and biface assemblages. Furthermore, the values for these two attributes in Table 69 show that the standard deviations are large with respect to the means, indicating that there is a great deal of variation in the data for these attributes. This large amount of variation makes the biface identifications suspect.

To summarize the results of the flake attribute analysis, the data show that the debitage from the Woodland II features is primarily derived from core reduction. Biface reduction does not seem to be a major activity in and around the house features that produced the samples that were analyzed. These findings match with the results of other studies which suggest that by Woodland II times, biface reduction was uncommon and that a large percentage of Woodland II triangular projectile points were made from flakes (see discussion in Custer 1989). Cortex percentages were also rather high for these samples, ranging from 38 to 56 percent, and this observation shows that secondary cobbles and pebbles were the most likely source of the cores that were reduced.

DISCUSSION AND CONCLUSIONS

This final section of the report will discuss some of the implications of the interpretations of archaeological data recovered from the Pollack Site. A short summary of the data from the site is presented along with discussions of paleoenvironments, cordage twist data, regional lithic technologies, subsistence systems, and household, community, and regional settlement patterns. Where applicable, potential future research directions are noted.

Site Summary

The land at the confluence of the Leipsic River and Alston Branch 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 these early occupations.

Some time after 3000 B.C., prehistoric groups began to spend more time at the various areas at the Pollack Site. These later inhabitants built circular to oval houses with bent saplings as supports for roofs of bark, hides, or rushes (Plate 19). The houses also had interior fireplaces, an excavated "basement"-like depression almost as large as the house itself, and a "sub-basement" storage pit. Outdoor storage pits and fireplaces were also present.

All of the houses are relatively small and would have housed individual families. 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 can be found 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. 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 Pollack 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 and Prehistoric Settlement

An extensive program of geologic coring of this section of the Leipsic River Valley was undertaken as part of the research at the nearby Leipsic Site (Custer, Riley, and Mellin 1994: Appendix I). This research provided a variety of paleoenvironmental information including sedimentary data and pollen information (Brush 1994). The sedimentary data revealed 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 Pollack Site, was the interplay of changing estuarine environments and climatic change. The data from the geologic cores allowed for these two factors to be studied at the Leipsic Site, and also can be applied to the Pollack Site.

The paleoenvironmental data indicate that three main riverine environments were present in the vicinity of the Pollack 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 71 shows a correlation of environmental data and settlement intensity for the Leipsic Site. The first two columns summarize the data on riverine environments and water salinity over time and the combination of riverine environmental types and salinity produces a situation where environmental productivity for hunters and gatherers increased through time. The biggest changes 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 71 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 was 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.

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.

TABLE 71
Correlation of Environmental Data and Settlement Intensity

	RIVERINE ENVIRON-MENT	SALINITY	CLIMATE (PRECIPITATION)	SETTLEMENT INTENSITY
AD 1600–1200	Tidal River Valley	Oligohaline	Intermediate	Highest
AD 1000–0	Estuary	Oligohaline	Intermediate	High
BC 0–1000	Tidal River Valley	Fresh/ Oligohaline	Dry / Wet / Dry / Wet	Low
BC 1000–1600	Alluvial Valley	Fresh	Dry	Lowest

The final column of Table 71 provides a measure of settlement intensity at the Leipsic Site. There is a continual increase in settlement intensity through time and a big difference occurred ca. 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 was probably related to the increase in local environmental productivity. Settlement pattern data from the Pollack Site lack the chronological controls seen at the Leipsic Site; however, it is very likely that the Pollack Site is similar to the Leipsic Site and the majority of the prehistoric use of the site occurred during the Woodland II Period in all site areas (Figures 124-132).

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 huge archaeological sites which line the river shores, and the Pollack Site is a part of one of these vast sites.

TABLE 72

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

For the most part, climate change does not seem to be closely related to the trends in settlement at the Pollack and Leipsic sites. The riverine environmental conditions linked to sea-level rise 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 71, 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 72. 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.

A final point to mention is the fact that research at the Pollack Site did include geological investigations (Appendix I) of the bay/basin feature in the southern part of Area C (Figure 17). The upper portion of the bay/basin sediments, which usually include the pollen and sedimentary structures most applicable to environmental studies relevant to archaeology, had been destroyed by plowing. Nevertheless, a cross section of the deeper portions of the bay/basin was exposed and studied (Plates 33-35). These studies showed that the stratigraphic profile of the lower section pre-dated 12,000 B.C., the earliest date of human habitation of the Delmarva Peninsula, and have no real relevance to the archaeology of the Pollack Site. However, the geological data are of interest and are described in Appendix I.

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 73. 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, consisting of only 39 total vessels, and no interpretations of the compiled data are offered. Nevertheless, these data are now 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 73

Delaware Cordage Twist Data

CERAMIC TYPE	SITE	SHERD COUNT S	SHERD COUNT Z	VESSEL COUNT S	VESSEL COUNT Z
Dames Quarter	Leipsic	5	0	1	0
Wolfe Neck	Snapp	54	0	1	0
	Pollack	2	0	1	0
Mockley	Leipsic	1	8	1	1
Hell Island	Leipsic	10	0	2	0
	Paradise Lane A	0	73	0	1
	Paradise Lane B	16	0	1	0
Clemson Island	Leipsic	98	0	2	0
Killens	Leipsic	9	1	4	1
	Pollack	2	7	2	7
Townsend	Leipsic	10	3	2	1
Minguannan	Lewden Green	9	25	--	--
	Pollack	4	11	2	9

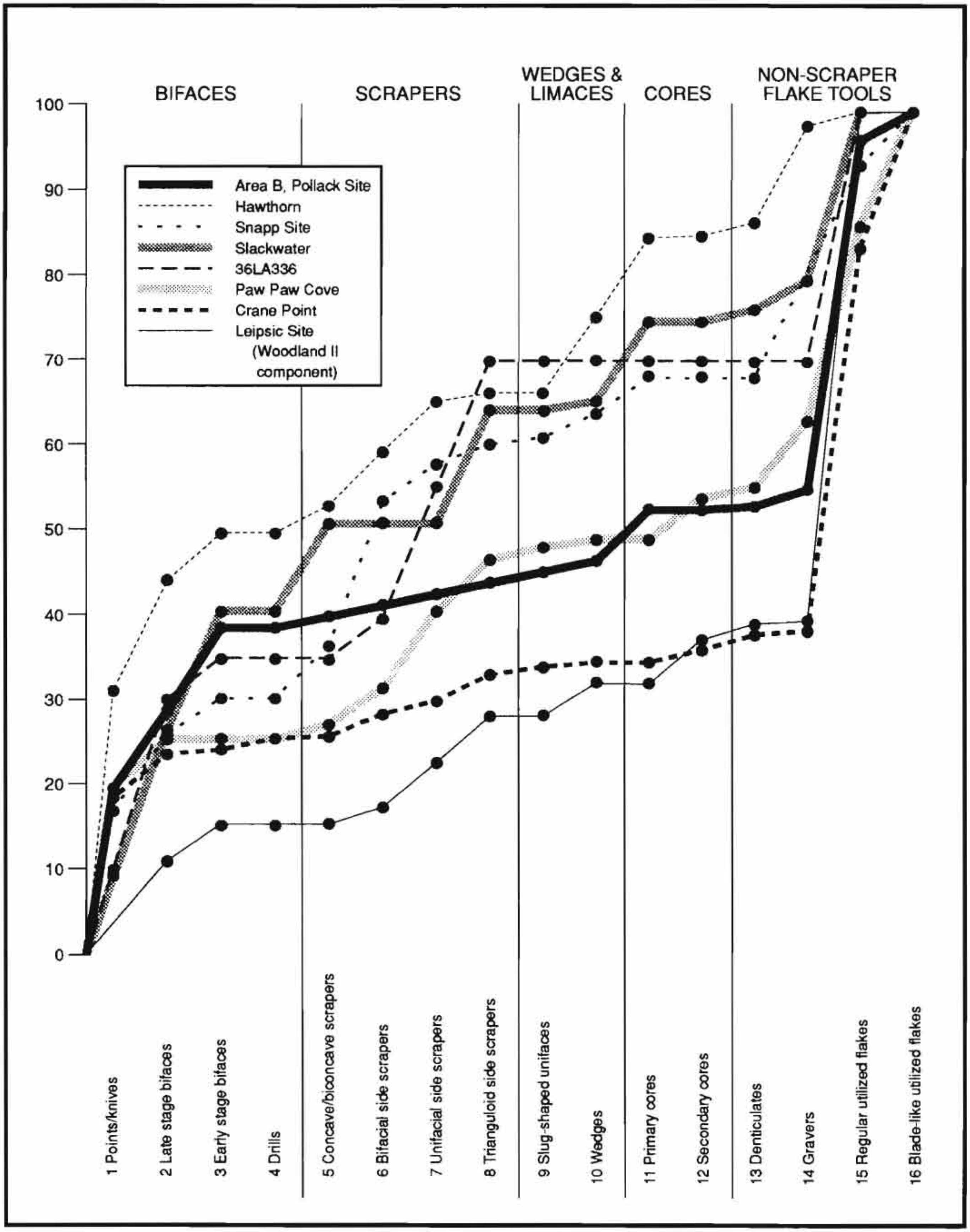
Regional Lithic Technologies

Various aspects of the Pollack 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 Pollack Site assemblages in Table 67, which was taken from the work of Lowery and Custer (1990), can be used to systematically compare the Pollack Site assemblages from Areas A, B, C, and the Woods Area with those of other sites where the data were organized and gathered in a similar fashion. Unfortunately, comparable data are not available

FIGURE 134

Regional Comparison of Tool Kits



from a wide range of sites. Figure 134 shows comparable data from seven 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. The Leipsic Site provides a Woodland II sample, and it is located across the Leipsic River from the Pollack Site.

Figures 133 and 134 can be compared and the cumulative percent curve for Area B of the Pollack Site is included in Figure 134 as a reference point for comparison. Area B, Area C, and the Woods Area of the Pollack Site are all most similar to the Snapp, Hawthorn, Slackwater, and Site 36LA336 assemblages. Area A is similar to Paw Paw Cove, Crane Point, and the Leipsic Site Woodland II assemblage. In general, the Paw Paw Cove, Crane Point, Leipsic, and Pollack Area A 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 can be 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, Leipsic, and Pollack Area A 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 134 reflect proximity to lithic resources along with relative reliance on bifaces as core sources of flakes.

The assemblages from Areas A, B, C, and the Woods Area of the Pollack Site 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 74 lists the data used in these comparisons and Figure 135 shows the locations of the sites used in the analyses. Tables 75 - 77 show rankings of the sites listed in Table 74 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 75 shows the site rankings by cortex percentages. Areas A and B fall into the category of sites with very high cortex percentages and Area C and the Woods Area fall into a category of sites with moderately high cortex percentages. Both these site groupings have a variety of site types within them. The presence of different site types in the groupings indicates that differential access to varied raw material types was more important than site functions in determining use of primary and secondary materials.

TABLE 74

Comparative Lithic Resource Use Data

Site	Function (Complex)	Total Artifacts	Cortex %	Crypto-crystalline %	Quartz/ Quartzite %	Reference
Pollack						
Area A	Base camp	1,163	40	85	14	
Area B	Base camp	3,184	36	75	24	
Area C	Base camp	5,452	33	69	23	
Woods	Base camp	1,496	26	41	57	
7K-C-194A	Base camp (Woodland II)	1,230	28	63	35	Custer, Riley, & Mellin (1994)
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 et al. (1994)
7K-C-359	Micro-band base camp	160	26	63	33	Riley et al. (1994)
7K-C-363	Procurement	133	21	76	19	Riley et al. (1994)
7K-C-364	Staging/ processing	1,742	32	56	39	Riley 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 et al. (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 et al. (1981)
7NC-D-55A	Cobble reduction base camp	132	45	16	69	Custer et al. (1981)
7NC-D-55B	Cobble reduction base camp	2,304	29	8	88	Custer et al. (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 et al. 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

TABLE 75

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
Pollack Woods	Base Camp	26
7K-C-359	Base Camp	26
7K-C-204	Base Camp	27
7K-C-194A	Base Camp (WoodlandII)	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
Pollack Area C	Base Camp	33
Pollack Area B	Base Camp	36
7NC-G-101	Base Camp (Webb)	37
7NC-A-2	Base Camp	38
7K-C-365 A	Processing/Staging	38
Pollack Area A	Base Camp	40
7NC-D-100	Procurement	41
7NC-D-55A	Cobble Reduction Base Camp	45
7S-G-123	Cobble Reduction Base Camp	54

TABLE 76

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
Pollack Woods	Base Camp	
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
Pollack Area C	Base Camp	
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
Pollack Area B	Procurement	
7K-C-363	Base Camp	76
7NC-E-9	Base Camp	79
7NC-G-101	Base Camp (Clyde Farm)	79
7NC-G-101	Base Camp (Woodland II)	80
Pollack Area A	Base Camp	
7NC-D-125B	Staging/Processing	92
7NC-D-125A	Staging/Processing	98
7NC-F-61A	Quarry Reduction Base Camp	99

Table 76 shows a ranking of sites by cryptocrystalline raw material percentages. The Woods Area assemblage falls in a group of sites with moderate cryptocrystalline percentages. Areas A, B, and C fall into the two highest categories. 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 than specialized site activities in determining the kinds of lithic resources used at a site. Except for the Woods Area, the Pollack Site areas fall in a group of sites with low quartzite/quartz percentages (Table 77). Quartzite, quartz, and cryptocrystalline materials are all available as secondary cobble resources in the vicinity of the Pollack Site and the data in Tables 76 and 77 indicate that the site's inhabitants preferred cryptocrystalline materials.

TABLE 77

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
Pollack Area A	Base Camp	
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
Pollack Area C	Base Camp	
7S-G-123	Cobble Reduction Base Camp	23
Pollack Area B	Base Camp	
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
Pollack Woods	Base Camp	
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 78 shows a classification of the sites listed in Table 74 on the basis of cortex and cryptocrystalline percentages. Areas A, B, and C fall in a group with high cortex and high cryptocrystalline percentages. The Woods Area 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 78 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 used whatever resources were available to manufacture the tools that they needed.

TABLE 78

Lithic Resource Use Classification

	CORTEX	
CRYPTOCRYSTALLINE	HIGH	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) Pollack Area A ← Pollack Area B ← Pollack Area C ←	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) Pollack Woods ←	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 Pollack Site can be compared to similar assemblages from other sites in Delaware to see if there are varied patterns of plant food use during Woodland I and Woodland II times. Table 79 shows the data from the Pollack Site along with those from other Woodland sites in Delaware. Some of the other sites either do not date to the same time period as the Pollack Site, or contain multiple components. The notes on Table 79 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, Pollack, Leipsic, Snapp (7NC-C-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 Pollack, 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

TABLE 79

Comparison of Plant Food Remains

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

Citations and Notes

(1) Custer, Riley, & Mellin 1994. Dates to Woodland I and Woodland II periods.

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

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

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

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

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

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

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

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

Note: Only the major plants from the Pollack Site are listed.

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 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 seven sites noted in Table 79 (Pollack, Leipsic, Snapp, 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 and the Pollack and Leipsic sites show a wide range of plants, but not as wide as Delaware Park. 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 Pollack Site, and their interpretations as houses and storage/refuse pits provide numerous insights to the study of household settlement patterns. The size of the houses discovered at the Pollack Site clearly implies that the main social unit of the site's inhabitants was the nuclear family because 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 to the end of the Woodland II Period. Houses from the Snapp Site (Custer and Silber 1994) and the Leipsic Site (Custer, Riley, and Mellin 1994) show similar continuity during the same time span. Furthermore, individual houses in varied dated contexts throughout Delaware (Artusy and Griffith 1975; Custer and Mellin 1987; Custer and Hodny 1989) are roughly the same size. These varied houses with their similar sizes would seem to indicate that the size of the basic social unit of Delaware's prehistoric inhabitants did not change between 3000 B.C. and A.D. 1500.

The continuity of house size, and presumably the size of the basic social units, noted above is not seen in other parts of the Middle Atlantic. For example, in nearby 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 occurred after the adoption of agriculture and occurred 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; Custer and Griffith 1986).

The house features at the Pollack Site showed a great deal of variation in the number of artifacts included in the feature fill. The actual artifact counts per feature ranged from no artifacts at all to more than 600. An analysis of this variation within the site, and in comparison with other sites, was undertaken, and the results are described below.

Artifact counts per feature are obviously related to the size of the features, so the first step in the analysis was to regularize the artifact counts in relation to feature volumes. An approximation of feature volume was calculated by multiplying the length, width, and depth of the feature together. All of the features had rounded plan views and profiles, and none of them were rectangular. Therefore, this calculation obviously over-estimated the feature volume. However, because the goal of the calculation was to develop a relative measure of volume, not an absolute measure, and because all of the feature volumes were subject to over-estimation, the calculations are applicable to this research question. After the volumes were calculated, the mean values for each site area were calculated and the volumes indexed by dividing them by the mean value. The artifact counts were then regularized by feature volume by multiplying the actual artifact count by the volume index.

Table 80 shows the percentage frequency distribution of the indexed artifact counts per feature for the varied areas of the Pollack Site. The same methods were also applied to data from the Snapp (Custer and Silber 1994), Leipsic (Custer, Riley, and Mellin 1994), and Delaware Park (Thomas 1981) sites and percentage frequency distributions from these sites are also shown in Table 80. The varied areas of the Pollack Site show very similar percentage frequency distributions with the overwhelming majority of the features having low numbers of artifacts per feature. Only a small proportion of the features have indexed artifact frequencies of more than 50.

TABLE 80
Percentage Frequency Distribution of Artifacts per Feature

SITE/AREA	INDEXED ARTIFACT COUNT PERCENTAGES					
	≤10	11-20	21-30	31-40	41-50	>50
Pollack Site						
Area A	87	3	3	2	1	4
Area B	83	5	4	1	1	6
Area C	92	3	2	1	<1	2
Areas D, E, F, G	88	6	1	0	1	4
TOTAL	88	4	2	1	1	4
Snapp Site	71	4	3	2	1	19
Leipsic Site	65	6	2	5	2	20
Delaware Park Site	84	0	0	0	4	12

The Delaware Park Site is very similar to the Pollack Site, but the Snapp and Leipsic sites, which are very similar to one another, show different percentage distributions. The Snapp and Leipsic distributions still show that a majority of the features have fewer than 10 artifacts. However, the percentage of features with fewer than 10 artifacts is not as large at the Snapp and Leipsic sites and there are more features with more than 50 artifacts at these sites. There are no significant differences among the percentage values for features with 11 - 50 artifacts among all of the sites.

There are a number of possible explanations for the varied artifact frequencies per feature among the different sites. Because the features are pits within houses, the different artifact frequencies may be related to varied seasonal occupations of the houses. The houses with more artifacts in the features may have been occupied during the cold-weather months when activities producing debris would be more likely to take place indoors, and that debris was more likely to be discarded in the indoor features. If this interpretation is correct, then the Snapp and Leipsic sites, with their higher numbers of house features with more than 50 artifacts, were more frequently occupied during the winter months than the other sites.

Varied artifact frequencies within features may also be related to the duration of the occupations. The houses with more artifacts in the features may have been inhabited for longer periods of time. However, it is important to remember that the occupations of the houses were interpreted to span the late summer through the spring months. Furthermore, it has been assumed that the storage pits within the houses were used to store food resources gathered during the summer and fall for consumption during the cold-weather months. If artifacts and other debris were deposited in the features, it would have been after the features were no longer needed for food storage, presumably during the spring. If there are few or no artifacts in the features, then it is possible that the houses were abandoned soon after the food resources stored in them were used, and before there was a chance for additional debris to accumulate inside the house. In this scenario, most of the houses at the sites would have been abandoned very early in the spring. In the case of the features with more than 50 artifacts, these houses may have been occupied until later in the spring. Further research is needed to clarify the meaning of the variation in numbers of artifacts per feature.

Community Settlement Patterns

The distribution of house features (Figures 51-58) provides a look at the intensity of settlement at the Pollack Site and a basis for the analysis of prehistoric communities. For the most part, the "communities" at the Pollack Site seem to consist of individual nuclear families. After the completion of Phase II research, the Pollack Site was considered to be a "macro-band base camp" based on 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 Pollack Site were individual families, is it really a "macro-band" base camp? We feel that the "macro-band" base camp label is probably <u>not</u> an accurate description of the Pollack 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 discovery that a large site like the Pollack 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 Pollack Site a "macro-band" base camp, there are still significant differences between sites like Pollack and traditional micro-band base camps. In general, micro-band base camps are not as large and have fewer artifacts. The excavations at the Pollack Site show that its larger size is 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 Pollack 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 Pollack 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 Pollack 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 nearby Leipsic Site (Custer, Riley, and Mellin 1994). The settlement pattern continuities evident at the Pollack 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

The settlement pattern data from the Pollack 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 136 and 137). The Pollack Site data indicate, however, 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 137). The first model is the traditional interpretation with groups coalescing at larger base camps during the cold-weather months as shown in Figure 136, 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 137). Riverine base camps, like the Pollack Site, would still be the locus of cold-weather occupations.

FIGURE 136
Woodland I Period Settlement Model

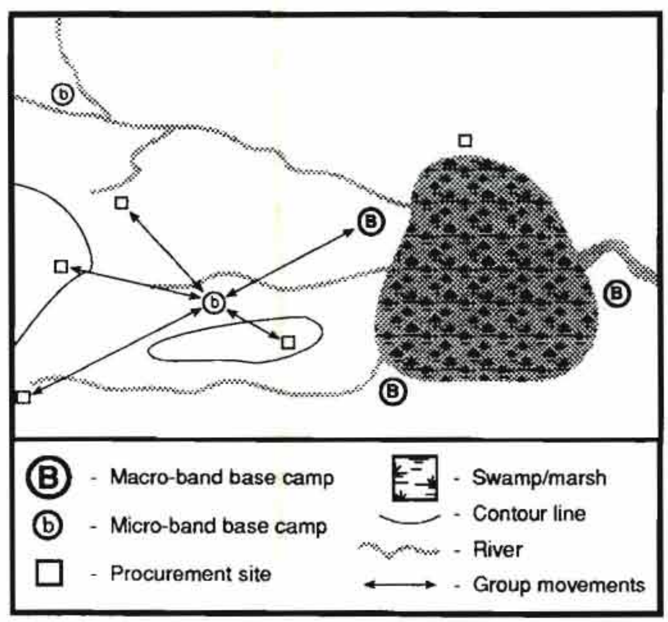
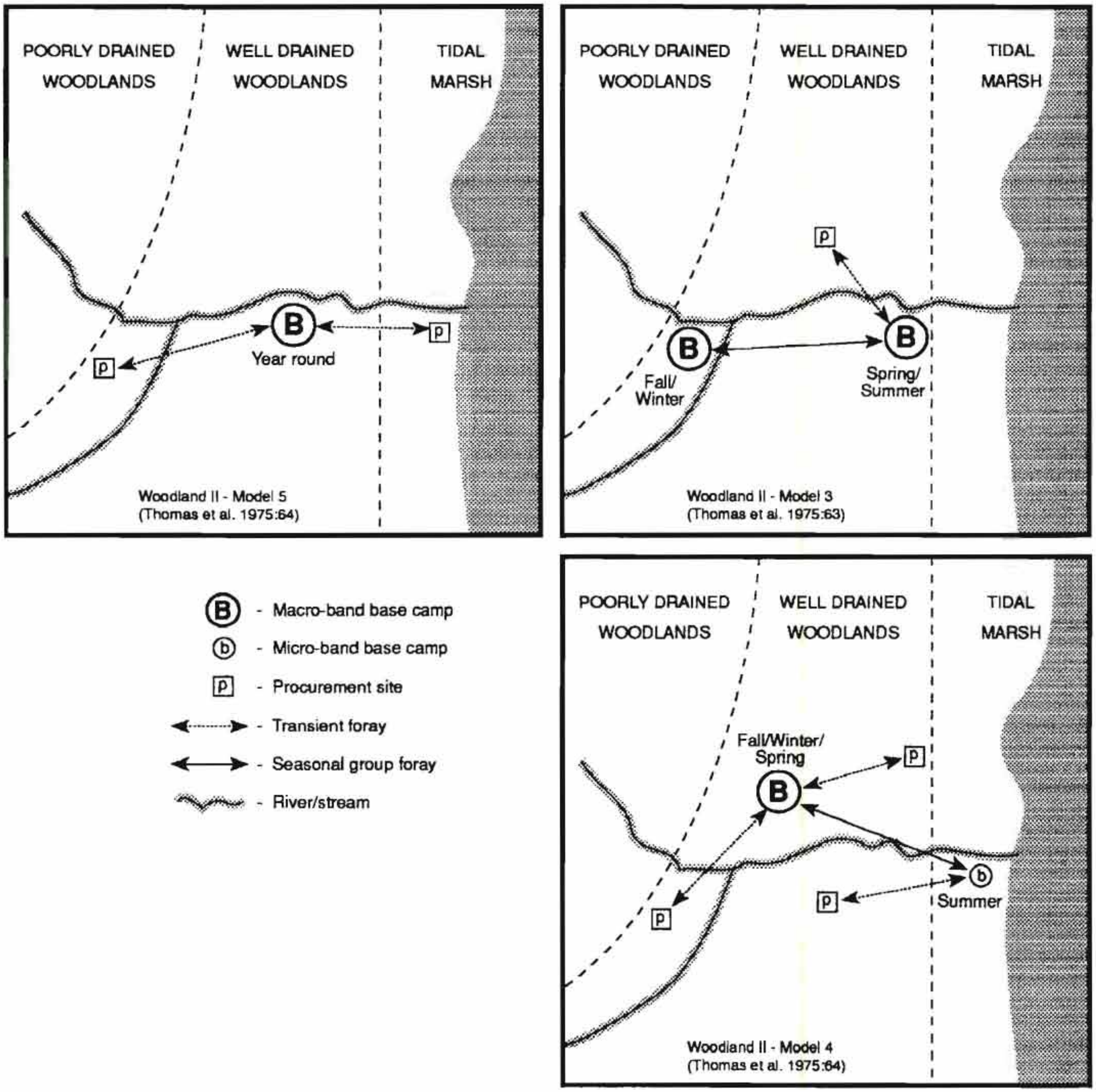


FIGURE 137

Woodland II Period Settlement Model



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 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.

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 137 would apply. However, on a irregular basis, probably not seasonally or yearly, they came together in larger social units and Figure 136 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 (Custer and Silber 1994) 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.

Although the chronological data from the varied areas of the Pollack Site were very sparse; too sparse, in fact, to develop measures of changing settlement intensity as has been done for other sites (e.g., Figure 71). Nevertheless, the limited chronological data can be used to generate some possible insights into how often the Pollack Site was inhabited. For the site as a whole, there were 50 dated house features, 20 of which date to the Woodland I Period. Thirty houses dated to the Woodland II Period. If the proportion of Woodland I and Woodland II houses among the dated features is representative of the total assemblage of 785 house features excavated at the site, then 314 houses were associated with the Woodland I Period and 471 were associated with the Woodland II Period.

As was noted earlier, there are no data to suggest that any of these houses were inhabited contemporaneously. Therefore, if we assume that each house represents a separate occupation of the site, and if the number of house/site-occupations is divided by the number of years in the relevant Woodland time period, we get an estimate of the frequency of site use. For the Woodland I Period, there are 314 houses spread over 3500 years yielding a frequency of occupation of approximately one occupation per decade. For the Woodland II Period, there are 471 houses spread over 600 years yielding a frequency of occupation of approximately one occupation per year.

It should be noted that there is a very good chance that the calculations noted above overestimate the frequency of site occupation. Although there are no data to indicate contemporaneous occupation of houses at the site, there are also no data to indicate that contemporaneous occupations did <u>not</u> occur. Furthermore, the above discussion treats the entire large site as a single unit, and it is hard to imagine that the site as a whole was never occupied by more than one family at any given time. Therefore, if there were several families living at the site at a single point in time, then the above estimates of occupation frequency and time intervals between occupations are too small. In other words, even though the figures provided above show relatively infrequent use during the Woodland I Period, the true use frequency could actually be even <u>less</u>. The Woodland II figure of one house per year would also be reduced.

In sum, the data on frequency of use of the Pollack Site would tend to indicate that it was used more frequently during the Woodland II Period, after A.D. 1000. A similar pattern is seen at the adjacent Leipsic Site (Custer, Riley, and Mellin 1994). This more frequent use could be due to the previously discussed tendency for Woodland Period societies to shift their settlements upstream on the major drainages as time progressed.

It is also possible that the changing settlement frequency is related to group mobility and population levels. Perhaps, the less frequent settlement occurred during the Woodland I Period because groups were more mobile and did not return as frequently to the same location for their winter base camps. More frequent use of the same locale in Woodland II times may indicate that those later groups did return to the same location from year-to-year and were less mobile than their predecessors over the course of several years. Such decreased mobility may have been due to increased population levels.

Future research in the Leipsic River Valley and at Woodland base camps in general can help to determine which process may account for the varied frequency of settlement. If the upstream shift of settlement is indeed the cause of the change in settlement intensity, then other sites further downstream in the Leipsic River Valley should show more frequent site occupation during the Woodland I Period. If growth of population and decreased mobility is the cause, then Woodland I sites throughout Delaware in general should show lower frequencies of site use than Woodland II sites. However, it is important to note that these questions cannot be answered without relatively large scale excavations of large areas with numerous house features that can be dated to specific time intervals within the general Woodland Period.

The results of the Pollack excavations also have implications for some recent attempts to estimate prehistoric population levels in Delaware (Custer and Silber 1994; Custer, Riley, and Mellin 1994). These studies used the data from the Snapp and Leipsic sites that showed that as many as five to six families inhabited these sites at a given point in time. Then, data on site catchments were utilized to show how much land in the vicinity of the base camp sites would be needed to support these families. Finally, the number of all possible catchments of this size in the state of Delaware were estimated in order to estimate how many six-family units could have been present in Delaware at any given time. The resulting population estimate was approximately 800 - 1000 people in the state at any given time during the Woodland Period, and this estimate matches well with ethnohistoric population density estimates for other parts of Eastern North America.

The population estimation methods described above rely on several assumptions that the findings from the Pollack Site call into question. The data from the Pollack Site show that it is very likely that fewer than five or six families could have inhabited base camp sites over time. The method described above assumes that all base camp sites were inhabited by five to six families at any given time. Therefore, the methods noted above are probably over-estimating the population levels, even though those levels (one person per square mile) are rather low. It is probably best to view the population estimate of 800 - 1000 people and one person per square mile for Delaware during the Woodland Period as an upper bound with the true population likely to be even lower.

In conclusion, the excavations at the Pollack Site gathered data that allowed a wide range of research issues to be investigated. In some cases, the results of the research confirmed previous interpretations of Delaware's prehistory. In other cases, new ideas and interpretations were revealed. As such, the data from the site were significant and justified the time and energy invested in their collection and analysis.