The Prehistoric Settlement Pattern of Nevis, West Indies

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This paper reports the results of an intensive settlement survey of Nevis, a volcanic island of 132 sq km in the Leeward Islands of the Lesser Antilles. Twenty-one sites were discovered from three major periods—the aceramic in the last millennium B.C., *the Saladoid in the first 600 years* A.C., *and the Ostionoid period dating from 600* A.C. *until European contact. The implications of the distribution of settlements and their artifact assemblages for the prehistory of the Leeward Islands are discussed.*

Introduction

This paper presents the results of three seasons of archaeological research on the settlement history of Nevis, a small member of the Leeward Islands of the Lesser Antilles (FIG. 1). The data reported here are from the settlement survey of the island, surface collections from the 21 sites located, and test excavations undertaken at 4 sites. The paper focuses on the history of prehistoric settlement on Nevis and on the implications of these data for the regional settlement history and prehistoric population dynamics of the Leeward Islands. In particular, the possibility of a period of rapid population growth in the last half of the 1st millennium A.C. is discussed, and the settlement history of Nevis is considered with special reference to that question.

The research on the island of Nevis is part of an ongoing project to expand our understanding of the prehistoric settlement history of the Leeward Islands. This small region (FIG. 2), lying between the large islands of the Greater Antilles (Puerto Rico, Hispaniola, Jamaica, and Cuba) and the N–S trending chain of the Windward Islands (from Guadeloupe south to Grenada) is important to our understanding of Caribbean prehistory both geographically and conceptually. Although the research presented here is confined in scope and preliminary in nature, it is intended as a contribution to a growing body of information about the Leeward Island region (Armstrong 1978; Davis 1974, 1982; Goodwin 1979, in press; Hoffman 1973, 1979; Josselin de Jong 1947; Nicholson 1976a, 1976b, 1983; Rouse 1976; Versteeg 1987; Watters 1980; Wilson 1985).

Nevis and the Leeward Islands

The arc of islands known as the Lesser Antilles stretches from Venezuela on the South American mainland to Puerto Rico, the easternmost of the Greater Antilles. The Lesser Antilles can be subdivided into groups on the basis of several criteria; geologically, they comprise four major units. Trinidad, Tobago, and Barbados, near the Venezuelan coast, are extensions of the mainland land mass. On the NW end of the island chain, the Virgin Islands are extensions of the fault block mountains of Puerto Rico and the rest of the Greater Antilles. The main part of the Lesser Antillean archipelago is divided into two parallel arcs, the inner (SW) one consisting of primarily volcanic islands, and the outer (NE) of uplifted sedimentary formations. The sedimentary and igneous arcs are the edges of a subduction zone into which the expanding Atlantic plate is being forced beneath the relatively immobile Caribbean plate. This tectonic dynamism accounts for the volcanism along this plate boundary (Blume 1974).

Another subclassification of the Lesser Antilles—divided into the Windward and Leeward islands—is based partly on geographical and partly on historical criteria. The Windwards trend N–S from Trinidad to Guadeloupe. The Leewards, in this traditional division dating to the British Colonial period, begin above Guadeloupe and angle to the NW. Most of the Windward Islands are relatively large and together total more than 12,000 sq km. The Leeward Islands are generally smaller, totalling only ca. 2000 sq km (Blume 1974).

From Nevis' shores one can see the other islands in the volcanic chain of the Leeward Islands: Saba, St. Eustatius, and St. Kitts to the NW and Redonda and Montserrat to the SE. To the east, one can just see the low outline of Antigua, but the other major sedimentary islands in the arc to the north—Barbuda, St. Barthélemy, St. Martin, and Anguilla—are below the horizon.

Two hundred years of plantation sugar cultivation (which virtually ended on Nevis before the middle of this century) resulted in extreme damage to the island's ecosystem, both onshore and off (Hall 1971; Pulsipher 1977). Clearing and cultivating sugar on the coastal plains caused devastating erosion on most of the island's cultivable area, and especially on the island's windward (SE) coast. As a result, historical populations have moved higher up the slopes, and capture nearly all of the runoff from Nevis Peak to obtain water for irrigation and drinking (ECNAMP 1980). Free-grazing goats, sheep, cattle, and pigs have ravaged the vegetation that would otherwise help to stem wind and water erosion. The nearly total erosion of large areas of topsoil, coupled with the change in island hydrology, has reduced the supply of runoff nutrients to Nevis' windward reefs. Approximately 80% of the windward reefs are no longer active. The breakup of the fringing reef has itself contributed to extensive and accelerating coastal erosion on the windward coast of the island, where sea cliffs of unconsolidated volcanic gravels as high as 25 m have developed.

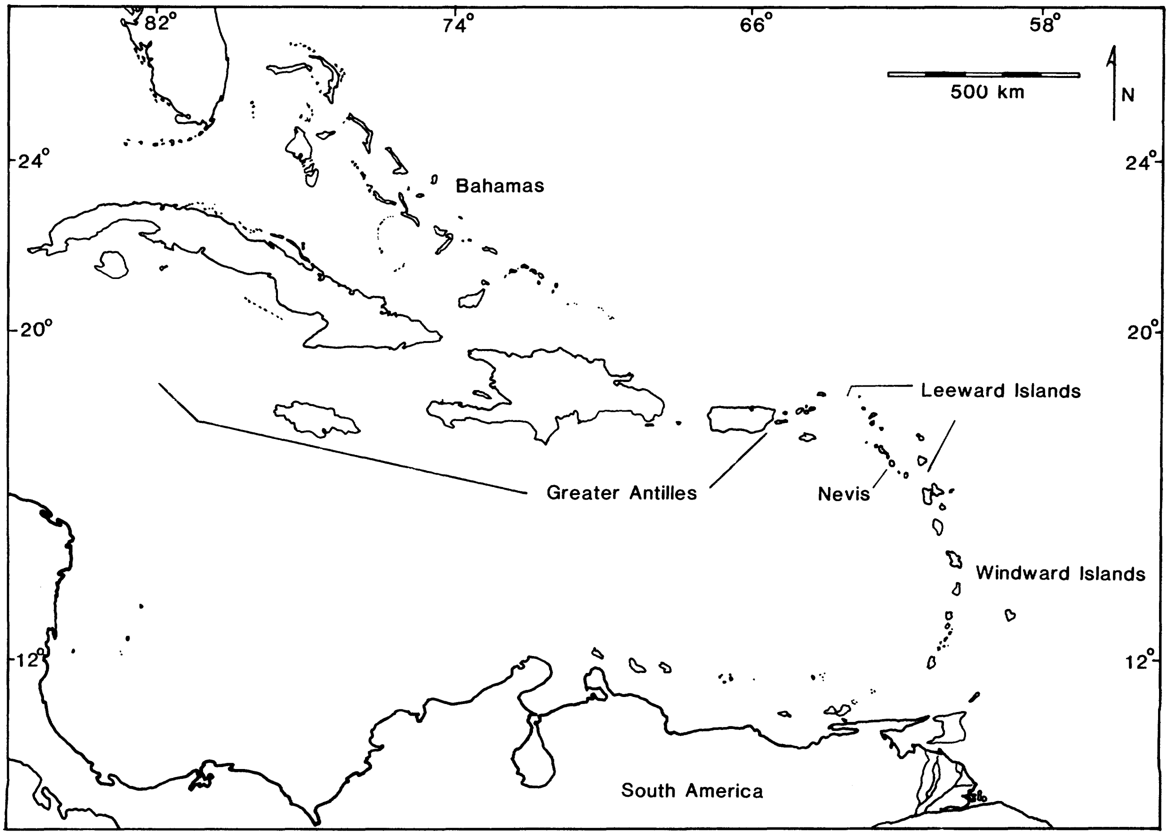
On the leeward, western coast of the island more favorable conditions have allowed more stable beach development. Ongoing beach formation processes and hurricanes build and rebuild beach ridges and lagoons, recycling the shifting sands. With the decreasing economic viability of sugar cultivation, some of the lagoons have been drained or filled for cocoanut cultivation, reducing the leeward coast's ability to absorb the impact of hurricanes (Butzer 1976: 222–242).

The upper portion of Nevis Peak receives more than 2500 mm of rain a year ("Nevis" is anglicized from Columbus' name for the island, *Nuestra Señora de las Nieves*, based on the nearly-constant veil of snow-like clouds on its summit).[1] The windward coast now receives less than 1000 mm of rainfall annually (ECNAMP 1980: map 2). On average, rainfall is lowest in February, March, and April, but periods of drought or heavy rain can occur at any time of year.

Temperatures are relatively constant year-round. August, September, and October (hurricane season) have the highest average temperature of 29° C (84.2° F), and January has the lowest at 27° C (80.6° F) (Blume 1974: 21).

1. There is some question as to which of the Leeward Islands Columbus named for its crown of clouds but it was upon Nevis that the name finally stuck.

Figure 1. Map of the islands of the Caribbean.



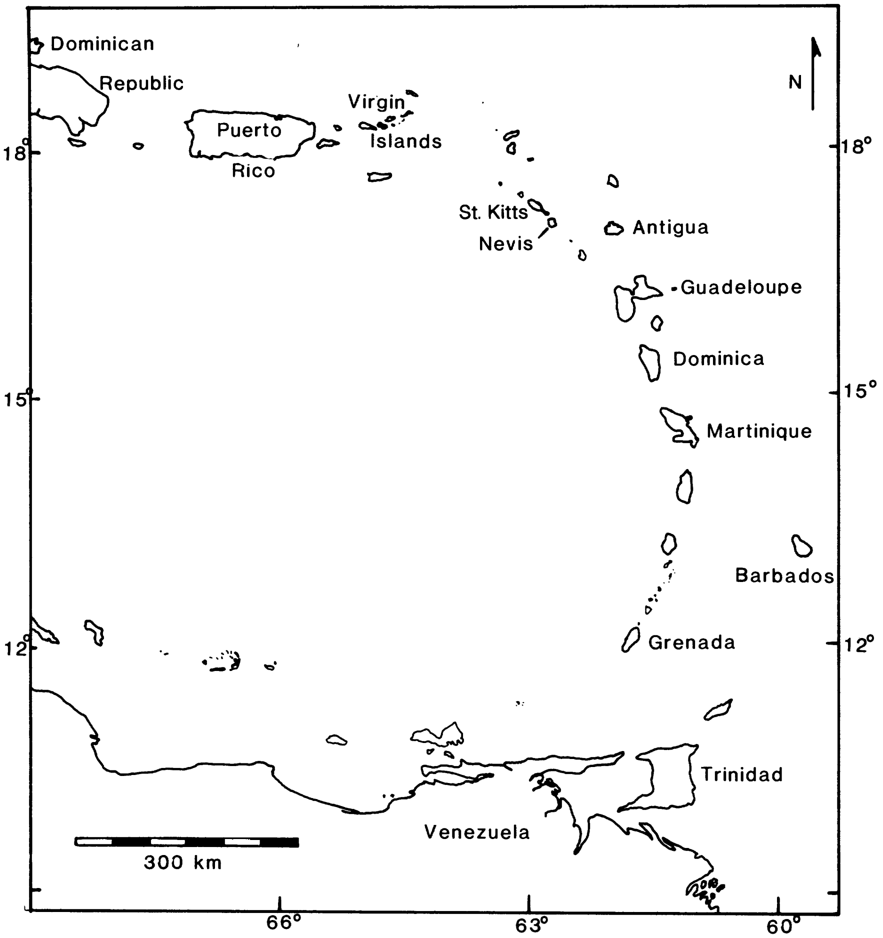


Figure 2. Map of the Lesser Antilles and Puerto Rico.

The intensive cultivation of sugar has transformed the vegetation of the Leeward Islands to such an extent that it is difficult to reconstruct the precolonial flora with accuracy (Beard 1949; Goodwin 1979: 30–50). The effects of altitude and the corresponding variations in rainfall and temperature would have produced a series of tropical forest types that were stratified vertically (Beard 1949; Pulsipher 1977). The coast and lower slopes of the cone would have been covered with dry-evergreen forests, probably consisting of various pines (*Tabebuia* sp., *Pisononia* sp.) and deciduous trees (*Lonchocarpus* sp.). The higher slopes and peaks were true rainforests dominated by gumlin (*Dacryodes excelsa*) and burrwood (*Sloanea* spp.), comprising what Beard (1949: 61) has called the *Dacryodes-Sloanea* association. The cabbage palm (*Euterpe globosa*) was an important element of this association; its heart was eaten either raw or boiled by the Island Caribs of the Lesser Antilles (Goodwin 1979: 38–39). Many other cultigens, some introduced to the region by humans, were eaten by the Precolumbian people of the Greater and Lesser Antilles, and included arrowroot, cocoanut, guayaba, papaya, and mamey apple (Rouse 1948: 523–524).

These plants, and probably others that are unidentified, complemented the protein-rich diet of seafoods and terrestrial animals. Land mammals are few in the Caribbean, but the hutia (*Geocapromys*) and Oryzomine rodents are common in later prehistoric deposits. The agouti (*Dasyprocta aguti*) was introduced from South America by aboriginal colonists (Wing in press). Iguanas (*Cyclura* and *Iguana*) were other important terrestrial species, along with *Gecarcinus* and *Cardisoma* land crabs. A variety of birds was exploited, although never in great numbers, including the families Columbidae, Laridae, Rallidae, Ardeidae, Podicipidae, and particularly the Procellariidae (Wing in press; Wing and Scudder 1983). Larger sea animals include the sea turtles, possibly the manatee (*Trichechus manatus*) (Wing, Ray, and Hoffman 1968), and the West Indian monk seal (*Monachus tropicalus*) (Goodwin 1979: 47; Elizabeth Wing, personal communication, 1989). An extremely diverse collection of shellfish, shallow and deep-reef fish, and pelagic fish also appears in the prehistoric diet of the Caribbean people (Steadman et al. 1984; Wing in press; Wing, Ray, and Hoffman 1968; Wing and Scudder 1983; Watters et al. 1984).

The Prehistoric Chronology of the Caribbean

From the past half-century of archaeological and linguistic research, a coherent working chronological framework has been established for the prehistory of the Caribbean (Allaire 1973; Bullen and Bullen 1976; Cruxent and Rouse 1969; Goodwin in press; Keegan 1985; McKusick 1960; Rouse 1985, 1986: 106–156; Rouse and Allaire 1978; Veloz and Vega 1982). The Caribbean archipelago appears to have been first colonized about 5000 B.C., when people moved into the islands of the Greater Antilles via the Lesser Antilles, or from Central America via the now-submerged mid-Caribbean islands that stretched between the eastern tip of Honduras and Nicaragua and the island of Jamaica (Keegan and Diamond 1987; Nicholson 1976c; Rouse and Allaire 1978: 465; Veloz and Vega 1982; Veloz Maggiolo and Ortega 1973). At present the latter route seems more likely; no archaeological evidence of these early immigrants, whose lithic tool kit is termed Casimiroid (Rouse 1986: 130, fig. 23), has been found in the Lesser Antilles, and there are similarities between Central American and Casimiroid stone tools (Coe 1957; R. Callaghan, personal communication, 1985).

The second migration into the Caribbean occurred ca. 3000 B.C. and has clear artifactual antecedents on the South American mainland. Like those of the Casimiran migration, these Ortoiroid people apparently did not practice horticulture. Their economy was principally oriented towards the collection of coastal and shallow-reef foods (Armstrong 1978; Davis 1982; Kozlowski 1978; Lundberg 1980; Rouse 1986), and their small settlements were usually located in proximity to these resources. The occurrence of adzes made of conch flares (*Strombus gigas*), ethnohistorically known to have been used in canoe manufacture, and the diverse origins of the chert used for their stone tools as well as the wide distribution of Ortoiroid sites in the Lesser Antilles, attest to their competence in ocean travel (Armstrong 1979; Keegan and Diamond 1987; Nicholson 1976c). It has been suggested that some (Nicholson 1983: 6) or all (Keegan 1985: 53; Keegan and Diamond 1987: 64) of the Lesser Antilles were abandoned about 1000 B.C., but the ^{14}C determination of 540 ± 60 b.c. (605 ± 190 B.C.) (recalibrated date, based on the consensual tables of Klein et al. [1982], are shown in parentheses for all dates) from the aceramic GE-6 site on Nevis (Hichmans' Shell Heap, discussed below) indicates that this conclusion may be premature.

In the last few centuries B.C., sedentary horticultural people moved into the Caribbean from the NE coast of South America. Their ceramics, including a distinctive decorative style of red and white painting, are of the Saladoid series. The Saladoid frontier moved through the Lesser Antilles rapidly to Puerto Rico, the easternmost of the Greater Antilles. The earliest radiocarbon dates available for Saladoid material are from St. Martin, where the Hope Estate site has produced dates of 325 ± 60 b.c. (360 ± 80 B.C.) and 300 ± 45 b.c. (293 ± 123 B.C.) (based on charcoal; Jay Haviser, personal communication, 1988). On Puerto Rico the earliest dates are 150 ± 80 b.c. (105 ± 290 B.C.) from El Convento, 110 ± 70 b.c. (163 ± 203 B.C.) from Hacienda Grande, and 110 ± 60 b.c. (163 ± 203 B.C.) from Maisabel (Rouse and Alegría in press). With the exception of the eastern end of Hispaniola (the Dominican Republic and Haiti), Puerto Rico was the northwestern-most extension of this migration for the next 500 years or more.

Artifacts representing aspects of the symbolic system recorded by Spanish explorers among the contact period Taíno Indians of the Greater Antilles were present in the earliest Saladoid settlements. One example is three-pointed, carved figurines: similar *zemi* or *cemí* artifacts represented the spirit helpers or supernatural allies of the contact period chiefs of the Greater Antilles (Arrom 1967, 1975; Chanlatte Baik 1985; Olsen 1974; Sued Badillo 1978; Wilson in press).

During the 1st millennium A.C. the societies of the Lesser Antilles, descended from the Saladoid colonizers, underwent changes that are not yet clearly understood. Food preferences as represented in archaeological faunal samples changed, perhaps as a result of overexploitation or technological innovation (Goodwin 1979, 1980; Keegan 1985; Wing and Scudder 1980, 1983). Decorative and formal aspects of ceramic assemblages changed as well, although at different times on different islands (Allaire 1973; Clerc 1968; Hoffman 1963, 1979; McKusick 1960; Rouse 1976; Rouse and Allaire 1978). On the basis of present evidence, house construction also changed (Versteeg 1987). Patterns of settlement locational preference appear to have changed as well (Bullen 1964; Goodwin 1979; Sleight 1962; Watters 1980). Population size clearly increased through the 1st millennium A.C., although the trajectory of that growth is still not clearly understood (Keegan 1985; Goodwin 1979).

The discontinuation of white-on-red painting, a diagnostic decorative attribute of Saladoid pottery, and the increased use of modeled incision as a decorative technique, marks the classificatory boundary between the Saladoid and the subsequent Ostionoid ceramic series (Rouse 1986: 143–144; Rouse and Allaire 1978: 464). This transition appears to have occurred around A.C. 600, although white-on-red painting continued longer on some islands such as Antigua (Hoffman 1963, 1979; Rouse 1976). Rouse sees the post-Saladoid ceramic development in the Leeward Islands as having affinities with contemporary developments in the Virgin Islands and eastern Puerto Rico and classifies the ceramics of all three areas in the Elenan subseries of the Ostionoid ceramic series (Rouse 1986: 143; Rouse and Allaire 1978).

Concomitant with the appearance of Ostionoid series ceramics after A.C. 600, archaeological evidence for colonization by sedentary agriculturalists of the Greater Antilles beyond Puerto Rico, especially Hispaniola, increases markedly (Veloz Maggiolo 1972; Veloz Maggiolo, Ortega, and Caba Fuentes 1981). This perceived movement is viewed by Rouse as the continued advance of the Saladoid frontier: "The Ostionan Ostionoids recommenced the previous Cedrosan Saladoid movement, expanding westward at the expense of the Courian Casimiroid people of the Archaic Age" (Rouse 1986: 144). An alternative to Rouse's view of the punctuated advance of a sedentary agricultural "frontier" is that the perceived "colonization" of Hispaniola is the archaeological manifestation of a pattern of logistical growth of populations that immigrated into Hispaniola earlier (Keegan 1985). The paucity of regional settlement research on Hispaniola (Wilson 1986) and well dated sites from the second half of the 1st millennium A.C. renders the question moot at present.

The settlement history of the Leeward Islands after A.C. 1000 is poorly understood. It is unclear whether the Elenan Ostionoid occupation in the Leeward Islands lasted until the time of European contact, whether subsequent cultural changes or immigration took place, or whether the region was semiabandoned before contact (Goodwin 1979; Nicholson 1983; Rouse 1976).

To the south, pottery of the Suazoid ceramic series was used predominantly in the Windward Islands after A.C. 800 (Bullen 1964; Bullen and Bullen 1968, 1972; Rouse and Allaire 1978). The relatively crude Suazoid ceramics seem to represent a further deterioration of ceramic technology of the Saladoid series.

When European observers arrived, the Windward Islands were occupied by an ethnic group called the Island Caribs. Male Island Caribs maintained a cultural and linguistic affiliation with mainland Carib groups. Their "men's language," used in ritual and trade, was a vestige of this linguistic heritage (Dreyfus-Gamelon 1976; Taylor and Hoff 1980: 312). The dominant "women's language" was an Arawakan language historically related to the Igneri language of the Saladoid people and to the Taíno language of the Greater Antilles. The correspondence between Suazoid ceramics and the historical Island Caribs is far from perfect (cf. Allaire 1980, 1984; Goodwin 1979; Sued Badillo 1978), and the difficult problem of identifying the archaeological assemblages used by the Island Caribs remains unresolved.

The florescence of complex sociopolitical institutions had already begun in the Greater Antilles by A.C. 1000. When Europeans arrived in 1492, they found complex chiefdoms of hundreds of allied villages (Alcina Franch 1983; Dreyfus 1981; Rouse 1948; Sauer 1966; Wilson 1985, 1986, in press). These people were known to the European explorers collectively as the Taíno. The Ostionoid ceramic series had diverged into two subseries on Hispaniola: the Meillacan and the Chican. To an extent, the archaeological evidence of the Greater Antillean developments in sociopolitical organization extended to the east beyond Puerto Rico, but the archaeological hallmarks of Classic Taíno culture (e.g., Capá or Chican ceramics and ball courts) are rare or nonexistent as far east in the Leeward Islands as the island of Nevis.

The Settlement Survey

An intensive archaeological survey for the remains of prehistoric settlements was conducted along the coasts and drainage systems of Nevis[2] (FIG. 3). Efforts were concentrated on a coastal strip 1 km in width, and most sections of the island's coast were walked more than once. Following Goodwin's (1979) strategy on St. Kitts, all of the major ravines, or ghuts, were surveyed as far inland as the topography (slope angle) seemed to permit settlement. At present, water reaches the sea in only a few of these drainages (except during heavy rains). We surveyed the following ghuts: Fountain Ghut, Camp River, Westbury Ghut, Cotton Ground Ghut, Grandee Ghut, Sulphur Ghut, and Bath Ghut. Fourteen inland transects between the larger drainages, located judgmentally, were also surveyed.

The design of the survey strategy, which emphasized 100% ground survey of the most probable areas of settlement location, and judgmentally-located survey of areas

2. Survey was carried out in October 1984, August and September 1985, and August through November 1986 by the author, Cornelia Wolf, Dave and Joan Robinson, Conrad Smithen, Vincent Hubbard, Richard Lupinacci, and members of the Nevis Conservation and Historical Society.

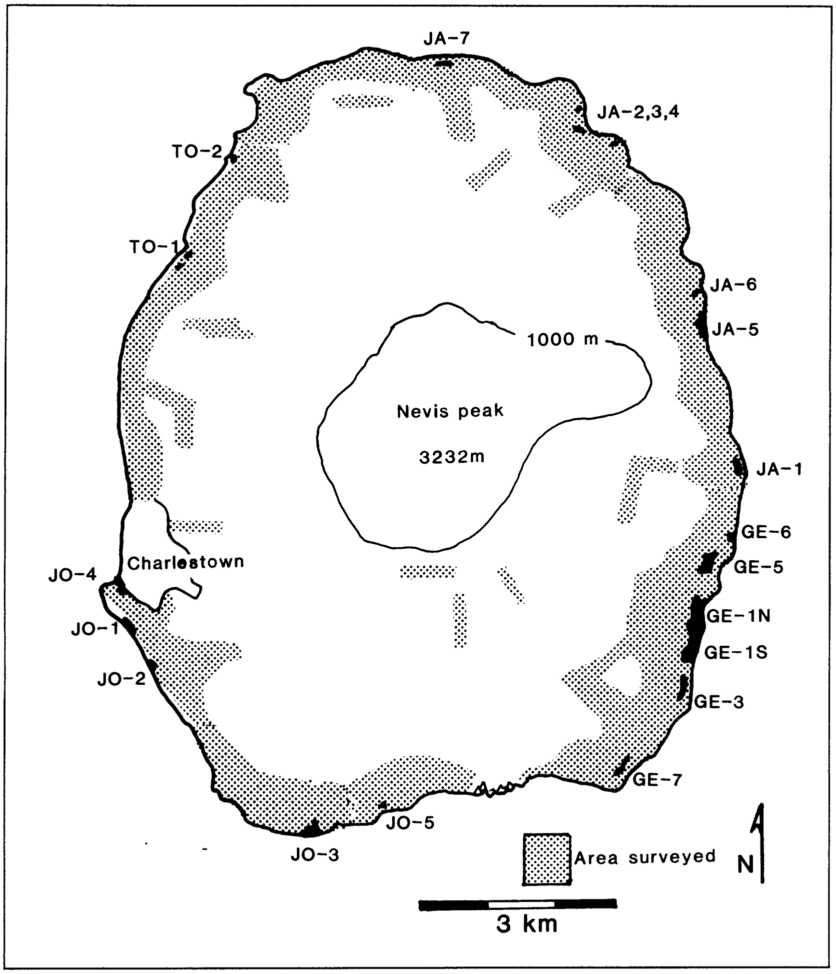


Figure 3. Map of the island of Nevis showing the areas surveyed and the location of the archaeological sites discovered.

where settlement was less likely, was based on the experiences of researchers surveying similar small islands in the Caribbean (Allaire 1974; Bullen 1964; Bullen and Bullen 1972; Goodwin 1978, 1979; Keegan 1985; Sleight 1962; Watters 1980; Watters and Scaglion 1980). Because they are the most complete and systematic studies of settlement distribution in the Leeward Islands, the studies of Goodwin (1979) on St. Kitts and Watters (1980) on Montserrat and Barbuda provided especially important precedents for this research.

The rationale for a complete survey of the coastal strip and of the drainage systems and ghuts, and the exclusion of Nevis' mountainous core, is supported by Goodwin's findings from his stratified random transect survey of St. Kitts, in which no sites were discovered above 1000 m (his stratum 1; Goodwin 1979: 114–206). The same strategy was also recommended by Watters' (1980: 289) findings in his research of all coastal settlement locations on Montserrat. This strategy has also been employed effectively by Keegan (1985: 193–196) in the Bahamas. Nevis' small size (132 sq km, with a coastline of approximately 39 km) and its topography (an oval, steep-sided volcanic cone) encouraged and made possible a survey strategy aimed at recovering a nearly complete sample of the prehistoric sites on the island. This does not necessarily mean that we found all of the sites that ever existed on Nevis; the erosional damage to the windward coast and the possible subsidence of the leeward coast (discussed below) may have destroyed or submerged other sites. Nor can I state with complete confidence that all of the sites existing at present on Nevis have been located. While the survey of the coastal strip, the drainage systems, and the judgmentally-located interior transects was intensive, beach formation processes (discussed below) or slopewash

Table 1. Prehistoric sites on Nevis, West Indies. Period 1 is aceramic, Period 2 is Saladoid, and Period 3 is Ostionoid. Measurements are in meters.

Period	Code	Name	Quad east	Quad north	Area (sq m)	Length	Width	Depth	Volume (cu m)	Distance from coast	Elevation
1	JA-7	Nisbetts	338	1903	270	30	9	0.25	67.5	100	10
	GE-6	Hichmans' Shell Heap	342	1895	250	25	10	0.40	100	5	8
2	GE-5	Hichmans'	342	1895	8800	110	80	0.50	4400	100	30
	GE-1N	Indian Castle N	341	1894	300	30	10	0.25	75	8	15
	GE-1S	Indian Castle S	341	1894	68750	550	125	0.60	41250	0	10
3	JA-5	Butlers	341	1898	8400	120	70	0.40	3360	10	5
	JA-1	Cocoanut Walk	342	1896	5500	110	50	0.40	3850	30	15
	GE-3	IC2	341	1893	3750	125	30	0.30	687.5	30	8
	JA-6	Tittle Ghut	341	1899	3200	80	40	0.40	1280	25	15
	GE-7	Indian Castle Estate	340	1892	2450	70	35	0.40	980	25	8
	JO-2	Bath Plain 2	333	1893	1200	40	30	0.70	840	5	5
	JO-1	Bath Plain 1	332	1894	1000	50	20	0.60	600	5	5
	JA-2	Hick's Cove	341	1901	750	30	25	0.25	187.5	10	15
	JO-5	Whitehall	338	1891	750	30	25	0.10	75	15	15
	JA-3	Hick's Cove	340	1901	625	25	25	0.25	156.25	10	10
	JO-3	Lighthouse	335	1890	600	30	20	0.70	420	5	5
	JA-8	Newcastle	337	1903	450	30	15	0.25	112.5	30	10
	TO-2	Cade's Bay	335	1900	300	30	10	0.25	75	5	5
	JA-4	Hick's Cove	340	1901	250	25	10	0.25	62.5	30	10
	TO-1	Nelson Springs	333	1899	250	25	10	0.40	100	10	10
	JO-4	Bath Stream mouth	332	1894	150	15	10	0.40	60	0	5

depositional forces may have buried other sites. No subsurface testing for the purpose of locating sites (beyond the examination of erosional features, gullies, ghuts, human excavations, garden plots, etc.) was conducted in the settlement survey.

To record site locations, we used the British Department of Overseas Surveys 1:25,000 scale topographic map (Series E803; DOS 343, "Nevis":1984), a partial set of 1:2500 scale maps surveyed by the DOS in 1984, and a partial set of 1968 aerial photographs.

We obtained a good deal of information on site locations from the island's inhabitants, including interested amateurs. The knowledge of archaeological sites is, to no small degree, a reflection of people's familiarity with their own island. People herding goats, fishing, and collecting whelks (*Cittarium pica*) knew where pottery, chert tools, and conch-shell tools could be found. This sort of information proved to be highly reliable and correlated so well with our results during the ground survey that I feel it helps confirm our empirical demonstration of the lack of prehistoric settlement farther into the interior. The seaward edges of all of the sites we discovered were within 0.5 km of the coast.

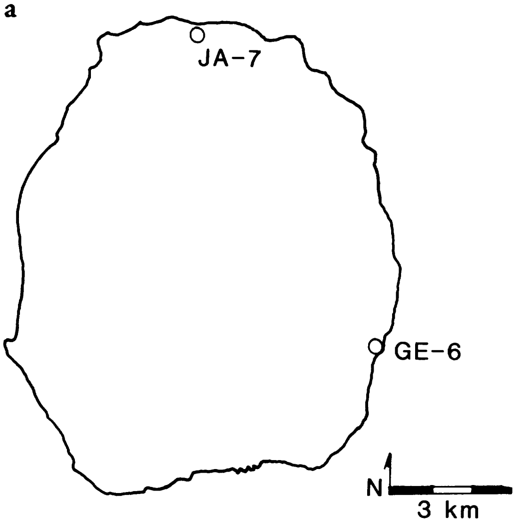
Geographic Distribution of Settlements

We located 21 prehistoric archaeological sites during the survey of Nevis. Table 1 lists them by their probable periods of occupation, and Figure 4 shows the locations of the sites and illustrates their relative size.

Figure 4 suggests an apparent preference for the windward, east coast for settlement. The eastern half of the island has 12 sites and the western half 9, but the combined surface area of the eastern sites is over 100,000 sq m, while the western sites total only some 4,500 sq m. Even if the largest site on the island (the 6-ha site called Indian Castle S or GE-1S) is removed from consideration, the area represented by the eastern sites is more than seven times greater than that of the western sites.

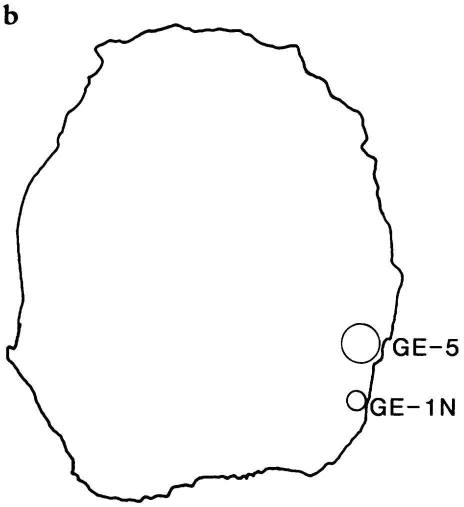
This pattern of eastern settlement seems to correspond to the distribution of reefs along Nevis' windward coast; the greatest concentration of prehistoric settlement is situated near the most extensive series of coral reefs. Even though a large percentage of the reefs along the windward coast are no longer growing, the area is still exploited by local inhabitants who fish the reefs with fishpots and spearguns. The other area that is even more favored by present-day fishermen is that of the reefs on the north and NE part of the island. In these reefs, although they are less extensive than the eastern ones, active coral growth is still taking place. This modern preference for the north and NE reefs raises questions about why there are not more and larger prehistoric settlements on the shores near these reefs. Two factors are likely responsible. First, the reefs off the north and NE coasts have not been as badly damaged as those on the east coast, and although smaller, they are richer.

a



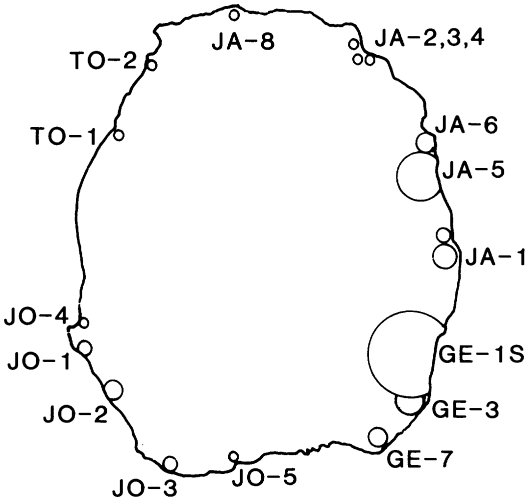
Code	Site
GE-6	Hichmans' Shell
JA-7	Nisbetts

b



Code	Site
GE-5	Hichmans'
GE-1N	Indian Castle N

c



Code	Site
GE-1S	Indian Castle S
JA-5	Butlers
JA-1	Cocoanut Walk
JA-6	Tittle Ghut
GE-7	Ind.Castle Est.
GE-3	IC2
JO-2	Bath Plain 2
JO-1	Bath Plain 1
JO-5	Whitehall
JA-2	Hick's Cove
JA-3	Hick's Cove
JO-3	Lighthouse
JA-8	Newcastle
TO-2	Cade's Bay
JA-4	Hick's Cove
TO-1	Nelson Springs
JO-4	Bath Stream m.

Figure 4. The archaeological sites of Nevis. **A)** Aceramic sites; **B)** Saladoid sites; **C)** Ostionoid sites. Circle diameters reflect the relative surface areas of the sites. Refer to Table 1 for actual surface areas and estimated site volumes.

The second factor may relate to the differential rates of survival for sites on different parts of the island. The NE coast has suffered erosion as bad as, and perhaps worse than, that on the SE coast. Three sites on the erosional bight called Hick's Cove (JA-2, JA-3, JA-4) are on partially-eroded cliff edges, and larger sites may once have existed there.

The almost total absence of sites in the sandy beach environments of the western side of the island may also be the result of site destruction through beach formation processes, storms, or tectonic activity. The early historical settlement of Jamestown on the northern end of the western beach system was partially destroyed by flooding that accompanied an earthquake in 1680 (Gordon 1985: 3). References to Jamestown continue in parish and government records into the 19th century, and it now appears that the settlement was either in a flood-prone area or one that was undergoing subsidence. In surveying the west coast we also snorkeled the 5-km length of Pinney's Beach. We were able to find historical-period artifacts near the site of Jamestown and offshore from the several gun batteries that lined the beach (Hubbard 1987), but no prehistoric artifacts. It is questionable, however, whether prehistoric ceramics could have survived for centuries in these shifting beach conditions. The taphonomic problems of differential site survival in diverse Caribbean environments could potentially introduce a systematic bias into our understanding of settlement systems throughout the Lesser Antilles. After intensive survey, however, including the examination of many exposures produced by digging foundations or drainage ditches, by bulldozer clearing for cocoanut cultivation and the like, we found no prehistoric remains on or in the beaches or dunes.

Chronological Distribution of Settlements

Aceramic Sites

We know of only two sites on Nevis dating from the long aceramic period in the Caribbean. The first and larger is Hichmans' Shell Heap (GE-6); the other is the Nisbetts site (JA-7) (FIG. 4). They are both small and consist of coastal scatters of molluscs, land crab shells, fish bones, chert tools, and conch-shell tools. Both sites are located adjacent to large reefs and by stream beds that formerly would have supplied water. Hichmans' Shell Heap is situated on top of a 3-m sea cliff, right next to the water. Behind it is a long gradient slope that formerly was used for sugar cultivation. Nisbetts is at the landward edge of a 100-m wide beach, now used for cocoanut cultivation on Nisbett Plantation. It is about 1 km from fields under cultivation, and 250 m east of a salt lagoon at the mouth of Camp River.

Test excavations were undertaken at Hichmans' Shell Heap and shell from the site was radiocarbon dated to 540 ± 60 b.c. (605 ± 290 B.C.). Preliminary results from the analysis of the faunal material (Elizabeth Wing, personal communication, 1989) indicate that shallow-reef fishes such as parrotfish (*Scarus* sp. and *Sparisoma* sp.) are abundant. Other reef fish such as grouper (Serranidae) and surgeonfish (*Acanthurus* sp.) are common, as is the pelagic barracuda (Sphraenidae). Other taxa, sparsely represented, are the Moray eel (Muraenidae), needle fish (Belonidae), wrass (Labridae) and porcupine fish (Diodontidae). Sea turtle remains were also present in the site.

The molluscan fauna was dominated by whelks (*Cittarium pica*), turkey wings (*Arca zebra*) and conch (*Strombus* sp.). Whelks represented 51% of the total minimum number of individual molluscs at the site; *Arca* comprised 42% and conch 4% of the sample. Other molluscs totalled 3%.

Somewhat inexplicably, none of the ground stone artifacts associated with Ortoiroid settlements on other islands (Armstrong 1978; Davis 1982; Nicholson 1976a) was found at either of these sites, although a large and well-worn grinding surface was found on a hard igneous rock of GE-6. Branch (1907: 317–320) reported 68 ground stone objects that were found on St. Kitts and Nevis, ranging from petaloid celts to complexly shaped grinding and hammerstones. The artifacts were in private collections for which there are only vague records of provenience. Site GE-6 was very close to a wagon road that went along the east coast of Nevis, and it is likely that the surface of the site has been well collected for centuries; it may have been the source for some of Branch's specimens.

Saladoid Sites

Only two sites containing Saladoid series ceramics have been found on Nevis. One is a small scatter of Saladoid sherds mixed with Ostionoid pottery at the north end of the badly-eroded Indian Castle site. The small, 300-sq-m Saladoid-occupation area of the Indian Castle site (GE-1) is designated GE-1N. The second and much larger Saladoid site, Hichmans' (GE-5), is located 1 km north along the windward SE coast (FIG. 5). Both sites contained a few sherds with Zone Incised Crosshatched (ZIC) decoration. This surface treatment was used by the earliest ceramics-using migrants in the Caribbean, and in some areas it persisted as a component of the Saladoid ceramic assemblage into the 5th century A.C. and possibly later (Versteeg 1987). Neither of the sites has been radiocarbon dated.

The site of Hichmans' (GE-5) covers about 8800 sq m in surface area, and is the second largest site on the island. Its edge is about 100 m from Hichmans' Shell Heap (GE-6), the aceramic site discussed above. Hichmans' site lies at an elevation of about 30 m on a relatively flat terrace

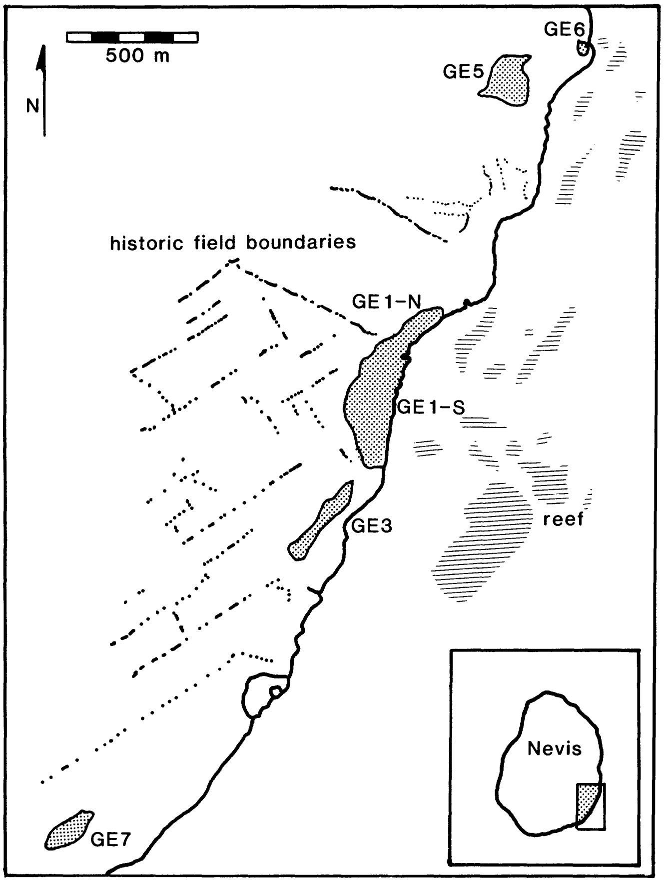


Figure 5. Map of the SE coast of Nevis.

and begins about 100 m from the coast. It is between two ghuts, at least one of which probably would have flowed year-round prehistorically.

Ten 1-sq-m test pits were excavated in the 1986 field season. The deposits ranged from 40 to 90 cm in depth, except in areas where the site had been badly eroded. In addition to ceramics and chert tools, we found one polished greenstone celt and several drilled and highly polished granite beads.

In the excavation of one test pit we encountered a burial between 15 and 45 cm below the surface. The body apparently had been desiccated, prepared in a compact bundle, and placed on an oval bed of stones in a pit, the top of which had eroded away. Orientation was approximately 210°, or SW. Two grave items were included, a large and complexly modeled bat's head adorno (ornament), a symbol associated with death among the historical Taíno (García Arévalo 1983), and a small oval dish placed in front of the skull. Both ceramic objects were finished with red paint.

Ostionoid Sites

The major prehistoric occupation of Nevis took place in the period after the Saladoid-Ostionoid transition, about 600 A.D. Whereas in the Saladoid period there were 2 sites with a total surface area of 9100 sq m, in the Ostionoid period there were 17 sites totalling 98,375 sq m. The largest sites are on the windward east coast, along the major reefs, but they occur nearly everywhere that fresh water would have been available on the coast. The seaward edge of all of the Ostionoid sites is within 30 m of the coast.

The largest site is GE-1S, Indian Castle South. It extends over 600 m of badly eroded coast. A sea cliff 2–10 m in height has eroded into a bank of loosely consolidated volcanic cobbles that forms the substrate of the thin topsoil layer. Much of the surface is a virtual pavement of pottery fragments, due to extensive wind and water erosion. This erosion is proceeding rapidly, and much of the site has disappeared within living memory. At its south end, the site is truncated by the shallow valley of a seasonal stream. Beyond it another site (GE-3), which may have been a part of GE-1, extends another 125 m.

Indian Castle is the only Ostionoid site at which we have conducted test excavations to date. From our excavations in 1985 we obtained a radiocarbon date of 670 ± 60 a.c. (745 ± 135 A.C.) based on carbonized wood.

The six largest Ostionoid sites, with surface areas of about 2500–8400 sq m, occur at intervals up the windward coast. A smaller group of sites, mostly under 1000 sq m in surface area, is distributed around the rest of the coast, with the exception of the 5-km stretch of sandy beach on the west coast. Along this beach, one small site (TO-1) is situated on a rocky outcrop towards the north end of the beach. Another (TO-2) is located nearby in agricultural fields adjacent to the coast. All of the sites are located near the mouths of streams.

The coastal part of the SW quadrant of the island is dominated by the dry and almost unpopulated Bath Plain. The vegetation is semi-arid and there is little reef development. The coast is a rocky shelf that serves as the dump for modern Charlestown. Three Ostionoid sites were found along this coast: one (JO-1) on a small point; one, designated Bath Plain 2 (JO-2), at the mouth of Sulphur Ghut; and one at the mouth of Grandee Ghut (JO-3).

Post-Ostionoid Sites and the European Contact Period

There is no indication on Nevis of a ceramic phase that supplants the Elenan Ostionoid. In the ceramic assemblages of the Ostionoid sites there are surface treatments reminiscent of Suazoid ceramics further south in the Windward Islands. Included are sherds decorated with finger-scraping or incision with a 4- or 5-tined incising tool, but these occur as minor wares (1.28% of the surface sample) in most of the Ostionoid sites. On a strictly archaeological basis, one must conclude that if there was a significant settlement on Nevis at the time of European contact, then the occupants used an assemblage of pottery and stone tools very much like the Ostionoid assemblage that had been in place since 600 A.C. This evidence supports Goodwin's conclusion that the contact period population on St. Kitts "developed from its Saladoid base more or less autochthonously on St. Kitts. In short, the precolonial Kittitians heretofore described in the historical literature as Caribs were Arawaks" (Goodwin 1979: 307).

The contact-period history of the region does not contribute very much to the ethnohistory of the aboriginal inhabitants of Nevis. Sir Francis Drake reported in 1585 that "wee spent some dayes [on St. Kitts] at Christmas, to refresh our sicke people, and to cleanse and ayre our ships. In which Island were not any people at all that we could heare of" (Hakluyt 1903 [1598–1600]: 8). In 1622 a group of English colonists landed on St. Kitts and founded what in the next few years would be the first successful English colony in the Caribbean (Goodwin 1979). They made an agreement with a Carib chief named Tegreman that allowed them to plant tobacco in an area of land on the SW coast. Between November 1625 and August 1626, relations between Tegreman's people and the colonists (both English and French) deteriorated. One skirmish reportedly involved six Carib war canoes holding over 400 men (Innis 1979: 4). This event seems to have involved a mobile raiding party, rather than people who lived on St. Kitts. Later in 1626 a combined force of French and English colonists killed an estimated 2000 Caribs (including Tegreman) in a surprise attack at night. It is suggested (Harlow 1926) that this was a preemptive strike on a group of warriors assembling from many islands to counter the threat of the rapidly-growing French and English colony on St. Kitts. Some survivors managed to escape to other islands in their canoes (Goodwin 1979; Harlow 1926; Innis 1979).

It is difficult to estimate how many of the Indians involved in these events were inhabitants of St. Kitts. The English spread from St. Kitts to Nevis in 1628 and to Montserrat and Antigua in the 1630s. The French moved SE into Guadeloupe, Martinique, and Dominica in the mid-1630s. The battles of 1625 and 1626 may have attracted Indians from all over the Leeward Islands or beyond, and thus it is difficult to arrive at reliable population estimates for St. Kitts. Certainly St. Kitts had some aboriginal inhabitants, but apart from the large-scale hostilities just mentioned, there is very little historical evidence for aboriginal people on St. Kitts and Nevis. Merrill (1958: 45–46) concludes that "[a]t the time of settlement of St. Christopher [St. Kitts] in 1624, the Caribs were present in that island in small number, but Nevis was unoccupied." Whether this was true 132 years earlier in 1492, when European explorers introduced a devastating suite of contagious diseases to the populations of the New World, is not known.

Ceramics Analysis

Subjectively, the ceramics from the 17 sites classified as Ostionoid seemed very similar. Using presence or absence of diagnostic ceramics traits, we were unable to differentiate between the pottery assemblages from the sites either chronologically, even by associating them with early and late sites, or functionally (for example, with agricultural villages and fishing or shellfish-collecting camps). To test whether there were changes in relative frequencies of various kinds of surface treatments or rim designs we measured the frequencies of various rim/body styles and combinations in order to see whether different clusters of ceramic attributes covary from site to site.

The purpose of this analysis is to begin to assess the variability in Ostionoid ceramics in the Leeward Islands, since Amerindian pottery is the most common artifact in Saladoid and Ostionoid archaeological sites in the Caribbean. In the Caribbean the most commonly used analytical frameworks have been based on the concepts of series and type (Hoffman 1979) or, following Rouse (1965), of series, subseries, type, and mode. The present analysis should be seen as a first approximation in the analysis of Ostionoid ceramics; a more detailed assessment of the technological and stylistic variability of the ceramics is in progress.

Within typological units, however defined, no uniformly agreed-upon set of technological or decorative/stylistic ceramic elements has been established for the Caribbean that lends itself to statistical analysis. This problem led Goodwin (1979: 230–250) to define nine categories of paste "recipes" of clay and tempering agents that comprised his ceramic sample on St. Kitts. The frequencies of these pastes were used in seriation analyses (following Ford 1962; Meggers 1968; Meggers and Evans 1957) of his ceramic samples. Goodwin's development of a typology of paste recipes drew upon Rouse's (1965) concept of ceramic modes. The approach taken here is similar, in that it seeks to analyze quantifiable elements of the ceramic sample, but instead of paste recipes I have used the more conventional (and more easily compared from island to island) attributes of rim profiles and surface treatments

Table 2. Comparison of rim and body modes between the Saladoid site GE-5 and seven Ostionoid sites.

Body decoration type	*Description*	*Saladoid site (Hichmans' GE-5) N = 95 sherds*		*Seven Ostionoid sites N = 297 sherds*	
		Count	*Percent*	*Count*	*Percent*
1	slipped plain	31	32.63	106	35.69
2	slipped plain incised	0	0.00	1	0.34
3	red paint	23	24.21	109	36.70
4	red paint incised	6	6.32	11	3.70
5	sandy undecorated medium	11	11.58	54	18.18
6	sandy undecorated medium incised	1	1.05	2	0.67
7	sandy undecorated fine	2	2.11	3	1.01
8	sandy undecorated fine incised	0	0.00	0	0.00
9	sandy undecorated coarse	0	0.00	3	1.01
10	sandy undecorated coarse incised	0	0.00	0	0.00
11	white on red	16	16.84	1	0.34
12	white on red incised	1	1.05	0	0.00
13	salmon on red	4	4.21	1	0.34
14	polychrome	0	0.00	1	0.34
15	wet incised	0	0.00	1	0.34
16	scratched	0	0.00	4	1.35
17	zone incised crosshatched	0	0.00	0	0.00
18	zone incised crosshatched red paint	0	0.00	0	0.00
Rim type					
1	plain	16	16.84	167	56.23
2	griddle	8	8.42	24	8.08
3	platform	3	3.16	2	0.67
4	rounded platform	6	6.32	51	17.17
5	canted platform	16	16.84	32	10.77
6	curved platform	5	5.26	1	0.34
7	flare	21	22.11	0	0.00
8	double platform	5	5.26	0	0.00
9	curved round	2	2.11	0	0.00
10	outcurved	2	2.11	0	0.00
11	bulb	6	6.32	0	0.00
12	complex bulb	4	4.21	1	0.34
13	flat	1	1.05	17	5.72
14	canted plain	0	0.00	2	0.67

(following Josselin de Jong 1947; Rouse 1965; Shepard 1965).

For this study of interassemblage variability, I created a typology of 14 rim modes and 18 surface treatments. The rim modes defined are shown in Figure 6; the names and numbers of the classes of rims and bodies are listed in Table 2. This typology must be seen as an experimental first attempt, designed to isolate characteristics of the Ostionoid ceramic assemblage that changed through time or varied from site to site. Using this method, very little variability can be isolated in the Ostionoid assemblage. The classifications of rim modes and surface treatments are relatively broad, resulting in many classes that were unrepresented or underrepresented in our samples and introducing statistical problems related to possible spurious correlations. To test the effects of the latter factor, the cluster analyses were also run with reduced samples consisting of the classes with the highest raw counts. The results of this analysis are presented so that future studies can benefit from both its positive and problematic aspects.

For each site discovered (with the exception of GE-1S) we made a 100% surface collection of rim sherds for the analysis of variability. In some of the sites it was difficult to get even a minimally adequate sample (>50) of rim sherds, so the majority of our analyses were run on a reduced sample of the eight largest sites.

Subjectively as well as statistically, there was a clear difference between the Saladoid ceramics assemblage of the Hichmans' site (GE-5) and the seven Ostionoid sites studied. This can be seen in the diversity of rim types at the former vs. the relative standardization in the Ostionoid sites (TABLE 2). The difference between the two assemblages can also be seen in the relative thickness of the body sherds of the sites studied. Saladoid ceramics are generally thinner and more finely made than Ostionoid ceramics. The mean thickness for ceramics from the seven Ostionoid

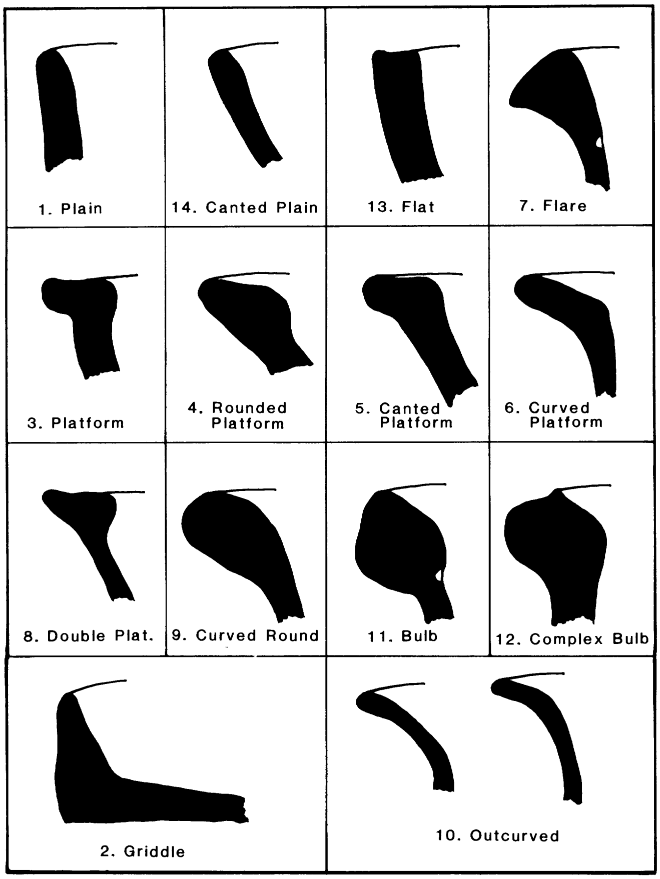


Figure 6. Ceramic rim profiles.

Table 3. Mean thicknesses of ceramic samples for eight sites on Nevis.

Site	*Name*	*Mean thickness (mm)*	*N*
GE-5	Hichmans'	8.567	95
GE-1S	Indian Castle S	11.069	36
GE-3	White Bay N	10.238	36
JO-3	Lighthouse	9.933	20
JA-5	Butlers	9.927	94
JO-2	Bath Plain 2	9.809	86
JA-1	Cocoanut Walk	9.511	45
GE-1N	Indian Castle N	9.450	32

sites was 9.99 mm, but only 8.57 mm from the Saladoid site (TABLE 3).

The six largest Ostionoid ceramics samples were compared statistically and proved to be remarkably similar in the frequency of the various rim and body styles. A cluster analysis was run using a matrix consisting of the number of rims in each of the 14 rim classes for each site. Using the unweighted pair-group method of clustering with arithmetic averages, all of the Ostionoid sites clustered at a level of .936 or higher.[3] The ceramics sample from the Hichmans' site, however, clustered with these sites at the .458 level. The matrix of the similarity of these sites is shown in Table 4, and the dendrogam based on this cluster analysis is shown in Figure 7.

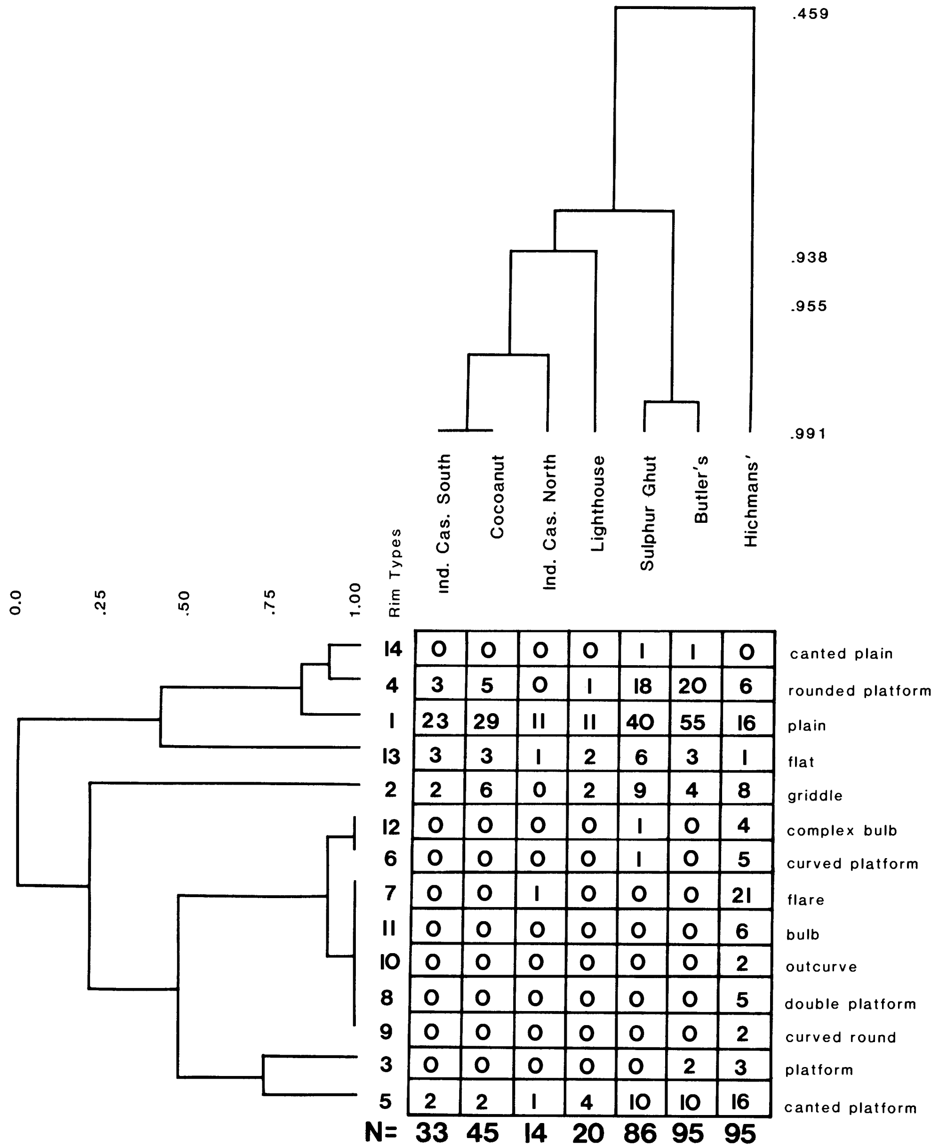
The level of clustering of the sites was not as great when the 18 classes of body/surface treatments were used in the analyses. This may be because both the Saladoid and Ostionoid assemblages contain three common surface treatments in high proportions—smoothed plain, red painted, and sandy, undecorated sherds. These three treatments are used in 86% of the Ostionoid body sherds found on Nevis.

3. Using a reduced sample of the five most common rim modes, the results were similar: the Ostionoid sites clustered at the .91 level or higher, while the similarity coefficient of Hichmans' was .66.

Table 4. Matrix of similarities for six Ostionoid sites and one Saladoid site (Hichmans').

Site	*Rim modes*						
(JA-1) Cocoanut Walk	1.00						
(JO-3) Lighthouse	.950	1.00					
(JO-2) Bath Plain 2	.955	.930	1.00				
(GE-1S) Indian Castle S	.991	.958	.942	1.00			
(GE-1N) Indian Castle N	.958	.941	.878	.982	1.00		
(JA-5) Butlers	.963	.929	.983	.966	.924	1.00	
(GE-5) Hichmans'	.426	.515	.445	.424	.494	.449	1.00

Site	*Body decoration*						
(JA-1) Cocoanut Walk	1.00						
(JO-3) Lighthouse	.600	1.00					
(JO-2) Bath Plain 2	.598	.995	1.00				
(GE-1S) Indian Castle S	.820	.618	.567	1.00			
(GE-1N) Indian Castle N	.361	.621	.547	.776	1.00		
(JA-5) Butlers	.500	.986	.974	.591	.686	1.00	
(GE-5) Hichmans'	.576	.885	.860	.679	.745	.889	1.00



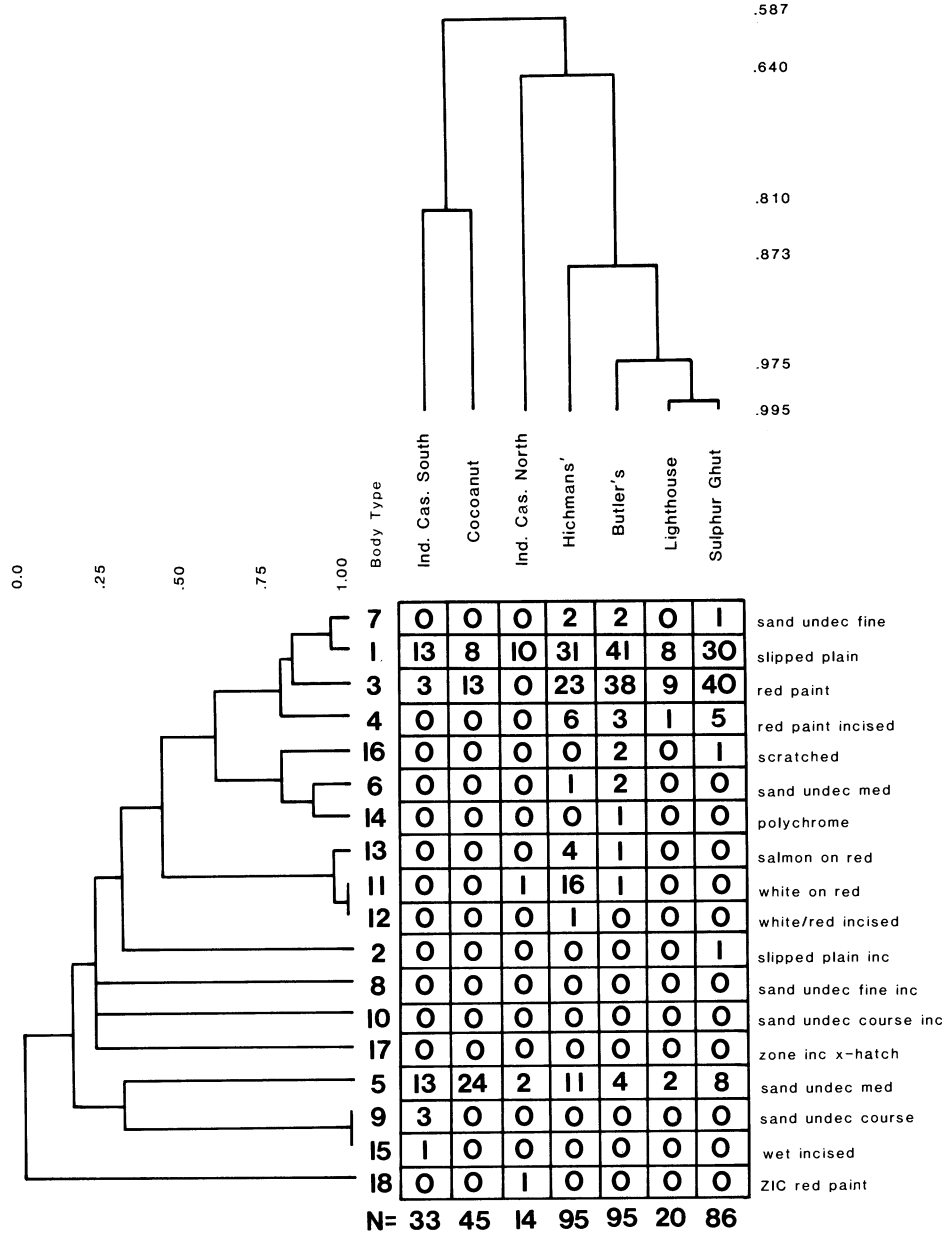
Rim Types	Ind. Cas. South	Cocoanut	Ind. Cas. North	Lighthouse	Sulphur Ghut	Butler's	Hichmans'	
14	0	0	0	0	1	1	0	canted plain
4	3	5	0	1	18	20	6	rounded platform
1	23	29	11	11	40	55	16	plain
13	3	3	1	2	6	3	1	flat
2	2	6	0	2	9	4	8	griddle
12	0	0	0	0	1	0	4	complex bulb
6	0	0	0	0	1	0	5	curved platform
7	0	0	1	0	0	0	21	flare
11	0	0	0	0	0	0	6	bulb
10	0	0	0	0	0	0	2	outcurve
8	0	0	0	0	0	0	5	double platform
9	0	0	0	0	0	0	2	curved round
3	0	0	0	0	0	2	3	platform
5	2	2	1	4	10	10	16	canted platform
N=	33	45	14	20	86	95	95	

Figure 7. R- and Q-mode cluster analysis of rim modes from seven sites. "Sulphur Ghut" is an alternate designation for Bath Plain 2.

Within the Saladoid collections from GE-5, the three classes accounted for 68% of the total. The matrix of similarity based on the frequency of 18 classes of body sherds is shown in Table 4.

The two R- and Q-mode representations (FIGS. 7, 8) summarize the results of these cluster analyses.

Our inability to create meaningful subgroups of the Ostionoid sites, especially using differential frequencies of rim types, raises an interesting question. Could the 17 Ostionoid sites on Nevis have been occupied at the same time? The close similarity of the ceramic samples does not refute the proposition, but neither does it support it unequivocally, since the characteristics of a pottery assemblage do not change at a specified rate, nor do they necessarily change at all. The distribution of the major Ostionoid sites at the mouth of each streambed around Nevis is also suggestive. There are some depositional similarities among the Ostionoid sites as well: while the Saladoid Hichmans' site has a depth of ca. 90 cm, the Ostionoid sites average about 40 cm, and so far the deepest shovel sounding in an Ostionoid site is 70 cm. Finally, the evidence from the historical period as well as other archaeological evidence (Keegan and Diamond 1987; Nicholson 1983; Rouse 1976) that suggests that the island was



Body Type	Ind. Cas. South	Cocoanut	Ind. Cas. North	Hichmans'	Butler's	Lighthouse	Sulphur Ghut	
7	0	0	0	2	2	0	1	sand undec fine
1	13	8	10	31	41	8	30	slipped plain
3	3	13	0	23	38	9	40	red paint
4	0	0	0	6	3	1	5	red paint incised
16	0	0	0	0	2	0	1	scratched
6	0	0	0	1	2	0	0	sand undec med
14	0	0	0	0	1	0	0	polychrome
13	0	0	0	4	1	0	0	salmon on red
11	0	0	1	16	1	0	0	white on red
12	0	0	0	1	0	0	0	white/red incised
2	0	0	0	0	0	0	1	slipped plain inc
8	0	0	0	0	0	0	0	sand undec fine inc
10	0	0	0	0	0	0	0	sand undec course inc
17	0	0	0	0	0	0	0	zone inc x-hatch
5	13	24	2	11	4	2	8	sand undec med
9	3	0	0	0	0	0	0	sand undec course
15	1	0	0	0	0	0	0	wet incised
18	0	0	1	0	0	0	0	ZIC red paint
N=	33	45	14	95	95	20	86	

Figure 8. R- and Q-mode cluster analysis of surface decoration modes from seven sites. "Sulphur Ghut" is an alternate designation for Bath Plain 2.

sparsely, if at all, inhabited at contact implies that there was a diminution of population on Nevis sometime between our date of a.c. 670 ± 60 (A.C. 745 ± 135) for the Ostionoid sites, and the early 1600s, when historical data are available.

The information on the distribution and size of settlements discussed below also offers some insight into this question, but the suite of radiocarbon, thermoluminescence, or other absolute dates that would confirm or challenge the hypothesized contemporaneity of Ostionoid sites on Nevis does not yet exist.

Settlement System Analysis

The distribution and size of Ostionoid settlements on Nevis is potentially relevant to the problem of whether Ostionoid sites were occupied contemporaneously. We have used a rank-size analysis of sites and their surface areas to test whether the contemporaneity of settlements

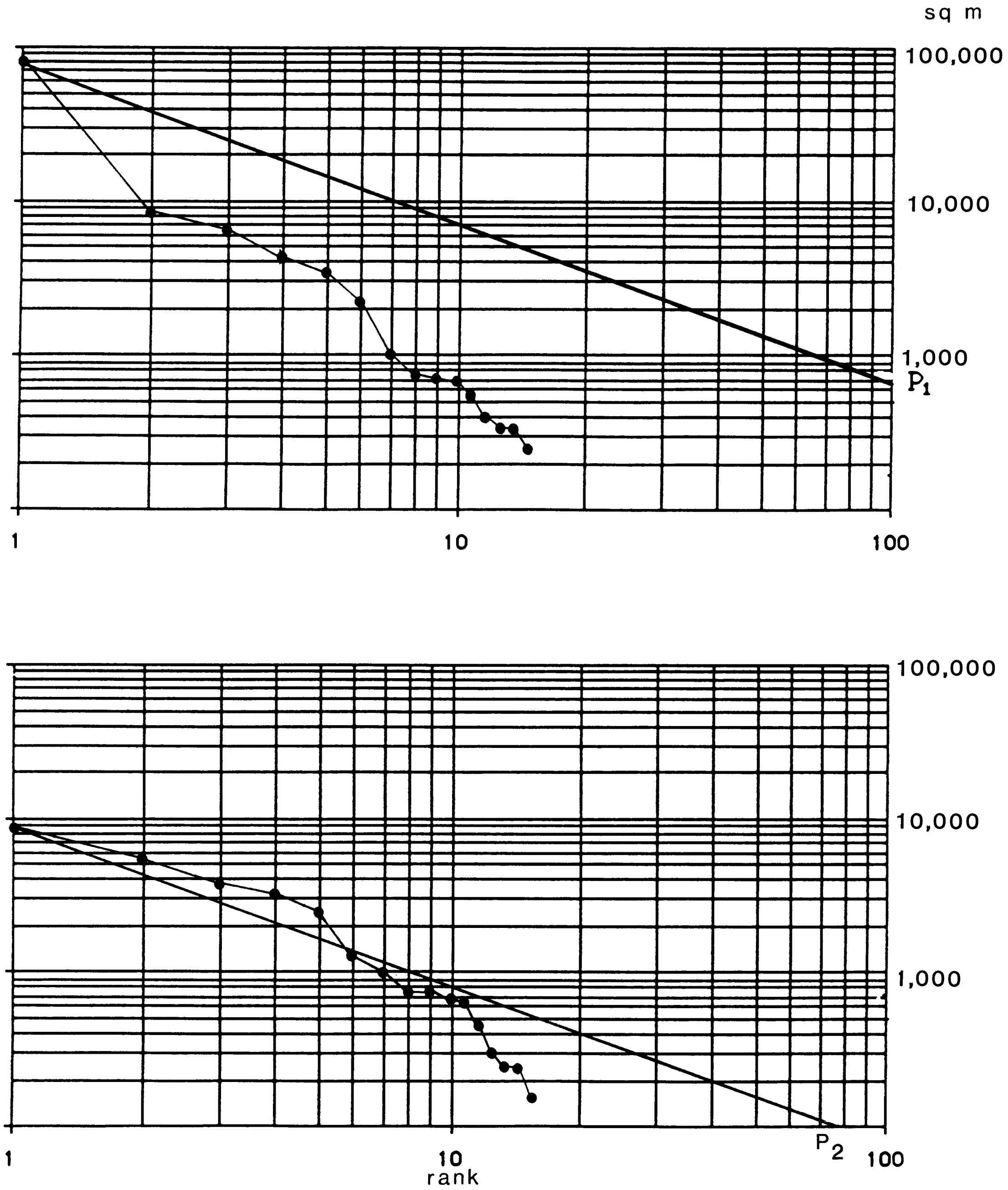


Figure 9. Rank-size distributions of all Ostionoid sites (top) compared with the rank-size distribution of Ostionoid sites excluding GE-1S (bottom).

is plausible. The rank-size rule is based on the observation of geographers that the distribution of site sizes in a contemporary settlement pattern often follows a very similar pattern. Johnson (1981: 144) explains: "The rank-size rule consists of the empirical observation that rank-size distributions from many different settlement systems have the same basic form, specifically that a settlement of rank *r* in the descending array of settlement sizes has a size equal to 1/*r* of the size of the largest settlement in the system." In the Nevis case, the question might be raised: if the sites were occupied serially, one after another, or perhaps with a few active settlements at any given time, should the sites not have roughly the same size? *In fact, predictions of the* rank-size rule reasonably approximate the size distributions of the Ostionoid settlements on Nevis (FIG. 9). This lends some credence to the proposition that the sites were occupied concurrently. Interestingly, the distribution of settlements and sizes conforms more closely to the predictions of the rank-size rule if the largest site is removed from consideration. This can be seen by comparing the fit of the line P_1 to that of P_2 in Figure 9.

There are problems with applying the methods of regional locational analysis drawn from human geography (e.g., gravity models, Markov models, central place and von Thünan land use models, nearest neighbor analysis) to an island like Nevis. Often the requisite assumptions necessary to apply the locational models cannot be made when dealing with islands (for example, Christaller's [1966] assumption in his central place theory of "an unbounded uniform plain in which there is equal ease of transport in all directions" [Bradford and Kent 1977: 6]). Here, I will only discuss the problems of comparing the Ostionoid settlements of Nevis with the predictions of the rank-size rule.

With respect to the rank-size distribution of the sites on Nevis, perhaps the most problematic assumption is that the island contains the entire settlement system since only 4 km of open water separates St. Kitts from Nevis, and other islands were in view and within reach of the islanders. Unfortunately, the settlement data currently available for St. Kitts could not be used in the sort of locational technique presented in Figure 9, because no site areas were reported. Although the physical distance between the two islands is only 4 km, the actual distance between the archaeological sites on Nevis and those on St. Kitts is much greater because of the dry peninsula that comprises the SE third of St. Kitts' length, and the preference for settlement on SE Nevis.

A second analysis undertaken on the Ostionoid sample of Nevis sites concerns the distances from site to site. The distances between the Ostionoid sites (FIG. 10) seem to follow a bimodal distribution, the first mode representing distances less than 1.5 km, and the second of distances between 2.5 and 5 km. Many factors in the physical and social environment must be presumed to have been involved in prehistoric choice for settlement locations, including the distribution of the following resources: fresh water; places to land canoes; productive agricultural lands and areas for catching terrestrial animals and collecting wild plants; and productive deep-reef, shallow-reef, beach, and estuarine environments (Goodwin 1979; Keegan 1985; Spriggs 1981; Watters 1980). Assuming that the sites, or some of them, were occupied contemporaneously, aspects of the sociocultural environment, including proximity to "primate," or parent communities, on Nevis would almost certainly have been considered in the establishment of new sites. Statistical techniques designed to

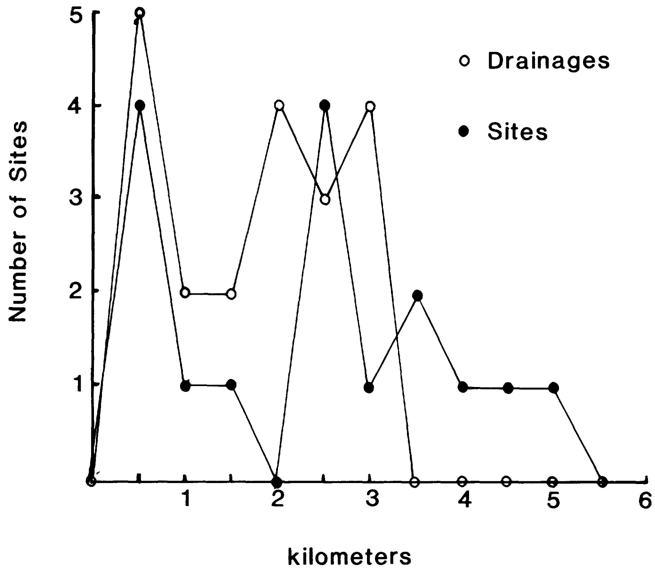


Figure 10. Linear distances between archaeological sites compared with the linear distances between fresh water sources along the coastline of Nevis.

analyze linear point-pattern data, such as linear nearest-neighbor analysis (Keegan 1985: 227–233; Pinder and Witherick 1973; Stark and Young 1981) measure deviations from randomness, and attempt to express the degree to which a pattern of points is regular, clustered, or random. Analyses of Markov properties of point patterns proceed similarly (Kemeny and Snell 1960; Reynolds 1976). The distribution of settlements on Nevis appears to be nonrandom, but the factors that potentially could explain the deviations are not easily measured. For example, the data needed to estimate the past productivity of Nevis' deep and shallow reefs, presumably a significant consideration in decisions about where to locate settlements, are at present unavailable.

Following Pinder and Witherick (1975: 17), the linear nearest-neighbor statistic can be interpreted in the following way: possible values range from 0 to 2; if the formula produces a nearest-neighbor statistic of 1.0, it indicates that the point pattern matches one predicted for a random situation. Values between 0.0 and 1.0 should indicate clustering, and a value of 2.0 should indicate perfectly regular spacing. The linear nearest-neighbor statistic for the 17 Ostionoid sites is 1.21,[4] which should indicate a

4. The linear nearest-neighbor statistic is calculated using the following formula:

$$2(n-1)/n\left(\frac{1}{L}(M_1 + M_2 + \ldots M_n)\right)$$

where n is the number of points; L is the total length (the circumference relatively random clustering of linear points, with more of a tendency towards regular spacing than towards clustering.

One potentially important factor that can be measured, and which appears to account for at least part of the bimodality represented in Figure 10 (and perhaps the linear nearest-neighbor statistic just mentioned), is the distribution of the mouths of streams or ghuts that would have provided fresh water for at least part of the year on Nevis. Figure 10 also shows the distribution of the distances between the 23 largest streams or ghuts on Nevis. A similar pattern of bi-modality is expressed. The linear nearest-neighbor statistic for this pattern of points (stream mouths) is 1.32, a value very close to that of the Ostionoid settlements.[5]

Discussion and Conclusions

The principal result of our work on Nevis so far is the inference that there was a localized Saladoid occupation on the island represented by 2 sites, followed by a relatively much larger and more widely distributed Ostionoid period of occupation, represented by 17 sites. We find no evidence of a ceramics phase that supplants the Elenan Ostionoid, and thus must conclude that either the island was abandoned or the contact-period people used Ostionoid pottery.

How can we account for the increase from 2 Saladoid sites totalling 9100 sq m to 17 Ostionoid sites totalling 98,375 sq m? It could represent a change from a population that, whether there permanently or intermittently, used only two locations on Nevis' windward coast, to a mobile one that occupied different sites at different times. Alternatively, the Ostionoid population could have grown rapidly over the 900 years between the appearance of Ostionoid ceramics on the island and the beginning of the contact period, with settlements fissioning rapidly to occupy all of the practical settlement locations. If this is the case, technological and stylistic preferences in ceramics changed little through time.

The close similarity in the rim and surface treatments of ceramics (and their co-occurring frequencies from site to site) reflected in the cluster analyses of Ostionoid ceramics, as well as the intriguing way in which the Ostionoid sites conformed to the predictions of the rank-size rule, argues more persuasively for another view of the settlement history of Nevis. On present evidence the more plausible interpretation seems to be that compared to the Saladoid period, the Ostionoid period saw a denser occupation of the island.

In order to understand this pattern, data from the rest of the Caribbean must be brought to bear on the problem of the demographic changes that took place in the Leeward Islands. This involves examining two periods within which the demographic characteristics of the Lesser Antillean populations can be presumed to have changed most radically: the early Saladoid colonization of the region and the period just after the abandonment of Saladoid decorative styles on ceramics.

One model of population growth that is potentially useful in trying to understand the initial colonization of the Lesser Antilles is a "replicator" model of settlement expansion along a linear course (Hassan 1981; Keegan 1985: 51–73). This model postulates that the communities of a small colonizing group, whose population was growing at a constant (and presumably rapid) rate, would divide into equal parts when their population doubled. The daughter communities would take advantage of the resources that lie farther away from the base of colonization, and a linear migration would result (a combined expansion and relocation pattern as defined by Hodder [1977]).

The predictions of this, or any, colonization model depend largely on the estimated rate at which the population was growing (Hassan 1981: 200–202). Using a rate of population growth based on both archaeological and ethnographic data from the Caribbean and Polynesia, Keegan (1985: 60) estimated that the coefficient of population growth (r) among the initial, rapidly growing group of colonists may have been as high as 1.2%. Based on this figure, even using a greatly reduced selection of islands that might have been colonized initially (the 8 largest of the 24 islands over 30 sq km in area), he inferred that the replicator model did not fit our present archaeological evidence for the initial Saladoid colonization, and that in fact that colonization probably proceeded rapidly, skipping most of the islands along the Lesser Antillean archipelago.

Most models for populations entering an environment with little or no population draw to some extent from the logistic growth curve model for colonization used in population biology. In this model, populations, upon encountering an environment without competition, tend to grow at the most rapid rate possible until an environmental limit to growth—an "upper asymptote"—is reached (Odum

of Nevis) and M_1 is the distance between point n and its nearest neighbor (Stark and Young 1981: 287–288).

5. The two distributions of distances between sites and drainage mouths were compared by computing Kolomogorov-Smirnov statistics; it was found that the differences between the distributions were not statistically significant ($K-S\ Z = .931695$).

1983: 319–329).[6] Although some of the assumptions involved are highly questionable in the Caribbean case—for example, that no inward or outward migration will occur after the initial colonization—the model provides a tool with which we can estimate population growth during the Saladoid colonization of the Caribbean and examine the deviations between the archaeologically reconstructed colonization and the predictions of the model.

Using the estimated coefficient of population growth of 1.2% discussed above, in which populations would double every 57.5 years, it is clear that the Lesser Antilles and Puerto Rico would fill up quite quickly. Using the year 200 B.C. as an estimated initial date for the Saladoid colonization (estimated by averaging the five earliest dates for Saladoid sites mentioned above), and an initial population of only 100 people, the population by A.C. 640 would be over one million, with a population density of around 65 people per square mile for all of the Lesser Antilles and Puerto Rico. If we estimated that there were 50 people per village (which seems plausible given recent excavations on St. Eustatius [Versteeg 1987] and Puerto Rico), there would be over 21,000 villages in the region, or 1197 villages on each of the 18 largest islands. Clearly this did not occur; in the first place, the colonizing Saladoid population would have reached a limit to its potential growth and moderated its rate of population growth much earlier. In the second place, a simple exponential growth model cannot reasonably be applied to a colonization situation like the one that took place in the Caribbean: the highest rates of population increase may only occur along the "wave front" of colonization (Martin 1973), and drop off sharply behind it (Hassan 1981).

The reasons why the rate of population growth rate diminished undoubtedly involve both economic and sociocultural factors, but have not yet been explored in detail on a regional basis (although the issue has been addressed by Keegan [1985] and Goodwin [1979, 1980]). Based on the data presented from the settlement survey of Nevis, I cannot contribute substantively to this issue. On Nevis, however, it is arguable that the Saladoid population regulated itself below "saturation level" (Hodder 1977), or the upper limits of the environment's carrying capacity. The reasons why this might be so merit closer examination in the future, especially on Puerto Rico, where early (Hacienda Grande phase) Saladoid settlements seem to exhibit a very regular spacing (Rouse and Alegría in press). It may be that Saladoid behavioral patterns regulating settlement spacing (Soja 1971), territoriality, or buffer zones (DeBoer 1981) may account for the apparent "underproductivity" (Sahlins 1972: 41–100) of the Saladoid settlement pattern.

The settlement data from Nevis do, however, raise an issue that relates to the trajectory of population growth after the colonization of the Lesser Antilles by sedentary horticultural people. The large increase in the number and total surface area of Ostionoid sites on Nevis (FIG. 4) suggests the possibility that the coefficient of population growth (r) underwent a *second* increase at the end of the Saladoid period (or, less likely, that there was significant immigration), and that the population of the Leeward Islands grew during this period.[7] The settlement data from Montserrat and especially Barbuda (Watters 1980) reflect a similar pattern of increase in this period (TABLE 5).

An alternative to this pattern of two periods of rapid population growth (what we might call the double logistic growth phase model, or following Goodwin [1979: 109], a compound logistic curve) is a model in which the rate of population growth moderated at some point during the Saladoid colonization of the Lesser Antilles, but that population continued to grow at a lower rate throughout the 1st millennium A.C. (the single logistic growth phase model). Within this model, the apparent acceleration in Ostionoid population on Nevis, Barbuda, and Montserrat would have to be explained as a sampling problem stemming from the fact that they are among the smaller islands in the region.

In attempting to understand the settlement history and prehistoric population dynamics of the Caribbean, we must incorporate successively larger regions into our synthetic framework; for Nevis, we must look at the island, the Leeward Islands group, the Lesser Antilles, and the Caribbean archipelago generally. Larger and more comprehensive syntheses rely directly on the quality and comprehensiveness of data collected from island to island. This paper has been an attempt to provide reliable settlement data from Nevis for future regional syntheses.

6. This may be expressed as

$$\frac{dN}{dt} = rN\left(\frac{K-N}{K}\right)$$

where dN/dt is the rate of population increase; r is the maximum possible rate of increase; N is the size of the population; and K is the limiting environmental resistance.

7. The possibility of two logistic growth phases in the demographic history of the Leewards was first made by Goodwin (1979: 106–111, fig. 14). His was an attempt to understand the economy of the earliest Saladoid colonizers of St. Kitts, and isolate the ways in which, through niche redefinition, they were able to raise the environmental limitations to settlement (K). The second stage of logistic growth suggested here would have occurred several hundred years later than that suggested by Goodwin's hypothesis, but we may be addressing aspects of the same phenomenon.

Table 5. Numbers and areas of Saladoid and Ostionoid sites on Nevis, Montserrat, Barbuda, and St. Kitts (from Goodwin 1979; Watters 1980).

	No. of Saladoid		*No. of Ostionoid*	
Island	*sites*	*Area (sq m)*	*sites*	*Area (sq m)*
Nevis	2	9,100	17	98,375
Montserrat	2	42,500	4	73,660
Barbuda	2*	14,175	7	78,560
St. Kitts	8	—	7†	—
Totals	14	65,775	35	250,595

*Watters (1980: 299) notes that "Barbuda ceramics are all post-Saladoid with the exception of sherds from BA3 (Sufferers) and the possible exception of few ZIC sherds at BA5 (Highland Road)." The area of BA3 and BA5 has nevertheless been included in the calculation of total area in the Saladoid period.

†This may reflect the interior and riverine focus of Goodwin's sampling design; only 14 of his 65 transects met the coast at any point (Goodwin 1979, figs. 17, 21).

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