A	Staging Processing	46
7NC-D-54	Cobble Reduction Base Camp	59
7NC-A-2	Base Camp	67
7NC-D-55A	Cobble Reduction Base Camp	69
7NC-E-46	Staging/Processing	69
7NC-A-17	Staging/Processing	71
7NC-D-55B	Cobble Reduction Base Camp	88
7K-C-365B	Lithic Reduction	94
36LE4	Lithic Reduction	97

Table 49 shows a classification of the sites listed in Table 45 on the basis of cortex and cryptocrystalline percentages. The Leipsic Site falls within a group of sites that shows relatively high cortex percentages and moderate percentages of cryptocrystalline materials. The other sites in the group share the locational characteristics of being distant from primary lithic resource sources and near to secondary resources. The other site groupings in Table 49 also share characteristics of lithic resource availability. In sum, the comparative lithic resource data show that resource availability was more important than any specialized lithic reduction activities and needs of prehistoric groups. Prehistoric flintknappers were opportunistic and use whatever resources were available to manufacture the tools that they needed. Data recently compiled by Andrefsky (1994) also underscores the importance of raw material availability.

TABLE 49

Lithic Resource Use Classification

CRYPTOCRYSTALLINE	CORTEX: HIGH	CORTEX: LOW
HIGH	7NC-G-101 (Webb Complex, base camp) 7NC-G-101 (Clyde Farm, base camp) 7NC-G-101 (Woodland II, base camp) 7K-C-363 (procurement) 7NC-D-140 (procurement)	7NC-E-9 (base camp) 7NC-E-6B, Area 2B (base camp) 7NC-D-129 (procurement) 7NC-D-125B (processing/staging) 7NC-D-125A (processing/staging) 7NC-F-61A (quarry reduction base camp) 7NC-D-19 (quarry reduction base camp)
MEDIUM	7S-G-123 (cobble reduction base camp) 7NC-D-100 (procurement) 7K-C-365A (processing/staging) 7K-C-364 (processing/staging) 7K-C-360 (processing/staging) 7NC-D-54 (cobble reduction base camp) 7K-C-194A (Woodland II, base camp) ← 7K-C-204 (base camp) 7K-C-359 (base camp)	7NC-D-125C (processing/staging) 7NC-E-6A, Area 2A (base camp) 7NC-D-3 (quarry reduction base camp) 7NC-D-5 (quarry reduction base camp)
LOW	7NC-D-55A (cobble reduction base camp) 7NC-A-2 (base camp) 7NC-D-55B (cobble reduction base camp) 7NC-E-46 (processing/staging)	7NC-A-17 (processing/staging) 7K-C-365B (lithic reduction) 7NC-A-2 (base camp) 36LE4 (lithic reduction)

Subsistence Systems

The floral assemblage from the Leipsic Site can be compared to similar assemblages from other sites in Delaware to see if there are patterns of plant food use during Woodland I and Woodland II times. Table 50 shows the data from the Leipsic Site along with those from other Woodland sites in Delaware with comparable data. Some of the other sites either do not date to the same time period as the Leipsic Site, or contain multiple components. The notes on Table 50 describe the specific components and their dates for each site.

Almost all of the sites show a basic plant food assemblage that usually includes hickory nuts, Chenopodium, and Amaranth. However, the Leipsic, Snapp (7NC-G-101), and Delaware Park (7NC-E-41) sites show a wider range of additional plants. Not all of these plants are foods, however. Some have medicinal uses (e.g. - spurge (Euphorbia). The Delaware Park and Leipsic sites include occupations spanning the time period from the initial portion of the Woodland I Period to the final portions of the Woodland II Period (Thomas 1981) and the long time frame may account for all of the varied plant remains. For example, beans (Leguminosae) are present at Delaware Park and certainly date to the Woodland II Period. However, the Snapp Site includes features from a wide range of time periods as

TABLE 50

Comparison of Plant Food Remains

	Lelpslc	7NC-G-101 (1)	7K-D-21 (2)	7K-D-3 (3)	7NC-E-41 (4)	7NC-E-46 (5)	7S-K-21 (6)	7S-D-9 (7)	7S-G-79 (8)
Copperleaf	X	X							
Hickory	X	X	X	X	X	X	X	X	X
Butternut	X	X	X				X	X	
Acorn	X				X		X		
Chenopodium	X	X			X	X	X		
Amaranth	X				X	X	X		
Carpetweed					X				
Clammyweed					X				
Chickweed					X				
Mustard					X				
Flax					X				
Sedge					X				
Spurge		X			X				
Mint					X				
Skullcap					X				
Sage					X				
Thyme					X				
Bean					X				
Hog Nut					X				
Bayberry		X			X				
Pokeweed					X				
Smartweed		X			X				
Raspberry	X	X			X				
Wild Grape	X				X				
Walnut					X				X
Corn									X
Hackberry						X			
Thimbleberry		X							
Ragweed		X							
Dogwood	X								
Greenbriers	X								
Sheep Sorrel	X								
Solomon's Seal	X								
Tulip Tree	X								

Citations and Notes

(1) Custer and Silber 1994 Dates to Woodland I and Woodland II periods.

(2) Thomas et al. 1975. Dates to Carey Complex (A.D. 600).

(3) Griffith 1974. Dates to Carey Complex (A.D. 0-A.D. 60).

(4) Thomas 1981. Variety of Woodland I and Woodland II Components.

(5) Custer and Bachman 1983. Clyde Farm Complex ca. 2200 B.C.

(6) Custer, Stiner, and Watson 1983. Delmarva Adena and Carey Complex Occupations (ca. 500 B.C. - A.D. 600).

(7) Custer and Mellin 1987. Carey Complex Occupation (A.D. 0-A.D. 600).

(8) Doms, Custer, Davis, and Trivelli 1985. Woodland II - Slaughter Creek Complex Occupation (ca. A.D. 1000-A.D. 1500).

well and does not show as wide a range of plant foods. Preservation differences may account for some of the variability in plant food remains; however, additional explanations of the variability can be offered to provide some future research directions.

The three sites from Sussex County (7S-K-21, 7S-D-9, and 7S-G-79) contain shellfish remains and show relatively intensive use of maritime resources. The shells in the feature matrices at these sites provides excellent preservation of organic materials, yet these sites have very few different types of plant remains. It is possible that the intensive use of maritime resources precluded the use of an extensive array of plant foods and the low numbers of plant types found at these sites reflects this subsistence pattern.

The other five sites noted in Table 50 (7NC-G-101, 7K-D-21, 7K-D-3, 7NC-E-41, and 7NC-E-46) are not associated with any intensive maritime resource use with the exception of 7K-D-3 which had one pit with oyster shell remains (Griffith 1974). The absence of shells in the pit fill of features at these sites could produce poor preservation of organic materials, especially when the porous soils of Coastal Plain sites, which inhibit organic preservation, are considered. Indeed, several of these sites show very few different types of plant remains. Nonetheless, the Delaware Park Site (7NC-E-41) still shows the largest array of plant remains of any of the sites. It is possible that the inhabitants of these non-maritime, or interior, sites needed to use a wider array of plants to fill the place in their diets that coastal resources would have filled. In sum, the preliminary data suggest that there were differences in prehistoric plant utilization in coastal and interior areas. Future research should seek to see if these differences are truly the result of differences in prehistoric behavior patterns, or if they result from preservation biases. Future research can also seek to establish links between varied resource use through time at these sites.

Household Settlement Patterns

The varied features present at the Leipsic Site, and their interpretations as houses and storage/ refuse pits provide numerous insights to the study of household settlement patterns. The consistent size of the houses discovered at the Leipsic Site (Figure 58) clearly implies that the main social unit of the site's inhabitants was the nuclear family. The houses are so small that there is no room for any larger social unit. The house size also does not appear to change through time from the beginning of the Woodland I Period throughout the Woodland II Period. The absence of change in house size implies that there was no change in the basic social unit of prehistoric groups through a relatively long period of time, from ca. 2500 B.C. to A.D. 1500.

The continuity of house size, and presumably the size of the basic social units, is not seen in other areas. For example, in southeastern Pennsylvania, there is a clearly defined increase in the size of houses through the Late Woodland Period (Custer, Hoseth, Cheshaek, Guttman, and Iplenski 1993). This increase in household size occurs after the adoption of agriculture and occurs in association with the development of settled village communities. The absence of such social change in central Delaware suggests that the associated factors of adoption of agriculture and development of settled villages did not occur in this area. Other data have led to similar conclusions (Stewart, Hummer, and Custer 1986).

Community Settlement Patterns

The description of the feature clusters in terms of households and overlapping occupations (Figures 59-61) provides a look at the intensity of settlement at the Leipsic Site and a basis for the analysis of prehistoric communities. For the most part, the "communities" at the Leipsic Site seem to consist of individual nuclear families. Only one Woodland II feature cluster (Cluster 3 - Figure 61) shows signs of multiple, contemporaneously occupied houses, and at most there were only six families present at the site at one time.

After the completion of Phase II research, the Leipsic Site was considered to be a "macro-band base camp" based on its size, the presence of features, and the site's size. Macro-band base camps are defined as habitation sites for numerous families and are contrasted with micro-band base camps, which presumably were inhabited by fewer people at any given time (Custer 1989:129-130). If most of the occupations at the Leipsic Site were individual families, is it really a "macro-band" base camp? Does the one occupation of no more than six families represent a "macro-band" base camp? We feel that "macro-band" base camp label is probably not an accurate description of the Leipsic Site. With individual family occupations through most of its history of use, the site does not really match the implicit idea in the definition of a "macro-band" base camp in that it does not show evidence of being the home for multiple social units. The occupation of the site by at most six families, may meet the definition of a macro-band base camp, but only at a minimal level.

The discovery that a large site like the Leipsic Site consisted of a series of overlapping individual occupations is not a complete surprise. A lesson to be learned is that the excavation of large contiguous areas is needed to truly assess the contemporaneity of features and individual occupations. It is recommended that future excavations of similar sites include excavation and exposure of similarly large areas.

Even though there are problems with calling the Leipsic Site a "macro-band" base camp, there are still significant differences between sites like Leipsic and traditional micro-band base camps. In general, micro-band base camps are not as large and have fewer artifacts. The excavations at the Leipsic Site show that its larger size and artifact assemblage are due to its repeated reuse, and such repeated reuse is missing at the traditional micro-band base camps. Perhaps it would be best to refer to sites like Leipsic as "repeatedly reused base camps" and traditional micro-band base camps as "individual base camps". Further research at both kinds of sites is needed to clarify this issue before changing the site typology terminology.

The long time frame of the repeated reuse of the Leipsic Site, the continuity in its use as a habitation site mainly by individual families, and the absence of change in house size and household cluster composition all point to significant levels of cultural continuity. This settlement continuity supports the idea that there are continuities in prehistoric life ways between 3000 B.C. and A.D. 1000 which define the Woodland I Period (Custer 1989:141-144). The Leipsic Site settlement data also show that this continuity extends into the Woodland II Period and spans the Woodland I/Woodland II transition that occurred ca. A.D. 1000. In other parts of the Middle Atlantic region there are significant settlement pattern changes associated with this transition (Stewart 1992; Gardner 1982) and these settlement pattern

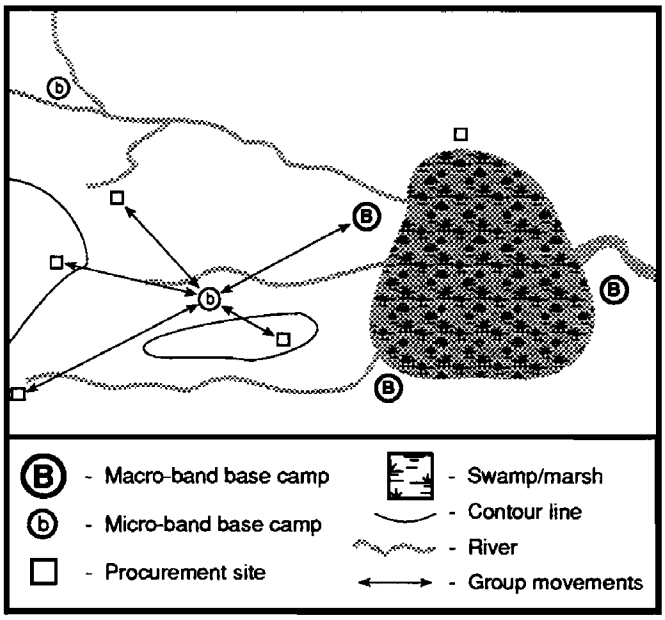
changes are probably linked to the adoption of agricultural subsistence systems. The absence of such settlement pattern changes in central Delaware supports the idea that agriculture was not that important in the northern Delmarva Peninsula (Stewart, Hummer, and Custer 1986).

The existence of settlement pattern continuities through the Woodland I/Woodland II transition is also interesting because even though it does not appear that the adoption of agriculture caused significant culture change on the Delmarva Peninsula at this time, some culture change is evident (Custer 1990). The culture change that is present has been linked to a hypothesized migration of Algonkian-speaking groups into the region (Fiedel 1987, 1990; Luckenbach, Clark, and Levy 1987), and this migration may be indicated by the presence of Clemson Island ceramics at the Leipsic Site itself. The settlement pattern continuities evident at the Leipsic Site span the time frame of this hypothesized migration and suggest that if such a migration took place, it did not involve groups with adaptations and household organizations that were significantly different from those of the original inhabitants of the region.

Regional Settlement Patterns

FIGURE 72

Woodland I Period Settlement Model

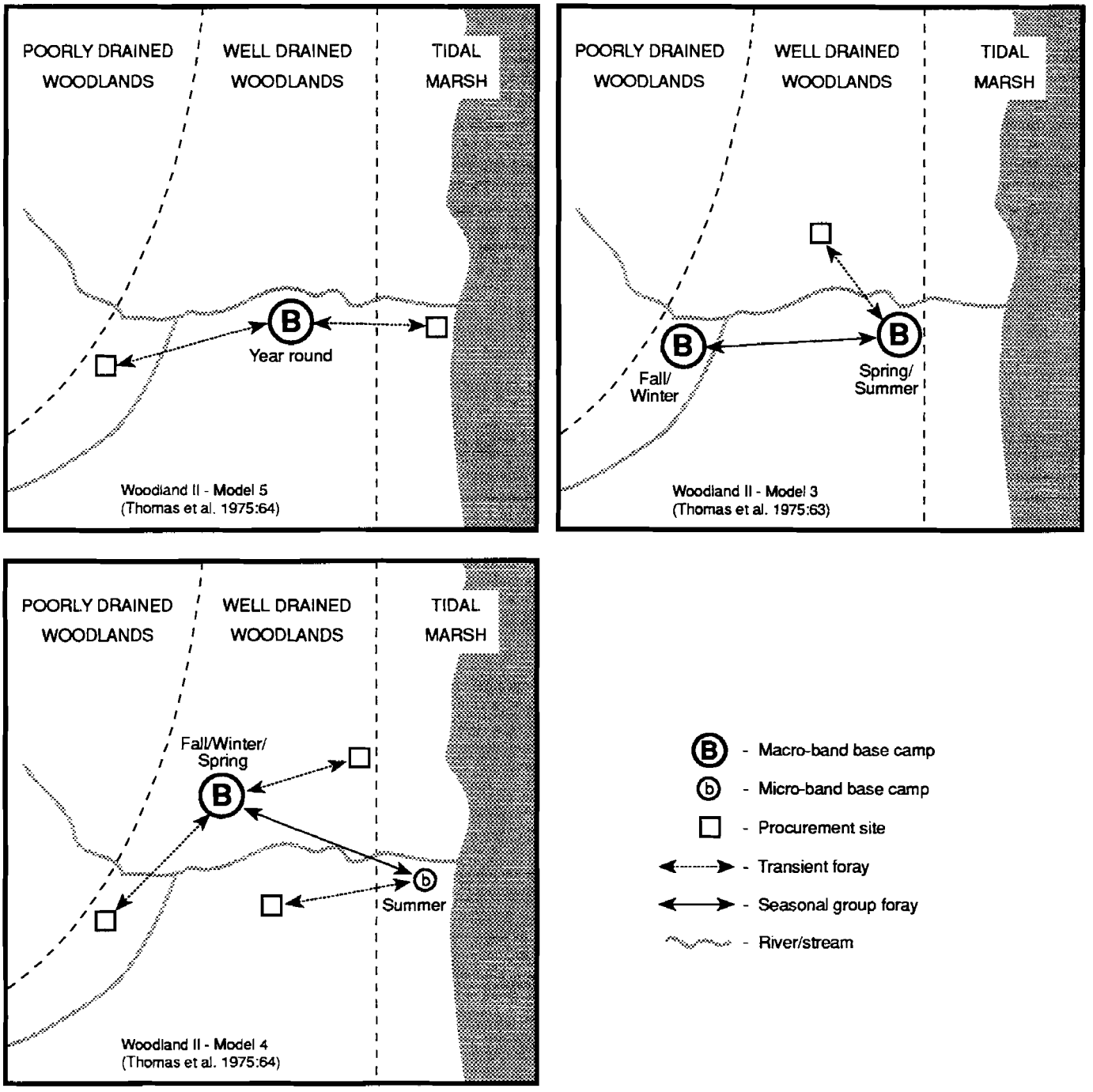


The settlement pattern data from the Leipsic Site can be used to address issues concerning regional settlement patterns. Regional Woodland I and Woodland II settlement pattern models have always included macro-band base camps (e.g. - Figures 72 and 73). Although Cluster 3 suggests that multiple families did indeed live at some base camps sites, the Leipsic Site data, and data from the Snapp Site (Custer and Silber 1994), also indicate that individual family occupations were more common. Thus, we probably should consider the possibility that there were two potential settlement systems in operation at any given time during the Woodland I and Woodland II periods (Figure 73). The first model is the traditional interpretation with groups coalescing at larger base camps during the cold weather months as shown in Figure 72, and then dispersing in the spring and summer. The second model would have individual families rarely joining together and spending most of their time moving alone across the northern Delaware landscape (Figure 73). Riverine base camps, like the Leipsic Site, would still be the locus of cold-weather occupations.

Both of these settlement systems were probably in operation at the same time during the Woodland I and Woodland II periods. It is unlikely that prehistoric groups never lived together in anything larger than nuclear family groups due to problems with inbreeding and genetic isolation. Therefore, there had to be some social mechanism for amalgamations of larger groups to facilitate exchange of mates and information. Such amalgamations are present among most hunting and gathering societies of Native North Americans and probably existed in Delaware as well during Woodland I and Woodland II times. Ethnohistoric data (e.g.- Becker 1986) for the Lenape clearly shows the existence of multi-family bands

FIGURE 73

Woodland II Period Settlement Models



who ranged over large areas and occasionally acted together as corporate groups. It is significant that corporate action and amalgamation of social groups did not always occur regularly among the Lenape and other hunting and gathering societies. Instead, amalgamation occurred only when special resources requiring communal processing were present, or especially abundant.

TABLE 51

Population Densities

Group	Population Density *	Citation
Delaware	1	Goddard 1978:214
Upper Chesapeake and Eastern Shore of Maryland and Virginia	3	Feest 1978a:242
Virginia Algonkians	2	Feest 1978b:256
Huron	60	Heidenreich 1978:369
Iroquois	2	Tooker 1978:421
Eastern Sub-Arctic Algonkians	<1	Brasser 1978:78

* Rounded to nearest person per square mile

Individual nuclear family groups almost certainly comprised the main social unit for prehistoric inhabitants of Delaware during Woodland I and Woodland II times. These groups spent most of their time living and traveling alone across the landscape. In most cases, the settlement model in Figure 73 would apply. However, on a irregular basis, probably not seasonally or even yearly, they came together in larger social units and Figure 72 would apply. The presence of a large communal processing hearth, which is thought to be tied to processing of nuts or fish, among a series of contemporaneously occupied house features at the Snapp Site suggests that the communal processing of these resources may have been the focus of the periodic amalgamations of social units. However, these resources may not have been sufficiently abundant to allow such amalgamations on a yearly basis.

If we are correct in our interpretation that Cluster 3 could have been occupied by up to six individual nuclear families, then it is possible to speculate on potential regional populations. Numerous studies (e.g. - Hassan 1981) have suggested that a community like the small group of families at the Leipsic Site required a support territory that approximates a circular area with a radius of 5 km. The size of this territory is based on ethnographic studies which show that the inhabitants of such a community will move the community rather than travel more than 5 km to procure critical resources.

The catchment area is approximately 78 square km, or 30 square miles. If we assume an average of five people per family and six families are present, then the population for the catchment area would be 30 people. This population figure yields a population density of one person per square mile. Table 51 shows a series of population density estimates for Eastern North America and the estimate presented here fits well with most of the other estimates.

If this population density is projected throughout the state of Delaware (Table 52), a total population estimate for the state during any given year of the Woodland Period would be approximately 2000 people. Table 52 also shows a population estimate based on data from the Snapp Site (Custer and Silber 1994) that was generated using similar methods. This estimate is somewhat lower and the average

TABLE 52

Prehistoric Populations in Delaware

COUNTY	SQUARE MILES	LEIPSIC ESTIMATE	SNAPP ESTIMATE
New Castle	437	437	364
Kent	595	595	495
Sussex	946	946	788
	TOTALS	1978	1647

of the two estimates is approximately 1800 people. These estimates are probably too high because they assume a constant population density throughout the state, and numerous studies (e.g. - Custer 1989) have shown that Woodland settlement is concentrated along the major drainages and not in interior areas. If we estimate that major drainage settings comprise approximately half of the state, then the population estimates would be between 800 and 1000 people. This population estimate may seem low, but fits well with the population densities for other hunting and gathering populations.

Prehistoric Migrations

The topic of prehistoric migrations in Delaware has been noted several times in this report; however, it is important to provide a final comment on the relationship between the Leipsic Site data and the topic of migrations. The presence of a significant amount of Clemson Island ceramics in the Leipsic Site assemblage has special relevance to the question of migrations because these ceramics are more commonly found in north central Pennsylvania which is located near the hypothesized homeland of the Algonkian immigrants to the Delmarva Peninsula (Fiedel 1987, 1990; Luckenbach, Clark, and Levy 1987). Their occurrence at the Leipsic Site lends credence to the hypothesized migration, and future studies should seek to identify these ceramics in other site assemblages.

In conclusion, the excavations at the Leipsic Site gathered data that allowed a wide range of research issues to be investigated. In some cases, the results of the research confirmed previous ideas about Delaware prehistory, but in other cases, we were forced to reevaluate our ideas. As such, the data from the site were significant and justified the time, energy, and money invested in their collection and analysis.