ARTICLES

PLANTS, PEOPLE, AND CULTURE IN THE PREHISTORIC CENTRAL BAHAMAS: A VIEW FROM THE THREE DOG SITE, AN EARLY LUCAYAN SETTLEMENT ON SAN SALVADOR ISLAND, BAHAMAS

Mary Jane Berman and Deborah M. Pearsall

Paleoethnobotanical remains from the Three Dog site (SS-21), an early Lucayan site located on San Salvador, Bahamas, are presented and compared to data from other prehistoric Caribbean sites. Flotation, in situ, and screen recovery (1/16", 1.58 mm) revealed six taxa of fuelwood and charred Sapotaceae seed fragments. Preliminary SEM analysis of six chert microliths revealed possible evidence of the Caribbean aroid, Xanthosoma sp. (cocoyam, malanga, yautía) or Zamia sp. The presence of Sapotaceae and possibly Xanthosoma sp. or Zamia sp. in the archaeobotanical record can be attributed to a number of alternative explanations. The site's inhabitants may have transported these plants from their homelands and transplanted them to home gardens. An alternative view is that they exploited or managed wild representatives or created disturbed habitats that encouraged the spread of wild or cultivated forms. The pollen data from two Bahama cores, one from Andros, the other from San Salvador, reflect anthropogenic disturbance during the prehistoric occupational sequence. The increasing frequency of Sapotaceae pollen in the San Salvador sequence is consistent with the occurrence of Sapotaceae at the Three Dog site. Finally, preservation- and recovery-related issues are discussed. The study suggests that multiple means of data recovery must be employed to gain a more representative picture of prehistoric Caribbean plant use and floristic environment.

En este estudio se presentan los restos paleobotánicos del sitio Three Dog (SS-21), un asentamiento doméstico Lucayano temprano que se localiza en San Salvador, Bahamas, y se comparan los datos con otros sitios prehistóricos del Caribe. Las muestras recuperadas mediante flotación, in situ, y en cribas (malla de 1.58 mm), representan seis taxa de madera empleada como combustible y fragmentos de semillas quemadas de Sapotaceae. Mediante el análisis preliminar con microscopio de barrido de electrones de seis microlitos de pedernal, se definieron evidencias probables de aroides caribeños, Xanthosoma sp. (cocoyam, malanga, yautía) o Zamia sp. La presencia de Sapotaceae y posiblemente Xanthosoma sp. o Zamia sp. en el registro arqueobotánico, puede atribuirse a una serie de explicaciones alternas. Los habitantes del sitio tal vez transportaron estas plantas desde su lugar de origen y las transplantaron en sus huertos domésticos. Una interpretación alterna es que explotaron o manipularon las plantas silvestres o generaron habitats alterados, que promovieron la dispersión de formas silvestres o cultivadas. Los datos polínicos de dos núcleos en Bahama, uno de Andros y otro de San Salvador, reflejan la alteraciones antropogénicas durante la secuencia ocupacional prehistórica. El incremento en la frecuencia de polen de Sapotaceae en la secuencia de San Salvador es consistente con la aparición de Sapotaceae en el sitio Three Dog. Por último, se discute la conservación en relación con temas asociados con la recuperación de polen. En este estudio se plantea que deben emplearse diferentes métodos para recuperar datos, de manera que se logre una imagen más representativa del uso de plantas y del ambiente florístico en el Caribe en épocas prehistóricas.

When Christopher Columbus sailed the islands constituting the Bahama archipelago, he was struck by the richness of the vegetation. Throughout his days among the islands (October 11–27, 1492), he commented exuberantly on its uniqueness, abundance, and diversity. He was awed by the colorful flowers, unfamiliar fruits, and fragrant smells and felt frustrated that he could not name the plants (Dunn and Kelley 1989:89, 93, 105, 111). Making landfall on Guanahaní (San Salvador), on October 11, he noted that there were "very green trees and many ponds and fruits of various kinds" (Dunn and Kelley 1989:63). The size of the trees impressed him. In his October 13 entry he commented that the Indians' canoes were constructed from the "trunk of one tree, like a long boat, and all of one piece and worked marvelously in the fashion of the land, and so big that in some of them 40 or 45 men came" (Dunn and Kelley 1989:69). On October 14, his last day on Guanahaní, he noted "groves

Mary Jane Berman ■ Department of Anthropology, Wake Forest University, Winston-Salem, North Carolina 27109
Deborah M. Pearsall ■ Department of Anthropology, University of Missouri, Columbia, MO 65211

Latin American Antiquity, 11(3), 2000, pp. 219–239

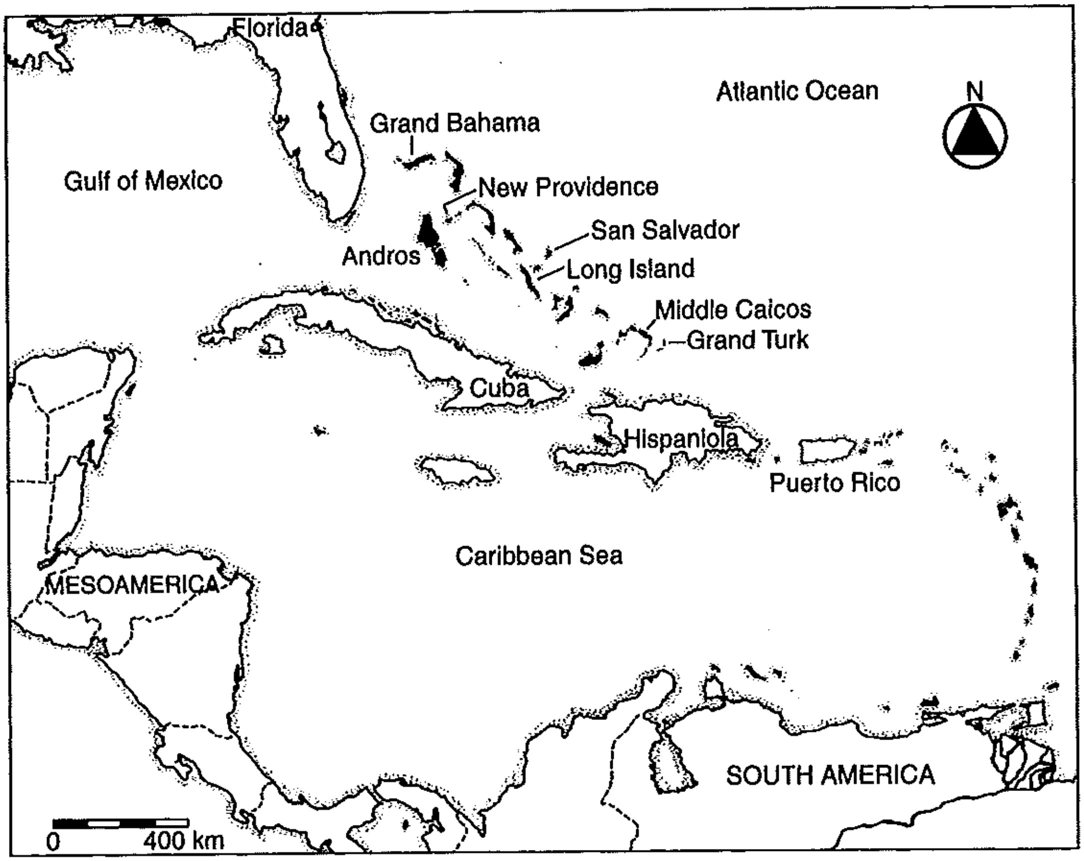

Figure 1. Map of the Caribbean.

of trees, the most beautiful that I saw and with their leaves of green as those of Castile in the months of April and May . . ." (Dunn and Kelley 1989:77). As he wended his way through the remainder of the archipelago, Cuba, and Hispaniola, he continued to note the trees and plants.

Numerous people have speculated on the exact nature of these trees (Berman et al. 1988; Chiappelli 1976; Morison 1963; Sauer 1966). In most cases, identifications have not been established because of Columbus's lack of botanical knowledge. As Gerbi (1985:14–15) and others have noted, Columbus's primary motivation was not a natural history treatise but proof of the success of his voyage in terms of the riches he encountered and a demonstration of the land's suitability for Spanish appropriation.

Besides commenting on the natural vegetation in the new lands, Columbus reported that the Lucayan people who inhabited the islands of the archipelago cultivated economic plants such as maize (which he recorded as panizo grass) (Dunn and Kelley 1989:89; Morison 1963:73), agave (which he lists as aloe) (Dunn and Kelley 1989:107, 111; Morison 1963), *Bixa orellana* (Sauer 1966:56), and a plant we interpret as tobacco (Dunn and Kelley 1989:85; Morison 1963; Sauer 1966:56). On numerous occasions, he noted objects made from cotton (Dunn and Kelley 1989:65, 67, 71, 73, 81, 89, 93, 95, 109), probably because he was familiar with its Old World form. He also mentioned that the natives used calabashes as water containers (Dunn and Kelley 1989:85, 107) and as a means of bailing water out of their canoes (Dunn and Kelley 1989:69). It is not known whether these were tree gourds *(Crescentia),* bottle gourds *(Lagenaria),* or squashes *(Cucurbita)* (Sauer 1966:55). In the early months of 1493, Columbus brought back to the Court of Spain maize (Bray 1993:290; Sauer 1966:55; Sauer 1976:824), kidney beans (Bray 1993:290), sweet potato (Bray 1993:290), and chili pepper (Bray 1993:290) that he had collected in the Greater Antilles. According to Loven (1935:402), Navarrete reported that Colum-

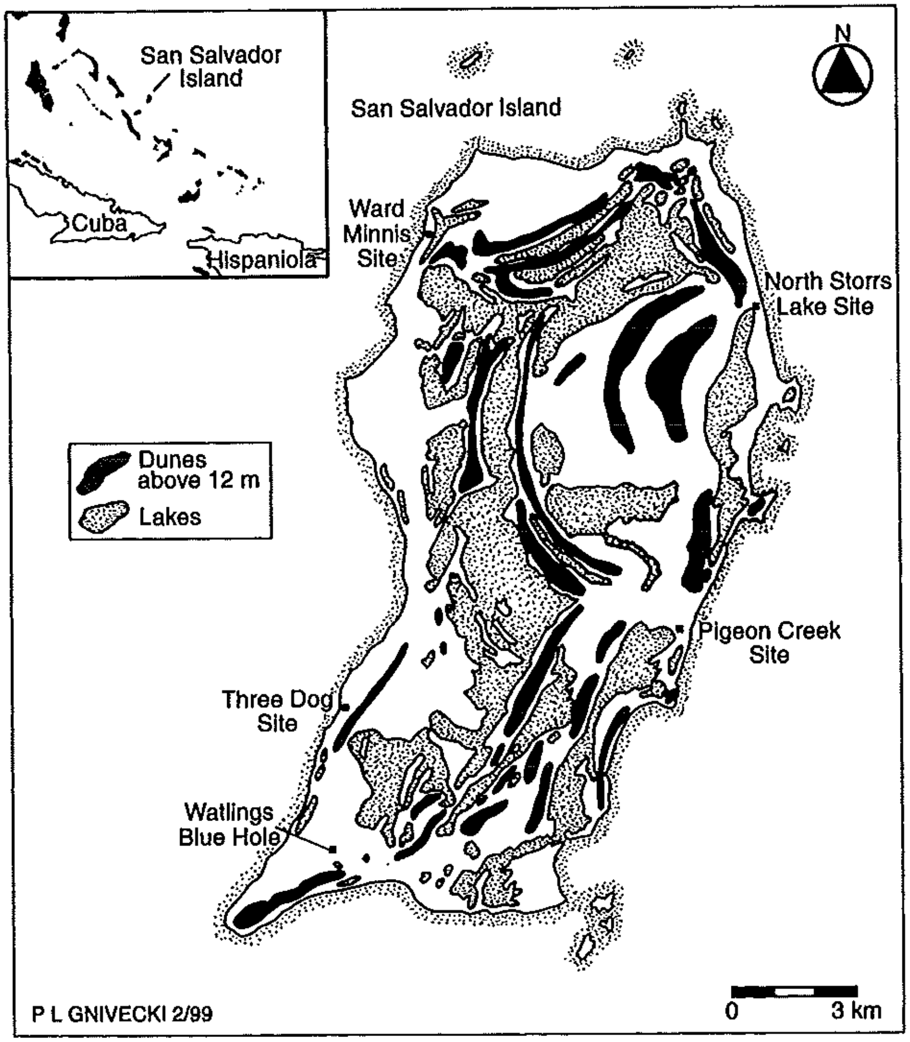

Figure 2. Map of San Salvador, Commonwealth of the Bahamas.

bus saw "juertas de arboles" on Guanahaní. Loven believes these refer to fruit trees. Las Casas also reported that the Taíno maintained "fruit gardens" on Hispaniola (Loven 1935:402).

A close reading of Columbus's *diario* reveals his scientific shortcomings. Nevertheless, his descriptions are useful because they serve as a foundation for viewing aboriginal floristic environment, plant use, and systems of production, as well as a fifteenth-century perception of them. Islands are dynamic ecosystems, sensitive to human modification and disturbance, as well as climatic and other environmental processes (Fosberg 1963). We do not expect fifteenth-century flora to mirror exactly what might have existed 600 years earlier or what exists today. But, used parsimoniously, Columbus's descriptions serve as a starting point for us to begin addressing a series of research questions: the study of West Indian prehistoric biogeography and biodiversity (Watters 1989; Watters and Rouse 1989), paleoenvironment, human modification of the aboriginal landscape (Miller 1988), impacts on indigenous biota through the introduction of alien species, the stability of certain prehistoric subsistence systems (Pearsall 1983), subsistence changes, forest resource management (Balée and Gély 1989), and indigenous systems of production and their role in the formation of social complexity (Earle 1997).

The paleoethnobotanical assemblage from the Three Dog site, located on San Salvador island, the Bahamas (Figures 1 and 2), is a good place to examine these questions and begin a longitudinal study of the Bahamian floristic environment and Lucayan plant use, since wood charcoal, seeds, and plant residues were among the plant remains identified from well-dated contexts. In this study we will review these remains and suggest some possible explanations as to their presence at the site. From this, comparisons and contrasts to other areas of the archipelago, the West Indies, and other island ecosystems can be drawn.

The floral data suggest that the diet of the site's inhabitants included tubers and tree fruits and that they used various trees as fuelwood. It is possible that the fruit trees were brought to the Bahamas from Cuba and Hispaniola, the source areas for the peopling of the Bahamas archipelago. Since the Three Dog site represents one of the earliest sites in the island chain and is the earliest one known for San Salvador, a baseline picture of the local floristic environment can begin to be constructed. Newsom (1993) and Newsom and Pearsall (2000) have begun to recognize long-term patterns of aboriginal Caribbean plant use in which certain plants were introduced to new environments by colonizing populations as they worked their way up the Antillean chain. The island inhabitants developed varying systems of cultivation and wild plant exploitation that suited the unique environmental regime of each island. Similarly, the islands of the Bahama archipelago are characterized by differences in vegetation, precipitation, and temperature (Berman and Gnivecki 1995; Sealey 1985; Sears and Sullivan 1978). Since Newsom and Pearsall (2000) did not include the Bahamas in their overview, this study allows us to begin the examination of whether the prehistoric settlers to the Bahama archipelago observed the pattern of importing cultigens and establishing them in a new setting seen elsewhere in the Caribbean and whether inter-island differences occurred in the adoption process. Finally, these findings represent the first direct body of data on aboriginal plant use for the central Bahamas for which systematic recovery methods were employed.[1]

Regional Overview

Recent findings spanning the period of initial occupation of the Bahamas archipelago to the Spanish Contact period are beginning to bring to light a picture of prehistoric plant distribution patterns, plant selection behavior, patterns of human modifications of the environment, and indigenous systems of production. As we discuss further below, a pollen sequence from Andros island (Kjellmark 1996) suggests human-induced disturbance is visible at 740 B.P., i.e., ca. A.D. 1200, a few centuries after Kjellmark believes the island was first colonized. A pollen core from the North Storrs Lake site (SS-4), located on San Salvador's east coast (Jones 1997:5), hints at some evidence of aboriginal plant cultivation or management. The pollen sequence was taken from the submerged portion of the site. Two *Cucurbita* sp. pollen grains were observed at 25 and 5 cm below surface, but it is not known if they represent wild or domesticated species. Jones also found a slight but noticeable increase in *Coccoloba* (sea grape) and Sapotaceae (sapote) pollen over the course of the sequence. While the core is undated, these findings are significant because one radiocarbon date from the site, 1140 ±70 B.P. (IACA 1998), indicates that it was contemporaneous with the Three Dog site.

Isolated botanical macroremains from a few other sites also have yielded useful information about arboreal environment and plant use. The Lucayans manufactured numerous wooden objects such as canoes and canoe paddles, duhos, zemís, fire-boards, fish-hooks, points, and bowls (Granberry 1955:249–260). Winter and Pearsall (1991:586) report that a wooden mortar from Watling's Bluehole on San Salvador was created from *Swietenia mahogani* (mahogany). The mortar dates to 530 ±65 B.P. (Winter and Pearsall 1991:586). Winter et al. (2000) report a wooden bowl manufactured from lignum vitae (*Guaiacum* sp.) from Major's Cave on Hog Cay in the San Salvador Island group. The site dates to 450 ±50 B.P. Keegan (1997:58) reports that a canoe, recovered from an Andros blue hole, was made from mahogany. Two duhos from Long Island have been identified as having been made from mahogany (Grace Turner, personal communication 1999). De Booy (1913:3) reported that a canoe paddle from a cave on Mores Cay was manufactured from cedar. Granberry (1955:251) believed the cedar to be *Juniperus barbadensis.* Pearsall has identified the woods from 11 objects from the Deadman's Reef site (GB-4) on Grand Bahama. These wooden artifacts, consisting of at least three zemís, one arrow shift, one fid, and a fishing implement were manufactured from *Eugenia* sp., *Rhizophora mangle, Concocarpus erectus,* and Mimosoideae/Papilionoideae (Pearsall 1999).

The record shows that other woods were used for food and fuel, and presumably building material, medicines, dyes, and poisons. Winter and Wing (1995:426) recovered a charred *Guaiacum* sp. seed from the Ward Minnis site (SS-3) (840 ± BP) on San Salvador. The remains of at least three types of edible fruits are present at Major's Cave (mentioned above). Winter et al. (2000) report 98 seeds identified as coco plum *(Chrysobalanus icaco)*, hog plum (*Spondias* sp.), and sea grape or pigeon plum (*Coccoloba* sp.). At the Deadman's Reef site, a hearth located adjacent to where the wooden objects were recovered yielded a radiocarbon date of 480 ±50 B.P. (Beta 120567; wood charcoal; $\delta^{13}C$ = -26.5 ‰; cal A.D. 1420–1450 [p = .05], cal A.D. 1400–1485 [p = .95].) (Calibrated at 2 sigma with the Beta Analytic/Pretoria Calibration Program [Stuiver et al. 1993; Talma and Vogel 1993].) Pearsall has identified numerous woods and Sapotaceae seed-coat fragments from two of the hearths. Newsom (Keegan 1997:21) reports the presence of wild lime (*Zanthoxylum* sp), ironwood *(Krugiodendron ferreum)*, buttonwood, (*Conocarpus* sp.), palm trunk wood, and Celastraceae (bittersweet family) in the fuelwood remains from the Coralie site (GT-3) on Grand Turk. Ten radiocarbon dates from the site indicate it was occupied between cal A.D. 705–1170 (Keegan 1997:21). Finally, Newsom (1993:315) identified *Mastichodendron* sp. seed fragments from a soil sample recovered from Luden's Cave on New Providence.

In summary, a body of prehistoric botanical data from the Bahama archipelago is being amassed as more investigators recognize the value of floral remains to their research, incorporate plant recovery and analysis into their excavation programs, and study museum-curated wooden objects. Researchers are beginning to use aboriginal floral remains, now being collected systematically from a variety of archaeological contexts such as open air sites, caves, and waterlogged environments, to reconstruct the paleoenvironment and construct models of subsistence and economic behavior. The findings are revealing that the Lucayan used numerous wild trees for fuel and the manufacture of tools, canoes, and ceremonial objects. Evidence for fruit-bearing species is known from seeds from several sites; we infer that the fruits were consumed. Pollen cores from submerged deposits are yielding information about long-term land-use practices and the composition of aboriginal environments. As plant data from chronometrically dated contexts from different sites and islands continue to be collected and studied, a large-scale view of spatial and temporal variation of plant distributions and aboriginal plant-use patterns will emerge.

The Three Dog Site

The Three Dog site, located on the west coast of San Salvador island, Commonwealth of the Bahamas, is one of the earliest sites thus far systematically excavated in the archipelago and the earliest site known from the Commonwealth of the Bahamas. Portions of the western margin of the site have eroded into the sea due to the devastating effects of a series of powerful hurricanes in the 1930s. Excavation was conducted by the Lucayan Ecological Archaeology Project (LEAP), under the auspices of the Bahamian Field Station and the Bahamas Department of Archives from 1984–1988 and 1990–1994. The goals of the Three Dog site excavation were to study how the early settlers of the central Bahamas responded and adjusted to the new insular environmental conditions that they settled. The research focused on the means by which the site's occupants reproduced, modified, and managed their new environments and how these practices resembled or varied from those observed elsewhere in the Antilles (Newsom 1993; Watters 1989) and other island situations such as the Pacific (Kirch 1982, 1983, 1997; Kirch and Hunt 1997). The analysis of artifact technology and use, and the study of the organization of technology (Berman et al. 1999; Nelson 1991), inter-island economic relationships, site spatial structure and organization, and the contributing role of taphonomic processes to site formation, are allowing us to establish a baseline understanding of early settlement in the central Bahamas. A rigorous program of paleoethnobotanical and zooarchaeological recovery, study, and analysis was undertaken to establish a foundation for understanding the paleoenvironment, subsistence strategies, economic plant-use patterns, and systems of production for this period. These data and interpretations are being used to establish a comparative framework with data derived from later occupations at other sites on San Salvador and on other islands.

Excavation of 102 1 x 1 m square units revealed two components, one dating to the Spanish Contact period and the other to A.D. 800–900 (Berman and Gnivecki 1995). The site was excavated in 10 cm levels. Cultural deposits were screened in window screen (1/16 inch or 1.58 mm), while noncultural sediments were passed through 1/4" (6.35 mm) mesh screen. Excavations were carried down to the sterile zone where fine screening continued for 20 cm or more until no more artifacts were encountered. A thin-scatter of historic metal artifacts lies above the earlier component. These artifacts, including a lead arquebus ball, reflect late fifteenth- or early sixteenth-century Spanish presence in the region (Brill et al. 1987). At least four discrete spatial units consisting of a midden, two activity areas, and a low density area identified on the basis of artifact and ecofact content and density, define the earlier component (Figure 3). The following discussion relates to this occupation.

The midden, N1-S7, located in the northernmost part of the site, is signified by a concentration of charcoal, fish and marine and freshwater turtle bones, shell tool and food debris, beads, sherds, and broken or exhausted artifacts made from local and nonlocal materials. At activity area #1, S8-S20, situated directly south of the midden, the inhabitants engaged in food preparation, cooking, consumption, stone-tool production and use, and tasks requiring shell tools, manufactured mainly from *Tellina radiata* and *Strombus gigas*, coral scrapers, abraders, and rasps, and flakes created from locally available limestone. The artifacts in activity area #2, S34-S42, located at the southern end of the site, appear to have been left in situ. Food preparation, and possibly consumption, took place there. Conch *(Strombus gigas)* tools were produced and chert microliths were used for various tasks two meters south of the food preparation area. The area was relatively free of bone and the charcoal remains were highly fragmented, suggesting that it was highly maintained. An area characterized by low densities of bone, ceramic, and coral, S22-S32, the low-density area, separates the activity areas from one another.

Other activities were noted. Bead productions, as indicated by small beads (three mm and less in diameter) and bead blanks, were recovered throughout the site. Although most of the beads were found in the midden, a specific locus of production could not be identified. Palmettan Ostionoid ceramics, in various stages of manufacture (e.g., unfired lumps of untempered clay, unfired pottery), are present in the midden and in activity areas #1 and #2, too. No unambiguous evidence of structures or postholes was recovered. There is no indication that the remains were subjected to conflagration. Therefore, none of

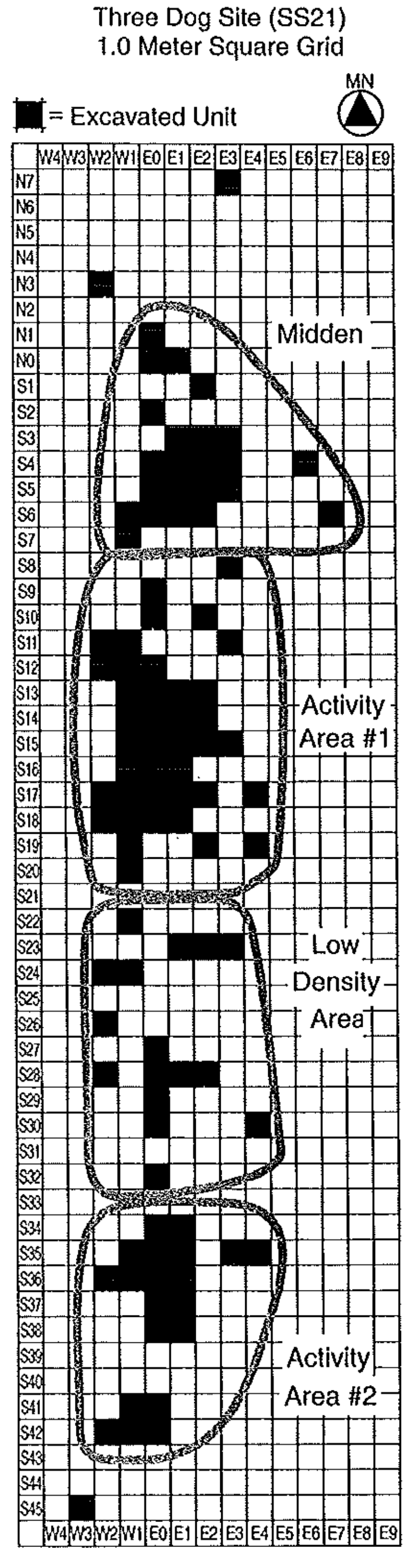

Figure 3. Three Dog Site Excavation Units and Activity Areas.

the charred wood is believed to have been produced from burned construction timbers. Moreover, there is no evidence that pottery firing took place at the site.

The early component of the Three Dog site reflects the domestic activities of one or possibly two households dating to the ninth or tenth centuries A.D. This early colonizing population, while successfully exploiting a local environment different from that of the Greater Antilles, also attempted to reproduce the biotic and cultural landscape of its homeland. The utilization of the adjacent reefs and nearby marine, inter-tidal, and inshore areas for food and tools reflected adaptation to local environmental conditions, as well as knowledge of animal behavior and capture techniques of the same marine fauna applied in Antillean environments (Tabío and Rey 1979). The remains of freshwater turtle in the midden may be an example of transported biota (Berman 1994). Alternatively, such fauna may have been procured through trade because of a culturally conditioned dietary preference. (An alternative explanation is that the freshwater lakes, today too saline to support freshwater fauna, may have been capable of supporting such biota in the past.) The technological strategies of artifact manufacture reflect the use of local materials and, in some cases, attempts to re-create tool forms present in homeland contexts, in spite of the fact that the raw materials differed. The ceramic assemblage, a temporally distinct variant of Palmettan Ostionoid ware, was manufactured from local clays and tempered with carbonate shell sand, gathered presumably from nearby beach strands. The application of appliqué and punctation to vessel surfaces, the manufacture of boat-shaped vessels and specific rim styles, and the firing of the local clay in a reduction environment reflect attempts to reproduce a technology typical of the Greater Antillean late Ostionan-Ostionoid and Meillacan-Ostionoid pottery from local materials. Bipolarly produced chert microliths made from nonlocally occurring materials from the Greater Antilles were used probably as inserts in root or tuber graters and for incising or engraving (Berman et al. 1999). Simple percussion flakes used in cutting and scraping resembling those made from cherts and other siliceous materials from parts of the Greater Antilles (Tabío and Guarch 1966) were derived from local limestone. Finally, the importation of nonlocal raw materials and goods from the Greater Antilles brought by the site's settlers or procured through trade, exchange, or direct acquisition is evident from a body of nonlocally manufactured ceramics and non-naturally occurring materials such as quartz abraders used in on-site shell-bead manufacture and the stone used to manufacture the microliths (Berman and Gnivecki 1995; Berman et al. 1999). An examination of wood and seed remains and plant residues (see below) explores the possibility that certain plants might, too, have been transported to re-create the homeland landscape.

Recovery and Identification of Plant Remains

We used four means of investigating plant use at the site. These included the study of charred botanical macroremains recovered from 1/16 inch (1.58 mm) mesh screen, in situ finds, and those remains recovered by water flotation; SEM analysis of chert microliths; phytolith analysis; and pollen analysis. Phytolith and pollen analyses failed to produce conclusive identifications (Berman 1992; Pearsall 1989), so they will not be discussed here. In both instances, the phytoliths and pollen were too eroded to permit precise identifications. The high pH of the deposits most likely contributed to the degraded state of the pollen grains and phytoliths, as did mechanical damage caused by wind and water erosion and deposition. The coarse nature of the matrix and the alternate wetting and drying of the deposits resulted in destruction and breakdown of macroremains.

Charred wood and seeds observed from in situ contexts and screens, referred to as carbon samples, were removed by tweezers and placed in aluminum foil bags that were then inserted into plastic bags. These were subsequently put in storage boxes insulated with ethafoam sheaves for storage and transferred to the University of Missouri-Columbia Paleoethnobotany Laboratory for examination.

Flotation, the process of separating charred archaeological plant remains from soil matrix by difference in specific gravity (Pearsall 2000), was carried out at the field laboratory on San Salvador. During excavation, between 20–22 liters of soil were sampled from the cultural level of each square for flotation. Additional samples were taken for phytolith and pollen study. All but a few samples floated the first year of the project were processed using an IDOT-style flotation system (Pearsall 2000) (Figure 4). Initially, the flotation box was constructed with 0.5 mm mesh to enhance recovery of small seeds. However, this resulted in very large heavy fractions,

Figure 4. Students Engaged In Flotation.

since much of the sandy matrix consisted of grains larger than this. After testing a variety of mesh sizes, the system was rebuilt with .84 mm mesh, which allowed the coarse matrix to pass through, but was small enough to catch small seeds. Both light and heavy (non-buoyant) fractions were examined for most samples.

Samples were sorted following standard procedures (Pearsall 2000). Materials were identified by direct comparison between archaeological types and the comparative collection of Caribbean wood species housed at the University of Missouri Paleoethnobotany Laboratory following the procedures described in Pearsall (2000).

Charred wood constituted the vast majority of remains recovered from both flotation and carbon samples, a pattern observed at other sites in the Caribbean where paleoethnobotanical recovery has been undertaken. Pearsall identified wood from eight carbon samples and eight flotation samples. All but two samples were from area N1-S7, the midden. The other two samples were from the S34-S42 activity area.

Wood was identified by direct comparison between archaeological types and the laboratory comparative collection of Caribbean wood species following the procedures described in Pearsall (2000). Features of wood commonly used for identification include vessels and their arrangement, size and arrangement of rays, abundance and nature of parenchyma, and physical characteristics such as texture and hardness. These features were viewed in the traverse (cross) section at 10–45 ×. For each sample, 20 pieces of wood were randomly selected for identification. In the case of samples that lacked 20 pieces, Pearsall examined all specimens of sufficient size.

There are about 100 genera of woody plants on San Salvador, divided among 41 families (Smith 1982, 1993). There are 46 of these genera in the Missouri comparative collection, in 30 families. All these were examined and compared to the six archaeological wood types in the Three Dog site samples. It was possible to identify most of the archaeological types to the genus level, which allows an assessment of patterns of wood utilization at the site. One archaeological type, Taxon 5, had no good match in the collection. Certainty of identification is discussed for each type below. We plan, as part of future research that compares wood utilization patterns among sites in the Bahamas, to work further on identifying Taxon 5, and to compare all archaeological types to an extended comparative collection.

Charred Wood Remains

Six wood taxa (including one unknown taxan and a body of unidentified fragments) were identified. The total wood count consisted of 1,005 pieces (Figure 5). A total of 232 pieces of wood was identified; only 19 fragments remain unidentified. The most common wood (n = 157) observed in the samples was *Erythroxylon* sp. (Erythroxylaceae). This taxon made up 74.8% of all identified wood. *Erythroxylon* is a genus in the coca family and is represented by two species on San Salvador (Smith 1982, 1993) and four species on Andros (Nickrent et al. 1991). Both San Salvador species occur in the scrublands. They are listed for the blackland plant community, an area of dense vegetation and high species diversity that covers most of the higher inland area of San Salvador. The archaeological specimens were quite hard, dense, and difficult to break. There is a good match between the archaeological type and *Erythroxylon* sp., not 100% certain, but a high probability.

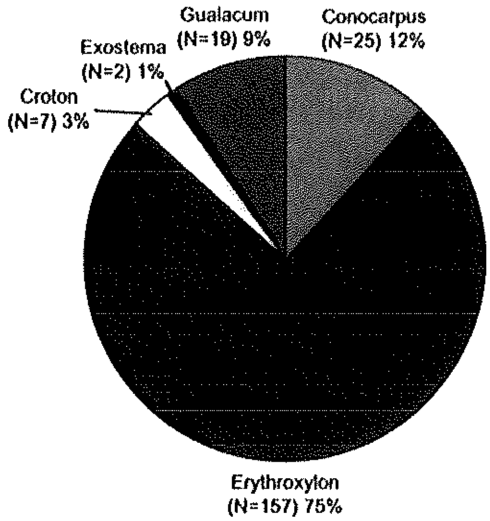

Figure 5. Site-Wide Occurrence of Identified Wood.

The next most common wood type, *Conocarpus* sp. (Combretaceae), made up 11.9% (n = 25) of all identified wood. *Conocarpus* is a genus in the white mangrove family, which is represented by four genera with one species each on San Salvador (Smith 1982, 1993) and on Andros (Nickrent et al. 1991). These species are *Bucida buceras, Conocarpus erectus* (buttonwood), *Laguncularia racemosa* (white mangrove), and *Terminalia catappa* (introduced, cultivated almond). The three wild species are represented in the Missouri comparative collection. Their wood is quite similar, but the archaeological type is most like *Conocarpus erectus*. It could possibly be one of the others, however. *Conocarpus* occurs in the open thicket formation of the blackland community, in palmetto flats, and in the back or higher side of mangrove swamp formation.

The next most common wood type in the Three Dog site samples is *Guaiacum* sp. (Zygophyllaceae), constituting 9.0% (n = 19) of all identified wood. Only one species in the Zygophyllaceae is listed for San Salvador and Andros (Nickrent et al. 1991). *Guaiacum sanctum*, lignum vitae (Smith 1982, 1993), occurs in the blacklands coppice formation. There is an excellent match between the archaeological type and lignum vitae. The archaeological specimens resemble no other wood in the collection. The wood is very hard, with occasional resinous inclusions in pores. It breaks very unevenly.

Croton sp. (n = 7) (Eupohobiaceae) ranks fourth in order of occurrence in the Three Dog site samples. It makes up 3.3% of all identified wood. *Croton* is a genus in the spurge family, which is represented on San Salvador by 16 genera (not all woody) and many species (Smith 1982, 1993). Six species of *Croton* occur, in scrub lands and coastal thicket habitats, while three species have been listed for Andros (Nickrent et al.1991). Species are listed in the *Coccothrinax*-shrub subcommunity of the coastal coppice community. The remains resembled both *Croton* and *Savia*, both in the Euphorbiaceae. The best match was to *Croton*, but it could be another genus in the family.

The least common identified wood in the Three Dog site samples was *Exostema* sp. (Rubiaceae), making up 1.0% (n = 2) of all identified wood. *Exostema* is a genus in the madder family, which is represented on San Salvador by 15 genera and many species (Smith 1982, 1993). One species is present on Andros (Nickrent et al.1991). *Exostema caribaeum* is listed for the blacklands coppice community. The archaeological wood was very similar to *Exostema*, but other genera in the family are possible.

In addition to the identified wood, which made up 90.5% of all wood examined, 9.5% of examined wood in the samples could not be identified. Some of this wood (n = 3, 1.3% of total wood) made up an unknown type, Taxon 5, which did not match anything in the comparative collection. The rest of the unidentified wood was too fragmented (n = 19) to characterize accurately.

It is informative to examine the wood data in terms of the site's four spatial units (Table 1). Charred wood varied in abundance among these areas, providing additional information about the nature of the activities that occurred at these loci. The distribution information presented here is based on flotation and carbon samples. Wood was counted and weighed from these samples, and nonwood remains tallied, but no further wood identifications were made due to time and funding limitations.

The midden is represented by 24 flotation samples, and 48 carbon samples, in addition to the 14 samples studied for wood identification discussed above. Flotation samples averaged 7.3 pieces of wood/sample, carbon samples 23 pieces/sample. The midden produced the highest wood concentrations in flotation samples. A large number of in situ or screen finds of wood in moderate concentration also occurred. Activity area #1 contained the second most abundant wood concentrations in flotation samples,

Table 1. Site-Wide Occurrence of Charred Wood Remains

Site Area	Recovery Mode	Number of Samples	Wood Count	Wood/ Sample	Sapotaceae Seed
Midden	Flotation	24	175	7.3	2
	Carbon Samples	48	1100	23	1
Activity Area #1	Flotation	17	66	3.9	3
	Carbon Samples	110	3731	34	1
Low Density Area	Flotation	1	0	0	0
	Carbon Samples	13	261	20	0
Activity Area #2	Flotation	8	5	0.6	0
	Carbon Samples	15	407	27	0

3.9 pieces per sample (17 samples). More in situ or screen finds of wood occurred in this area than in the midden and wood was more concentrated: 110 finds with 34 pieces/find. The midden and activity area #1 are similar in showing relatively abundant wood remains, suggesting that activities involving burning and/or disposal of burned waste occurred here. Wind-borne fragments may have contributed to the accumulation. Interpretations of activity area #1 as a food preparation area and N1-S7 as a midden are consistent with the wood data. These areas are also similar further in that each contained fragments of Sapotaceae seeds (see below).

Little charred wood was recovered from the low density area: 13 in situ or screen finds, 20 pieces/find. This area yielded the lowest incidence of charred remains. No plant evidence that could be interpreted as food remains were recovered here. The single flotation sample contained no material. It appears that any burned debris that might have been present in this locus was cleared away and disposed of, leaving little in the way of charred remains. The wind may have deposited the few small fragments present in this area.

The artifact assemblage found in activity area #2, particularly in the squares designated as S34-S38, suggests the locus was a food preparation area. The wood record is distinct from that found at activity area #1, however. It resembles more closely that recovered from the low-density area. Only 15 in situ or screen wood finds, 27 pieces/find; 0.6 pieces of wood/flotation sample (8 samples) were recovered. No economic plants were present. We can assume that if burning occurred here, the site's inhabitants disposed of charred remains by sweeping, raking, pick-up, or other forms of disposal. DeBoer and Lathrap (1979) and Siegel and Roe (1986) observe that the Shipibo Indians of eastern Peru remove habitation refuse from their residential areas through various clean-up and maintenance practices. Both note that the inhabitants keep their house areas and plazas essentially clear of refuse. Columbus noted that the Lucayan houses on Long Island (Fernandina) were "well-swept and clean" (Dunn and Kelley 1989:93). Although Columbus recorded this observation 500–600 years after the early component of the Three Dog site was abandoned, it is possible that site inhabitants maintained their houses and habitation area similarly and engaged in numerous debris removal practices resembling those reported for contemporary peoples.

Seed Remains

The systematic program of water flotation and screening carried out at the Three Dog site yielded abundant wood remains, but little else. The paucity of accidentally charred wild seeds, as well as other food remains and economic plants, is puzzling, given the contexts sampled. We expected more food refuse from the midden and food preparation areas than that from other locales. We discuss possible explanations below.

Seven charred fragments of the robust seeds of a Sapotaceae fruit, probably *Manilkara* sp. or *Mastichodendron* sp., were encountered in areas N1-S7 and S8-S20. In addition, eight carbonized seed-coat fragments of another, unidentifiable plant, and two pieces of porous tissue, possibly root or tuber fragments, were found in these areas. No economic plants were found in the other areas of the site. Newsom (1993:32) noted 11 charred seed-coat fragments, probably belonging to *Mastichodendron foetidissimum* (mastic bully) mixed in samples sent to the Florida Museum of Natural History for faunal analysis.

The Sapotaceae, or sapodilla family, is a large tropical family of trees and shrubs occurring throughout the Neotropics. *Mastichodendron* (mastic-bully) is the most widely observed plant food resource in the Caribbean, having been recovered at sites dating to all time periods in the Lesser and Greater Antilles (Newsom 1993:315; Newsom and Pearsall 2000). This may be a result of preservation as much as a dietary or economic preference, as the seed is large and robust (Little and Wadsworth 1964:454). This tree grows in moist, limestone coastal environments (Little and Wadsworth 1964:454) and is adapted to numerous soil types, particularly calcareous soils (Martin et al. 1987:60). Two species of *Manilkara* are found in San Salvador's blackland community (Smith 1993:45). Wild dilly, *Manilkara bahamensis,* is found in the scrublands (Smith 1993:45). Sapodilla, *Manilkara zapota*, the cultivated form, is grown in house gardens on San Salvador (Smith 1993:84) and throughout the Bahamas as human and animal food (Randolph et al. 1997).

SEM Examination of Microliths

Six bipolar-produced chert microliths consisting of three compression flakes, one distal flake, one retouch flake, and one thinning flake (Berman et al. 1999) were examined using the scanning microscopy facilities of the Geology Department, University of Missouri, in October 1997. The objective of the study was to see if phytoliths were present on the artifacts. Due to extensive mechanical and chemical weathering of the microliths, high-power microwear analysis failed to detect evidence of use that could be attributed unequivocally to plant processing (Berman et al. 1999). However, the microliths' small size and distinctive morphological and technological characteristics resemble chips set in grater boards used to process manioc. A substance resembling the resin applied by the Post-Classic Yucatan Maya to secure their grater chips into grater boards (Sievert 1992) was present on several of the microliths, strengthening the association. Manioc, the basis of the Taíno subsistence economy (Sauer 1966; Sturtevant 1969, 1991), is assumed to have been grown, too, by the Lucayan-Taíno (Keegan 1992, 1997). Therefore, an important part of our study is to develop ways of locating manioc archaeologically from Lucayan sites and identifying the timing of its introduction from the Greater Antilles. However, manioc does not produce phytoliths. Thus, we looked for evidence of other plants that might have been processed using the microliths.

No phytoliths were observed on any of the tool surfaces, but organic material was relatively abundant back from the edges and in crevices on the surfaces (Figure 6, a-f). The material pictured in Figure 6 was determined to be organic by elemental analysis and morphology. The composition of the residues was studied using an energy-dispersive x-ray spectrometer (EDS) with a standard berilium window, which absorbs energies below 1 keV (thousands of electron volts). The x-ray energies for carbon (.277 keV) and oxygen (.525 keV) have values well below the 1 keV and thus can not be detected. Materials that produce no characteristic x-ray lines (peaks) about 1 keV are interpreted, by default, as organic (L. Ross, personal communication, 2000). Elemental analysis of the particles illustrated in Figure 6 showed only aluminum as an artifact peak, gold from the sample coating, and silicon from the stone tools themselves. No other elements registered. Most of the material adhering to the microliths was in the form of thin, torn tissue fragments. Few diagnostic features were visible on these. However, several of the microliths had smooth spherical bodies adhering to the surfaces (Figure 6 a, c, f). These bodies tended to fracture in the element beam and in the condensing electron beam (i.e., at higher magnifications needed to observe the spheres). Organic signals were obtained, however, before several of the spheres exploded. The spheres ranged in size from 3–15 microns.

Although microwear study indicated that rootlets and a resinous substance were present on several of the microliths (Berman et al. 1999), we did not expect a high degree of organic preservation on the set of artifacts chosen for phytolith study. Thus, all six were gold-coated, mounted on stubs, and examined following standard SEM procedures. This precluded removing the spherical bodies and testing whether they were starch grains (i.e., with iodide test or under polarized light). The alternative would be very small fungal spores as pollen grains are typically larger. The spheres are the right size and shape—small and spheroidal to irregularly angled—to be starch from *Xanthosoma* sp. (*cocoyam, malanga, yautía*), the native Caribbean aroid. Aroids produce some of the smallest starch grains of any root crops. The mean for *Xanthosoma sp.* is about 12 microns according to Loy (1994:106). A comparative specimen of cultivated *Xanthosoma* in the University of Missouri comparative collection produced starch grains ranging from 2–16 microns, with a mean of 7.2 microns for 45 grains. Starch from an

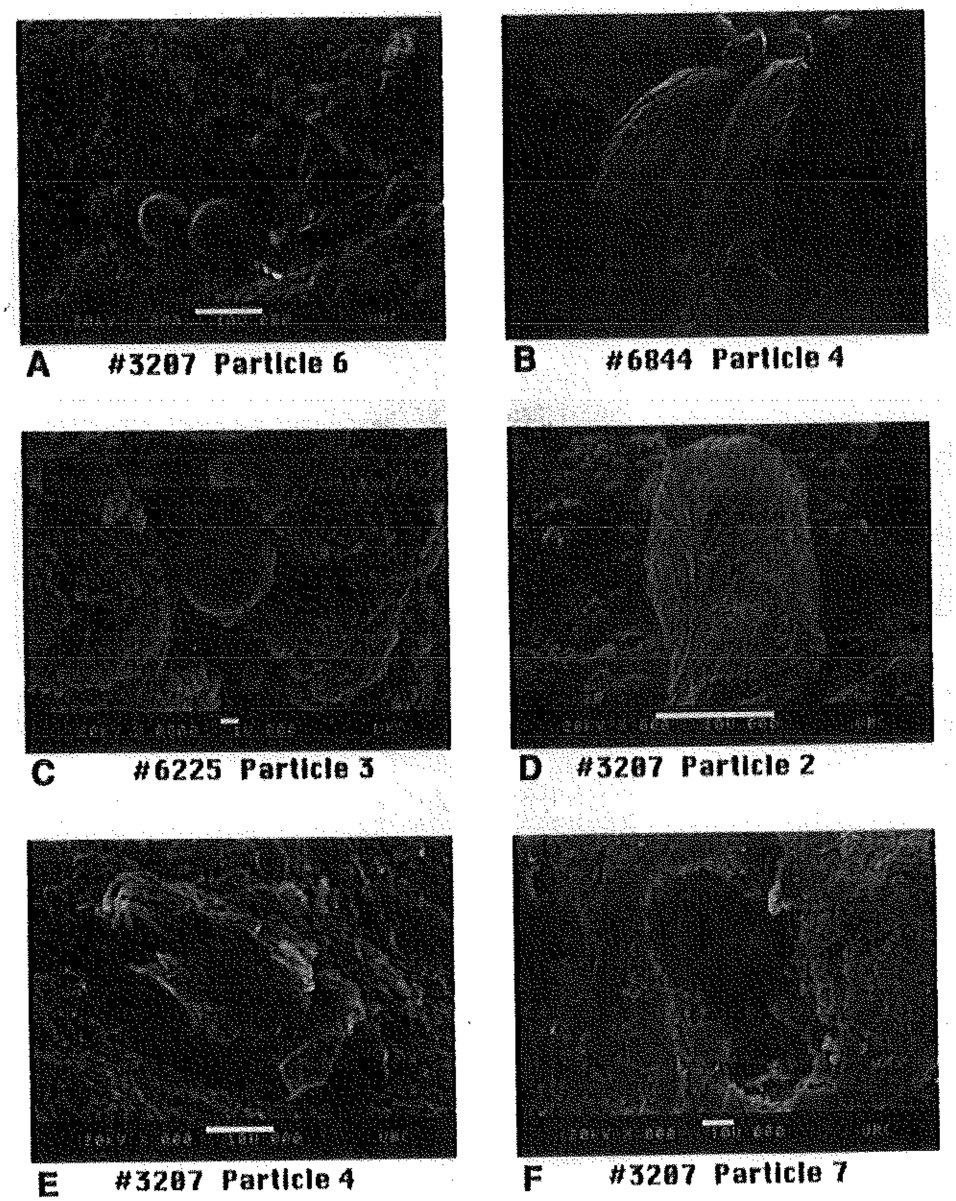

Figure 6. Plant Remains Observed Using SEM.

ornamental *Zamia* was also examined; grains were virtually the same shape as *Xanthosoma*, but somewhat larger (range 4–24 microns, average size of 9.8 microns for 45 grains). The grains on the microliths are not consistent in size or shape with manioc starch that ranges in size from 5–20 microns and are bell-shaped (Piperno and Holst 1998:775). Like other tropical tubers and roots, the starch from *Xanthosoma* sp. is extracted by grating and boiling (Piperno and Pearsall 1998:116). The starch residing in the subterranean stem of *Zamia* is removed by grating and pounding (Sturtevant 1969). Since the chert microliths resemble the technology associated with processing the root crop, manioc, it is possible that they were used, too, to prepare other root and tuber crops, in this case, possibly *Xanthosoma* sp. or *Zamia* sp. Study of other chert microliths using methods appropriate for starch grain analysis is planned, as is a systematic study of the starch of cultivated and wild tuber and root resources of the Caribbean.

Table 2. Wood Hardness and Specific Gravity

Species	Hardness[a]	Specific Gravity[a]	Site
Conocarpus sp.	Very hard	1.0 (Heavy)	Three Dog, Coralie
Croton sp.	Moderately hard	0.6 (Moderately heavy)	Three Dog
Erythroxylon sp.	Hard	Heavy	Three Dog, Ward-Minnis
Exostema sp.	Hard	1.0 (Heavy)	Three Dog
Guaiacum sp.	Extremely hard	1.2–1.3 (Heavy)	Three Dog
Krugiodendron ferreum	Exceedingly hard	1.3–1.4 (Exceedingly Heavy)	Coralie
Zanthoxylum flavum	Very hard	0.9 (Heavy)	Coralie

[a]Conocarpus (Little and Wadsworth 1964:390); Croton (Little and Wadsworth 1964:266); Erythroxylon (Little and Wadsworth 1964:210); Exostema (Little and Wadsworth 1964:508); Guaiacum (Little and Wadsworth 1964:214); Krugiodendron (Little and Wadsworth 1964:320); Zanthoxylum (Little and Wadsworth 1964:228)

Discussion

Excavations at the Three Dog site represent the first systematic attempt to report and interpret plant remains from archaeological sites in the Commonwealth of the Bahamas. Flotation and screening yielded evidence of only a few economic plants, but abundant wood remains permit discussion of wood procurement patterns and offer insights into past environments. SEM analysis indicated that possible *Xanthosoma* sp. starch grains were present on some of the chert microliths, suggesting they were used for plant processing.

Charred Wood

Wood charcoal was well preserved in most Three Dog site flotation and carbon samples. However, we must consider a number of preservation-related issues bearing on interpretation. The preservation of charred wood is a complex process dependent upon numerous factors related to wood temperature, moisture content, chemical composition, wood size, length of exposure to the fire, firing temperature, and amount of oxygen among other things (Lopinot 1984; Miksicek 1987; Smart and Hoffman 1988:172; Thompson 1994), rendering wood taphonomy a poorly understood topic (Thompson 1994). Soil chemistry, floral- and faunalturbation, and aeolian and alluvial processes during and post-deposition also affect the kinds, amounts, and physical properties of charred wood, as well as other plant remains likely to be recovered from the archaeological record (Miksicek 1987). Woods with high specific gravities and high extractive content are more likely to survive through time (Thompson 1994; Rossen and Olsen 1985). With the exception of *Croton* sp., which is moderately hard, all of the woods observed from Bahamian archaeological deposits range in hardness from hard (*Erythroxylon* sp., *Exostema* sp.) to exceedingly hard (*Krugiodendron ferreum*) and have specific gravities that vary from heavy to exceedingly heavy (Table 2). This might explain why *Croton* sp. constitutes a minor portion of the Three Dog site wood assemblage. Moreover, in addition to being a heavy wood, *Guiacum* sp. contains a distinctive oily resin (Little and Wadsworth 1964:212).

The charred wood appears to have been primarily the byproduct of purposeful burning from cooking. Pieces of charred wood and ash were found adhering to the exterior of numerous vessel sherds from the midden and both activity areas. Other sources of the site's charcoal assemblage can be attributed to incinerating food and debris for garbage removal, smoking fish and shellfish, and making smoke to serve as insect repellant. On San Salvador, today, for example, numerous people burn *Conocarpus* sp. because it repels insects. The incineration of plant remains involved in the preparation of medicines, adhesives, dyes, and tools, and other woodworking and wood-using activities may likely have contributed to the charred-wood assemblage. Seeds might have fallen accidentally into fires. Airborne fragments probably made their way into some of these fires.

Numerous reasons exist why people choose specific fuelwoods. These include firing and heating properties, availability, abundance, proximity, ease in gathering and transport, and the kind of procurement technology that exists within the culture (Smart and Hoffman 1988). Woods with high specific gravities make the best fuel because they produce more intense heat and burn more slowly and steadily than low-density woods (Shelton and Shapiro 1976:18). Other woods make good fuel because they contain resin that increases their kilocaloric and energy values.

Berman (1992:6) has suggested that the site's inhabitants practiced least effort strategies in the selection of some of their woods. For example, three of the woods found in the assemblage, *Guaiacum* sp., *Erythroxylon* sp., and *Exostema* sp., grow in the blackland plant community. Today, the site is adjacent to this community, and the high organic content of the soil in which the cultural remains were deposited suggest that prior to and during the aboriginal period, the site was situated in this plant community. Carneiro (1978:201–202) has observed that the Kuikuru of Brazil collect their fuelwood over a period of several months from the charred wood produced from preparing their fields. In this way, fewer trips to the dense parts of the forest have to be made. Thus, proximity to the habitation area may have been a factor in selecting these woods. *Conocarpus* sp. grows on the backsides of dunes and is a component of the mangrove formation. In the Bahamas, mangroves grow typically along tidal creeks and inland lakes. It has been suggested that a tidal creek once connected a portion of the coast to the north of the site; a small mangrove swamp is located there today.

Ford (1979, 1988) has noted that cultures have their own unique classification systems for firewood. Certain species are preferred over others depending on the tasks for which they are put or taboos that have been conferred upon them. Some species are avoided. Shackleton and Prins (1992:633) suggest that in relatively unexploited areas where wood is plentiful, inhabitants select species that are the most desirable for their intended purposes. They propose that people first select dry wood of a particular species, since it is lighter to carry and takes less time to dry than fresh wood. If little wood exists, people will take whatever materials are present (Shackleton and Prins 1992:633).

The Three Dog site presents an interesting case to examine this observation, since it represents one of the earliest occupations on San Salvador. There is no evidence of earlier settlements on the island, although the North Storrs Lake site appears to be contemporaneous, and Dune #2, Pigeon Creek site (SS-1) was occupied slightly later. The inhabitants of the Three Dog site would have found themselves in an unexploited environment, one in which they could choose from a variety of species. Since wood would have been readily available, the species that we find in the assemblage might have been chosen for particular reasons, not just proximity. Least effort might have played a role in selection but was not necessarily the only reason for the procurement of certain woods. When the fuelwood assemblages from other sites such as the Pigeon Creek and North Storrs Lake sites are analyzed completely, we will have a clearer idea as to why certain species were chosen. Newsom (1993) and Newsom and Pearsall (2000) have found that the Ceramic Age inhabitants of the Greater Antilles used a wide variety of fuelwoods, although some woods appear consistently through time, a result of vegetation similarities among the islands, and, in the case of the small, arid islands, limited species.

Arboriculture

The evidence for the consumption of Sapotaceae fruits in this early Lucayan occupation raises the possibility that tree fruit stocks (or seeds) were brought by the inhabitants from their Greater Antillean homelands to San Salvador and presumably to other islands during the colonization of the archipelago during the Ceramic age. From this evidence, it can be inferred that the site's inhabitants kept and maintained home gardens or established and managed such trees in their natural settings. Newsom (1993) and Newsom and Pearsall (2000) have found evidence of Sapotaceae seeds from Archaic and Ceramic Age sites in the Lesser and Greater Antilles and have suggested that these were introduced initially from South America and brought up the Antillean chain with advancing migratory movements. Since it is difficult to distinguish between wild or cultivated Sapotaceae from our data, it is possible that the site's inhabitants harvested, and possibly cultivated, wild forms. Tropical forest agriculturists are well known for leaving useful wild trees, transplanting them, and creating disturbed habitats that encourage the spread of wild trees (Piperno and Pearsall 1998).

Sapotaceae seeds and seed fragments are found throughout the Caribbean. *Manilkara* sp. seeds have been recovered from several sites, including the Archaic age Krum Bay site in the Virgin Islands (Newsom and Pearsall 2000; Pearsall 1990). Charred-seed fragments (Pearsall, lab documents) from the Rio Chico site in north-central Cuba indicate that Sapotaceae fruits were utilized by people there as early as 3070 ±70 B.P. (Beta 99071; charred wood and seeds; $\delta^{13}C$ =-27.2‰) or cal 1485–1120 B.C. (p = .95), cal 1414–1260 B.C. (p = .05). (Calibrated at 2 sigma with the Beta Analytic/Pretoria Calibration

Program [Stuiver et al. 1998; Talma and Vogel 1993].) Pearsall (1995a) identified Sapotaceae (cf. *Mastichodendron*) wood and seed-coat fragments from both the early (A.D. 150– 649) and late (A.D. 1140–1390) occupations at the Tutu site, U.S. Virgin Islands. Newsom (1993:230, 248) reports that wood and seeds from two to three species of Sapotaceae were recovered from the Chican Ostionoid occupation (A.D. 1250–1500) at En Bas Saline in Haiti.

Heaton (1997) reports that *Manilkara* sp. is a relatively difficult plant to propagate. The germination of seeds is difficult and slow. Today, various methods such as cuttings, veneer-grafts, and approach grafting are used successfully. While it is possible that humans imported *Manilkara* sp. seeds or cuttings to San Salvador, natural vectors may have been responsible for the dissemination of Sapotaceae trees throughout the islands. As discussed above, charred remains are too fragmentary for identification except at the family level; we do not know whether the seeds are from wild or cultivated fruits. Animals are the most likely dispersers, since the fruits and seeds are large. Bats are believed to be one of the main pollinators of the plant (Heaton 1997). Finally, it is possible that the uncultivated forms of the trees were already present when the colonizers arrived.

Tuber and Root Crops

Our study of chert microliths suggests that *Xanthosoma* sp. (native American *cocoyam*, *yautía*, and *malanga*) may have been processed at the site, as starch grains consistent in size and shape with *cocoyam* are present on a small sample of microliths. *Zamia* root, which produces similar, but larger, grains is another possible source of the starch on the microliths. If the identification of *Xanthosoma* sp. starch grains is confirmed in our follow-up study, this finding implies that the prehistoric inhabitants of the site either harvested wild *Xanthosoma* sp. present on the island, brought domesticated *Xanthosoma* sp. with them from the Greater Antilles, or were involved in trading relationships in which such plants or plant stocks were transferred. Sturtevant (1969, 1991) notes that the Taíno grew yautía, *Xanthosoma sp. sagittifolium*. *Cocoyams* were grown in tropical Central and South America and the Caribbean at the time of European contact, with distinctive varieties (if not species) grown throughout the region. Too little is known to suggest an ancestral species or region, however (Piperno and Pearsall 1998:116–117). *Zamia* sp. is mentioned in the chronicles, as well; the Taíno used it, too, as a source of dietary starch. Veloz Maggiolo and Vega (1982) recovered *Zamia* sp. remains from Archaic contexts in the Dominican Republic. The Three Dog site data suggest the intriguing possibility that *Xanthosoma* sp. and/or *Zamia* sp. may have been harvested and consumed at least by the A.D. 800s in the central Bahamas.

Paleoenvironmental Reconstruction

It is useful to consider the Three Dog site botanical results in the context of human-landscape interrelationships on the island at the time of site occupation. As mentioned earlier, there are two pollen sequences available for the Bahamas that shed light on the nature of vegetation at the time of human migration to the islands and on the subsequent impact of humans on island environments. Table 3 summarizes these sequences from Church's Blue Hole on Andros Island (Kjellmark 1996) and the North Storrs Lake site on San Salvador (Jones 1997), with other sequences from the Caribbean (Burney et al. 1994; Curtis and Hodell 1993; Higuera-Gundy 1991; Hodell et al. 1991; Jones and Pearsall 1999; Siegel et al. 1999).

The earliest section of the Andros Island sequence, Zone 3, documents a pan-Caribbean dry period (3000–2500 B.P. to around 1500 B.P.) and is a unique combination of species for the island (Kjellmark 1996). The Bahamas may have been too dry for human habitation at this time due to lack of surface water. Conditions ameliorated after 1500 B.P. and hardwood thickets adapted to mesic conditions became established (Zone 2). Toward the top of this pollen zone, pine pollen begins to increase in frequency, and there is a decrease in some hardwoods and a slight increase in charcoal concentration values. High levels of pine pollen are associated with a charcoal peak at 740 B.P. (beginning of Zone 1). Kjellmark (1996) interprets this change as anthropogenic burning, since fire is essential for maintaining pinelands on Andros. Associated high levels of bracken fern further support this interpretation.

A series of pollen samples from underwater levels at the North Storrs Lake site suggest that a similar sequence of vegetation shifts occurred on San Salvador. Dates from the site bracket the period from 1140 B.P. to 360 B.P. (IACA 1998). The pollen sequence, summarized from Jones (1997), is placed on Table 3 to reflect the earliest site date and two dis-

Table 3. Pollen and Charcoal Records for the Caribbean.

Years b.p.	Church's Blue Hole Andros Island Bahamas[a]	North Storr's Lake San Salvador Bahamas[b]	Lake Miragoane Haiti[c]	Lake Tortuguero Puerto Rico[d]	Lake Maisabel Puerto Rico[e]
		Zone 1	**Zone 7** Severe		**Zone 4**
			deforestation		0-75cm: recent
500	**Zone 1**	Open, taxa shift			base: charcoal &
	Pinewoods	**Zone 2** Charcoal			weeds increase
750	Charcoal peak	peak, disturbed	**Zone 6**		**Zone 3**
		Zone 3	Disturbed forest		
				Zone 4	
1000	**Zone 2**	Wooded (palm,			Arboreal increases;
	Hardwood thicket	Combretaceae)			
	mesic		**Zone 5**	Charcoal low	moister,
					low charcoal,
					herbs & cultigens
1500					abundant
			Drier, open forest		
			weeds common,		**Zone 2**
	Zone 3		charcoal peak,		Arboreal low;
			rapid sedimentation		charcoal, weeds,
2000					grasses increase
	Shrubby, open			**Zone 3**	**Zone 1** Arboreal low;
	drier than modern				charcoal moderate
2500					
			(Drying starts)	Charcoal	
				decreased	
3000			**Zone 4**	(moderate-low)	
			Mature mesic forest,		
3500			charcoal increases,		
			fluctuates	**Zone 2**	
				High, sustained	
4000			**Zone 3**	charcoal, first	
4500			Pioneer mesic forest,	from grasses,	
			charcoal increases,	then grasses	
5000			fluctuates	and wood	
5500					
6000			**Zone 2**	**Zone 1**	
6500			Moderate forest		
7000			growth; low charcoal	Charcoal absent	

[a] Kjellmark (1996).
[b] Jones (1997).
[c] Curtis and Hodell (1993); Higuera-Gundy (1991); Hodell et al. (1991).
[d] Burney et al. (1994).
[e] Jones and Pearsall (1999); Siegel et al. (1999).

tinctive vegetation shifts. Mesic woodlands (Zone 3, palm, white mangrove, and other taxa) are replaced by more open, disturbed environments at the point where a charcoal concentration peak occurs (Zone 2). Pine pollen is present, but in this case represents long-distance transport: levels are low throughout the sequence and pine does not occur today on San Salvador (Patterson and Stevenson 1977). Disturbance continues and intensifies later in the sequence (Zone 1, placed at European contact; herbs and cultigens drop as human population declines; new [introduced?] taxa appear).

The anthropogenic influences documented in the Andros Island sequence at 740 B.P. and later postdate archaeological evidence for the initial peopling of the archipelago, which dates to the A.D. 700s for Grand Turk (Keegan 1997:22) and the A.D. 800s for San Salvador (Berman and Gnivecki 1995). This finding could be explained by a later occupation of Andros or a light environmental impact by early colonists. In other words, if people arrived around 1100 B.P. on Andros, as on San Salvador, the occupation did not have a dramatic initial impact on the environment. The point in the sequence where the vegetation shift began (top of Zone 2) is interpolated by Kjellmark (1996) to date to 900–1000 B.P. Perhaps this marks the initial peopling of Andros.

If we use the Andros sequence to model the vegetation of San Salvador, the Three Dog site was occupied some 400 years into a mesic interval that followed a long dry period that affected much of the Caribbean. Wood resources would have been abundant, both in coastal thickets and mangroves and in the inland blacklands formation. Numerous wild trees with edible fruits would have been available. Pollen from the lower levels of the North Storrs Lake site core is consistent with the presence of such communities. The extensive blacklands formation is preferred today for agriculture (Smith 1982, 1993). Humans eventually disturbed this environment by clearing trees creating open habitats suitable for planting seed and root crops. In doing so, this allowed and encouraged the spread of wild native and introduced plants preferring such areas. Many of the most important tree crops of the Neotropics, including a number of species in the Sapotaceae, are adapted to secondary growth and open habitats. Some tree crops, like guava (*Psidum guajava*) and a number of palms, in fact, thrive to the point of invasiveness in human-influenced environments (Piperno and Pearsall 1998:155–158). Sapotaceae pollen rises slightly in later levels in the North Storrs Lake site sequence. The increasing frequency of these useful trees is consistent with the occurrence of charred seed coats of *Manilkara* or *Mastichodendron* in the Three Dog site deposits.

This pattern of anthropogenic vegetation change occurs throughout the Caribbean. In the other islands for which there are data, the charcoal and vegetation shifts discussed above occur against a backdrop of drier climatic conditions (i.e., shortly after the beginning of the most xeric interval, 2500–1500 B.P.). The later occurrence of this shift in the Andros and North Storrs Lake site sequences is consistent with the later date of occupation of the Bahama archipelago.

Conclusion

Most of the preserved plant remains at the Three Dog site consisted of charred wood. There were few small fragments of robust seeds and a few unidentifiable remains. We did not recover any small seeds. It is possible that small seeds were lost through the .84 mm mesh used in the flotation device. Moreover, it is possible that sample sizes were too small to concentrate highly dispersed remains. The harsh depositional environment was also responsible for the destruction of any fragile charred remains that might have been present. It is also possible that other charred remains, such as root and tuber fragments and woods characterized by low specific gravities and weights were destroyed in the flotation process. Newsom's work at other Caribbean sites (personal communication, 1994) indicates that habitually dry charcoal may break up when wetted.[2] Finally, the maintenance and artifact disposal practices (e.g., sweeping, raking, artifact pick-up, weed clearing) (De Boer and Lathrap 1979; Schiffer 1987; Siegel and Roe 1986) of the site's inhabitants very likely contributed to the low density of charred wood remains in at least two portions of the site.

Newsom (1993) and Newsom and Pearsall (2000) argue that a unique system of plant use existed for the Caribbean during prehistory. As early as the Archaic age, the archaeobotanical record reveals that prehistoric inhabitants transported and established successfully plant resources such as fruit trees from their homelands to new island locales. A result of this process was change in the islands' native plant communities: virgin forests were cleared to create planting areas; native plants adapted to open settings expanded their ranges; and inadvertent introductions such as weeds took hold. This pattern appears to have occurred throughout the migration sequence. Evidence from the central Bahamas suggests that as late as the A.D. 800s (and possibly earlier in the Turks and Caicos), ceramic-bearing people may have deliberately employed this strategy as a means of reproducing their homeland environments. In the Pacific, Kirch (1982, 1983, 1997) and Kirch and Hunt (1997) have found that colonizing populations transported large portions of their aboriginal landscapes consisting of plants and animals, from one island to the next. They, too, have studied the anthropogenic effects brought about by the deliberate and unintentional introduction of new biota and have found major and sometimes devastating effects to the local indigenous plant and animal communities requiring new cultural responses and adaptations. Wing (1989) and Wing and Wing (1995) note that animals such as guinea pigs and dogs were introduced from South America to the Antilles and that the rodent *Isolobodon portoricensis* was imported from Hispaniola to Puerto Rico and many of the Virgin Islands. Zooarchaeological remains from later sites on San Salvador such as the Palmetto Grove site have yielded hutía (Wing 1969). These exist in fossil form on numerous islands in the Bahamas (Morgan and Woods 1986: 10) and were likely present on the islands prior to human occupation. It is possible that the Lucayan moved them around from island to island as local populations were depleted. Numerous species of useful plants, including root and tuber crops, annual seed crops, and tree fruits, too, were introduced throughout the Caribbean region (Newsom and Pearsall 2000).

The Three Dog site paleoethnobotanical study has also demonstrated that, as in the tropical lowlands of Central and South America, multiple means of data recovery must be employed to get a more representative picture of the floristic environment and indigenous plant use, since the potential for preservation and the preservation environment may be different for each type of plant and fossil material (Pearsall 1995b). In highly alkaline calcium carbonate geological environments such as that characterizing the Three Dog site and other archaeological sites in the Bahamas, phytolith and pollen preservation may be poor, so other means of inferring plant use at sites, such as starch grain analysis, must be used. However, off-site sampling localities in which preservation of pollen and phytoliths is good may exist even in such environments (Piperno and Pearsall 1998). Good pollen preservation in the submerged deposits of the North Storrs Lake site is an example of how inland lakes can be good sources of vegetative data in the Bahamas. As our research at the Three Dog site and other studies by Newsom (1993) and Newsom and Pearsall (2000) indicate, systematic flotation or fine sieving is necessary to secure samples that reflect a representative array of charred materials preserved at sites. Even if preservation of varied remains is poor due to post-depositional destruction, as we suspect was the case at the Three Dog site, clearly formulated botanical recovery strategies can yield valuable results. Finally, foods prepared from tubers and roots are rarely found as charred material in the archaeological record and must, therefore, be recovered through other means. The most promising method of finding evidence for tuber and root processing and consumption appears to be through microscopic analysis of plant residues, including pollen, phytoliths, and starch grains.

Acknowledgments. Laboratory facilities and administrative support for the macroremain and phytolith analyses were provided by the American Archaeology Division, University of Missouri-Columbia, Michael J. O'Brien, Director. Pearsall carried out the SEM analysis of the microliths at the facilities of the University of Missouri's Department of Geological Sciences. Louis Ross Jr., Senior Electron Microscope Specialist, shared his technical knowledge and assisted in numerous ways. Midori Lee of the University of Missouri-Columbia and the 1994 Wake Forest University Caribbean archaeology field school students assisted with flotation. Lee, Linda Pluscke, and Brigitte Holt sorted flotation and carbon samples. Perry L. Gnivecki, Lucayan Ecological Archaeology Project co-director, drew the figures, read the draft copies, assisted in the plant collections on San Salvador, made copious observations, and shared his knowledge of Caribbean archaeology with us. Funds for the analyses were provided by a Wake Forest University RECREAC grant, a Gerace Foundation grant, and a National Geographic Society grant to Berman. Funds to travel to Cuba were provided by a Pew Spires Grant to Berman. We thank Dean Gordon Melson and the Wake Forest University Graduate School's Research and Publication Fund for supporting the photography and computer imaging. A special note of thanks goes to the Hartwick College, Wake Forest University, and Sweetbriar College students who excavated the site. We appreciate and acknowledge the unflagging support and interest of Dr. Gail Saunders, Director, Department of Archives, Commonwealth of the Bahamas, Dr. and Mrs. Donald T. Gerace of the Bahamian Field Station, who provided us with the opportunity to conduct fieldwork in the Bahamas, and to Dr. Richard I. Ford who taught us the value of studying plant remains. Drs. Jorge Febles, Milton Pino, Pedro Godo, and other members of the Centro de Antropología, Havana, Cuba, graciously gave us samples from Rio Chico to date and study. Special acknowledgement goes to Linda Arcure Wake Forest University School of Medicine Department of Biomedical Communications, computer imaging specialist, and WFU students Emma Bate and Morgan Edwards who checked the bibliographic citations. Drs. Antonio Curet, Lee Newsom, Peter Siegel, and one anonymous reviewer provided constructive criticism. We appreciate their astute insights and recommendations.

References Cited

Balée, W., and A. Gély
1989 Managed Forest Succession in Amazonia: The Ka'apor Case. In *Resource Management in Amazonia: Indigenous and Folk Strategies,* edited by D. A. Posey and W. Balée, pp. 129–158. Advances in Economic Botany, vol. 7. The New York Botanical Garden, Bronx, New York.

Berman, M. J.
1992 Fuel Wood Selection and the Lucayan-Taíno Landscape: A Preliminary View. In *Proceedings of the Fourth Symposium on the Natural History of the Bahamas,* edited by W. H. Eshbaugh, pp. 1–12. Bahamian Field Station Ltd., San Salvador, Bahamas.
1994 Preliminary Report on a Vertebrate Assemblage Excavated from the Three Dog Site, San Salvador, Bahamas. In *Proceedings of the Fifth Symposium on the Natural History of the Bahamas,* edited by L. B. Cass, pp. 5–13. Bahamian Field Station Ltd., San Salvador, Bahamas.

Berman, M. J., and P. L. Gnivecki
1995 The Colonization of the Bahama Archipelago: A Reappraisal. *World Archaeology* 26:421–441.

Berman, M. J., P. L. Gnivecki, and D. M. Pearsall
1988 Paleoethnobotanical Investigations at an Early Contact Site, San Salvador, Bahamas: A Preliminary Study. Paper Presented at the 53rd Annual Meeting of the Society for American Archaeology, Phoenix.

Berman, M. J., A. K. Sievert, and T. R. Whyte
1999 Form and Function of Bipolar Lithic Artifacts from the Three Dog Site, San Salvador, Bahamas. *Latin American Antiquity* 10:415–432.

Bray, W.
1993 Crop Plants and Cannibals: Early European Impressions of the New World. In *The Meeting of the Two Worlds, Europe and the Americas,* edited by W. Bray, pp. 289–326. Pro-

ceedings of The British Academy 81. Oxford University Press, Oxford.

Brill, R.H., I. L. Barnes, S. S. C. Tong, E. C. Joel, and M. J. Murtaugh

1987 Laboratory Studies of Some European Artifacts Excavated on San Salvador Island. In *Proceedings, First San Salvador Conference: Columbus and His World*, compiled by D. T. Gerace, pp. 247–292. College Center for the Finger Lakes, Bahamian Field Station: Ft. Lauderdale.

Burney, D. A., L. P. Burney, and R. D. E. MacPhee

1994 Holocene Charcoal Stratigraphy from Laguna Tortuguero, Puerto Rico and the Timing of Human Arrival on the Island. *Journal of Archaeological Science* 21:273–281.

Carneiro, R.

1978 The Knowledge and Use of Rain Forest Trees by the Kuikuru Indians of Central Brazil. In *The Nature and Status of Ethnobotany*, edited by R. I. Ford, pp. 201–216. Anthropological Papers, Museum of Anthropology, University of Michigan, No. 67, Ann Arbor.

Chiappelli, F. (editor)

1976 *First Images of America*, vol. 2. University of California Press, Berkeley.

Curtis, J. H., and D. A. Hodell

1993 An Isotopic and Trace Element Study of Ostracods from Lake Miragoane, Haiti: A 10,500 Year Record of Paleosalinity and Paleotemperature Changes in the Caribbean. In *Climate Change in Continental Isotopic Records*, edited by P. K. Swart, K. C. Lohmann, J. McKenzie, and S. Savin, pp. 135–152. Geophysical Monograph 78. American Geophysical Union.

DeBoer, W. R., and D. W. Lathrap

1979 The Making and Breaking of Shipibo-Conibo Ceramics. In *Ethnoarchaeology, Implications of Ethnography for Archaeology*, edited by C. Kramer, pp. 102–138. Columbia University Press, New York.

De Booy, T.

1913 Lucayan Artifacts from the Bahamas. *American Anthropologist* 15: 1–7.

Dunn, O., and J. E. Kelley, Jr.

1989 *The Diario of Christopher Columbus's First Voyage to America*, 1492–1493. University of Oklahoma Press, Norman.

Earle, T.

1997 *How Chiefs Come to Power, the Political Economy in Prehistory.* Stanford University Press, Stanford, California.

Ford, R. I.

1979 Paleoethnobotany in American Archaeology. In *Advances in Archaeological Method and Theory*, vol. 2, edited by M. B. Schiffer, pp. 285–336. Academic Press, New York.

1988 Commentary: Little Things Mean A Lot—Quantification and Qualification in Paleoethnobotany. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains*, edited by C. A. Hastorf and V. S. Popper, pp. 215–222. The University of Chicago Press, Chicago.

Fosberg, R.

1963 The Island Ecosystem. In *Man's Place in the Island Ecosystem: A Symposium*, edited by F. Fosberg, pp. 1–7. Bishop Museum Press, Honolulu.

Gerbi, A.

1985 *Nature in the New World from Christopher Columbus to Gonzalo Ferndndez de Oviedo.* Translated by J. Moyle. University of Pittsburgh Press, Pittsburgh.

Granberry, J.

1955 *A Survey of Bahamian Archaeology.* Unpublished Masters Thesis, University of Florida, Gainesville.

Heaton, H. J.

1997 *A Study on Variation in Chicozapote (Manilkara zapota).* Unpublished Masters Thesis, University of California, Riverside.

Higuera-Gundy, A.

1991 *Antillean Vegetational History and Paleoclimate Reconstructed from the Paleolimnological Record of Lake Miragoane, Haiti.* Unpublished Ph.D. Thesis, University of Florida, Gainesville.

Hodell, D. A., J. H. Curtis, G. A. Jones, A. Higuera-Gundy, M. Brenner, M. W. Binford, and K. T. Dorsey

1991 Reconstruction of Caribbean Climate Change over the Past 10,500 Years. *Nature* 352:790–793.

IACA

1998 Bahamas. *Newsletter (1).* International Association for Caribbean Archaeology.

Jones, J. G.

1997 Pollen Analysis of a Sediment Core from San Salvador, Bahamas. Report from a Core Taken at the North Storr's Lake Site, Excavated by Dr. Gary Fry under the Auspices of the Bahamian Field Station. Manuscript on file, Bahamian Field Station Ltd., San Salvador, Bahamas.

Jones, J. G., and D. M. Pearsall

1999 Pollen and Phytolith Evidence for Settlement, Agriculture, and Paleoenvironment at the Maisabel Site, a Multicomponent Site in Puerto Rico. Paper Presented at the 64th Annual Meeting of the Society for American Archaeology, Chicago.

Keegan, W. F.

1992 *The People Who Discovered Columbus: The Prehistory of the Bahamas.* University Press of Florida, Gainesville.

1997 *Bahamian Archaeology, Life in the Bahamas and Turks and Caicos Before Columbus.* Media Publishing, Nassau.

Kirch, P. V.

1982 Transported Landscapes. *Natural History* 91(December):32–35.

1983 Man's Role in Modifying Tropical and Subtropical Polynesian Ecosystems. *Archaeology in Oceania* 18:26–31.

1997 *The Lapita Peoples, Ancestors of the Oceanic World.* Blackwell Publishers, Cambridge, Massachusetts.

Kirch, P. V., and T. L. Hunt (editors)

1997 *Historical Ecology in the Pacific Islands: Prehistoric Environmental and Landscape Change.* Yale University Press, New Haven.

Kjellmark, E.

1996 Late Holocene Climate Change and Human Disturbance on Andros Island, Bahamas. *Journal of Paleolimnology* 15:133–145.

Little, E. L., Jr., and F. H. Wadsworth

1964 *Common Trees of Puerto Rico and the Virgin Islands.* Agricultural Handbook No. 249. U.S. Department of Agriculture, U.S. Forest Service, Government Printing Office, Washington, DC.

Lopinot, Neal H.

1984 *Archaeobotanical Formation Processes and the Late Middle Archaic Human-Plant Interrelationships in the Midcontinental U.S.A.* Ph.D. dissertation, Southern Illinois University at Carbondale. University Microfilms, Ann Arbor, Michigan.

Loven, S.

1935 *Origins of the Tainan Culture, West Indies.* Elanders Bokfryckeri Akfiebolag, Göteborg.

Loy, T. H.

1994 Methods in the Analysis of Starch Residues on Prehistoric Stone Tools. In *Tropical Archaeobotany: Applications and New Developments*, edited by J. G. Hather, pp. 86–114. Routledge, London.

Martin, F. W., C. W. Campbell, and R. M. Ruberté
1987 *Perennial Edible Fruits of the Tropics: An Inventory.* United States Department of Agriculture Handbook No. 642. Government Printing Office, Washington, D.C.
Miksicek, C.
1987 Formation Processes of the Archaeobotanical Record. In *Advances in Archaeological Method and Theory* 10, edited by M. B. Schiffer, pp. 211–248. Academic Press, New York.
Miller, N. F.
1988 Ratios in Paleoethnobotanical Analysis. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Plant Remains,* edited by C. A. Hastorf and V. S. Popper, pp. 72–85. University of Chicago Press, Chicago.
Morgan, G. S., and C. A. Woods
1986 Extinction and the Zoogeography of West Indian Land Mammals. *Biological Journal of the Linnean Society.* 28:167–203.
Morison, S. E.
1963 *Journals and Other Documents on the Life and Voyages of Christopher Columbus.* Heritage, New York.
Nelson, M. C.
1991 The Study of Technological Organization. In *Archaeological Method and Theory,* vol. 3, edited by M. B. Schiffer, pp. 57–100. University of Arizona Press, Tucson.
Newsom, L. A.
1993 *Native West Indian Plant Use.* Unpublished Ph.D. Dissertation, Department of Anthropology, University of Florida, Gainesville.
Newsom, L. A., and D. M. Pearsall
2000 Spatial Trends Indicated by a Survey of Archaeobotanical Data from the Caribbean Islands. In *People and Plants in Ancient America,* edited by P. E. Minnis. Smithsonian Institution Press, Washington, D.C., in press. Ms. 1996.
Nickrent, D. L., W. H. Eshbaugh, and T. K. Wilson
1991 *The Vascular Flora of Andros Island, Bahamas.* Willard Sherman Turrell Herbarium, Department of Botany, Miami University, Miami, Ohio.
Patterson, J., and G. Stevenson
1977 *Native Trees of the Bahamas.* Jack Patterson, Hope Town, Abaco, Bahamas.
Pearsall, D. M.
1983 Evaluating the Stability of Subsistence Strategies by Use of Paleoethnobotanical Data. *Journal of Ethnobiology* 3:121–137.
1989 Final Report on Analysis of Macroremains and Phytoliths from the Three Dog Site, San Salvador, Bahamas. Manuscript on file, American Archaeology Division, Department of Anthropology, University of Missouri, Columbia.
1990 Appendix C. Plant Utilization at the Krum Bay Site, St. Thomas USVI. In *Preceramic Procurement Patterns at Krum Bay, Virgin Islands,* by E. R. Lundberg, pp. 290–361. Unpublished Ph.D. dissertation, Department of Anthropology, University of Illinois, Urbana.
1995a Final Report: Analysis of the Charred Botanical Remains from the Tutu Site, U.S. Virgin Islands. Manuscript on file, SHPO Office, St. Thomas, U.S.V.I.
1995b "Doing" Paleoethnobotany in the Tropical Lowlands. In *Archaeology in the Lowland American Tropics,* edited by P. W. Stahl, pp. 113–129. Cambridge University Press, Cambridge.
1999 Wood Identification from Zemís from Grand Bahama, Bahamas. Manuscript on file, American Archaeology Division, Department of Anthropology, University of Missouri, Columbia.
2000 *Paleoethnobotany: A Handbook of Procedures.* 2nd ed. Academic Press, San Diego.
Piperno, D. R., and I. Holst
1998 The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25:765–776.
Piperno, D. R., and D. M. Pearsall
1998 *The Origins of Agriculture in the Lowland Neotropics.* Academic Press, San Diego.
Randolph, L. R., W. H. Eshbaugh, and M. Burrows
1997 Home Gardens of Central Andros. *Bahamas Journal of Science* 5:10–12.
Rossen, J., and J. Olsen
1985 The Controlled Carbonization and Archaeological Analysis of SE US Wood Charcoals. *Journal of Field Archaeology* 12:445–456.
Sauer, C. O.
1966 *The Early Spanish Main.* University of California Press, Berkeley.
Sauer, J. D.
1976 Changing Perception and Exploitation of New World Plants in Europe, 1492–1800. In *First Images of America,* vol. 2, edited by F. Chiappelli, pp. 813–832. University of California Press, Berkeley.
Schiffer, M. B.
1987 *Formation Processes of the Archaeological Record.* University of New Mexico Press, Albuquerque.
Sealey, N.
1985 *Bahamian Landscapes: An Introduction to the Geography of the Bahamas.* Collins Caribbean, London.
Sears, W. H., and S. D. Sullivan
1978 Bahamas Prehistory. *American Antiquity* 43:3–25.
Shackleton, C. M., and F. Prins
1992 Charcoal Analysis and the "Principle of Least Effort": A Conceptual Model. *Journal of Archaeological Science* 19:631–637.
Shelton, J., and A. B. Shapiro
1976 *The Woodburner's Encyclopedia: An Information Source of Theory, Practice, and Equipment Relating to Wood as Energy.* Crossroads Press, Waitsvield, Vermont.
Siegel, P. E., and P. G. Roe
1986 Shipibo Archaeo-Ethnography: Site Formation Processes and Archaeological Interpretation. *World Archaeology* 18:96–115.
Siegel, P. E., J. G. Jones, D. M. Pearsall, and D. P. Wagner
1999 Consumption, Climate, or the Cosmos: The Relative Importance of Subsistence, Environment, and Ideology in the Development of Complex Society in Prehistoric Puerto Rico. Paper Presented at the 64th Annual Meeting of the Society for American Archaeology, Chicago.
Sievert, A. K.
1992 *Maya Ceremonial Specialization: Lithic Tools from the Sacred Cenote at Chichen Itza, Yucatan.* Monographs in World Archaeology 12, Prehistory Press, Madison.
Smart, T. L., and E. S. Hoffman
1988 Environmental Interpretation of Archaeological Charcoal. In *Current Paleoethnobotany: Analytical Methods and Cultural Interpretations of Archaeological Plant Remains,* edited by C. A. Hastorf and V. S. Popper, pp. 167–205. University of Chicago Press, Chicago.
Smith, R. R.
1982 *Field Guide to the Vegetation of San Salvador Island, The Bahamas.* Bahamian Field Station Ltd., San Salvador, Bahamas.
1993 *Field Guide to the Vegetation of San Salvador Island, The Bahamas.* 2nd ed. Bahamian Field Station Ltd., San Salvador, Bahamas.
Stuiver, M., A. Long, R. S. Kra, and J. M. Devine
1993 Calibration-1993. *Radiocarbon* 35(1).

Sturtevant, W. C.
1969 History and Ethnography of Some West Indian Starches. In *The Domestication and Exploitation of Plants and Animals*, edited by P. J. Ucko and G. W. Dimbleby, pp. 177–199. Gerald Duckworth and Co., London.
1991 Taino Agriculture. In *Spanish Borderlands Sourcebooks 13. Earliest Hispanic/Native American Interactions in the Caribbean*, edited by W. F. Keegan, pp. 241–254. Garland Publishing Inc., New York.
Tabío, E., and J. M. Guarch
1966 *Excavaciones en Arroyo del Palo, Mayari, Oriente, Cuba*. Departamento de Antropología, Academia de Ciencias de Cuba, Havana, Cuba.
Tabío, E., and E. Rey
1979 *Prehistoria de Cuba*. 2nd ed. Editorial de Ciencias Sociales, Havana, Cuba.
Talma, S., and J. Vogel
1993 A Simplified Approach to Calibrating C14 Dates. *Radiocarbon* 35:317–322.
Thompson, G. B.
1994 Wood Charcoals from Tropical Sites: A Contribution to Methodology and Interpretation. In *Tropical Archaeobotany: Applications and New Developments*, edited by J. G. Hather, pp. 9–33. Routledge, London.
Veloz Maggiolo, M., and B. Vega
1982 The Antillean Preceramic: A New Approximation. *Journal of New World Archaeology* 5:33–44.
Watters, D. R.
1989 Archaeological Implications for Lesser Antilles Biogeography: The Small Island Perspective. In *Biogeography of the West Indies: Past, Present, and Future*, edited by C. A. Woods, pp. 153–166. Sandhill Crane Press Inc., Gainesville, Florida.
Watters, D. R. and I. Rouse
1989 Environmental Diversity and Maritime Adaptations in the Caribbean Area. In *Early Ceramic Population Lifeways and Adaptive Strategies in the Caribbean*, edited by P. E. Siegel, pp. 129–144. BAR International Series 506. British Archaeological Reports, Oxford.
Wing, E. S.
1969 Vertebrate Remains Excavated from San Salvador Island, Bahamas, *Caribbean Journal of Science* 9(1–2):25–29.
1989 Human Exploitation of Animal Resources in the Caribbean. In *Biogeography of the West Indies: Past, Present, and Future*, edited by C. A. Woods, pp. 137–152. Sandhill Crane Press Inc., Gainesville, Florida.
Wing, E., and S. R. Wing
1995 Prehistoric Ceramic Age Adaptation to Varying Diversity of Animal Resources along the West Indian Archipelago. *Journal of Ethnobiology* 15:119–148.
Winter J., and D. M. Pearsall
1991 A Wooden Mortar of the Lucayans. In *Proceedings of the Fourteenth Congress of the International Association for Caribbean Archaeology*, edited by A. Cummins and P. King, pp. 586–590. Barbados Museum and Historical Society, Bridgetown, St Michael's, Barbados.
Winter, J., and E. Wing
1995 A Refuse Midden at the Minnis-Ward Site, San Salvador, Bahamas. In *Proceedings of the 15th International Congress for Caribbean Archaeology*, edited by R. Alegría and M. Rodriguez, pp. 423–434. Centro de Estudios Avanzados de Puerto Rico y el Caribe, San Juan, Puerto Rico.
Winter, J., E. Wing, L. Newsom, A. Fierro, and D. McDonough
2000 A Lucayan Funeral Offering in Major's Cave, San Salvador, Bahamas. In *Proceedings of the 17th International Congress for Caribbean Archaeology*, edited by J. Winter. Molloy College, Rockville Centre, New York, in press.

Notes

1. Newsom has been studying the plant remains from sites in the Turks and Caicos (Keegan 1997) which geographers classify as the southern Bahamas (Sealey 1985).

2. Using three midden samples, we compared the abundance of remains from flotation and dry sieving samples. Due to small sample size, the test was inconclusive. Our initial observations suggest, however, that recovery method is not strongly biasing the results in the Three Dog site paleoethnobotanical samples. We will continue to explore the issue with samples from other sites on San Salvador and Grand Bahama.

Received September 10, 1999; accepted February 2, 2000; revised May 30, 2000.