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Interior Resources Exploitation: A Woodland Settlement Model for Long Island, New York

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INTRODUCTION

Archaeological research on Long Island, New York, has heavily emphasized Amerind adaptations to coastal environments. Excavations of more than a hundred shell middens have provided information on the coastal subsistence and settlement patterns of prehistoric hunter-gatherers (see, for example, Salwen 1970; Kaeser 1974; Gwynne 1982). By comparison, little research has been conducted on prehistoric land use and settlement of the interior woodlands of Long Island; until recent years, few intensive subsurface surveys or large-scale excavations had been undertaken in non-coastal environs.

The study of the interior has been hampered by the common misperception that this area is largely devoid of archaeological remains. Settlement studies have tended to underscore the diverse and bountiful resources of the island's coastal strip, emphasizing this environ as the primary focus of prehistoric subsistence and settlement activities while ignoring or downplaying the potential significance of the interior base (Saxon 1975; Wyatt 1977). Sporadic hunting or gathering forays into the interior by coastal groups are believed to have produced few tangible archaeological remains outside of occasional lithic scatters, and these scatters are

recognized as being both difficult to detect using standard survey techniques and difficult to interpret. Scant information is available to make reliable chronological assessments or to define specific site functions (see Vetter *et al.* 1978; Johannemann and Schroeder 1982).

This paper reevaluates the role that the interior woodlands played within the regional settlement patterns of Long Island hunter-gatherers. We question many of the traditional perceptions concerning the prehistoric exploitation of the interior and, most importantly, we argue that the interior woodlands served as a critical resource base for obtaining raw materials and foodstuffs, including deer and mast nuts. We also argue that a relatively diverse range of archaeological remains should be found in this area. We begin our discussion with a consideration of the kinds of interior foodstuffs and raw materials that were exploitable by local groups. We then outline a settlement model for the Woodland period occupation of the interior. The final section of the paper describes the preliminary results of an interior survey conducted in west-central Suffolk County, and compares the observed site distributions with those predicted from our settlement model.

RESOURCES OF THE INTERIOR WOODLANDS

The interior landscape of Long Island, a product of glacial activity during the late Pleistocene, consists primarily of morainal deposits, outwash plains, and kettle holes. The Harbor Hill moraine, situated along the north shore, and the Ronkonkoma moraine, located along the central section, serve as the twin backbones of Long Island, providing vertical relief up to 77 m above sea level along the 198 km length of the island. Between the morainal deposits, and extending some distance south of the Ronkonkoma moraine, is an outwash plain composed of sand and gravel deposits drained by numerous small streams. Kettle holes—substantial depressions formed by ice stranded by stagnant or retreating glaciers—are also widely scattered across the outwash plain. These tend to contain perennial or seasonal sources of fresh water.

Since the Late Pleistocene, a succession of plant communities have adapted to Long Island, beginning with a park-tundra or spruce dominated forest (17,000/15,000 B.P.), followed by a pine dominated forest (10,000 B.P.) and climaxing with a hardwood forest about 6,000 to 7,000 years ago (Sirkin 1977:213-15; Ogden 1977:23-30; Newman 1977:564). The extent and composition of the deciduous woodlands have changed markedly over the years, largely as result of modern human activities. Recent land use

modifications such as agriculture, the cord-wood industry, and forest fires and disease have greatly reduced the density and spatial distribution of some species of oak, walnut, hickory, and chestnut trees (see Turano 1983). In fact, much of the remaining woodland of Suffolk County now consists of "pine barrens," a term used to define an ecosystem characterized by pine and oak associations in different stages of succession (Lambe 1984:24). The pine barrens represent a fire-tolerant community that appears to have expanded at the expense of less fire-resistant hardwood forests (Olsvig *et al.* 1979:277; Little 1979:312-13).

Several researchers have attempted to reconstruct the forest types of Long Island during the historic period and prior to the advent of modern land use practices (see Harper 1917; Conard 1935; Svenson 1936; Cain 1936). One of the most detailed reconstructions, by Frank Turano (1983), employs information from both historic accounts and extant edaphic conditions to suggest that the contact period vegetation was a fertile mosaic of mixed hardwoods and grasslands. His reconstruction indicates that an oak-chestnut forest, specifically adapted to the dry sand-gravel soils of low relief ridges, once flourished along the Harbor Hill and Ronkonkoma moraines. The outwash deposits between the two moraines of western Long Island appear to have supported a white oak forest, consisting of white, black, and scarlet oaks, chestnut, and pignut hickory trees, and an extensive grassland prairie, known locally as the Hempstead Plains. The eastern end of the island between the two moraines, and the southern outwash plain, sustained a mixed oak forest similar to this oak-chestnut association except for a greater density of scarlet oak and the presence of pitch pine. Turano argues that the pitch pine community (pine barrens) was a relatively minor component of the interior until land use practices and frequent forest fires resulted in its expansion during the 19th century.

Turano's reconstruction, as well as earlier studies (Svenson 1936; Cain 1936) suggest that a wide spectrum of plant and animal resources flourished in the interior of Long Island during the contact and late prehistoric periods. The hardwood forests could have provided a variety of nutritious mast nuts, including acorns, chestnuts, hickory, and beech nuts, which would have supported a sizeable population of deer, squirrels, turkeys, and other game birds and animals. Other potential foodstuffs included wild berries, roots such as the ground nut (*Apios americanus*), and seeds, available in forest clearings, along streams and pond edges, and in the grasslands. Finally, the kettle ponds and streams that dissect the interior would have provided hunter-gatherers with fresh water, freshwater fish, and, in the case of coastal-linked streams, anadromous fish.

In a preliminary study of the resource potential of Long Island's hardwood forests, SUNY/Stony Brook students and volunteers participated in fall harvests of mast nuts at several locations. On the Sarnoff Property, Central Brookhaven township (described below), our inexperienced collectors amassed an average of 1.36 kg of nut meat per hour of work, the equivalent of roughly 6400 calories' worth per hour. The mixed hardwood forests of Shelter Island produced somewhat lower return rates, approximately .22 kg of nut meat (1340 calories) per hour of work.

The mast nut return rates derived from our study are on the lower end of those reported by Perlman (n.d.). Perlman, basing his estimates on nut-gathering experiments and modern yields of oak trees, suggests that large acorns can produce return rates of 5400 to 16,200 calories per hour of gathering. He notes (n.d.:14) that mast nuts produce among the highest return rates of any wild resources, including anadromous fish, found in the eastern woodlands. It is clear, given both Perlman's and our results, that the diverse hardwood forests of the late prehistoric and contact periods could have produced a considerable supply of mast nuts, which could have been collected in substantial quantities and processed for immediate consumption or stored for use during the lean winter and early spring seasons.

It is also estimated that Long Island supported a sizeable deer population. At present, a deer population of about 3000 head is scattered over about 777 km² of deer cover or range. Controlled hunting produces about 300 head per year (Reichman 1983). Our own observations of the deer herd at the Sarnoff Property, an area of about 2510 hectares, indicates it has a winter density of about 6 deer per km². Estimates of the prehistoric deer density of pine-oak forests are somewhat higher, ranging from about 6 to 13 deer per km² of range land (Gramly 1977:603; Hassan 1983:15). It thus appears that the mosaic of hardwood forests and grasslands present during the late prehistoric and contact periods, representing an area of at least 10,000 km², could have supported a deer population of well over 10,000.

A WOODLAND PERIOD SETTLEMENT MODEL OF THE INTERIOR

In this section we examine the kinds and spatial distribution of archaeological remains that might have been produced by prehistoric hunter-gatherers who exploited the resources of the interior. The discussion is based on a consideration of 1) previous research on Long Island's settlement patterns, 2) the distribution of interior resources, and 3) the spatial configuration of Long Island.

- 1) *Long Island's Settlement Patterns*. Previous studies of

coastal shell middens suggest that at least two kinds of subsistence/settlement strategies were practiced by hunter-gatherer groups. The first, designated the nomadic foraging pattern after Binford (1981, 1982), is based on the identification of seasonally-occupied midden sites. Some of these middens appear to represent *short-duration residential bases*, places where family members resided and carried out a variety of subsistence, domestic, and maintenance tasks. Analyses of the Oakland Lake site (Kaeser 1974), the Wading River site (Wyatt 1977), and the Stony Brook site (Ritchie 1959) suggest that these were residential bases occupied during either the spring/summer or fall/winter months. These studies also suggest that at least some hunter-gatherer groups practiced a seasonal-round economy, moving their residential bases in relation to seasonally-available resources along the coastal strip and possibly into the interior as well.

Studies of nomadic foragers have implications for the kinds of archaeological remains we should find in the coastal and interior sections of Long Island. During the course of a seasonal round, multiple residential bases might have been set up in both coastal and interior locations. These sites would have served as the bases of operation for exploiting available foodstuffs and raw materials within the nearby hinterland. Ethnographic and archaeological research shows that the distance over which hunter-gatherers commonly exploit food resources from residential bases on a daily basis, referred to as the catchment range, varies from 5 to 10 km (or about a one- to two-hour walk from camp) (Vita-Finzi and Higgs 1970; Roper 1979:123-24; Bailey 1983:60). Of course, the catchment range of a residential base may oscillate somewhat depending upon local topographic conditions and modes of transportation (foot travel, canoe, snowmobile; see Binford 1982:7; Clark 1983:102).

Within the catchment range of residential bases we might expect to find a) *non-site manifestations*, and b) *procurement stations*. The former includes very sparse scatters of artifacts that often cover extensive areas. These low-density scatters result from food procurement parties repeatedly pursuing mobile game or exploiting low-density plant resources over a large foraging range. The non-site manifestations commonly contain tools—such as projectile points, knives, and choppers—that were lost or discarded during the hunting or gathering forays (see Thomas 1975; Binford 1980:9; Nance 1983:316-20). Procurement stations are special-purpose sites established to process the bulk harvests of dense resource patches (see Custer 1984:67-68). Clustered, high-yield resources might include anadromous fish migrating upstream to spawn, productive mast nut groves, or rich shellfish

beds. At these locations, large quantities of foodstuffs could have been harvested over a very short period. Procurement sites might have included the field processing of resources in order to separate the edible portions from bones, shell, and nut hulls. Similarly, procurement stations might be used to exploit concentrations of raw materials; at lithic sources, for example, initial quarrying and lithic reduction activities would have been undertaken. Procurement stations commonly consist of a limited artifact assemblage, a limited range of ecofacts or raw materials (except for those being mass-processed), and few architectural features outside those used in the processing activities (see Lightfoot 1985).

The second subsistence/settlement strategy, designated [after Binford (1980, 1982)] the sedentary collector pattern, is based on the analysis of shell middens that appear to represent *year-round residential bases*. Studies of Pipestave Hollow (Gwynne 1982), the Englebright site (Gramly and Gwynne 1979), and the Tiger Lily site (Wisniewski and Gwynne 1982) suggest that these middens were occupied on a year-round basis. Gwynne (1982) hypothesizes that the sedentary settlement pattern was facilitated by the placement of these sites along rich estuaries where a variety of marine, estuarine, and terrestrial resources could have been exploited in close proximity to the main residence.

The archaeological remains produced by sedentary collectors would be similar, in many respects, to those produced by nomadic foragers. One should find, for example, non-site manifestations and procurement stations within the catchment ranges of sedentary residential bases. Yet the two subsistence/settlement strategies differ in the length of time spent at residential bases, and the manner in which resources were exploited beyond the catchment range of the main residence. This distinction is especially relevant to the exploitation of distant resource patches situated deep in the interior woodlands. Instead of moving the entire residential group to the resource patch and setting up a new residential base, as nomadic foragers might do, collectors would dispatch specialized task groups to these locales. At these distant places, the task groups would set up *field camps*, overnight camps that served as the focal point for harvesting or processing a particular resource patch. These field camps might serve as the temporary bases of hunters pursuing mobile game, or of gathering parties harvesting a rich mast nut grove. The logistical movements of the task groups (see Binford 1980, 1982) would allow the collectors to harvest distant resources without moving the location of the main residential base. The task groups could transport the food back to the main residence, where it could either be consumed by family members and/or stored for use

during the winter months.

2) *Resource Distributions*. The spatial distribution of interior resources is an important factor in predicting the possible locations of procurement stations, field camps, and residential bases. Of course, the location of good hunting grounds and productive nut groves would vary seasonally and annually, depending upon local precipitation and temperature conditions as well as human and animal predation patterns. The resource distributions would also be influenced by topographic relief, in which slightly different combinations of nut and game resources might have been available on morainal and outwash deposits (Turano 1983).

If nomadic foragers erected residential bases in the interior, then a logical place to find them would be along the banks of kettle ponds or streams. These places would not only provide sources of fresh water, but also habitats for fish and natural water holes for game. A residential base established at such a location would allow food procurement parties to hunt deer and gather nuts over an interior catchment range that would include, given their close proximity, both morainal and outwash resources. In the nearby vicinity of the interior bases, we should also find non-site manifestations and procurement stations used to exploit outlying nut groves or hunting grounds.

A sedentary collector's strategy would provide more flexibility in selecting the location of field camps. Since water could be carried by the task groups, there may have been little need to set up the camps along interior water sources—unless the specific task involved harvesting anadromous or freshwater fish. One might expect to find these camps wherever good hunting grounds or nut groves were found in the interior.

3) *The Spatial Configuration of Long Island*. Diachronic changes in the shape of Long Island over the millennia since the withdrawal of the Laurentian ice sheet would have influenced the spatial patterning of archaeological remains. Sea level oscillations have altered the dimensions of the island, significantly increasing or reducing the land mass of the island depending upon the magnitude of sea level rise or fall. Currently, there is no clear consensus about the rate of sea level change in coastal New York, although several models have been proposed for the region (Bloom and Stuiver 1963; Stuiver and Daddario 1963; Edwards and Emory 1977; Newman 1977:565). However, most studies agree that the modern coastline did not begin to take shape until the Woodland period, about two or three thousand years ago. Prior to this time it appears that the shallow continental shelf of Long Island was exposed, providing a much greater land mass for prehistoric exploitation and settlement.

Settlement studies of Long Island should consider how changes in the overall land mass influenced the location of prehistoric sites. During much of the prehistoric period (Paleo-Indian, Archaic, Transitional) the potential existed for coastal sites to be situated many kilometers from interior places (see Edwards and Emory 1977:247). Settlement options might have been implemented that were geared toward the exploitation of a relatively large land mass, and these options might have involved the establishment of numerous interior residential bases, procurement stations and field camps. Sea level rise and the subsequent inundation of the shallow continental shelf surrounding Long Island would not only have drowned early coastal settlements but some of these interior sites as well.

With the formation of Long Island's modern coastline during the Woodland period, the kinds of settlement options available to local groups might actually have been reduced. The establishment of the north and south forks and small islands (Plum, Robins, Shelter, and Gardiners) of eastern Long Island provided a very limited area for prehistoric exploitation. Similarly, the spatial reduction of western and central Long Island curtailed the ranges over which hunter-gatherers could exploit deer, mast nuts, and other interior resources.

SETTLEMENT EXPECTATIONS FOR WOODLAND PERIOD LONG ISLAND

We predict that few interior residential bases or special-purpose camps of Woodland age will be found on the north or south forks or on the islands of eastern Suffolk County. This prediction is based on the compact nature of the area. A coastal residential base established on one of the forks or small islands would have included within its catchment range the full complement of interior resources from that particular fork or island. In other words, the coastal base would have been close enough to any interior place to allow procurement parties to walk easily back and forth in a day's time. Given the close spatial proximity of the coastal strip and interior, there would have been little need to establish secondary residential bases or overnight field camps. The archaeological remains of the non-coastal areas of eastern Long Island should therefore consist primarily of procurement stations and non-site manifestations produced by food procurement parties working from coastal bases. Fig. 1 illustrates the proposed Woodland settlement distribution of eastern Long Island, using Shelter Island as an example.

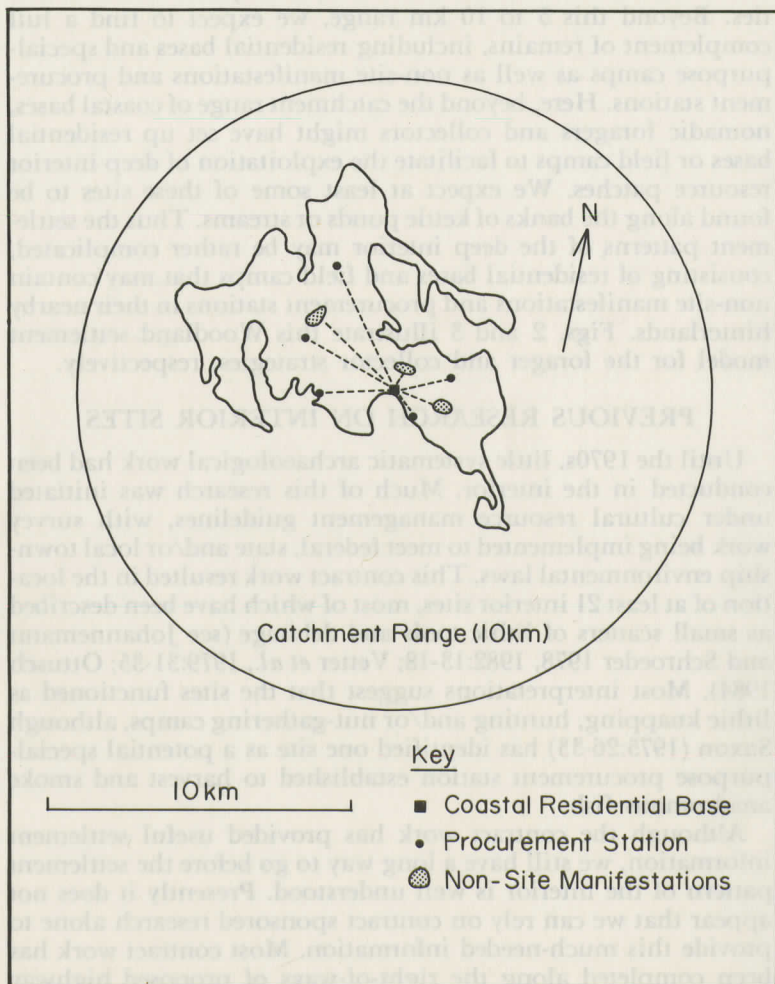


Figure 1. Woodland period settlement model of eastern Long Island (Shelter Island).

In contrast, we expect the interior of central and western Long Island (Kings, Queens, Nassau, and western Suffolk counties) to contain a diverse range of Woodland age archaeological remains. Within a five to ten km range of coastal residential bases, we expect to find primarily non-site manifestations and procurement stations that resulted from daily food procurement activities. Beyond this 5 to 10 km range, we expect to find a full complement of remains, including residential bases and special-purpose camps as well as non-site manifestations and procurement stations. Here, beyond the catchment range of coastal bases, nomadic foragers and collectors might have set up residential bases or field camps to facilitate the exploitation of deep interior resource patches. We expect at least some of these sites to be found along the banks of kettle ponds or streams. Thus the settlement patterns of the deep interior may be rather complicated, consisting of residential bases and field camps that may contain non-site manifestations and procurement stations in their nearby hinterlands. Figs. 2 and 3 illustrate this Woodland settlement model for the forager and collector strategies, respectively.

PREVIOUS RESEARCH ON INTERIOR SITES

Until the 1970s, little systematic archaeological work had been conducted in the interior. Much of this research was initiated under cultural resource management guidelines, with survey work being implemented to meet federal, state and/or local township environmental laws. This contract work resulted in the location of at least 21 interior sites, most of which have been described as small scatters of lithic tools and debitage (see Johannemann and Schroeder 1978, 1982:13-18; Vetter *et al.*, 1979:31-35; Ottusch 1984). Most interpretations suggest that the sites functioned as lithic knapping, hunting and/or nut-gathering camps, although Saxon (1975:26-33) has identified one site as a potential special-purpose procurement station established to harvest and smoke anadromous fish.

Although the contract work has provided useful settlement information, we still have a long way to go before the settlement pattern of the interior is well understood. Presently it does not appear that we can rely on contract sponsored research alone to provide this much-needed information. Most contract work has been completed along the right-of-ways of proposed highway modification and transmission lines, and thus the surveys have been relegated to narrow, linear transects of the interior. As a consequence, broad survey coverage, which is necessary to study the hinterland of interior sites and to define local community patterns, has not yet been accomplished.

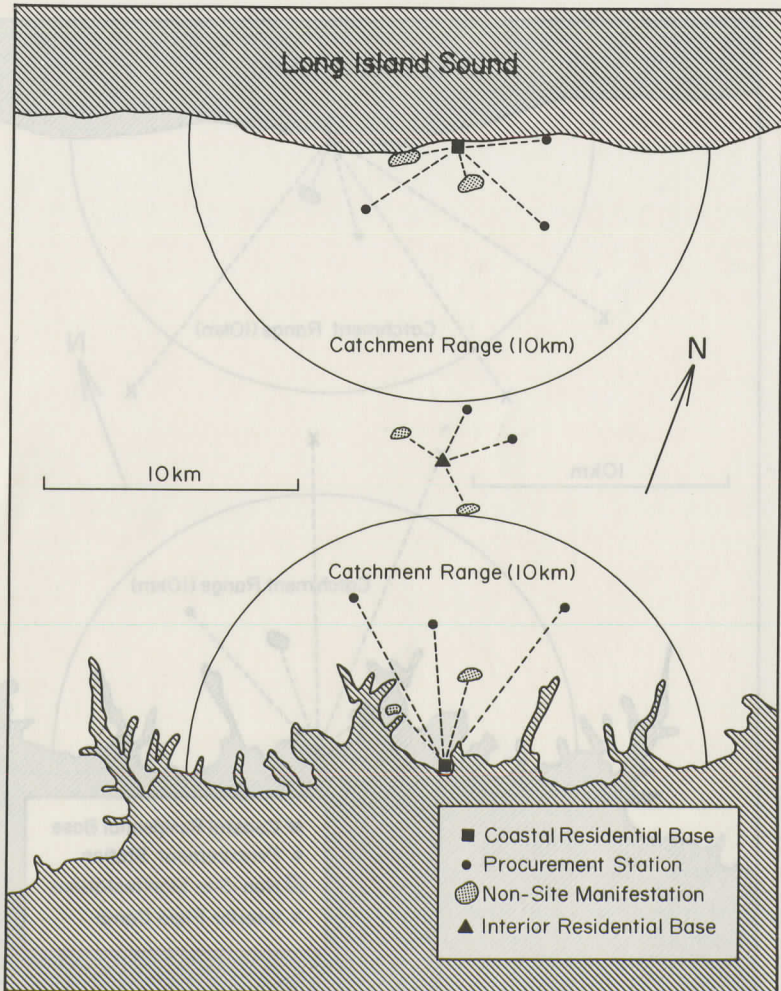


Figure 2. Woodland period settlement model of western and central Long Island (forager pattern).

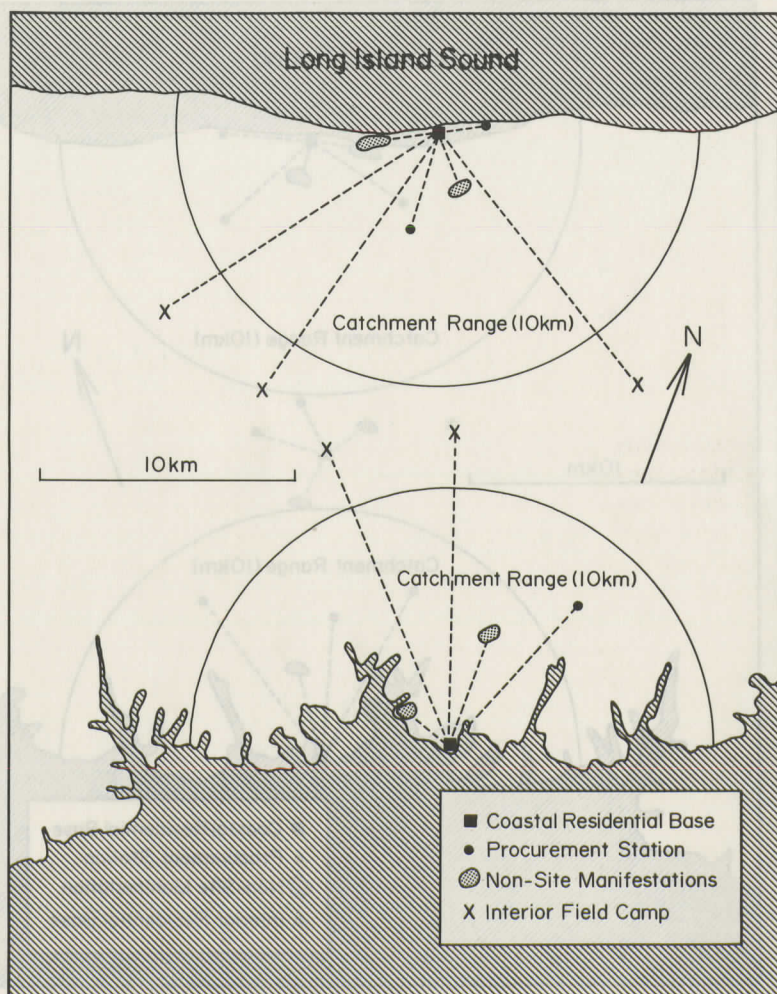


Figure 3. Woodland period settlement model of western and central Long Island (collector pattern).

THE SARNOFF PROPERTY SURVEY

To augment our understanding of interior sites and to collect the data necessary to evaluate our settlement model, a team of archaeologists from SUNY Stony Brook, Suffolk County Community College, and Queens College (CUNY) initiated fieldwork in a large study area of west-central Suffolk County. The study area includes the former RCA property, now designated the Sarnoff Property, and an adjacent parcel of Brookhaven Town Nature Study tract (see Fig. 4). The study area encompasses about 2510 hectares located just south of the Harbor Hill moraine on a glacial outwash plain that dips gently to the south. The northeast and southern edges of the study area are pockmarked with multiple, deep kettle holes, some containing seasonal or perennial sources of water. Today the area is mostly wooded, and characterized by both oak-dominated and pine-dominated plant communities.

The Sarnoff Property represents an ideal area to test and refine our settlement model. We expect to find a variety of archaeological remains for two reasons. First, the study area is characterized by considerable topographic relief, including morainal hills, outwash plains, and numerous kettle hole depressions. Second, the northern section of the property is not far from known coastal archaeological sites. It is about 8.5 km west of the Wading River estuary, where Wyatt (1977) and Ritchie (1959) excavated several shell middens, and about 6 km east of Mt. Sinai Harbor, where Pipestave hollow (Gwynne 1982) and other sites are located. Yet the southern boundary of the property, situated about 10 to 12 km from the north shore estuaries, is probably beyond the presumed catchment ranges of these coastal sites. Thus the Sarnoff Property provides us with a unique opportunity to examine the kinds and spatial distributions of sites found within and beyond the presumed catchment radii of late prehistoric coastal sites. Given our proposed settlement model for western and central Long Island (Figs. 2 and 3), we predict that a north/south continuum of archaeological remains will be found across the property, with non-site manifestations and procurement stations found primarily in the northern section and residential bases, field camps, procurement stations, and non-site manifestations found in the south.

A two-phase survey program was implemented during the summers of 1983 and 1984. Phase I consisted of walking exposed roads and firebreaks and collecting and plotting locations of surface artifacts (Kalin 1983). In Phase II, a grid system of ten hectare blocks was laid out on a topographic map of the study area. A

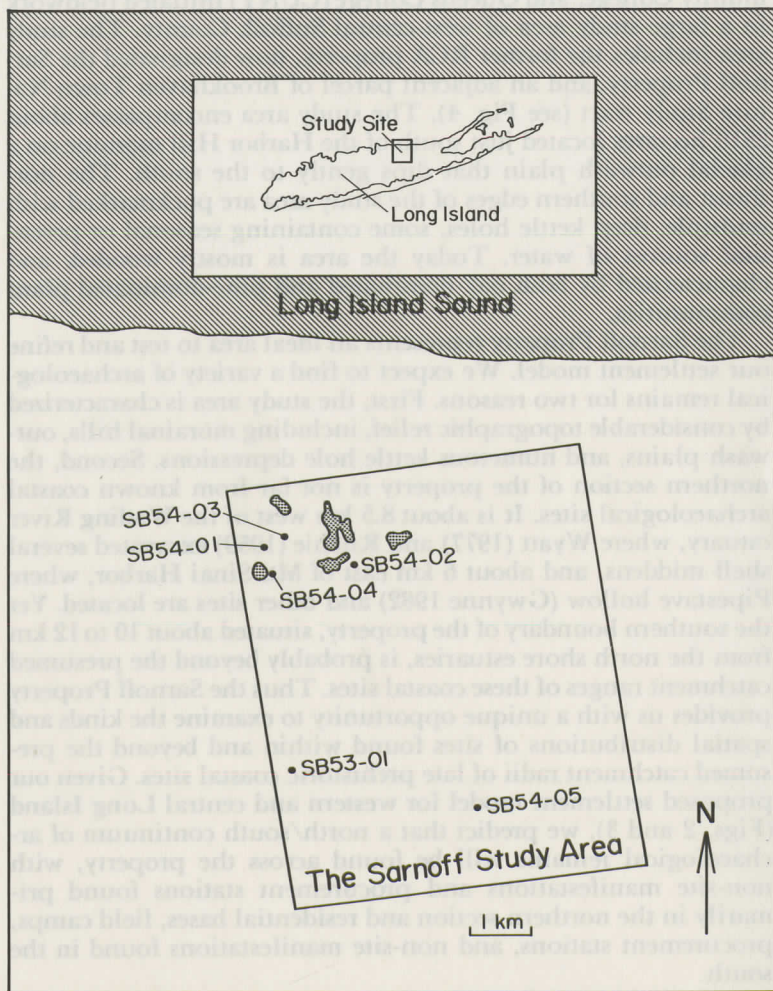


Figure 4. Map of the Sarnoff property, west-central Suffolk County, Long Island.

random sample design was then employed to select blocks for survey. For each one selected, a randomly oriented transect was walked across the survey block, each 316 meters long and 40 to 50 meters wide. Shovel probes were excavated at ten-meter intervals by crew members spaced ten meters apart along the transect. To aid in the detection of artifactual material, soil was screened through a .6 cm wire mesh screen. [For a more detailed description of the survey methodology, see Lightfoot (in press).]

Only a limited number of transects, representing about a 1% sample of the ten hectare blocks, have been surveyed to date. Although rather preliminary, the data collected in both Phase I and II indicate a variety of archaeological remains found in this inland area. The following is a brief description of the remains detected to date. These remains consist of two non-site manifestations, two procurement stations, a possible field camp, and one potential residential base.

SB54-01: This location consists of a very sparse scatter of projectile points, flakes and ovoid bifaces scattered over a 1.6 hectare area. The non-site manifestation is situated on high ground, about 40 m above sea level, between two dry kettle holes on the glacial outwash plain approximately 3.4 km south of the north shore (see Fig. 4). The local hinterland consists of six dry glacial kettles that form a general circular pattern around a central kettle. The kettles, dispersed over a circular area of 1.5 km in diameter, vary in depth from about 16 to 25 m below the present ground surface. On the high ground separating the central kettle and the deeper western kettle, a total of nine projectile points, consisting primarily of Wading River and Levanna types, have been recovered. The non-site manifestation appears to have resulted from Late Archaic and Woodland hunting forays near the kettle holes.

SB54-02: This location consists of a small scatter of lithic remains found southeast of the broadly defined circle of kettles described above (Fig. 4). We collected several primary and tertiary decortication flakes, a fragment of a Wading River point, a cobble core, and a bifacially worked knife. The projectile point suggests a Late Archaic date. The artifacts indicate that lithic manufacture and possible butchering activities occurred at this place, which probably represents a procurement station (or brief overnight encampment) where one or more hunting parties produced sharp-edged flakes and bifacial knives that could then have been used to skin and butcher game.

SB54-03: North of the central kettle described above is a shallow basin, 65 cm wide and 25 cm deep, which has been filled

with cores, flakes, and shatter of milky quartz, crystal quartz, and quartzite. The feature was naturally exposed and sectioned by the headward erosion of extensive gullies that formed along the steep-edged rim of the kettle. The location appears to represent a procurement station where quartz and quartzite cobbles were extracted and reduced to usable flakes.

SB54-04: The location consists of a sparse scatter of flakes and projectile points found on the eastern slope of a deep kettle hole. The area is only 400 meters south of *SB54-03* (Fig. 4). Here both Wading River and Brewerton Side Notched points were recovered. Similar to *SB54-01*, the location appears to be part of a low-density non-site manifestation produced by hunting parties pursuing game near the kettle holes.

SB54-05: In the southern section of the Sarnoff Property, about 6 or 7 km south of the north shore beaches, a scatter of flakes, cobble cores, and fire-cracked rocks is found along the east edge of a small, unnamed pond (Fig. 4). The pond, roughly 100 meters long and 60 meters wide, is an elongated depression that was once part of a glacial outwash channel. Future fieldwork is needed to clarify the function of the site, but it appears to be some form of field camp or procurement station. The substantial evidence of fire-cracked rock hints that food processing or cooking activities took place at the site.

SB53-01: The majority of our research efforts to date have been devoted to this large site found on the southern boundary of the study area (Fig. 4). The site is situated on the southern edge of a kettle pond that contains water year-round, and between two low hills of glacial drift. Subsurface testing indicated that prehistoric artifacts cover a 1.3 hectare area, buried (for the most part) under 12 to 30 cm of light grey sand. The site has been impacted by a firebreak bulldozed along the western edge, and by artifact collectors who have produced numerous depressions from their digging activities. Much of the digging occurred in the central section of the site, and here artifacts have been brought up to the surface and deposited over a .2 hectare area.

The investigation of the site during the 1984 field season involved the preparation of a topographic map and the systematic collection of surface artifacts. Four- by four-meter squares were laid out across the central section, and within each square artifacts were collected. Topographic features, such as "pothunter" holes and backdirt piles, were mapped within each square as well. Field crews collected and mapped a total of 38 squares or about a .06 hectare area of the site during the 1984 season.

The artifacts collected were analyzed at the archaeological lab-

oratories at SUNY/Stony Brook, to identify the range of artifact forms and to determine the kinds of activities that might have been conducted at the site. All chipped stone materials, which comprised the bulk of the artifact assemblage, were measured, weighed, identified by raw material type, and examined under a binocular dissecting microscope for evidence of use wear at magnifications of 15 to 70 diameters.

A relatively diverse range of artifacts (n=2044) was studied, including flakes, shatter, projectile points, cores, hammerstones, pottery, a substantial quantity of fire-cracked rock, and small chunks of marine shell. The counts and proveniences of the artifacts are presented in Table 1.

Chipped Stone Artifacts: Most artifacts appear to be workshop debris resulting from the reduction of quartz and quartzite cobbles into usable chipped stone tools. The unutilized flakes (n=1796) and shatter (n=79) make up almost 92% of the entire surface assemblage. Most of the flakes were produced from milky quartz (44%), variegated quartz (34%), and crystal quartz (9%), followed by smaller quantities of smokey quartz, rose quartz, citrine quartz, quartzite, granite, and chalcedony. A few pieces of non-local flints and cherts were also recovered. In addition to the unutilized flakes, 16 cores and 5 hammerstones were identified.

To define the different stages of core reduction represented at the site, three categories of unutilized flakes were defined. The first, primary decortication flakes, contains those flakes initially removed from the outside of a core; the dorsal side of the flake contains little or no evidence of flake scars and a high percentage of cortex material (90-100%). The second category, secondary decortication flakes, was defined by a dorsal surface exhibiting one or two flake scars and approximately 30 to 90% cortex material. The third category, tertiary decortication flakes, consists of lithic pieces showing multiple scars and little or no (0-30%) cortex on the dorsal side. Shatter was defined by the absence of attributes characteristic of flakes (*i.e.*, striking platforms, bulbs of percussion, etc.) Interestingly, more than 63% (n=1142) of the unutilized flakes were tertiary flakes, and only 9% (n=164) exhibited the characteristics of primary flakes. This observation, in conjunction with the relatively small number of cores and hammerstones, suggests that the initial reduction of cores might have been performed elsewhere. This interpretation is supported by the size of the tertiary flakes. About 28% (n=322) of the flakes were less than 10 mm along their longest dimension. Another 56% of the tertiary flakes (n=640) measured between 10 and 20 mm, and 15% (n=167) were between 20 and 30 mm. Only 1% (n=13) were greater than 30 mm in size. The small-sized flakes suggest that much of the lithic

Table 1: Artifacts Recovered from the Surface Collection of SB53-01

Collection Units	Flakes			Projec.			Fire-			Ham.		
	Prim.	Sec.	Tert.	Shatter	Cores	Points	Knives	Scrap.	Chop.	Rocks	stones	Pottery
8N 0E	0	0	0	0	0	1	0	0	0	0	0	1
8N 8E	0	4	1	0	0	1	0	1	0	0	0	7
4N 16W	7	14	29	0	0	1	0	0	0	0	1	52
4N 12W	11	47	74	0	2	1	0	0	0	12	2	149
4N 8W	5	24	52	1	0	2	1	0	0	4	0	89
4N 8E	1	14	15	0	0	0	2	0	0	1	0	33
ON 24W	7	18	29	0	1	1	0	0	0	2	0	58
ON 20W	13	6	21	2	1	2	4	0	0	0	0	49
ON 12W	4	21	36	0	0	0	0	2	0	5	0	68
ON 8W	0	2	15	0	0	0	0	0	0	0	0	17
ON 4W	0	22	13	0	0	2	0	1	0	1	0	39
ON 0E	16	20	116	13	2	1	1	0	0	3	0	173
ON 4E	0	2	2	0	0	0	0	0	0	0	0	4
ON 8E	14	17	14	15	1	0	0	0	0	1	0	62
ON 12E	2	7	26	3	0	0	0	0	0	0	0	38
4S 12W	1	8	10	1	1	0	0	0	0	8	0	29
4S 8W	0	13	20	0	0	0	0	0	0	0	0	33
4S 4W	3	7	34	0	2	0	0	0	0	3	0	49
4S 0E	3	6	17	0	0	0	0	1	0	5	0	32

4S 4E	4	5	22	2	0	0	0	0	0	0	0	33	
4S 8E	0	5	12	0	0	0	0	0	0	0	0	17	
4S 12E	0	4	5	1	0	0	0	0	0	0	0	10	
8S 8W	24	91	255	0	0	1	2	6	1	0	2	382	
8S 0E	2	3	10	4	1	0	0	0	1	0	0	22	
8S 4E	5	0	14	23	0	0	0	0	0	0	0	42	
8S 8E	8	21	43	0	1	4	1	0	0	9	0	87	
8S 12E	0	4	4	0	0	0	0	0	0	0	0	8	
12S 4W	0	6	9	0	0	0	0	0	0	1	0	16	
12S 0E	4	13	41	1	0	0	1	5	0	2	1	68	
12S 4E	4	2	13	5	0	0	0	0	0	8	0	32	
12S 8E	0	4	19	0	0	1	0	0	0	1	0	25	
12S 12E	12	31	65	0	1	0	1	3	0	2	0	115	
16S 8W	2	4	12	0	0	0	0	0	1	4	0	23	
16S 4W	2	4	18	0	0	0	1	1	0	1	0	27	
16S 4E	0	8	20	0	0	0	0	0	0	0	0	28	
16S 8E	3	5	28	7	0	0	0	0	0	1	0	44	
16S 12E	0	5	2	0	2	0	0	1	0	1	0	11	
20S 8W	7	23	26	1	1	0	0	0	0	13	0	72	
Total	164	490	1142	79	16	18	14	21	3	88	5	4	2044

production might have involved tool maintenance tasks, such as resharpening tools by secondary retouch. Other activities might have included the manufacture of chipped stone tools into their final shape.

A total of 38 flakes exhibited use wear patterns under the microscope. Of these, 14 (37%) were acute-edged (edge angle 30° or less) tools suitable for slicing and cutting activities (Wilmsen 1972:202). We defined these as knives. Twenty-one (55%) have moderate edges, ranging from 31° to 48° , possibly used for skinning and hide scraping tasks (Wilmsen 1972:202). We defined these tools as scrapers. Three of the flakes exhibited obtuse-edged angles (58° to 60°), suitable for performing heavy-duty chopping activities (Wilmsen 1972:202). These tools were placed in the chopper category. Other chipped stone tools included 18 projectile points manufactured mostly from milky and variegated quartz. Only 13 points were complete enough to identify. Most ($n=12$) were classified as Levanna points, a Middle/Late Woodland triangular point commonly found on Long Island. One Late Archaic point, a Brewerton Side Notched, was also identified. Finally, two worked cobble stones were recovered during the surface collection.

Ground Stone, Bone, Pottery, etc.: With the exception of fire-cracked rocks, of which 88 pieces were identified, few other artifacts were recovered from the surface collection units. These other artifacts include four pieces of pottery and two pestles found during a surface reconnaissance in the spring of 1985. The pottery is sand-tempered, ranges in color from tan to orange, and is characterized by a smoothed interior and incised exterior. The surfaces of the sherds are eroded to the point of blurring the geometric pattern of the incising. No bone artifacts were recovered, which was expected since surface conditions do not normally preserve organic materials for any length of time.

Two interpretations have resulted from our investigation. First, the site appears to date to the Middle/Late Woodland period, although earlier occupation episodes may also be represented. Second, it appears that the inhabitants of the site performed a variety of activities. These activities included tool maintenance and manufacture, hunting (projectile points), butchering (knives, scrapers), plant processing (pestles, choppers), and cooking (fire-cracked rocks, pottery). The range of activities suggests that the site might have been established as a residential base where family members resided and performed domestic, subsistence, and tool maintenance tasks.

To evaluate the residential base interpretation, diversity indexes were calculated for the site's tool assemblage. In a previous

study of Long Island shell middens, the senior author attempted to differentiate special-purpose shellfish procurement stations from residential bases. The analysis was based on the proportion of shellfish species, the presence of architectural features, and the calculation of diversity indexes (see Lightfoot 1985). The latter were computed as follows (after Whittlesey and Reid 1983):

$$J = \frac{H}{H \text{ max}} \quad \text{Where: } H = \frac{n (\log n) - \sum f_i (\log f_i)}{n}$$

$$H \text{ max} = \log K$$

n = sample size

f_i = number of observations in artifact class

K = number of artifact classes

The diversity index ranges from 0 to 1, with 0 representing the least diverse or most limited artifact assemblage and 1 representing the most diverse or varied artifact assemblage. Two categories of artifacts were included in the study: *chipped stone artifacts* (8 artifact classes: projectile points, knives, scrapers, choppers, utilized flakes, perforators, worked cobbles, and fish sinkers), and *ground stone, bone, and ceramic artifacts* (8 artifact classes: mano/pestle/mortar, axe/celt/gouge/adze, paintstones, antler tines/spikes, awls, pendants/pipes, steatites/ceramic vessels, other (bannerstones/abraders/hoes).

The study of the nine shell middens suggested that procurement stations were characterized by few architectural features, by one primary specie of shellfish, and by a low density index ranging from .06 to .15. The limited range of tools was apparently used to extract meat from shellfish valves. Within this group of sites, Muskeeta Cove A was more ambiguous in its function, being characterized by few architectural features, a limited range of shellfish species, and moderate diversity indexes ($J=.42$). This site was also interpreted as a shellfish procurement/processing station. The residential bases, on the other hand, were characterized by various architectural features, including post-molds, hearths, and pits; a mix of different shellfish species; and relatively high diversity indexes, ranging from .47 to .67. The artifact assemblages suggested that woodworking, hunting, butchering, lithic production, cooking and sewing activities occurred at these base camps (see Lightfoot 1985:314-19).

In comparison to the midden sites, the interior site (SB53-01) produced a *chipped stone* J score of .63 and a *ground stone, bone, and ceramic* J score of .37. The latter category was calculated without including the bone artifact classes, since we expected that few organic artifacts would be preserved on the surface of the site. The average J score of SB53-01 was .5, a value that falls within the lower range of the residential bases.

However, one must view the residential base interpretation with caution, for three reasons. First, while the analysis of the midden sites was based on excavated data, our investigation of SB53-01 includes only surface material at this time. Since some of the more exotic materials might have been selectively collected from the site prior to our investigation, the surface collection might not provide a truly representative sample of the interior site's artifact assemblage. As a consequence, the diversity indexes calculated for SB53-01 might be undervalued. Second, the temporal and spatial parameters of the site are not well defined as yet. The kettle pond location might have been repeatedly used by hunter-gatherer groups over several hundred years, and such an occupation history could have produced a complex mix of artifacts dating to different occupation episodes. This could lead to an over-inflated J score. Finally, functional interpretations should take into account other archaeological data, such as architectural features, faunal and floral remains, etc. Thus, until a full-scale excavation of the site is completed, one must view the residential base interpretation as tentative.

CONCLUSION

This paper has made two major points: that the interior of Long Island, especially during the late prehistoric and contact periods, could have provided a variety of foodstuffs for hunter-gatherers, and that a diverse range of archaeological remains should be found in the inland region. We outlined a settlement model for the Woodland period that employed the distance from coastal residential bases as an important factor in predicting the function and spatial distribution of interior sites. Within the presumed catchment range of coastal bases, a distance of 5 to 10 km, we expect to find primarily non-site manifestations and procurement stations. Beyond the catchment range of coastal bases, deep in Long Island's interior, we expect to find the greatest range of archaeological remains, such as residential bases, field camps, procurement stations, and non-site manifestations. Furthermore, we expect that at least some of these sites will be found on the banks of streams and kettle ponds.

Although a full evaluation of the settlement model is still

forthcoming, preliminary investigations at the Sarnoff Property suggest that it has some merit. Most of the archaeological remains discovered to date in the northern section of the study area, well within the catchment range of coastal sites at Mt. Sinai Harbor and the Wading River estuary, appear to be either non-site manifestations (SB54-01, SB54-04), lithic procurement stations (SB54-03), and/or butchering stations (SB54-02). The archaeological remains indicate that this section of the property was used periodically by hunting parties pursuing game near the kettle holes.

The southern section of the property, situated just outside the catchment range of coastal bases, contains more substantial sites. Here a field camp and/or procurement station (SB54-05) has been found adjacent to a small pond. Not far away is a large scatter of artifacts that may represent the remains of an interior residential base (SB54-01). The latter site contains a variety of artifacts, relating to lithic manufacture and tool maintenance, hunting, butchering, vegetable processing, and cooking activities, scattered over at least a 1.3 hectare area.

We recognize that further fieldwork is needed to evaluate our settlement model and to refine the functional interpretations outlined above for the seven archaeological manifestations. Future field seasons will be spent surveying additional transects (Phase II) in the northern and southern sections of the property. In addition, excavation will be initiated at a sample of the sites to evaluate whether they served as bulk harvesting loci, field camps, or residential bases. A major focus of our research will be the excavation of SB53-01. If the site did serve as a residential base, then we expect to find evidence of house structures, pits, hearths, etc. In addition, the temporal and spatial parameters of the site need to be outlined in detail. Finally, we hope to define the season(s) of occupation by collecting and analyzing faunal and ethnobotanical remains.

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