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The Architecture of Ancient Maya Saltmaking; Distribution and Analysis of Preserved Wooden Posts at the John Spang Site in Paynes Creek National Park, Belize

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THE ARCHITECTURE OF ANCIENT MAYA SALTMAKING; DISTRIBUTION AND ANALYSIS OF PRESERVED WOODEN POSTS AT THE JOHN SPANG SITE IN PAYNES CREEK NATIONAL PARK, BELIZE

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Abstract

Archaeological investigations were undertaken at the John Spang Site, a Late Classic Maya saltwork, in Punta Ycacos Lagoon, in Paynes Creek National Park, southern Belize. The field survey mapping yielded over 149 wooden architectural posts preserved below the sea floor in mangrove peat. The presence of briquetage indicates the wooden architecture is associated with the infrastructure associated with production and distribution of salt. The mapped survey areas, including the wooden architecture, artifact boundaries, and site boundaries, as well as the wooden post measurements were combined in a GIS to analyze the spatial distribution. I compare and contrast the patterns observed in the post data with Robert C. Wauchope's 1938 *Modern Maya Houses.* I also compare the wooden architecture present at the John Spang with modern and historic investigations about saltmaking. My investigations revealed wooden rectangular structures similar to those described by Wauchope, as well as structures associated in the process of making salt. My research shows that there is continuity from the past to the present in regards to the shapes of buildings and structures. However, variations exist between the past and the present in regards to the layout of the site and the sizes of posts preferred.

Chapter 1
Introduction

My research includes the study of patterning and significance of wooden architectural posts at the John Spang Site, a Late Classic (A.D. 600-900) Maya saltworks in the Punta Ycacos Lagoon, a large salt water lagoon, in Paynes Creek National Park, southern Belize, Central America (Figure 1). I report the discovery, mapping, and analysis of wood posts in terms of the spatial structure of ancient Maya wooden architecture and its role in the organization of production and distribution in the ancient Maya economy.

Organic artifacts at terrestrial sites in the Maya area and elsewhere in the tropics usually have poor preservation. In contrast, sites submerged underwater can yield well preserved organic artifacts. The wooden architecture at the John Spang Site is preserved due to the wood's location in mangrove peat, an anaerobic sediment. Apart from similar mapped sites in Paynes Creek National Park, no other ancient Maya wooden architecture has been discovered in the Maya area.

Ethnographic and archaeological investigations can bridge the gap between the past and present. I examine modern Maya wooden architecture, including houses and associated buildings, as well as structures associated with the modern and historic salt industry in Mesoamerica. In my study, I compare and contrast modern and ancient Maya wooden architecture.

The Ancient Maya

The ancient Maya lived in the present-day countries of Mexico, Belize, Guatemala, Honduras, and El Salvador. This area is still inhabited today by the indigenous Maya people. The ancient Maya culture stretched from the Yucatan Peninsula, all of Guatemala, and Belize to

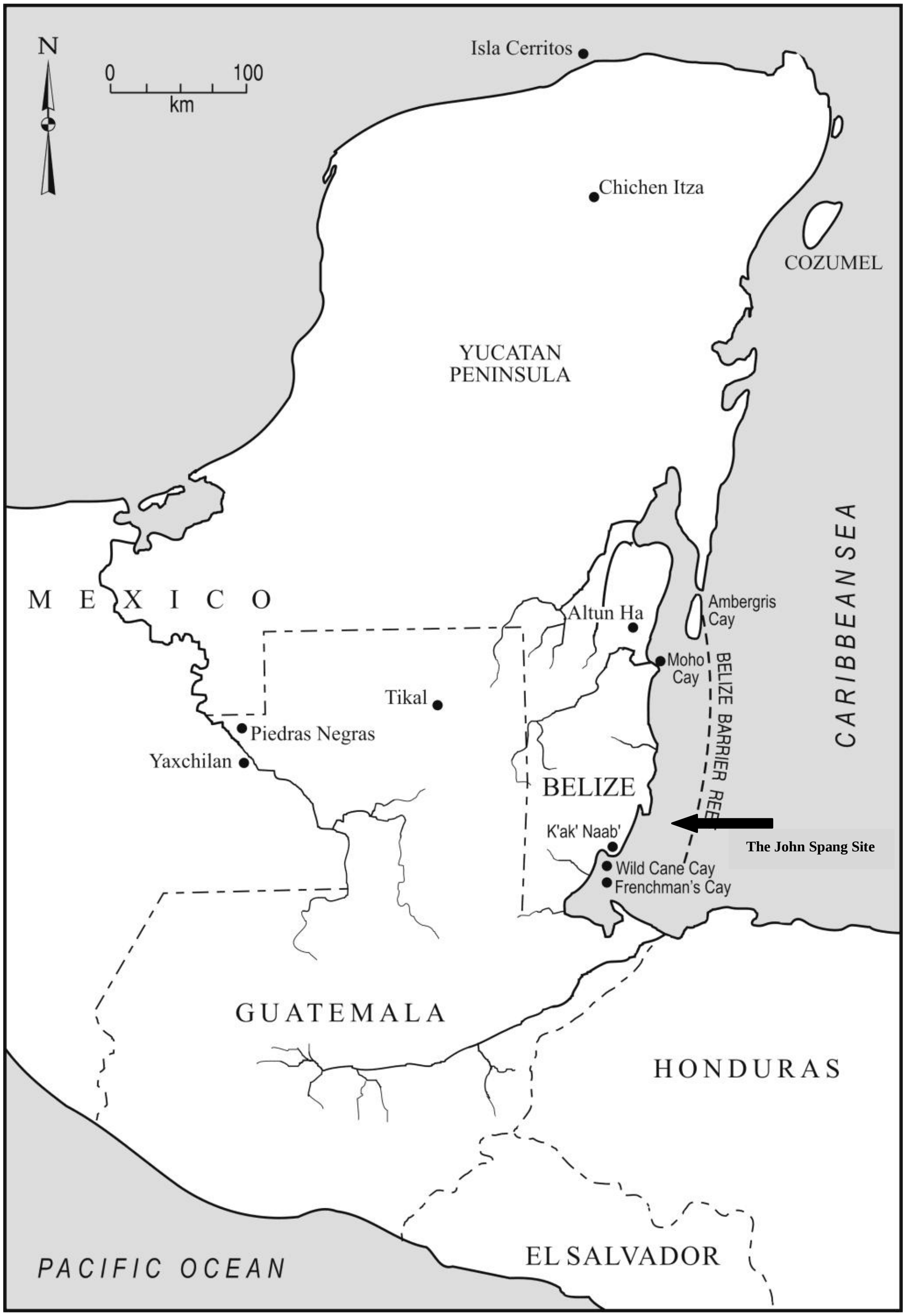


Figure 1. Map of Maya Area Showing the Location of the John Spang Site, southern Belize, Central America (McKillop 2004a).

the Mexican states of Chiapas and Tabasco to the western portions of Honduras and El Salvador. Based on the diversity of natural resources, the ancient Maya area has been divided geographically and culturally into the Northern Maya Lowlands, the Southern Maya Lowlands, and the Southern Maya Highlands (Figure 2). What is known as the Classic Maya (A.D. 300-900) period developed in the Southern Maya Lowlands. The flatter and dryer Northern Maya Lowlands include the Yucatan Peninsula. The moister Southern Maya Lowlands include Guatemala, parts of the Mexican states of Tabasco and Chiapas, all of Belize, and western Honduras. The Caribbean Sea is located to the east of this area. The Southern Maya Highlands include the volcanic areas of western El Salvador, the mountainous region of Guatemala, and continues into the Mexican state of Chiapas (Coe 1999; McKillop 2004a).

A limestone shelf extends from the Yucatan Peninsula of Mexico into Belize and the Petén District of Guatemala. The limestone shelf in the Yucatan is porous creating cenotes, collapsed caves, which is a source of water. Quarried limestone was used by the ancient Maya for sacbes, stone monuments, and buildings as well as for the plaster. The Puuc Hills in northern Yucatan and the Maya Mountains in Belize add variation to the terrain of the northern and southern lowlands. The Belize Barrier reef lies to the east of the lowlands extending from Cozumel in Quintana Roo Mexico to southern Belize. The ancient Maya exploited the sea for numerous resources, including salt. The Maya Highlands are characterized by lying at least 305 meters (m) above sea-level. The volcanic highlands supplied the ancient Maya with obsidian, basalt, and ash. Numerous rivers bisect the Southern Maya Lowlands and the Southern Maya Highlands. These rivers were used as transportation and for natural resources (Coe 1999; McKillop 2004a).

The general cultural history of the ancient Maya can be divided into five chronological

Figure 2. Map Showing the Ancient Maya Cultural Areas (McKillop 2004a).

periods, Paleoindians (ca. 9,500 to 7,000 B.C.), Archaic (7,000 to 1800 B.C.), Preclassic (2,000 B.C. to A.D. 300), Classic (A.D. 300-900), Postclassic (A.D. 900-1519), and Historic (A.D. 1519-present). The archaeological sites within Punta Ycacos Lagoon date to the Late Classic period, based on previous research (McKillop 1995, 2002). The Classic period is subdivided into the Early Classic (A.D. 300-600), the Late Classic (A.D. 600-900), and the Terminal Classic (A.D. 800-900).

The ancient Maya Civilization reached its height during the Classic period (A.D. 300-900). These dates are based on the earliest recovered carved stelae from Tikal and the last recovered dated monument at Tonina. The stelae dates are recorded in the Maya long count and accompany hieroglyphic inscriptions. These recorded dates indicate the period of dynastic authority of the lowland city centers (McKillop 2004a). The emergence and grandeur of the ancient Classic Maya can be characterized as consisting of city states containing monumental architecture plastered in limestone and an increase in population. Carved stelae marked events, histories, and achievements of the elites. Carved on these stelae and monuments were hieroglyphic writing and cultural imagery. The Maya developed an advanced calendar system and marked events and histories of their people. Maya artists produced elaborate painted polychrome pots and eccentric flints.   Trade was widespread and occurred along the Caribbean coast and inland toward Teotihuacan, in the Valley of Mexico. The Classic Maya collapse resulted in the abandonment of cities and towns in the southern Maya lowlands. Researchers disagree as to the cause of the decline of the ancient Maya. Ecological disaster, widespread disease, endemic warfare, and environmental change are considered to be some of the culprits leading to the collapse (Culbert 1977; Demarest 1997; Hodell et al. 1995; Webster 2002).

The Ancient Maya Political and Subsistence Economies

Perspectives regarding the ancient Maya political economy are concerned with how much control the city-states's wielded over the production, exchange, and distribution of material resources. Debates concerning ancient Maya economy center on the degree to which the Maya were centralized or decentralized (McKillop 2004a). Centralized implies that states wielded economic and administrative control through a hierarchical approach, or top down. The city-states, controlled by the elite, would thus have direct control over the economy even at the household subsistence level. Whereas, decentralized implies the elite controlled the prestige economy and wielded little or no control over the household subsistence economy. Another possibility suggested by Marcus (1993, 1998) in her dynamic model, consists of a more fluid model of control that stresses the variability over space and time between centralized and decentralized.

Many researchers have postulated models to understand economy, trade, (Blanton and Feinman 1984; Leventhal 1990; Masson 2002; Tourtellot and Sabloff 1972) and the rise of the major centers in the Maya lowlands (Freidel 1978, 1979; Rathje 1971; Voorhies 1982). Rathje (1971) proposes a cultural ecological model in which trade is an economic way to redistribute items from the highlands to the lowlands. An example given is that the Maya lowlands, or core area, did not contain the necessary basic resources such as, obsidian, salt, and basalt and needed to acquire the goods from other geographical areas, buffer or periphery areas. To support this claim, Rathje notes the preference of durable basalt metates in the lowlands imported from the highlands verses the limestone metates that were wildly available in the region. Based on this model, a complex society was formed to distribute the goods/resources acquired through trade from the buffer and periphery to the core.

Voorhies (1982) also proposes a model for the development of complex society based on lowland Maya export of raw materials to the highlands in exchange for goods. Voorhies suggested that lowland goods are not commonly found at highland sites because they were organic materials and thus, invisible in the archaeological record. Highland goods, such as obsidian, are more durable and therefore are more visible in the lowland archaeological record. Centers developed to disperse the goods acquired. Tourtellot and Sabloff (1972), in contrast, argue that prestige objects, or elite goods, were traded among communities for long distance trade whereas subsistence goods were exchanged within communities for local trade. Tourtellot and Sabloff (1972:1) state that “the lack of differential access to basic resources among the ranked social groups of the Maya lowlands did not stimulate the development of the state in this area." Leventhal (1990:127) also supports an uncentralized economy where elite goods were procured through long distance trade while "localized regional trade, provided for the primary economic stability within regions".

Blanton and Feinman (1984) propose a World Systems approach to interregional exchange in Mesoamerica. Their argument is that the elite had control of the luxury goods; centralized core areas developed in response to trade and elite priorities. Movements of trade between the core and the periphery spurred the development of complex society. In contrast, investigations at Cerros, a Late Preclassic (300 B.C. to A.D. 300) center, allow Freidel (1978, 1979) to propose that complex society was formed by interaction, exchange, and trade. This "interaction model" implies that trade between the northern and southern lowlands focused on the coast during the Late Preclassic. The northern lowlands supplied the southern lowlands with elite goods and the southern lowlands supplied the north with basic resources. Towards the center of these two interaction spheres conflict occurred with the southern lowlands eventually gaining control of the trade and exchange. The idea of interaction spheres was used to describe the emergence of civilization in the Maya lowlands (Freidel 1978, 1979).

Graham (1987), on the other hand, states that researchers should not always differentiate long distance trade from local exchange of goods. The same set of controls that operate at the local level can also operate at the regional level as well. As previous researchers viewed the Maya lowlands as resource deficient, Graham (1987) stresses that numerous resources were available for exploit that could have been utilized by the lowland Maya. These items include sources of rock/minerals, chert, volcanic ash and pumice, clay resources, and scarce items like alabaster, albite, copper, and gold (Graham 1987). Research along the coast of Belize and

Mexico shows that salt and marine resources also were utilized (Andrews 1990; Andrews and Mock 2002; Guderjan and Garber 1995; Hamblin 1985; McKillop 1984, 1985, 1987, 1995, 1996, 2002, 2004b, 2005).

McKillop (2002) introduces another model regarding salt trade based on investigations within Punta Ycacos Lagoon: the saltworks discovered in the Punta Ycacos Lagoon are located away from urban centers. McKillop suggests that salt was produced for the people living on the coast and for trade to inland cities. If the coastal Maya were economically and politically independent, due to control of salt production and trade of coastal goods, McKillop (2005) suggests the ancient Maya political economy may have been more decentralized in southern Belize. Following this argument, single center sites did not have control overall, due to the smaller separate regions where the main political and economic focus took place. However it is unknown how much political control, if any, was exerted by urban centers in this area (McKillop 2005). My research addresses this issue.

Coastal Trade

The importance of the coast for the ancient Maya has been the focus of numerous investigations (Andrews 1990; Guderjan and Garber 1995; Hamblin 1985; Hammond 1972, 1974; Healy et al. 1984; McKillop 1984, 1985, 1987, 1995, 1996, 2002, 2004a, 2004b, 2005; McKillop and Healy 1989; Rajthe 1971). Many of the items obtained from the coast are perishable. However, nonperishable items, like obsidian, have been used to document trade. Coastal areas contain needed resources, such as salt, fish, sand stingray spines. The coast also held a cosmological importance to the Maya. Chase and Chase (1989) discuss the cosmology and long-distance trade from the site of Santa Rita Corozal (see Figure 3). The site contained an early locus prior to 1000 B.C. but it did not reach its peak until the Late Postclassic (A.D. 1200-

1500). They postulate that the importance of Maya coastal trade was to distribute items like stingray spines and other materials that were "crucial for sustaining the Maya cosmological system" (1989:32). Freidel (1979) proposes that coastal sites were crucial for the development of the Maya, suggesting that the site of Cerros developed due to its participation in long distance trade.

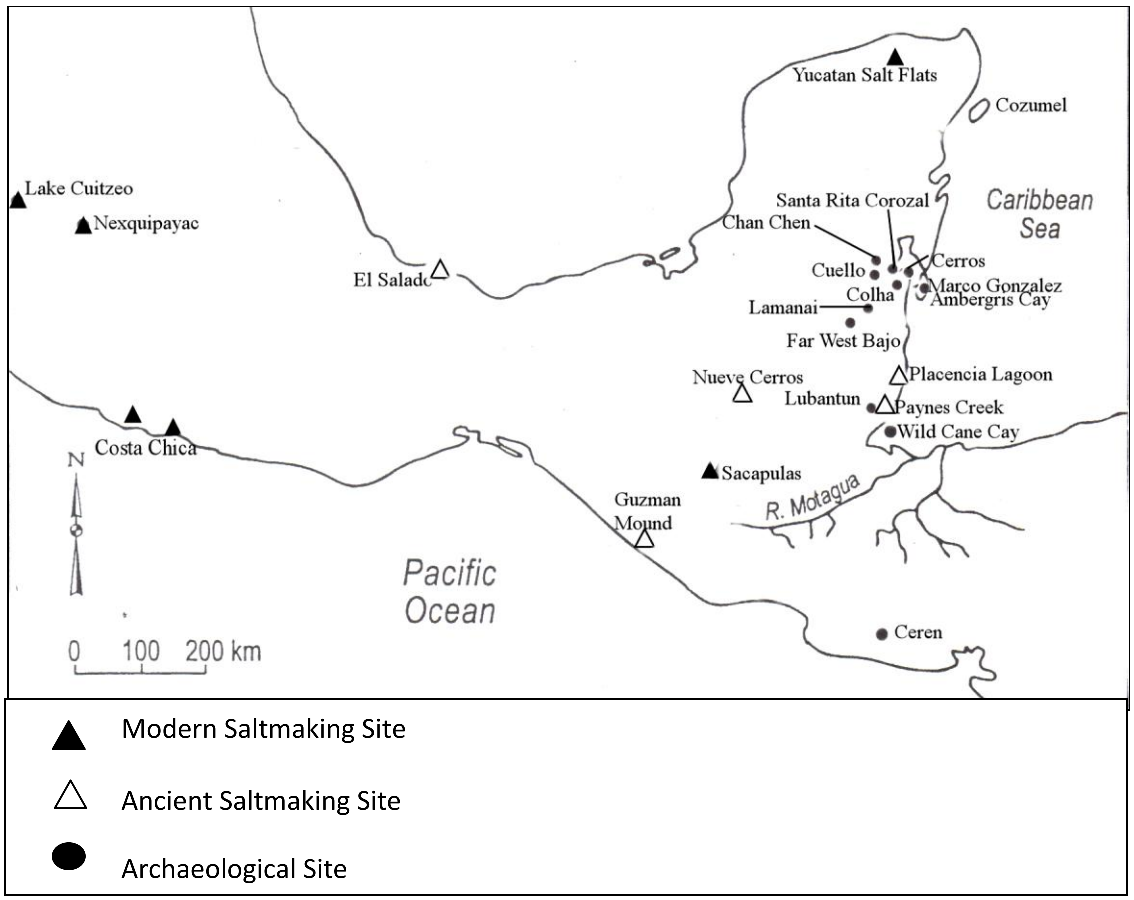


Figure 3. Map of Central America Showing Sites Mentioned in the Text.

Hamblin's (1985) analysis of faunal remains from the island of Cozumel, located off the coast of the Yucatan, Mexico showed that the island was involved in marine trade during the Late Postclassic (A.D. 1200-1519). The 1972 and 1973 excavations conducted by the Cozumel Archaeological Project resulted in the recovery of a large amount of fish bones, shark, stingrays, sea turtles, and crabs. The Maya living on the island of Cozumel relied heavily on a marine diet. The numerous netsinkers recovered "imply the involvement of fish in Cozumel's long-distance trade network" (Hamblin 1985:170) indicating the site's dietary focus was on seafood. Graham's and Pendergasts' (1989) 1986 excavations on the Ambergris Cay at the Marco Gonzalez site present information regarding trade along the coast of Belize. They suggest the coastal site was involved in inland trade with the Maya center of Lamanai by way of the New River. Ceramic artifacts recovered from the cay are related to the Buk phase at Lamanai (A.D. 1140 to 1300). Salt production also was conducted at the site during Late Classic and declined during the Terminal Classic. Further excavations carried out at other sites on Ambergris Cay by Guderjan and Garber (1995) present detailed information regarding the cays' importance for long distance and local trade during Late Classic period.

McKillop (1984, 1985, 1995, 1996, 2002, 2004b, 2005) also stresses the reliance of the ancient Maya on coastal resources as well as extensive trade along the coast with Wild Cane Cay a major Classic to Postclassic trading port.

Salt Production

The discovery of salt production sites as well as infrastructure associated with salt production in Paynes Creek National Park, southern Belize, indicates that salt was a substantial trade commodity (McKillop 1995, 2002, 2005). Trade routes have been documented for salt production from ethnohistoric and archaeological evidence (Andrews 1983). Salt would have been needed to supplement the diet of the ancient Maya. Also, salt could be used for tanning hides, as a preservative for meat and seafood, and for ritual and medicinal uses (Andrews 1983). Andrews (1984:827) states that the "southern lowlands were not self-sufficient in meeting their own salt demands and depended on foreign exports mainly from the north coast of Yucatan, to satisfy their basic needs". This view has been subsequently challenged based on new evidence from Paynes Creek and other coastal salt works along the coast of Belize (Andrews and Mock 2002; McKillop 2005). The recent investigations conducted in Punta Ycacos Lagoon resulted in the discovery of 41 Late Classic Maya saltworks (McKillop 2005). According to McKillop (McKillop 2005:5631) the "research shows that there was extensive production" of salt and "they produced surplus for trade". The discovery of these saltworks, which appear to represent significant industry that was distantly located from inland cities, supports the view that they were not controlled by the inland city centers (McKillop 2002, 2005).

Salt is made using two different methods, "sal solar" and "sal cocida." The "sal solar" technique involves using the sun to evaporate the water in salt pans or in a shallow holding pans or tanks. The "sal cocida" or briquetage technique involves pouring the salt through saturated soil to produce a heavy salt enriched brine (Andrews 1983; Mackinnon and Kepecs 1989; McKillop 2002). The salt acquired in southern Belize was made from using the "sal cocida" technique (McKillop 1995, 2002, 2005), which produces briquetage, the pottery vessels and associated cylinders, sockets, and spacers used to boil brine in order to acquire salt. The salt is then placed in vessels and boiled, forming loose salt or heated further to make hard cakes which are for easier transport by foot or canoe (McKillop 2002).

Modern Salt Workshops

Ethnographic investigations of modern salt works provide useful models for interpreting the ancient salt production at the John Spang Site in Paynes Creek (Andrews 1983; Dillon et. al 1988; Good 1995; Parsons 1989; Reina and Monaghan 1981; Williams 1999). Reina and Monaghan (1981) report their ethnographic research at the saltmaking site of Sacapulas in northwestern Guatemala. This area has produced salt during historic times to the present day.

During the dry season, when these saltworks are active, the Maya journey to their playa to prepare plats of soil. Once the soil is saturated enough with salt it is taken to the kitchens. Reina and Monaghan (1981:21-22) describe the kitchens at Sacapulas as “small, stone-walled rooms of approximately 6 x 8 m set deep into the ground.” Located outside the kitchen is a cajon, or wooden box, where the soil is placed and water added for leaching. Next, the salt water is ladled out of the wooden box and into a ceramic bowl and taken into the kitchen to be fired. Many of these bowls are placed on a fire platform to be fired. Variability exists among the various saltworks at Sacapulas. Andrews (1983) describes numerous bowls placed on a platform encompassing an area approximately 5.5-x-7.5 m^2.

Parsons’ (1989) study of modern saltmakers at Nexquipayac, Mexico includes discussion of how the modern salt production process can be applied to archaeological saltmaking sites. The saltmakers of Nexquipayac use the “sal cocida” technique. Even though the tools have changed, there are similarities between what was observed at archaeological sites and the modern saltmaking. Observing the modern saltmakers, Parsons listed the various activities and tools used for each activity such as:

> mixing floor, leaching pits and receptacles for brine, massive ridges of discarded leached soil, facilities for storing soil, boiling facilities, larger storage containers for water and brine, smaller containers for moving water and brine around within the workshop, scraping tools for preparing and repairing the pila surface, digging and pounding tools for excavating the pila pits and hardening its walls, and facilities for drying and dripping-wet fresh salt (Parsons 1989:121).

Out of three remaining modern salt workshops investigated by Parsons, all exhibited variation in their use of space of where to place their facilities. At the SN workshop, Parson (1989) notes that the mixing floor is approximately 2.5-x-2.5 m whereas at the IC workshop the space is 3-x-3 m square. The boiling hut at the SN workshop is 2.3-x-2.7 m and made from adobe. The same space at the IC workshop is 2-x-3 m and made from miscellaneous building materials. Limited information is given for the third workshop known as MC due to the owner's reluctance to participate in the study.

Williams (1999) investigates the continuity between modern saltmaking and the past in the Lake Basin Cuitzeo in Michocan, Mexico. Due to the area's abundance of salt springs, canals are built to connect the springs to the salt works. Each saltmaking area contains wooden structures, called estiladeras, which are funnel shaped structures "used as filters to separate the salt from the earth by leaching" (Williams 1999:404). The estiladera is supported by four forked posts embedded in the ground. "The estiladera rests on a wooden block, which sits on top of the banco, a wooden trough where the salty water falls after being filtered through the estiladera" (Williams 1999:404). Each separate saltwork contains wooden canoas, shaped like canoes that are slightly elevated off of the ground (Williams 1999: Figure 4). Their use is to dry out the brine previously filtered through the estiladera. The quantity of canoes in use varies from saltwork to saltwork. Usually one or more estiladera is in use at any given time.

Good (1995) conducted ethnographic study of the modern Nahuatl saltmakers of the Costa Chica in Guerrero, Mexico. Here, the salt industry uses the sal solar method. During 1989 and 1990, Good visited four independent cottage-style industry saltmaking sites. At these saltworks, the salt laden soil is harvested during the dry season and carried to a wooden filter, called a tapeite. "They construct the tapeite on a raised base of wooden or cane slats covered with palm or tough grass" (Good 1995:2). Once the soil is placed on the tapeite, brackish water is poured over the soil to increase the salt content of the soil. The tapeites have about eight forked posts embedded in the ground on which the bed is placed, forming a rectangular structure (Good 1995: Figures 4 and 5).

Other "sal solar" saltmaking facilities include the northern Yucatan salt flats. Andrews (1983) study of salt trade and production shows that the northern Yucatan salt flats are the largest producers of salt in the area during modern times. The salt works encompass grids, or pans, where the salt evaporates and then is raked up into piles. The pans are divided into large rectangular grids made from earth, rubble, and wooden stakes. The salt pans fill up in the rainy season and then evaporate in the dry season. This "sal solar" technique is possible in the Yucatan because of the prolonged dry season. According to Andrews (1983), salt also was produced in two salt water lagoons on Ambergris Cay in Belize, using the "sal solar" method during the dry season.

Salt Workshops in the Archaeological Record

Archaeological investigations conducted at saltmaking sites can yield information regarding salt site layout and archaeological remains of salt production. The majority of saltmaking sites are identified by their ceramics and the debris (charcoal and pottery) left over from the boiling process. Certain sites include landform modification such as the saltmaking site at El Salado, in Veracruz, Mexico. Investigations of these El Salado resulted in the analysis of two occupations at the site (Santley 2004). One occupation dates from the Early Formative (1,400 to 1,000 B.C.) and the later from the Late Classic. Based on evidence of ceramic deposits, more salt was produced during the Late Classic period compared with the Early Formative. The Late Classic also showed major salt produced in Punta Ycacos Lagoon (McKillop 2002, 2005). In the Early Formative at El Salado, a couple of techniques were employed. There is evidence of low dams built across a salt stream where ceramic pans were placed to collect the salty water. The second technique involves using the dams as impoundments to collect the water from which the water was placed in shallow ceramic pans for partial evaporation, before the salt was reduced further by boiling. Salt production increased in this area during the Late Classic. The presence of distinctive salt ceramic wares suggests that salt was boiled during the Late Classic. The saltmaking sites were organized as a workshop industry with each household contributing to a workshop. Santley (2004:219) claims that "salt production was organized at the household level or by small groups of families and destined to stay at that level because increasing the number of producers probably would not greatly increase the efficiency of manufacture."

On the inland shore of Placencia Lagoon in Belize, ten saltmaking sites were recorded by the Point Placencia Archaeological Project (MacKinnon and Kepecs 1989). The sites, identified by the presence of ceramic sherds and cylinders, date to the Late Classic period. Numerous mounds of the leached earth, remnants of the saltmaking process, were observed at several of the lagoon sites. The largest of the mounds is approximately 20-x-12 m. The mounds were interpreted as "prehispanic saltmaking middens, as they contain both saltmaking refuse and leached earth" (MacKinnon and Kepecs 1989:530). A technique in experimental archaeology was conducted using the technology discovered by the project. MacKinnon and Kepecs (1989) placed the Placencia Lagoon soil in a trough with holes drilled in the bottom. Salt water was poured over the soil. After allowing time for soaking, the briny substance was boiled to produce salt.

The saltmaking site at Guzman Mound on the south coast of Guatemala shows that artificial mounds also were constructed in order to harvest salt (Nance 1992). Nance's (1992) excavations at the Guzman Mound yielded artifacts interpreted as the remains of saltmaking activities. The artifacts consisted of ceramics, daub, and charcoal. The mound was constructed in the middle of a wet salt flat that was 70 % destroyed at the time of investigation. The mound and the artifacts were the only remains of activities observed in the area.

Some archaeological sites exhibit evidence of both the “sal solar” and the “sal cocida” technique. The Salinas de los Nueve Cerros in southern Guatemala is a salt producing area encompassing approximately six square kilometers (Dillon et. al 1988). These saltworks date from the Late Preclassic to the Classic. The salt was harvested from a salt spring that tapped an underground salt dome. Large ceramic vessels excavated in situ reveal that the salt was produced by the “sal cocida” technique. A rock dam observed in the Tortugas salt stream and subsequently excavated into the terrace was interpreted as basins to hold water. At the end of the wall, is another parallel limestone wall which forms a rectangular space where a fire pit is located. Dillon et al. (1988) argue that although only the “sal cocida” technique leaves an imprint in the archaeological record at the site, the presence of the salt flats could indicate that solar evaporation also was taking place during the dry season.

Graham’s and Pendergasts’ (1989) 1986 excavations at Marco Gonzalez show that salt production was conducted during Late Classic times and declined during the Terminal Classic. Saltmaking activities were identified by over a meter of charcoal and ceramics sherds such as those observed at Sacapulas. This Late Classic saltwork was subsequently built over by a later structure.

An underwater archaeological excavation at Stingray Lagoon, a Late Classic saltworking site, was carried out in 1991 in Punta Ycacos Lagoon. At the time of excavation, the site was located approximately 1 m below sea level (McKillop 1995, 2002). Preservation at the site was good since the site was submerged and the artifacts did not have the trampling that terrestrial sites encounter. Artifacts recovered from the site include salt producing artifacts such as saltmaking ceramics, fired clay, clay cylinders, clay sockets, and charcoal. Intact features such as hearths, for boiling brine, were also observed and recorded. Based on the investigations at the site, salt production was determined to be the main activity.

Other sites investigated in the Punta Ycacos Lagoon system include Orlando's Jewfish, David Westby, and the Killer Bee Site (Braud 1996; McKillop 1995, 2002). Daivd Westby was excavated in 1994 as part of Melissa Braud's (1996) Masters Thesis. Orlando's Jewfish and David Westby are underwater sites near the Stingray Lagoon site. An analysis of the artifacts showed that the sites are specialized salt production sites. The Killer Bee site was visited initially in 1988 and then excavated in 1991. The site consists of an earthen mound in a mangrove swamp. The mound is interpreted as a slag heap from salt production. During excavations, the water table was located at approximately 40 centimeters (cm) below surface. McKillop (2002) suggests the paucity of ceramics and organic material is due to the lack of preservation as compared with the sites of Stingray Lagoon, Orlando's Jewfish, and David Westby.

Underwater survey in Punta Ycacos Lagoon in 2003 and 2004 resulted in the discovery of 29 more underwater saltworks for a total of 41 Late Classic Maya saltworks in Paynes Creek National Park (McKillop 2005). According to McKillop the "research shows that there was extensive production" of salt and "they produced surplus for trade" (McKillop 2005:5631). The discovery of these saltworks supports the view that they were not controlled by the inland city centers (McKillop 2002, 2005).

Red mangrove peat in the eastern arm of the lagoon preserved "wooden buildings, a paddle, and other wooden objects, along with pottery" (McKillop 2005:5631). The wooden structures are recorded at 23 of the sites that were located in 2004. The wooden posts investigated are in mangrove peat which is anaerobic and acidic, preserving the wood. Mapping at the largest structure of Chak Sak Ha Nal reveals exterior walls and interior walls of a wooden building. Artifacts are observed within the structure but are scarcer outside, suggesting that the structure was used "in some aspect of salt production, storage, or transportation" (McKillop 2005:5631). The recovery of an ancient Maya canoe paddle dating from A.D. 680-880 from the site of K'ak' Naab' indicates canoe transportation by the Maya and suggests salt was transported from the lagoon saltworks.

Modern Perishable Architecture

Wauchope's (1938) seminal ethnological study of Maya house types provides information regarding ways to interpret the wooden posts at the John Spang Site. During 1934, Wauchope visited towns and villages in the Yucatan of Mexico, Guatemala, and Belize to study how the modern Maya at that time built their wooden houses, storerooms, and miscellaneous house plot buildings. The study was conducted to provide data to compare with archaeological data of house formations. Wauchope assumes the premise that continuity exists between modern Maya houses and the remnants found at archaeological sites.

Wauchope (1938) observes four different construction shapes (Figure 4). These are apsidal houses, flattened end houses, rectangular houses, and square houses. Apsidal houses are rectangular with rounded ends. The mainposts of apsidal houses lie outside the line of walls and typically have one mainpost in each of the four corner. Flattened end houses are rectangular in shape with rounded corners (or ends). The mainposts are not as far from the walls as with the apsidal houses and up to eight mainposts can be used. The mainposts of flattened end houses also lie outside the line of the walls. The walls for both apsidal and flattened end houses are typically 12 to 75 cm from the mainposts.

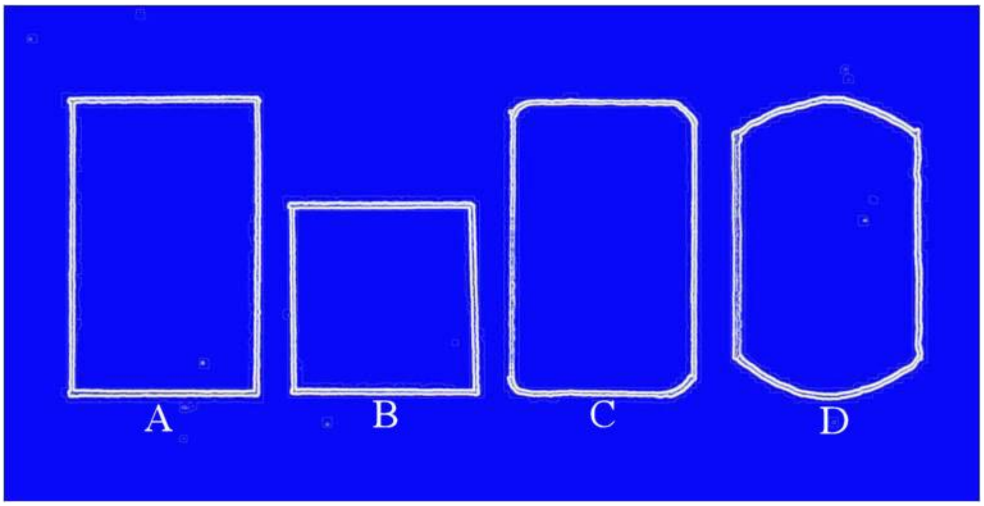


Figure 4. Four Construction Shapes Based on Wauchope 1938 (a) rectangular, (b) square, (c) flattened end, (d) apsidal.

Rectangular houses have four or more mainposts that are usually in line with the walls of the house. The size of mainposts can decrease depending on the number of posts added to support the walls. Wauchope mentions the size of mainposts of rectangular houses might decrease due to an increase in the amount. However, Wauchope does not mention that the diameter of mainposts differ depending on the house type. Square houses have an equal length of walls so that the mainposts are in line with the walls (Wauchope 1938).

Mainposts for all four construction types range from 12 to 18 cm in diameter. Wall poles range from 4 to 8 cm in diameter. Walls are sometimes left out of the construction plan for temporary shelters or storehouses. Also, walls can lie directly on the ground or can be imbedded. Wauchope (1938:30) notes that, "regardless of the ultimate plan of the house (apsidal, rectangular, or square), mainposts are set up in the ground in such a position that lines were drawn between adjacent posts the space thus enclosed would be rectangular." Walls not aligned with mainposts are supported by pole plates that rest on the ends of the crossbeams.

Walls that are aligned with the mainposts usually contribute to the support of the roof (Wauchope 1938).

Typically, there are one or two doors on houses. If there are two doors they are opposite one another. The width of the doors varies between 80 cm to 150 cm in width. Porches extend the length of either one side or end of a dwelling. If the extension of a porch is wide enough to not be covered by the roof, then additional posts may be needed to hold the roof extension. More variability is observed concerning non-dwelling buildings such as storehouses or temporary shelters than main dwellings. Extra buildings other than the main dwellings are built similar to houses but on a smaller scale. For example, granaries have four slender corner posts roughly seven cm in diameter. These slender posts are lashed with horizontal cane (Wauchope 1938).

Some items in the interior of the dwellings are embedded in the floor (Wauchope 1938). In the kitchens of Guatemala the "fireplace is occasionally mounted on a table staging, which carries a bed of rubble with clay or mud on top. The table legs are embedded in the ground" (Wauchope 1938:117). Metates can be placed either on the ground or placed on troughs with the legs of the trough embedded. Beds sometimes consist of four low posts on which cane is placed.

Pole and thatch buildings are common in coastal Chiapas, Mexico. According to interviews by Moore and Gasco (1990) on modern dwellings in Acacoyagua, parts of a perishable structure deteriorate at different intervals. The palm thatching needs to be replaced every five to six years. The rafters and crossbeams need to be replaced every six to 10 years. The mainposts, usually made from more durable wood, determine the life of the building. Moore and Gasco (1990:207) note that the most durable wood can last up to twenty years and "the type of wood used for upright posts is a major factor in the length of time a house is occupied."

Ancient Perishable Architecture

What evidence is encountered in the archaeological record to indicate the shape, size, and function of perishable structures? A plazuela group is the basic unit of Maya architecture. Buildings are placed in such a way that they form a square plaza. A plazuela group can encompass only two buildings facing each other or more buildings forming a closed space. This architectural layout is observed on a large scale, such as a city center, and at the household level (Ashmore 1981, 1990; Chase and Chase 2004; Scarborough and Robertson 1986). However, Cliffs' (1988) analysis of two structures that do not share a patio or even face each other at the site of Cerros suggest that not all structures are located within plazuela groups.

Although Wauchope (1938) encountered no round houses or buildings but these have been recovered in the archaeological record. Ceren is a site located on the southeastern Maya periphery in El Salvador. Due to the eruption of the Loma Caldera vent around A.D. 600 the site contains remarkable preservation of the hamlet. Eleven structures have been excavated at the site. All buildings at Ceren sit atop a fired earthen platform, have waddle-and-daub walls, and earthen columns in the corners. Poles are set into the floor approximately 20 cm apart to help support the thatch roofs. The majority of buildings are square or rectangular. Kitchens tend to be round buildings (Beaudry-Corbett et. al 2002; Calvin 2002; Sheets 2002).

Household 1 at Ceren comprises four spatially separate buildings and is the most completely excavated complex at the site. The four buildings consist of a domicile, a storehouse, a kitchen, and a ramada. The planview map of Structure 1 shows eight postholes that are in line with the columns and support the walls and porch. Outside of the structure is a metate on 'horquetas' a set of two forked wooden posts embedded in the ground. Structure 11, known as a kitchen, is circular and walled with poles that were not daubed. A metate on a 'horquetas', also was observed. The walls of Structure 2, a domicile, are constructed by vertical poles approximately 2 to 5 cm in diameter and spaced 8 to 15 cm apart (Beaudry-Corbett et. al 2002). Structure 7, located in Household 2, has posts 4 to 5 cm in diameter and a raised wooden shelf supported by four 8 to 10 cm in diameter embedded legs (McKee 2002). Structure 16, located in Household 3, is a circular kitchen with pole and thatch walls. The poles are 1 to 1.5 cm in diameter (Calvin 2002). Inside the workshop (Structure 4) at Household 4 there is maize crib. The crib is circular with small poles in the ground encompassing an area 90 cm in diameter (Gerstle and Sheets 2002).

In contrast to the houses preserved at Ceren, the majority of the time, the only indication of a perishable structure in the Maya area is preserved thatch impressed daub or postholes. Postholes allow interpretation of the type and form of the perishable structure. Survey and excavation in the Far West Bajo in Belize yielded one posthole during excavations at patio group H. The posthole was excavated into bedrock approximately 25 cm from the southeast corner of the platform and was 15 cm in diameter (Kunen 2004:65). At the site of Chan Chen, postholes were excavated from a Late Preclassic round platform. No dimensions were given from the postholes, but the structure encompassed an area approximately 10.2 to 10.9 m in diameter (Sidrys 1983). Posthole remains also were encountered at Cuello (Hammond et al. 1995).

Excavations at San Juan, Chac Balam, and Ek Luum, on Ambergris Cay reveal variability of perishable structures constructed on raised platforms. San Juan, Structure 1 lies on a north to south axis and is 11 x 4 m in size where a perishable structure once stood. Structure 2 is aligned on a northwest to southeast axis and is 8 m in length and 5 m wide. Two postholes are documented associated with an alcove for the structure. Structure 3 and 4 both small round buildings. Based on the distribution of postholes Structure 4 encompasses an area of 3 m in diameter (Guderjan 1995).

At the site of Chac Balam, Structure 1a has a preserved floor with postholes ranging from 10 to 20 cm in diameter. Structure 2 is large, measuring 61 m in length. Structure 3a is 15 m wide and 25 m in length. Structure 4a yielded 12 postholes on a platform that measured 26 x 8 m. The dimensions of the oblong perishable structure are 2.75 by 2.25 m. Another construction phase of Structure 4a (4a-3rd-1) reveals postholes suggesting a perishable structure 3 x 4 m (Driver 1995). More than 17 postholes are observed at the site of Ek Luum. The postholes form Structures 1 and 2 at the site. Structure 1 was made of perishable materials with a diameter of approximately 2.50 m. Structure 2 is unique in that the posts form a double wall. The structure was an 8 x 5 m rectangular building (Guderjan and Brody-Foley 1995).

Many researchers use ancient Maya architecture to study social, demographic, political, economic, and ideological processes. However, the buildings are stone or adobe, and perishable wooden structures are inferred from the postholes. Therefore, there is potential for understanding many aspects of ancient Maya culture with the wooden architecture discovered in Paynes Creek National Park. An understanding in the variability that exists among the size, shape, and materials of ethnographic and archaeological investigations of architecture is a necessary beginning to interpreting the wooden architecture at the John Spang Site.

Previous Research Conducted on the Southern Coast of Belize

Archaeological research on the south coast of Belize has been directed by Heather McKillop since 1982 (Figure 5). Numerous sites have been investigated along the present coast line and on the cays inside the Belize Barrier Reef. Many of these sites have yielded evidence of direct participation in coastal trade. These sites include Wild Cane Cay, Frenchman's Cay, Arvin's Landing, Stingray Lagoon, and Pork and Doughboy Point, among others (Ascher 2000; Braud 1996; Brandehoff-Pracht 1995; Magnoni 1999; McKillop 1987, 1995, 1996, 2002, 2004a, 2005; McKillop and Healy 1989; Pemberton 2005; Seidemann 1999; Somers 2004; Steiner 1994; Watson 1999).

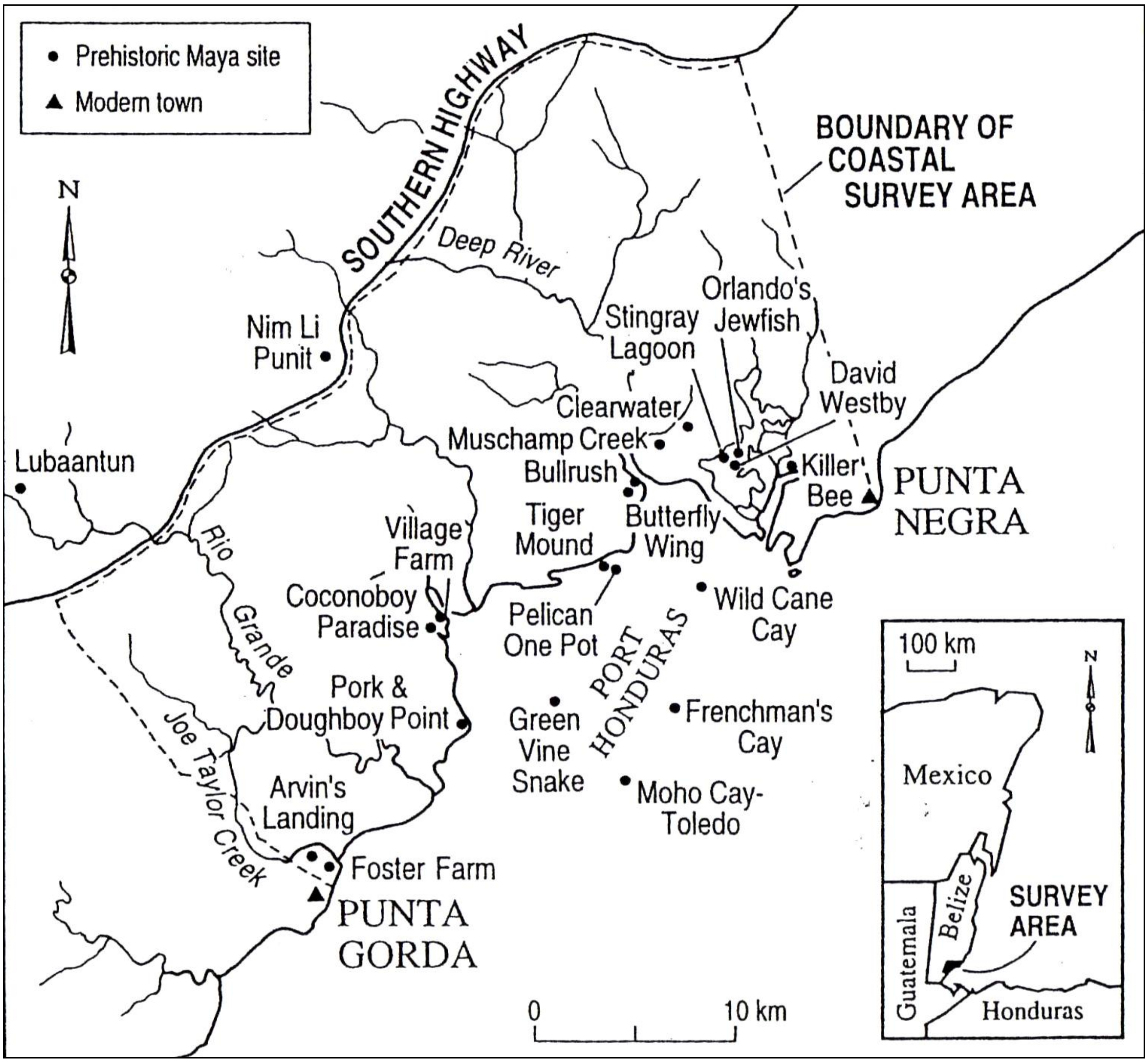


Figure 5. Map Showing Previous Research Conducted on the Southern Coast of Belize (McKillop 1996:Figure 2).

Stratigraphic excavations in middens at Wild Cane Cay in 1982 identified the site as an offshore trading port (McKillop 1987). Mound excavations in 1982 and from 1988 to 1992 indicated the use of coral as a building material for foundations for pole and thatch structures (McKillop 1987, 2005). Offshore excavations at Wild Cane Cay in 1990 and 1991 revealed deeply buried deposits indicating sea level rise (McKillop 2002, 2005b). Investigation efforts were first focused on Wild Cane Cay and then expanded into the surrounding area to focus on direct trade from and to the cay and the trade conducted along the southern coast. Radiocarbon dates indicate that Wild Cane Cay was occupied from the Classic into the Postclassic periods (A.D. 300-1500). Large amounts of obsidian were recovered from the surface and excavations on the cay indicating that the island participated in trade and was connected to obsidian producing areas (McKillop 1989; McKillop et al. 1988). Other exotic goods recovered from the site include Tohil Plumbate pottery from the Pacific coast, Tulum Red pottery, and chert similar to that found around Colha in northern Belize. With the decline of the southern inland sites like Lubantun, Wild Cane Cay reoriented its maritime trade to the northern Maya lowlands (McKillop 1987, 1989, 1996, 2005b).

In 1994, the partially inundated coastal site of Pork and Doughboy Point was investigated (Brandehoff-Pracht 1995). One test unit was excavated, at 55 cm below sea level, at the site showed that the site dated to the Late Classic and Terminal Classic periods (A.D. 600 to 900). The intact stratigraphy at the site showed that sea-level rise occurred after the occupation dates at the site. Further investigations in 2003 by the "In Search of Maya Sea Traders" project by Pemberton and McKillop (Pemberton 2005) were undertaken on the dry portions of the site to further date them and to establish the sites role in the regional economy. Based on surface collection and two 1-x-1 m test units further indicate that the site was a settlement and not a salt workshop or a trading port.

The 1994 and 1997 excavations of three mounds on Frenchman's Cay included trenches in Spondylus Mound (Watson 1999), Crown Conch (Magnoni 1999), and Great White Lucine (McKillop et al. 2004). The stone foundation of the latter two mounds were 80 cm below sea level. Transect excavations in middens at Frenchman's Cay revealed dense inundated archaeological deposits (McKillop and Winemiller 2004). These investigations showed that the Maya adapted to their surroundings and used coral for their architecture based on the style of building found at inland sites.

Arvin's Landing on Joe Taylor Creek also has been a focus of research directed by McKillop (McKillop 1996, 2005; Somers 2004; Steiner 1994). Joe Taylor Creek is located south of Punta Ycacos Lagoon at the north end of Punta Gorda. Arvin's landing included a stone platform for a structure (McKillop 1996), as well as extensive midden deposits revealed by transect excavations by Joe Taylor Creek (Steiner 1994) and in the adjacent forest (Somers 2004; Somers and McKillop 2005).

The Punta Ycacos Lagoon research by directed by Heather McKillop has been carried out in a phased approach. The first phase of the research was carried out in 1991 and 1994 (Braud 1996; McKillop 1995, 2002) with the discovery and excavation of Stingray Lagoon, David Westby, Orlando's Jewfish, and the Killer Bee Site. Analysis of the briquetage indicates standardization of the salt pots suggesting the mass production of a product, salt. The second phases of the research began in 2004, with some preliminary survey in 2003, and is ongoing (McKillop 2004a, 2005a, 2005b). The second phase of research, in 2003 and 2004, was a search for additional saltworks. Sites located within Punta Ycacos Lagoon are specialized saltmaking sites. These sites include Stingray Lagoon, Orlando's Jewfish, David Westby, the newly recorded K'ak' Naab', Chak Sak Ha Nal, and thirty-nine more salt works recently documented, all of which, have been inundated by sea-level rise.

Environment at the John Spang Site

The country of Belize is bounded on the north by Mexico, the west and south by Guatemala and to the east by the Caribbean Sea. The barrier reef parallels the country for 260 km extending from the northern portion of Belize, near Ambergris Cay, to the Port of Honduras in the south. The John Spang Site is located on the sea floor in southern Belize, north of the town of Punta Gorda within the Punta Ycacos Lagoon (Figure 6).

Figure 6. Overview of the John Spang Site, Facing Northeast.

The site lies within the Old Antilla physiographic province which is characterized by low plains and rolling hills. The Old Antilla physiographic province is situated between two ranges.

Beginning in Chiapas, Mexico, the first range spans into Guatemala, and ultimately forms the Maya Mountains in Belize. The second range runs south of the first range along the southern parts of Mexico, Guatemala, and Honduras (West and Augelli 1976).

The Maya Mountains and the rivers and streams that drain from them are a source of raw material for the ancient Maya. The mountains are located to the west and north of the John Spang Site. According to Dixon (1956:5), the Maya Mountains are "an upfaulted block of Paleozoic sediments" with granite intrusions. Granite, sandstone, limestone, and other minerals were mined for building materials and household goods in southern Belize, including manos and metates (Abramiuk and Meurer 2006). Elevations in the Maya Mountains reach approximately 1,100 m and break the coastal plain. The coastal plain is relatively flat, with rolling hills. Several rivers and creeks drain from the mountains including Deep River to the south Punta Ycacos Lagoon.

The Belizean barrier reef reduces wave energy from the Caribbean sea and provides a shallow safe harbor. Bathymetry south and east of the Punta Ycacos Lagoon show water depths of less than six meters (Purdy and Gischler 2003:Figure 2). Sea-level rise, of at least 1 m, occurred after the Late Classic (A.D. 600 to 900) human occupation, and inundated this coastal area (McKillop 1995, 2002, 2005).

The climate of Belize is a tropical wet climate with a relatively small difference between temperatures throughout the year. During the day, the average temperatures are between 27^{o} and 32^{o} C. In the evenings, the average temperature ranges between 21^{o} and 24^{o} C. Due to the northeast trade winds, the coast of Belize receives between 203 and 305 cm of rainfall a year. The presence of a dry season is less marked. There is a dry season, rainy season pattern, with some rain most months, although the area tends to be drier in the months of April and May (West and Augelli 1976). There is no weather station in the Punta Ycacos Lagoon vicinity but there is one near Punta Gorda to the south. According to the Belize National Meteorological Service (BNMS), mean annual precipitation in Punta Gorda is around 203 cm a year. The driest months are from March to mid June with rainfall levels from 9 to 15 cm. Rainfall averages increase in June, July, August, and September. July usually receives the highest rainfall average of roughly 750 millimeters (BMS, Figure 1). Hurricanes occasionally make landfall in Belize. The most recent, Hurricane Iris, made landfall to the north near Monkey River.

The vegetation of southern and coastal Belize consists of Tropical Savanna including evergreen broadleaf trees and shrubs, palms and pines. The inland areas of Belize consist of tropical rainforest consisting of broadleaf trees and shrubs (West and Augelli 1976). Three different mangrove species occur in Belize. These are red mangroves (Rhizophora mangle), black mangroves (Avicennia germinans), and white mangroves (Laguncularia racemosa). Red mangroves "typically dominates the zone proximal to water, i.e., the creekbank position" (McKee 1995:334). Black mangroves can be found farther inland or on slightly higher land whereas white mangrove are the least common species in Belize (Murray et al. 2003). The majority of the red mangroves within Punta Ycacos Lagoon fall within the dwarf class (< 3 m tall) with some stands in the medium to tall class (3 to 8 m and > 7 m tall, respectively), (Murray et al. 2003: Table 4).

The John Spang site is inundated by water. The only vegetation present on the site is five clusters of red mangroves. Punta Ycacos Lagoon is a shallow salt water lagoon surrounded by mangrove vegetation. Higher land within the area contains palmetto palms.

Chapter 2
Methodology

My thesis fieldwork was undertaken at the John Spang Site between March 21 and April 12, 2006. These investigations were conducted as part of the "Mapping Ancient Maya Wooden Architecture on the Sea Floor Project" research project directed by Dr. McKillop within Paynes Creek National Park in the Punta Ycacos Lagoon.

The field crew consisted project team members, including Dr. McKillop, Amanda Evans, Bretton Somers, Mark Robinson, John Young, and me. The John Spang site is accessible only by boat in a western arm of the Punta Ycacos Lagoon. Due to the shallow water in this portion of the lagoon the boat was anchored in deeper water. The field equipment was then unloaded onto a smaller portable research vessel and transported through the lagoon to the site.

Survey

The John Spang site was discovered on March 21, 2006. A low pressure system had lowered the sea-level during low tide and exposed portions of the site. Late in the day, artifacts were observed on the surface of the sea-floor and the area was marked for further investigation. On March 25, 2006 the field crew returned to the site and conducted a reconnaissance survey by searching the site for the presence of wooden posts. The initial reconnaissance survey yielded the presence of 23 wooden posts and artifacts associated with saltmaking. At the end of the day, we decided that this site should be surveyed and that it would become my thesis research.

On March 25 we returned to the site to further document the lowering of the sea and to assess the site in preparation for a systematic flotation survey. Between March 28th and April 3rd the team conducted a 100 percent systematic flotation survey meaning that a systematic flotation survey was completed across the whole site. The field crew lined up parallel to each other, shoulder to shoulder, on our flotation devices and moved systematically across the site. Our hands are placed flat on the surface of the peat feeling for wooden posts, artifacts, and other cultural material. Surveying in the water can be disorienting. Wind and the tide can cause the transect lines to stray off course. In order to minimize straying off course and to insure complete coverage, each transect line was marked with pin flags which were pulled as each transect was completed. The field crew moved shoulder to shoulder, floating over the site while using our hands to locate wooden posts, artifacts, and the surface boundaries of the site. Yellow pin flags were used to mark the posts and were placed on the northern side of each post encountered. Artifact boundaries, based on the surface distribution of artifacts, were marked with pin flags tied with pink flagging tape. These boundaries were determined based on the distribution of surface artifacts and posts. All survey transects were expanded, approximately 5 meters past the surface distribution of artifacts, in order to further define the site. The site boundaries at the John Spang site were marked at the edge of the artifact surface distribution and wooden post distribution. The diagnostic artifacts were marked with yellow pin flags tied with pink flagging tape.

The continued presence of a low pressure system made the flotation survey difficult because portions of the site were exposed above sea-level. The survey continued in sections over a couple of days to take advantage of high tide when the site was underwater. A flotation survey is preferred over a more traditional pedestrian survey because it minimizes the disturbance to the site and allows for greater coverage while searching for wooden posts. The field crew floated on individual research flotation devices (RFD's) to minimize the disturbance to the site. During this portion of the investigations a site marker was placed in a centrally located area and marked with a ¼-inch PVC pipe. GPS coordinates for the site were taken from this marker.

Surface Collection

A limited surface collection of artifacts was conducted. Artifacts were flagged based on their preliminary temporal importance or their uniqueness. The surface collection of artifacts can help to verify the function and temporal range of the site. Both ceramics and lithic artifacts were collected. All of the flagged artifacts were labeled with letters, beginning with the letter A and ending with the letter Z. Since more than 26 artifacts were labeled the letters were doubled or tripled, for example AA, or MMM. All artifacts collected were placed in plastic bags with water to avoid drying out. The bags were labeled by their assigned letter, site name, site number, and date. Upon return to the field station the artifacts were entered into a field catalog along with a brief description. All artifacts collected were latter point plotted with the total station during mapping of the site.

Post Labels and Measurements

All of the wooden posts flagged during the survey were labeled and measured. The pin flags marking the wooden posts were labeled with an H or a P and assigned a number starting with 1 using a durable sharpie. Posts that were composed of harder wood were labeled H and the pimenta posts that are more brittle to the touch and hollow inside were labeled with the letter P. All horizontal posts were flagged on either end and also given a post number and labeled. Using a flat tailors tape each wooden post was measured for diameter and circumference. These measurements were recorded in a waterproof book and later entered into an excel spreadsheet.

Mapping

Mapping of the site was accomplished on April 11 and April 12, 2006 using a Topcon GTS-725 total station with built-in Windows®CE.Net operating system and a prism stadia rod. The total station was placed at a project datum located south of the site on a small sandy mangrove beach. All of the flags marked on the site were recorded. Points recorded on the total station include the flagged wooden posts, flagged diagnostic artifacts, the flagged artifact boundaries, and the mangrove vegetation present at the John Spang Site.

Statistical Analysis

During the fieldwork phase of my research, correlations were observed between the diameter and the circumference of the wooden posts. In order to assess the observed correlations, the diameters and circumference were entered into SPSS® for Windows®. A simple linear regression analysis was run to determine the relationship between the two observations, or variables. The variables are circumference and diameter. In SPSS diameter is the independent variable and circumference is the dependent variable. Linear regression analysis can be used to observe direct relationships and be used as a predictive model to predict data. If the linear regression analysis presents a strong relationship between the two variables then there is a correlation between diameter and circumference allowing for filling in the gaps of any absent or missing data. Due to the deterioration of some of the wooden posts above the sea floor at the John Spang Site only diameter or circumference of some of the wooden posts could be measured. A strong relationship between diameter and circumference allowed me to fill in any holes or missing data from the fieldwork.

SPSS was used to create a graph, histogram, line graph, and a boxplot of the diameters of hardwood posts. These descriptive statistic plots are graphical methods used in order to visually analyze the wooden hardwood posts. These displays also helped to form class intervals to divide the diameters and compare them with the ethnographic data in the literature. These class intervals were visually displayed in a GIS.

Geographical Information Systems

After mapping of the John Spang site was completed, the data collected using the total station were downloaded into a Microsoft Excel™ file where the post measurements were added to the spreadsheet. The Microsoft Excel spreadsheet contains all attributes of the points recorded including description, northing, easting, and height. The file was then attached to the GIS GeoMedia® by Intergraph™ for analyses of spatial patterns and distribution of the wooden posts (i.e., hardwood and pimenta). Using this GIS software allows me to create spatial queries and spatial overlays to compare the distribution of posts, as well as comparisons of post sizes. Viewing the artifact boundaries that were mapped allows assumptions to be made regarding initial site size and the spatial relationship among artifacts and the wooden architecture.

In order to analyze the spatial distribution of the wooden posts, two techniques were implemented in GeoMedia®. One method involved the discovery of patterns in the data based on statistical analysis SPSS. The second method involved imposing patterns from ethnographic and archaeological investigations. Based on a histogram created in SPSS, the diameters of hardwood posts were divided into four class intervals. The intervals are 3 to 6 cm, 7 to 10 cm, 11 to 14 cm, and 15 to 19 cm. The class intervals were used to create a ranged thematic in Geomedia.

This same technique is used for the imposed ethnographic and archaeological data available in the literature. Another ranged thematic was created using Wauchope's (1938) study of modern Maya houses. Wauchope (1938) observed that mainposts for modern Maya houses ranged from 12 to 18 cm and that wall post ranged from 4 to 8 cm. These two class intervals, 12 to 18 and 4 to 8, were used to create a ranged thematic in Geomedia. The results of the two thematic's are analyzed and discussed in the analysis section of my thesis.

Chapter 3
Results

The archaeological investigations conducted at the John Spang Site found an array of wooden posts and artifacts. The site is submerged under the sea. Wooden posts and artifacts are embedded in peat. The peat has preserved the wood while the location of the site underwater has limited the trampling and weathering observed on more terrestrial sites. The sediment at the site is a firm compact peat overlain in some areas by pockets of a fine silt.

The systematic flotation survey revealed 149 wooden posts which were then mapped with the total station (see Figure 7). The site size is 80 m north to south and 50.6 m east to west, is based on the distribution of surface artifacts and the extension of the wooden posts. The species of the wooden posts are not yet known. Preliminary classifications are hardwood and pimenta. The hardwoods are hearty solid wood, whereas the pimenta posts are fragile. Often, the pimenta are hollow due to decay which leaves only the shell of the bark to note its presence. Out of the 149 mapped wooden posts, 100 are vertical hardwood, 40 are vertical pimenta, six are horizontal hardwood, and three are horizontal pimenta. The length or depth of the vertical wooden posts is unknown since no excavation of the posts was undertaken during this stage of the research. Also, any excavation of the wooden posts would hasten its deterioration because the peat acts as a preservative keeping the post intact while excavation, in effect, destroys the past.

By viewing the spatial layout of the site, initial observations can be presented. Overall, the mapped wooden posts at the John Spang Site have a northwest to southeast alignment (see Figure 7). The site boundary differs from the artifact boundary slightly in the central portion of the site (Figure 8). No artifacts were observed surrounding the pimenta lines. Seven or more clusters of wooden posts can visually be observed at the site. These clusters are separated by

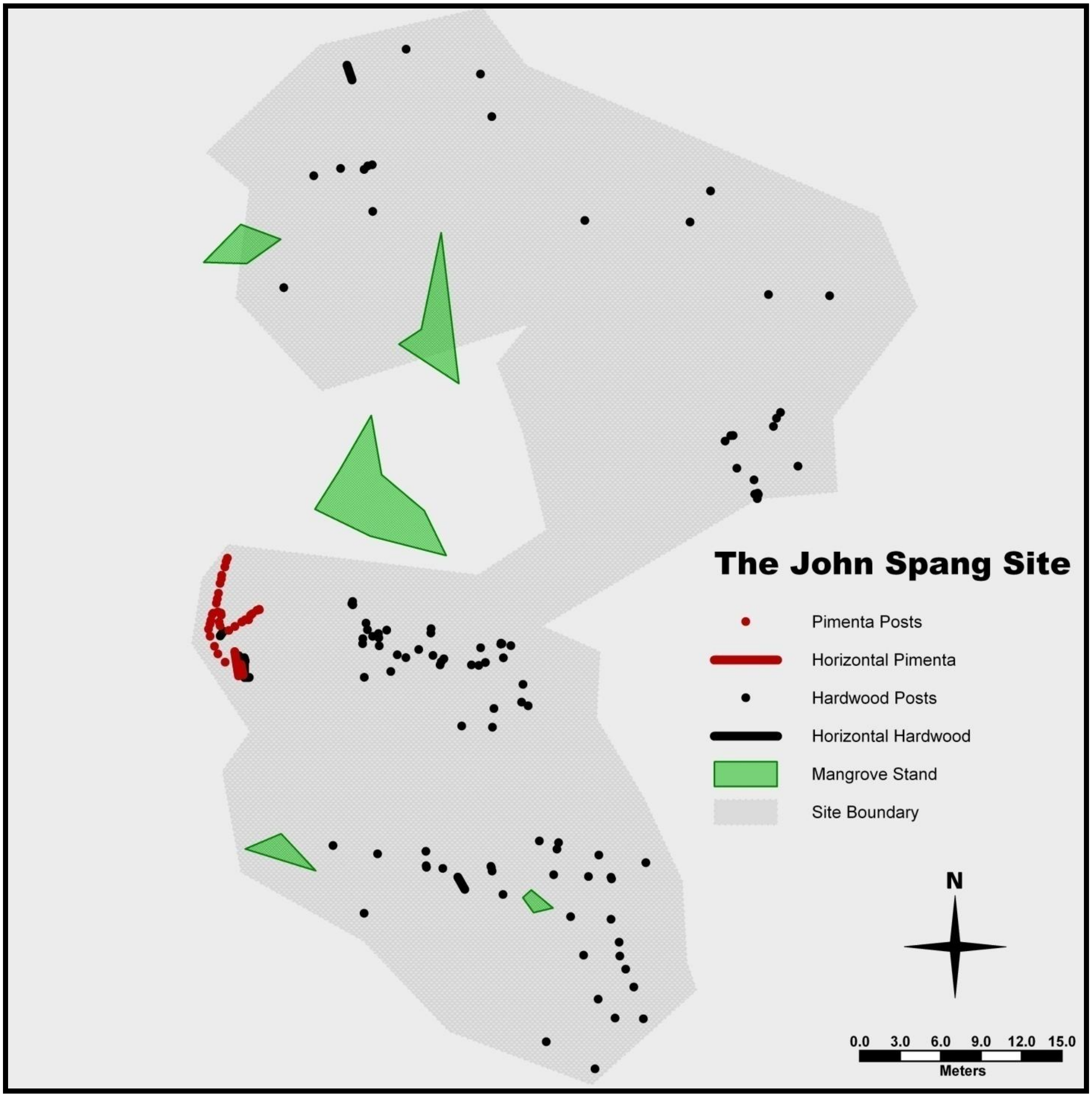


Figure 7. Map of the John Spang Site

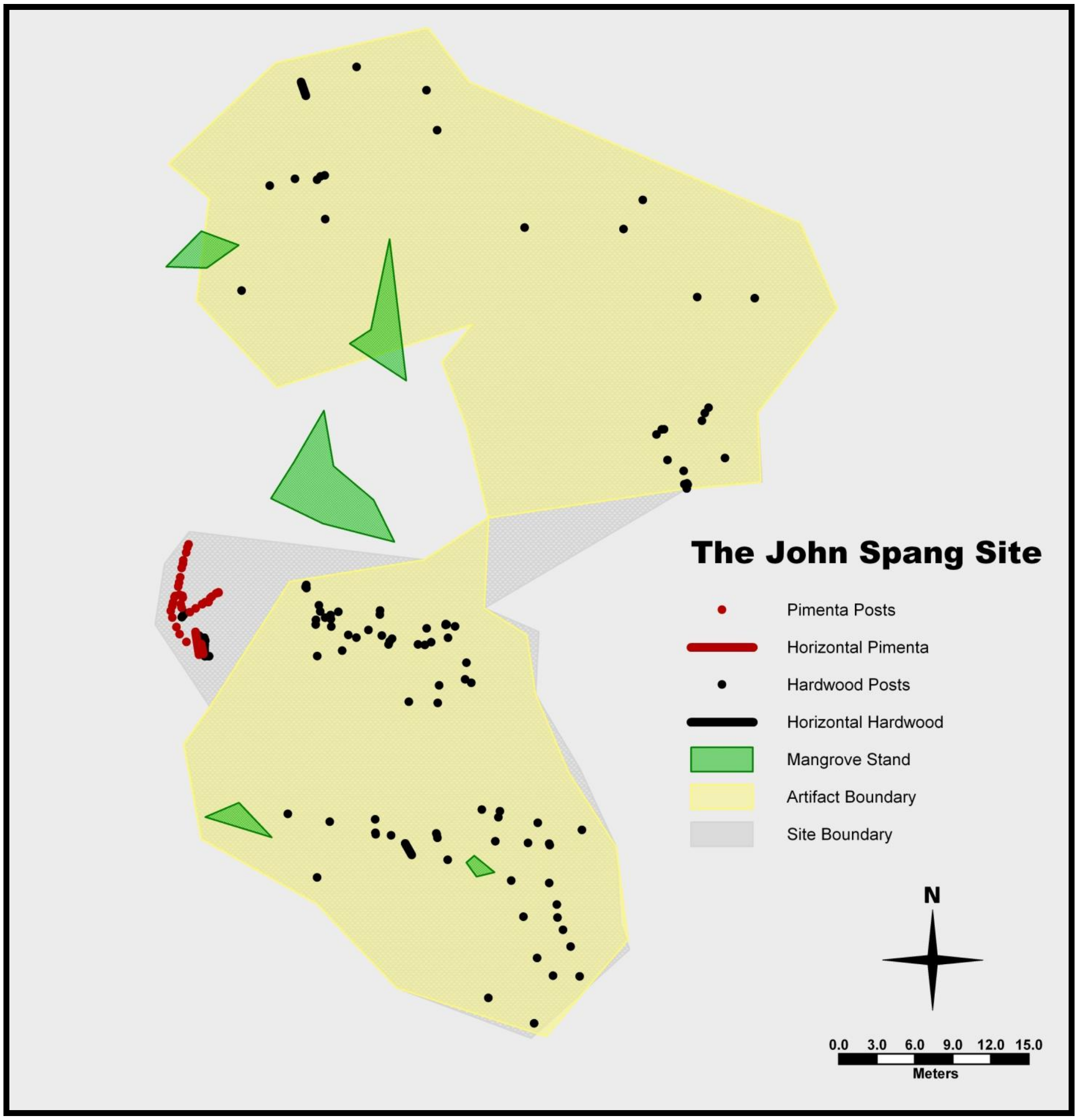


Figure 8. The John Spang Site showing Artifact Boundary.

spaces where no wooden posts were found. Even though no wooden posts were discovered in these areas, artifacts are abundant throughout the site, except around the line of pimenta, where no artifacts were observed.

The southern portion of the site yielded 32 vertical hardwood posts and one horizontal hardwood post (Figure 9). This portion of the site is approximately 17 m north to south by 23 m east to west based on the distribution of posts. No pimenta posts were observed in this portion of the site. This southern portion of the site might actually have one or more clusters of posts divided by a red mangrove stand. The horizontal hardwood post measures one meter in length and was found at the surface of the peat and is aligned on a northwest to southeast axis. The diameter of the post is 8 centimeters with a circumference of 24 centimeters. Both ends of the horizontal post show evidence of tool marks.

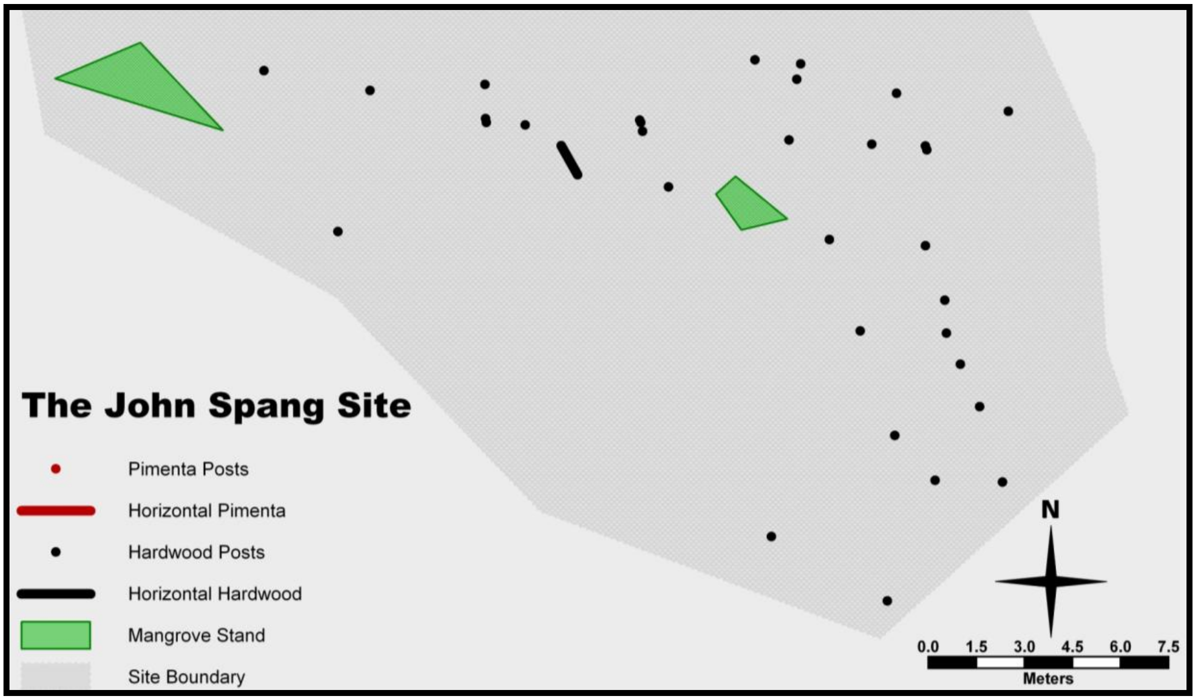


Figure 9. Southern Portion of the John Spang Site.

There is an approximate 8.4 m space in wooden posts between the southern and central portions of the site. Even though this area is devoid of wooden posts, a dense scattering of artifacts was observed. The central portion of the site can further be divided into two areas; the eastern central portion and the western central portion (Figure 10). The eastern central portion yielded 38 hardwood posts and encompasses an area of approximately 9.5 meters north to south by 13 meters east to west based on the distribution of hardwood posts. No pimenta posts were found in this area.

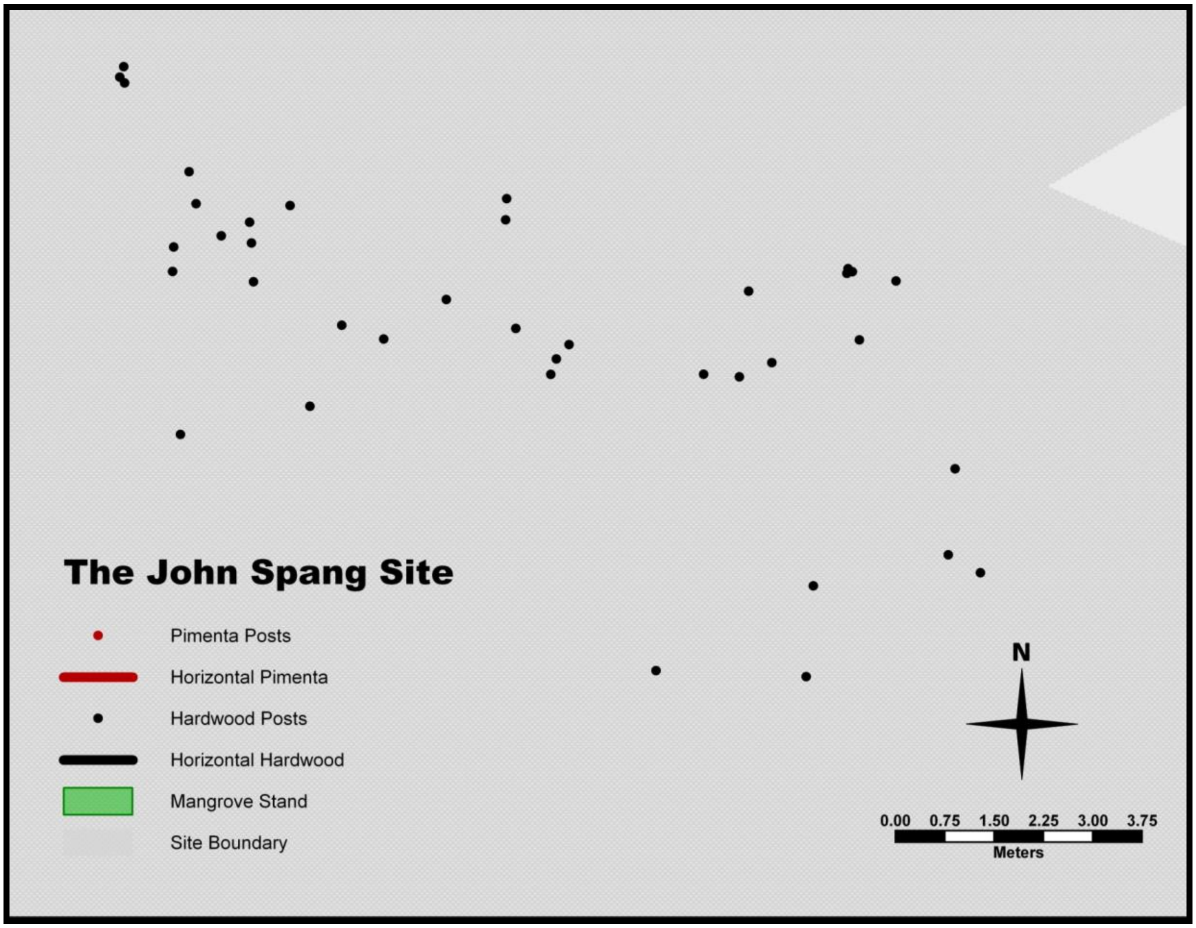


Figure 10. Eastern Central Portion of the John Spang Site.

There is approximately a seven meter distance between the eastern and western central portions of the site (Figure 11). The western central area contains the only pimenta posts discovered at the site and encompasses an area of approximately nine meters north to south by four meters east to west. In this area, there are 33 vertical pimenta posts, two pimenta horizontal posts, one pimenta horizontal post whose end could not be delineated, one vertical hardwood post, and four horizontal hardwood posts. The lines of pimenta posts form a backward y shape. The two pimenta horizontal posts measure 1.8 m and .8 m in length. These two posts were embedded into the peat and are angled a little west of north and are located to the southeast of the pimenta line. The horizontal hardwood found in the dip of the inverted y is .4 m in length and was found on a northeast to southwest axis. The other three horizontal hardwood posts are located to the southeast of the pimenta line and east of the two pimenta horizontal posts. The northwestern most of these is on a axis a little west of north and is .3 m in length. The center horizontal hardwood is .7 m in length and is on a north to south alignment. The southernmost horizontal in this area is .3 m in length and is on an east to west axis. All but one of the horizontal posts in this area lies southeast of the pimenta line. One hardwood vertical post was located in this area. No artifacts were observed surrounding this area.

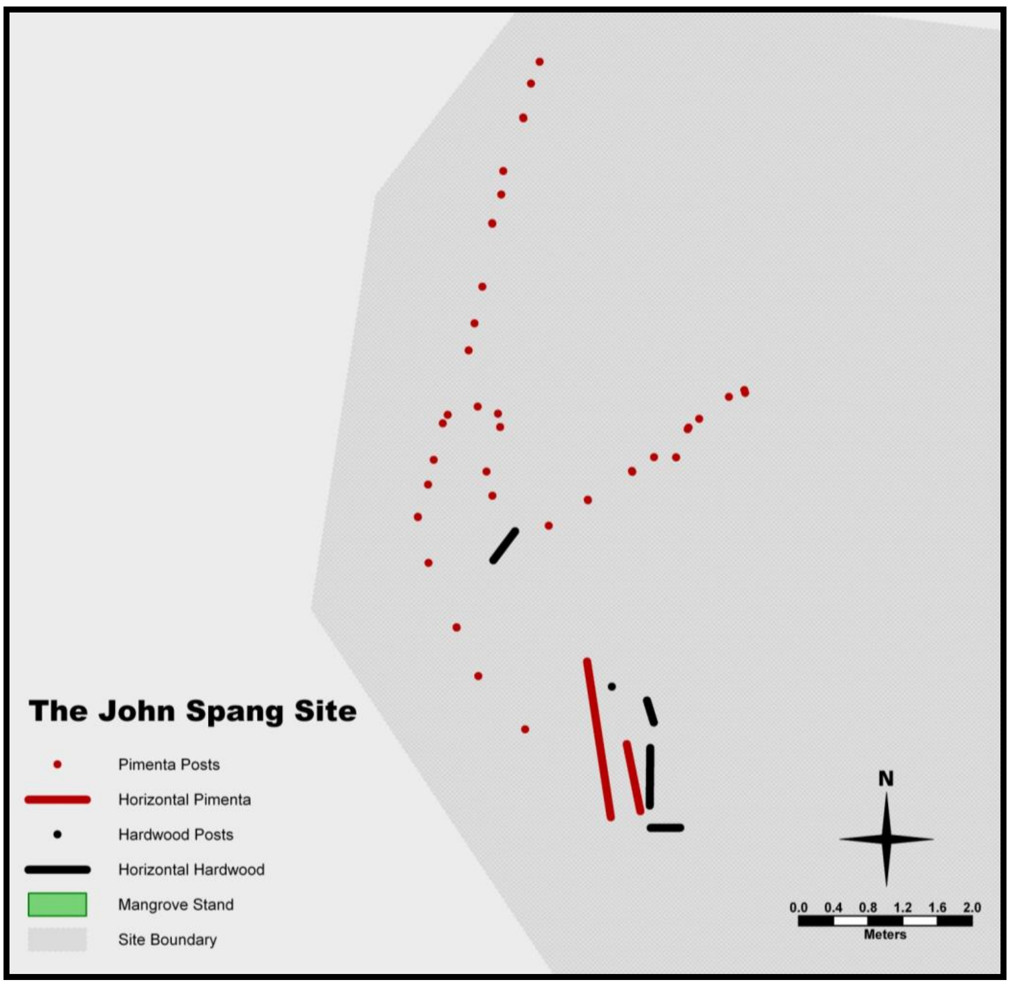


Figure 11. Western Central Portion of the John Spang Site.

Heading northeast, approximately 21 m, from the eastern central portion of the site is a cluster of 14 hardwood posts (Figure 12). These hardwood posts span an area of approximately 6.5 m north to south by 5.5 m east to west. All but three of these posts seem to be aligned on a northwest to southeast axis. The northeastern three posts in this area are possibly aligned on a northeast to southwest axis. Approximately, 9 m north of this area of hardwood posts is a loose cluster of five more hardwood posts (Figure 13). These five posts are spaced far apart. These spaces range from 2.8 m to 7.9 m. No pimenta posts were discovered during the systematic survey of either of these areas. This area is also approximately 32 m northeast of the central portion of hardwood posts.

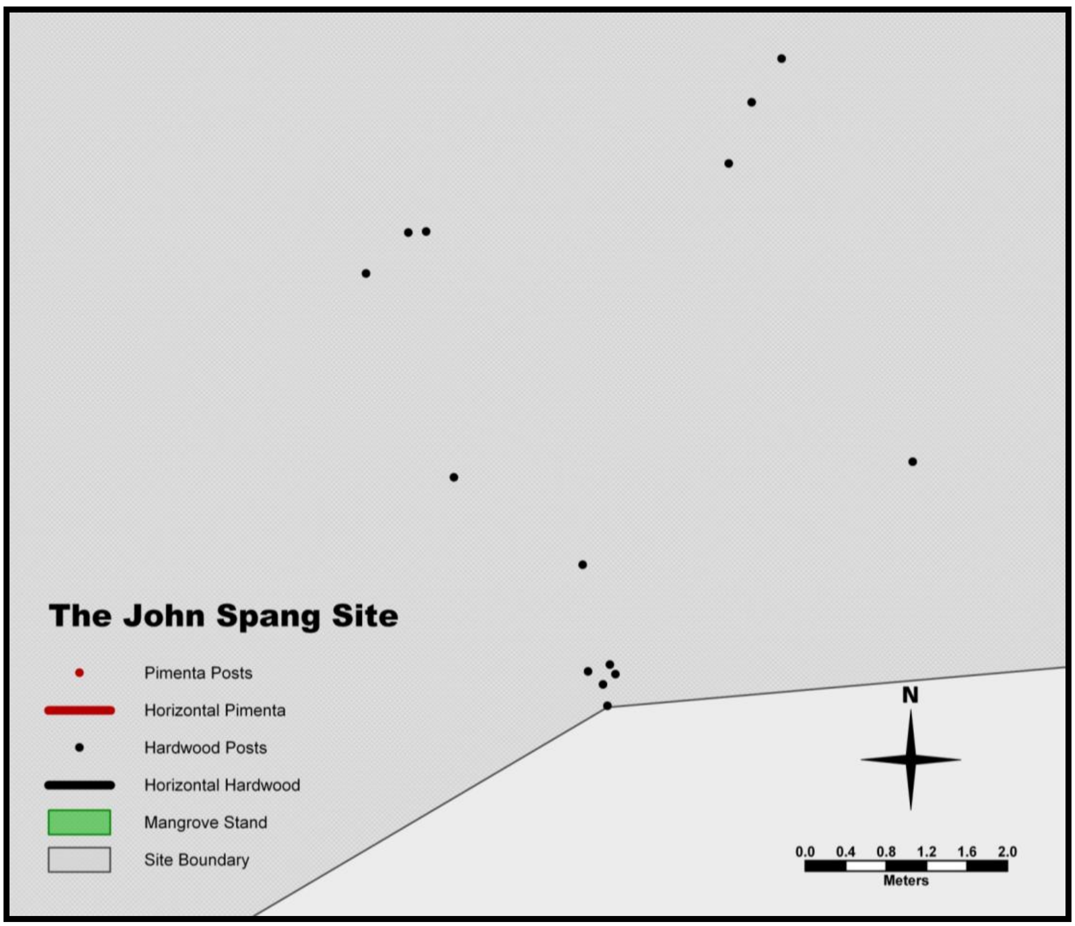


Figure 12. Area of 14 Hardwood Posts at the John Spang Site.

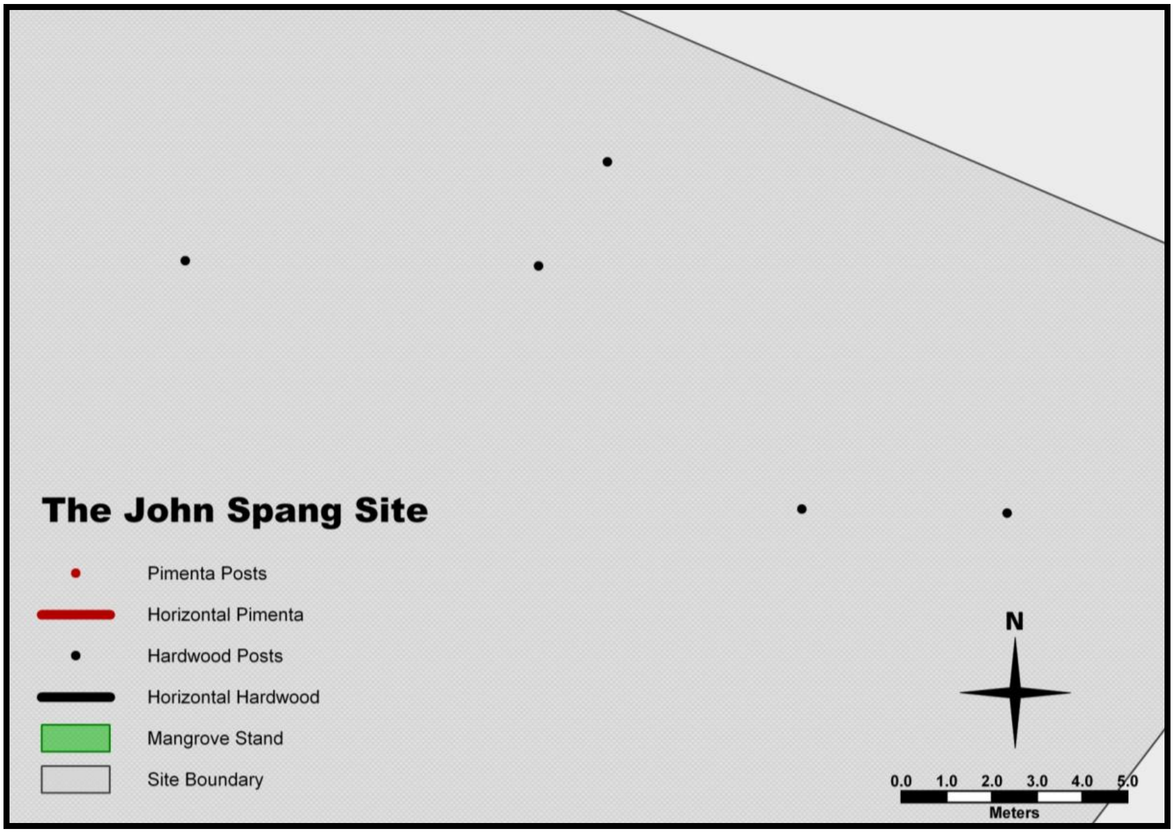


Figure 13. Area of Five Hardwood Posts at the John Spang Site.

In the northwestern portion of the John Spang Site are two or more clusters of wooden posts (Figure 14). The northern most of these consists of three hardwood posts and one horizontal post and encompasses an area of approximately 5 m north to south by 10.6 m east to west. The horizontal hardwood post measures 1.2 m in length. This area of the site is 6 m from the area immediately to the southwest.

The final cluster of wooden posts is situated between two mangrove stands and consists of six hardwood posts and an outlier hardwood post to the south (Figure 14). The six hardwood posts encompass an area approximately3.5 m north to south by 4.5 m east to west. This area is approximately 20 m north of the pimenta lines and 24 m northwest of the central area of hardwood posts. No pimenta posts were discovered in this area. Dense layers of artifacts were observed in this area of the site. Artifacts were observed within the area of hardwood posts and slightly outside the outside post clusters.

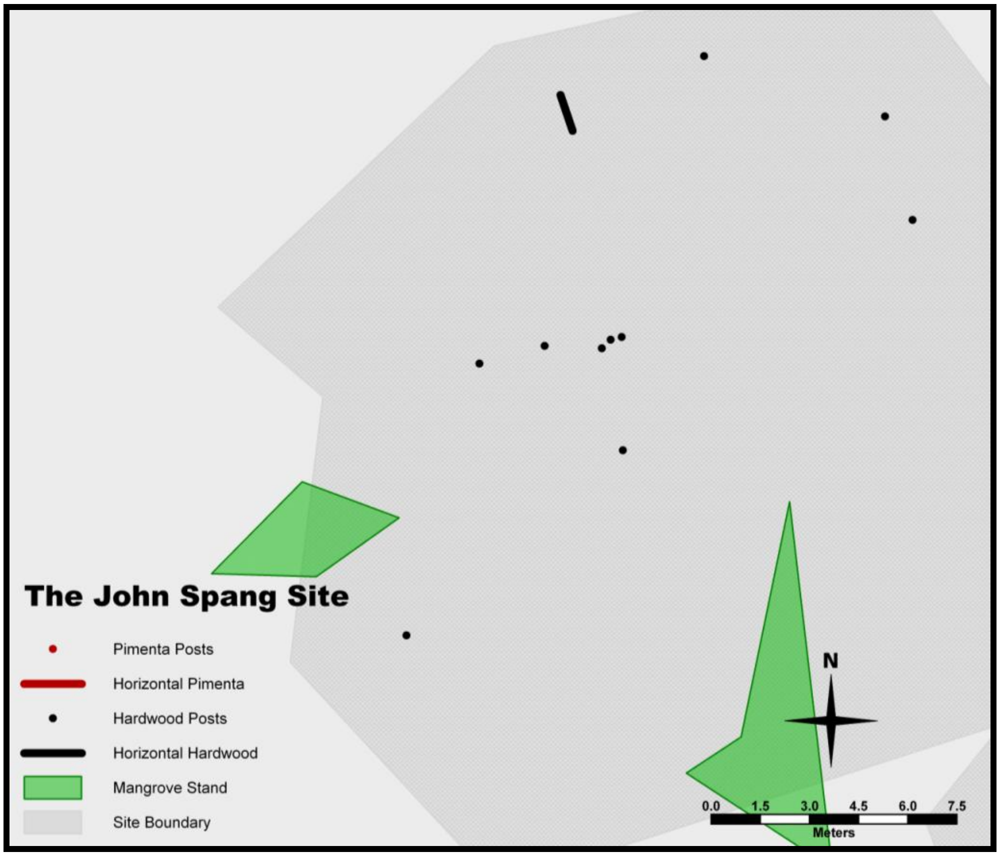


Figure 14. Northwestern Portion of the John Spang Site.

The hardwood post diameters range from 3 to 18 cm and the circumferences for hardwood posts range from 10 to 55 cm. Measurements for circumference, diameter, or both of numerous wooden posts could not be taken due to the deterioration of the wooden post on the surface. Out of the 106 hardwood posts discovered and mapped no measurements were taken for post numbers 148, 149, and 151. Posts 148 and 149 are horizontal and post 151 is vertical. No diameter could be measured for post number 147 and no circumference could be measured for post numbered 145, 28, 4, 70, 79, 80, 84, and 97.

Measurements taken from pimenta posts yielded a smaller range. The diameters recorded for pimenta posts range from 5 to 8 cm and the circumferences range from 15 to 22 cm. Out of the 43 pimenta posts surveyed and mapped no measurements could be obtained for vertical post numbers 102, 105, 107, 109, 125, 129, 131, 133, 140, 141, 150, and horizontal post number 135. Circumferences could not be measured for vertical posts 104, 106, 112, 117, 123, 127, 130, 134, 138, 139, and horizontal posts 142 and 146.

The measuring of posts at the John Spang Site allowed observations to be made in the field regarding correlations between diameter and circumference. Direct correlations were observed between the two measurements. In order to prove the correlation, simple linear regression analysis was run in SPSS® for Windows®. Linear regression analysis is a statistical method that helps to determine the relationship between two variables. The variables for this analysis are circumference and diameter where diameter is the independent variable x and circumference is the dependent variable y. The results of the analysis are displayed in terms of the correlation coefficient. The closer the correlation coefficient is to +1 the stronger the relationship between the variables. Linear regression analysis was performed individually for hardwood posts, pimenta posts, and for all of the posts (both hardwood and pimenta). Individual wooden posts where neither circumference nor diameter could be measured were not added to the statistical analysis (see Table 1).

The results of the regression analysis show a strong positive relationship between circumference and diameter for both hardwood and pimenta posts. The correlation coefficients results for both hardwood and the combined sample of hardwood and pimenta are .97 while the results for pimenta alone are slightly lower, but still strong at .85. The pimenta posts are more fragile and the measurements were less discernable in the field because of this. This is probably why the correlation coefficient is lower for pimenta then for hardwood alone. A scatter plot graphed for the pimenta and hardwood posts combined also show a strong linear relationship between diameter and circumference (Figure 15).

Table 1. Summary of Regression Analysis Results

Sample	Sample Size	Correlation Coefficient (R)
Hardwood	103	.97
Pimenta	31	.85
Hardwood and Pimenta	134	.97

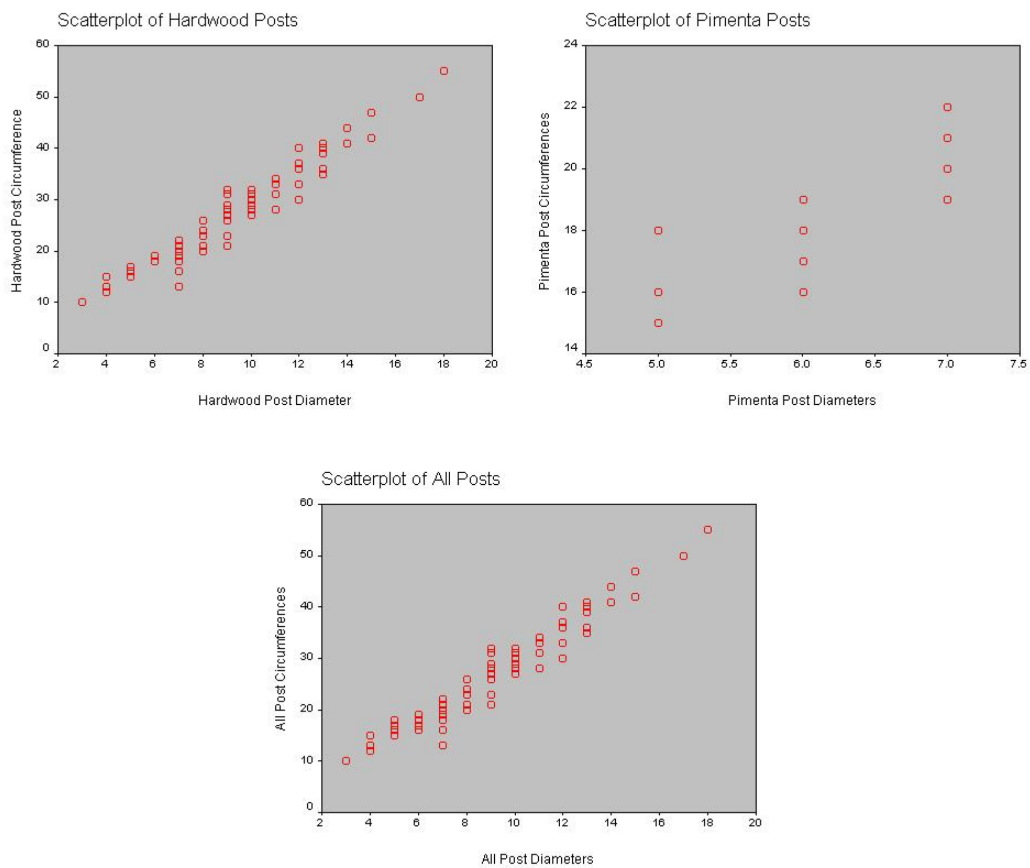


Figure 15. Scatterplot of Wooden Post Diameters (a) Hardwood Post Diameters, (b) Pimenta Post Diameters, and (c) All Post Diameters.

The results of the regression analysis can also be used for a predictive model to fill in the missing measurements of posts that have a measurement for either diameter or circumference. Circumference is the distance around a circle and diameter is the distance through a circle. P is the ratio of the circumference of a circle to the diameter. Using the equation $\frac{c}{d} = \pi$ where c is circumference and d is diameter by dividing c by d will give you a value close to π. In order to determine the missing diameters and circumferences the values were substituted into the equation. Where circumference is unknown the equation is $C = \pi d$ and where the diameter is known the equation $= \frac{c}{\pi}$. In all, these two equations were used to fill in the missing measurements for nine hardwood and 12 pimenta posts.

The investigations conducted at the John Spang Site and the mapping using geospatial software of the wooden architecture show that there are patterns in the measurements of the wooden posts. Based on the spatial analysis of the location and layout of these wooden posts testable hypotheses can be presented to test the current data to ethnographic and archaeological investigations concerning saltmaking and perishable structures in the Maya area. The following chapter is to present these hypotheses and discuss the patterns observed in the GIS.

Chapter 4
Analysis of the Distribution of Wooden Posts

What is the significance of the distribution of wooden posts at the John Spang Site mean in terms of ancient Maya wooden architecture? Are these houses as described by Wauchope (1938)? Are some outbuildings? Are they specialized structures to support salt production? If they are buildings, is there a plazuela group? The size of buildings varies within the Maya area. Wauchope (1938) describes various house shapes, sizes, and materials used in the construction of houses and miscellaneous houseplot buildings. Wauchope (1938) observed that outbuildings are smaller than houses in domestic dwellings. Based on the results at the John Spang Site, there may be a variety of sizes and shapes of structures. However, the systematic flotation survey revealed an abundance of briquetage. This find indicates that these structures were used in salt production. Modern studies of saltmaking suggest that the wooden structures at the site could have been used in the salt production process and not specifically as buildings (Andrews 1983; Good 1995; McKillop 2002, 2005; Parsons 1989; Reina and Monaghan 1981; Williams 1999).

Based on the ethnographic and archaeological literature, there is a diversity of structures and spatial layouts at saltmaking sites. However, the same concepts of harvesting the soil and brine, leaching the soil, boiling the water, and preparing the salt are found at the majority of saltmaking sites using the sal cocida or briquetage method. Reina and Monaghan (1981) and Andrews (1983) describe platforms housed inside buildings at Sacapulas, in Guatemala. Outside of the buildings are large vessels, called cajons, for holding and leaching salt laden soil. McKillop (2005a) mentions exterior walls of a rectangular wooden building at the saltmaking site of Chak Sak Ha Nal in Paynes Creek National Park, in Belize. Williams (1999) describes structures used in the salt production process, estiladeras and canoas. Estiladeras are for salt leaching and canoas are used to dry out the brine to obtain salt. Good (1995) mentions tapeites, which are platforms used for leaching. Various other modifications to the environment can be found at saltmaking sites, such as, drying pans made from soil or posts, and retaining walls (Andrews 1983). Other landform modifications include, dams or impoundments that have been recorded in the archaeological record at saltmaking sites at Salinas de los Nueve Cerros in southern Guatemala and at El Salado, in Veracruz, Mexico (Dillon et al. 1998; Santley 2004).

The results of the systematic flotation survey and mapping conducted at the John Spang site reveal wooden architecture associated with the ancient Maya saltmaking industry in the Late Classic period. In order to discover what the structures at the John Spang Site represent I analyze the wooden posts in two different ways. I divide the diameters of the hardwood posts into class intervals; one based on observations made using descriptive statistics and the other on Wauchope's (1938) ethnographic observations of Modern Maya Houses. This analysis is conducted in order to observe possible architecture at the John Spang Site.

To determine how the Maya spatially built their architecture in relation to the saltmaking industry the results of the diameters and orientation of wooden posts were examined using ranged thematics in GeoMedia®. By utilizing thematics in Geomedia, patterns emerge from the data itself and patterns can also be applied from historical accounts onto the data to discover what the distribution of wooden posts at the John Spang Site means in terms of ancient Maya wooden architecture.

Thematic Based on the Data

Spaulding (1953) stresses the importance of statistics in revealing patterns in the data not imposed by templates. The diameters of wooden posts at the John Spang Site do show patterns used by the ancient Maya. Based on the establishment of a correlation between diameters and circumferences, the missing measurements (either diameter or circumference) were added (Figure 16). In all, only three hardwood posts and 12 pimenta posts do not have measurements. These measurements could not be acquired because of the decay of the post above the surface of the peat. Any further excavation of the wooden post would thus hasten the decay process and was not attempted during the survey. Once a strong correlation between the measurements was established, the frequency distribution of these measurements were examined using a histogram to view if there are any natural breaks in the data (Figure 17).

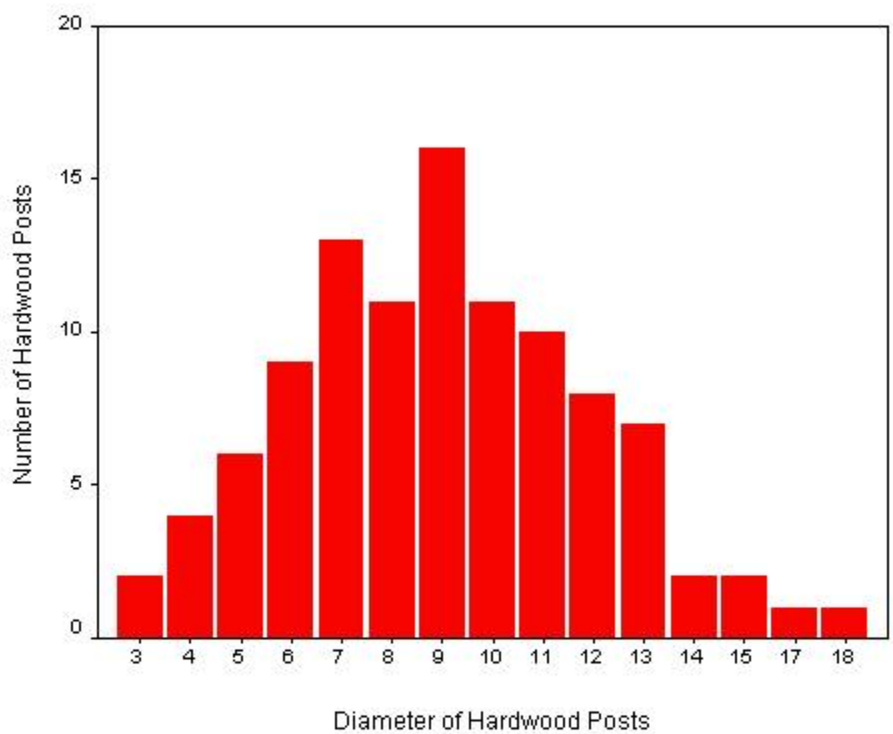


Figure 16. Graph of Hardwood Post Diameters Showing Their Distribution.

The histogram is based on only the hardwood posts for a sample size of 103 posts (Figure 17). An analysis of diameters was performed verses circumference in order to compare with the literature. Also, diameters are usually easier to take in the field and more accurate than circumferences. The diameters of 103 hardwood posts were entered into SPSS and then graphed using a histogram. No natural breaks were observed in the histogram. The results of the histogram show an unimodal, positively skewed, light tailed curve in the diameters of hardwood posts (see Figure 17). The mean diameter for all hardwood posts is 9 cm with a standard deviation of 2.99.

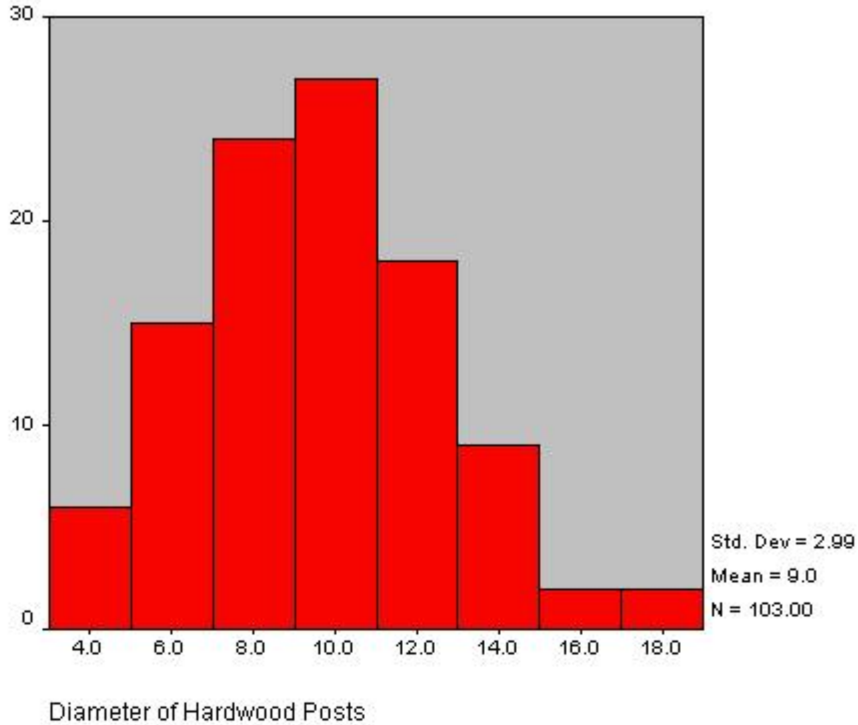


Figure 17. Histogram of Hardwood Post Diameters.

The problem with a continuous data set with the diameters of hardwood posts is that there are no defined categories. The only categories available are based on Wauchope's observations on modern Maya houses and not the ancient Maya. In order to analyze the diameters of hardwood posts at the John Spang Site categories were defined using arbitrary class intervals. All of the frequencies of hardwood posts diameters were placed into a table for division (Table 2). Based on a sample size of 103 hardwood posts with ranges of diameters from 3 to 18 cm, four class intervals were created. These intervals are 3 to 6, 7 to 10, 11 to 14, and 15 to 18

(Table 3). Table 4 shows the even class intervals as well as their frequencies and their cumulative frequencies.

Table 2.

Frequency of Hardwood Post Diameters

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	3	2	1.9	1.9	1.9
	4	4	3.9	3.9	5.8
	5	6	5.8	5.8	11.7
	6	9	8.7	8.7	20.4
	7	13	12.6	12.6	33.0
	8	11	10.7	10.7	43.7
	9	16	15.5	15.5	59.2
	10	11	10.7	10.7	69.9
	11	10	9.7	9.7	79.6
	12	8	7.8	7.8	87.4
	13	7	6.8	6.8	94.2
	14	2	1.9	1.9	96.1
	15	2	1.9	1.9	98.1
	17	1	1.0	1.0	99.0
	18	1	1.0	1.0	100.0
	Total	103	100.0	100.0	

Table 3. Class Interval Divisions

Class Interval	**Number of Hardwood Posts**	**Percentage (%)**
3 to 6	21	18.8
7 to 10	51	45.5
11 to 14	27	24.1
15 to 18	4	3.6
Other	3	8

Table 4. Frequency Distribution with Cumulative Relative Frequencies.

Class Interval	Frequency	Relative Frequency	Cumulative Relative Frequency
3 to 6	21	0.20	0.20
7 to 10	51	0.50	0.70
11 to 14	27	0.26	0.96
15 to 18	4	0.04	1

The class intervals using the upper end and the cumulative frequencies were used to create a cumulative relative frequency plot (Figure 18). The cumulative frequency plot shows that over 70 % of the hardwood posts diameters at the John Spang Site are smaller than 11 cm in diameter leaving only approximately 30% of hardwood posts having diameters between the ranges of 12 and 18 cm. This does not correspond with Wauchope's observations that all weight bearing posts fall between the ranges of 12 to 18 cm. Also, almost 96% of all hardwood posts are smaller than 15 cm in diameter. Based on Table 3 almost half of the hardwood post diameters are within the class interval of 7 to 10. Only four hardwood post diameters fall within the upper class interval of 15 to 18. No hardwood posts with a diameter of 16 were observed at the John Spang Site. There is only one post each for the diameters of 17 and 18 cm leaving these two posts as outliers, based on a boxplot of all diameters of hardwood posts (Figure 19). There is a clear preference for post diameters between the ranges of 7 to 14 cm in diameter at the John Spang Site. On the other hand, larger posts, greater than 15 cm in diameter, were not as preferred or utilized at the John Spang Site.

The class intervals were then used to spatially view the site in Geomedia using a ranged thematic. A ranged thematic classifies data on attribute values, in this instance the attribute values are hardwood posts and then divided by diameters. Thematics were arranged in Geomedia in order to visually display these class intervals and to draw conclusions about the architecture at the John Spang Site.

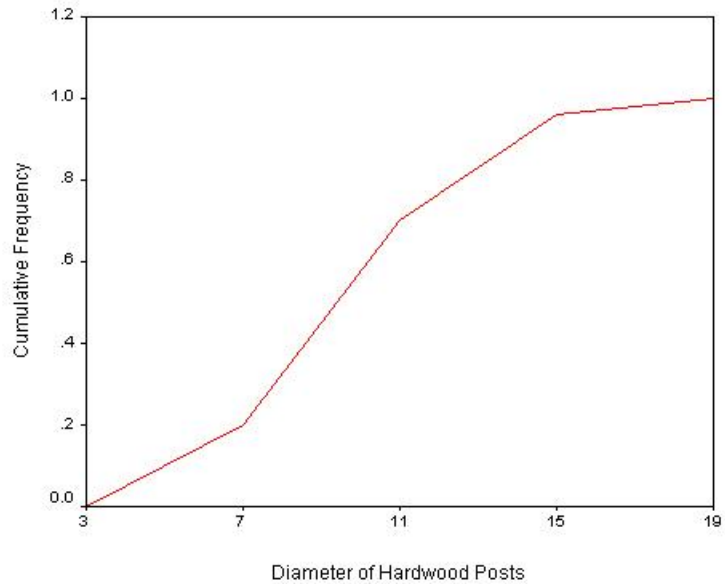


Figure 18. Cumulative Relative Frequency Plot of Hardwood Post Diameters.

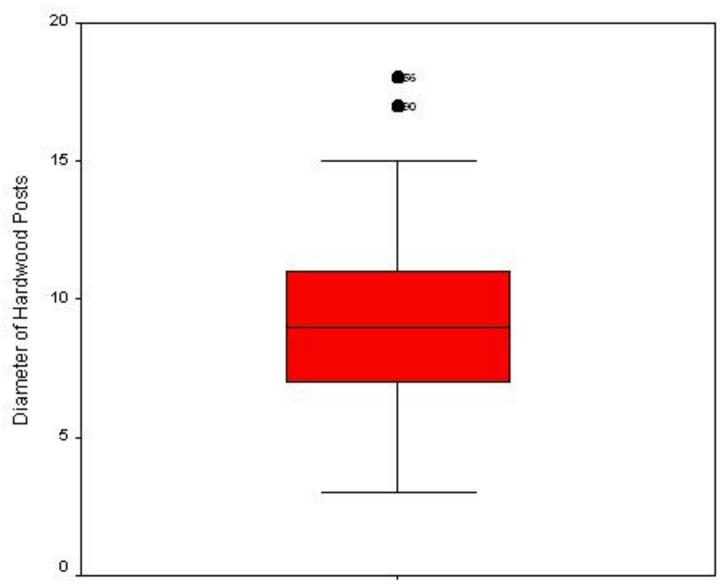


Figure 19. Boxplot of Hardwood Post Diameters Showing two outliers, one post each with 17 cm and 18 cm in diameters.

A ranged thematic map was created in Geomedia using the above class intervals (Figure 20). The thematic map divided the class intervals by color and size. The smallest circles represent the smaller diameters and the largest circles represent the largest diameters. Hardwood posts that do not have diameters are represented as other and displayed with small black circles. The pimenta lines were not added into this category and are displayed by burgundy circles.

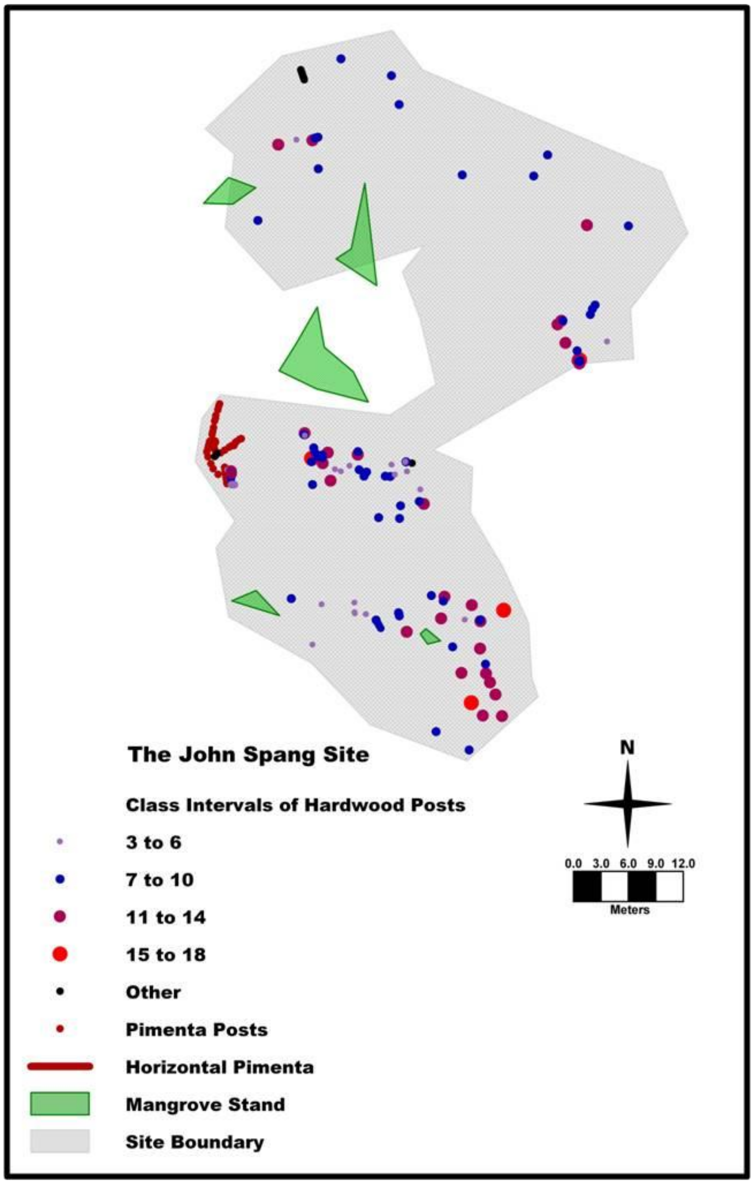
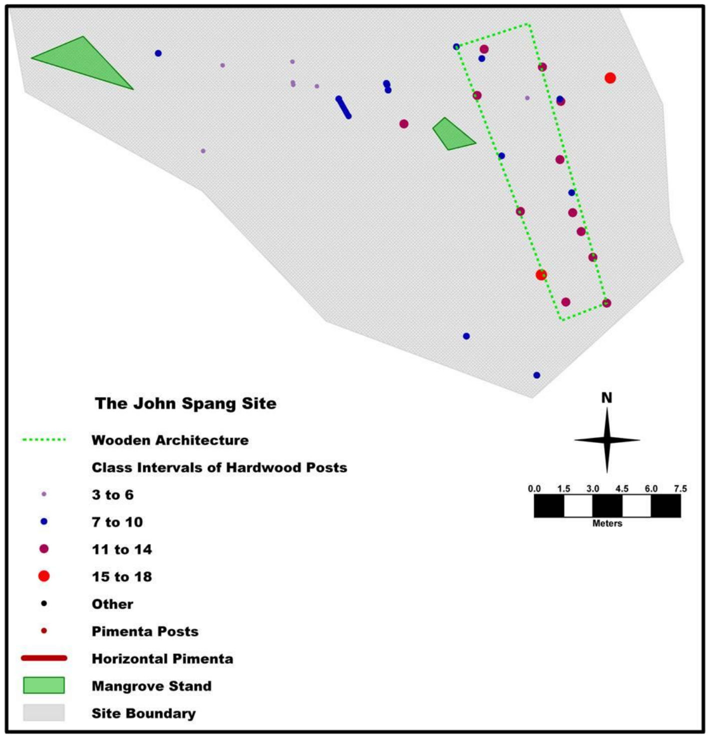


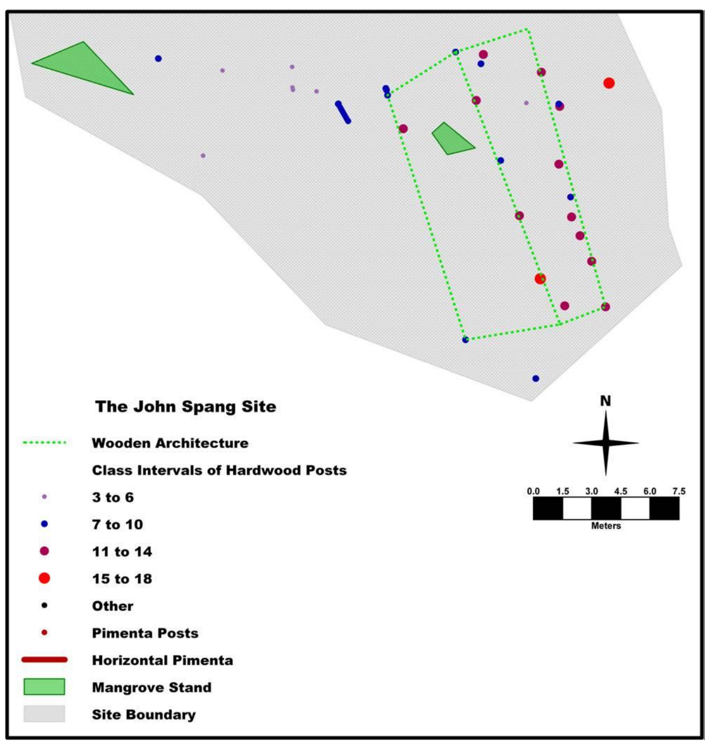
Figure 20. Ranged Thematic Map of the John Spang Site Based on Class Intervals.

Overall, the John Spang Site has the same alignment that was presented with a basic spatial map. However, using the class intervals allows new shapes and structures to present themselves. Out of the 32 vertical hardwood posts and one horizontal hardwood post in the southern portion of the site, seven are within the class interval of 3 to 6, 11 are within 7 to 10, 12 are within 11 to 14, and two are within the class interval of 15 to 18. The division of the class intervals reveals a rectangular structure in the eastern portion mostly comprised of hardwood posts in the 11 to 14 class interval (Figure 21). This rectangular structure is large and is approximately 15 m in length by 2.8 m in width at the narrowest point and 3.7 m in width at the widest point. This structure is aligned on a northwest to southeast axis. Other rectangular structures can be observed in this portion of the site. Connecting to the west of the rectangular structure there is a possible patio or awning (Figure 22). This extension has a limited amount of mainposts along the north to south line that could hold up a large framework. The extension is approximately 13.3 m in length with a width of 4.2 m at the northern end and 5 m at the southern end.

Wauchope (1938) mentions in regard to rectangular structures that they will probably have many smaller mainposts which are in line with the walls. This rectangular structure could be a building and not a saltmaking apparatus based on the size of the structure and the numerous amounts of posts in line with each other. Another possibility is that there are room divisions at the northern end of the rectangular structure forming two smaller rooms or possible patios. These room division's measure approximately 2 m north to south by 4 m east to west (Figures 23 and 24).

The majority of the hardwood posts in the southern section of the site are concentrated near or around the rectangular structure. However, there are numerous smaller hardwood posts.





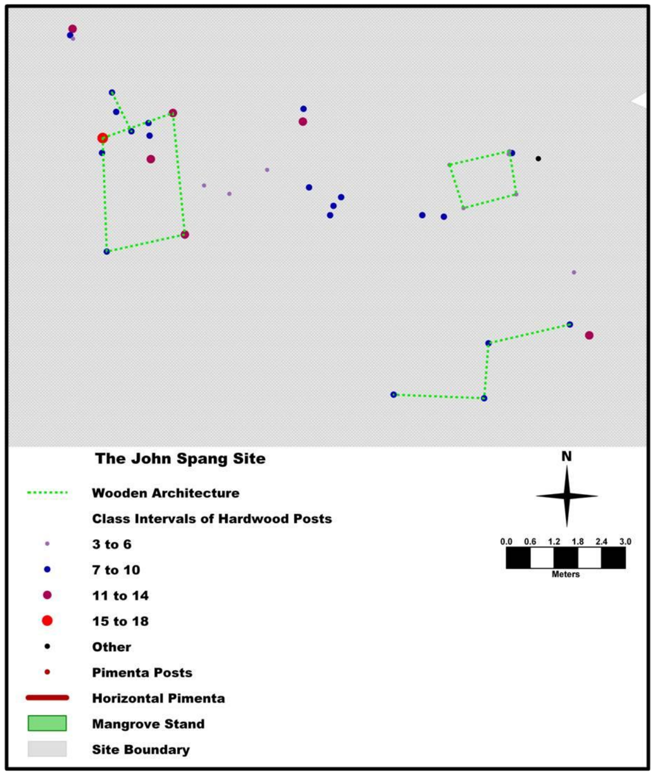
Figures 21 and 22. Possible Rectangular Structures at the John Spang Site.

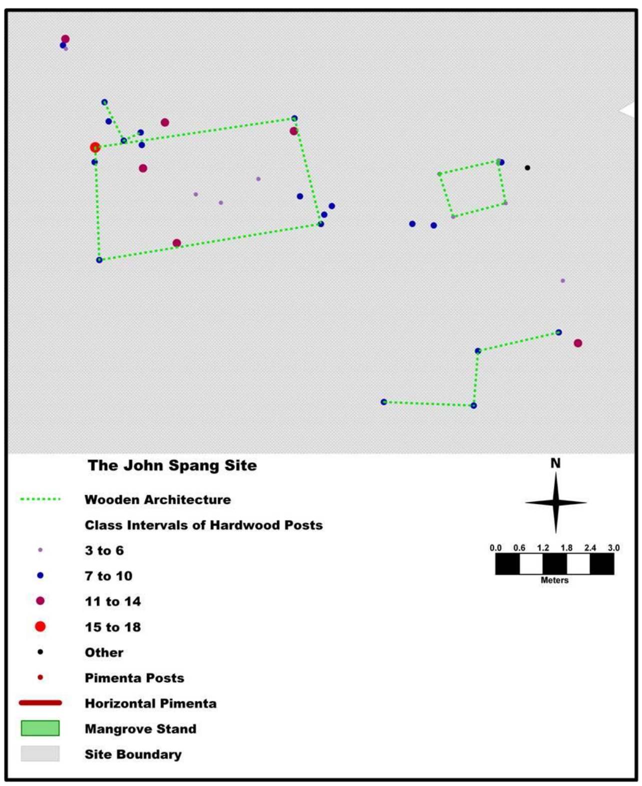
Figures 23 and 24. Possible Rectangular Structure with Room Divisions.

located west of the rectangular structure. Three hardwood posts that fall within the 3 to 6 class interval form a right angle and is missing a fourth corner (Figure 25). A hardwood post could have been missed during the flotationation survey. This structure could possibly be a base for a saltmaking apparatus such as a leaching vessel or could be a small platform

Figure 25. Possible Small Structure in the Southern Portion of the Site.

The central portion of the John Spang Site shows a dense amount of hardwood posts. Out of the 37 hardwood posts in this area, ten are within the 3 to 6 class interval, 20 are within 7 to 10, six are within 11 to 14, and one is within the class interval of 15 to 18. There seems to be more ambiguity in this portion of the site as compared to the southern section. Many possibilities arise as to how to divide the possible structures. However, based solely on the division of class intervals a couple of observations can be presented. A larger rectangular structure is observed in the western portion (Figure 26). This wooden structure measures





Figures 26 and 27. Possible Structures in the Central Portion of the John Spang Site.

approximately 2.9 m to 3.1 m in length by 2 m in width. This rectangular structure could also be expanded to encompass a much larger area to the east (Figure 27). This expanded structure would be oriented east to west in length and north to south in width and would measure approximately 5.1 to 5.7 m in length and 2.9 m in width. Also, there is an extension from the north on the larger rectangular structure comprised of smaller posts in the 7 to 10 class interval (Figures 26 and 27). Given the considerably size of this structure with main posts located at the corners present the possibility that the structure might not be a building but a possible platform. However, if the structure is a building the diameters of mainposts, between 12 and 18 cm in diameter, mentioned by Wauchope (1938) are smaller than ethnographically recorded. This rectangular structure could also be a saltmaking apparatus or platform.

Another smaller four cornered structure is observed to the east. All four hardwood posts are within the 3 to 6 class interval (Figures 26 and 27). There is one post along its northern side within the 7 to 10 class intervals. This structure is approximately 1 to 1.1 m north to south by 1.4 to 1.6 east to west. By connecting the four hardwood posts in the 7 to 10 class interval in the south the posts form a long segmented line (Figures 26 and 27).

To the northeast of the central cluster is the area of the site with 14 hardwood posts. Out of the 14 hardwood posts in this area there is one hardwood post each in the 3 to 6 and 15 to 18 class intervals, 7 hardwood posts in the 7 to 10 class interval, and five hardwood posts in the 11 to 14 class interval. By connecting the exterior posts in the class interval of 11 to 14 posts and one post in the 7 to 10 class interval a right angle is formed on a northwest to southeast alignment (Figure 28). All that is missing is a fourth corner. There are a couple of possibilities as to why there is not a fourth corner. One is that there never was a fourth corner. Two, the fourth larger post was missed during the survey, or thirdly the fourth corner is more deeply buried than the smaller post in the area. The northern axis of this structure measures approximately 4.6 m and the western axis measures approximately 4.9 m. Given that there are no posts to support the walls for a building I suggest this structure is a possible platform for saltmaking or a saltmaking apparatus for leaching. If a missing post is there then there is a possibility that this is also a rectangular structure.

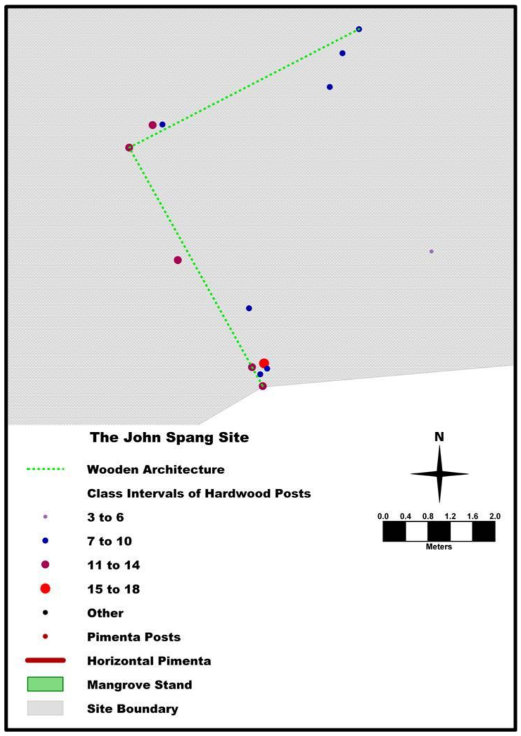


Figure 28. Structure Possibilities in the Area of 14 Hardwood Posts.

The loose cluster of five hardwood posts could possibly be the borders for two separate structures (Figure 29). Out of the five hardwood posts in this area, four are within the class interval of 7 to 10, and one is within the class interval of 11 to 14. Unfortunately there are not enough hardwood posts in this portion of the site to make assumptions about the possible architecture that could have been present in the past.

The northwestern section of the site yields two or more separate structures (Figure 30).

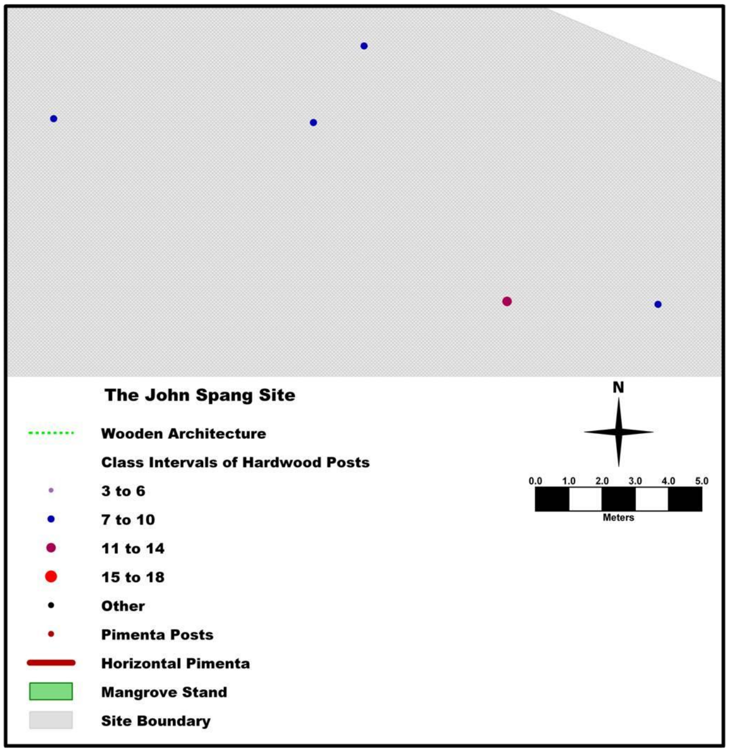


Figure 29. Area of Five Hardwood Posts Based on Class Intervals.

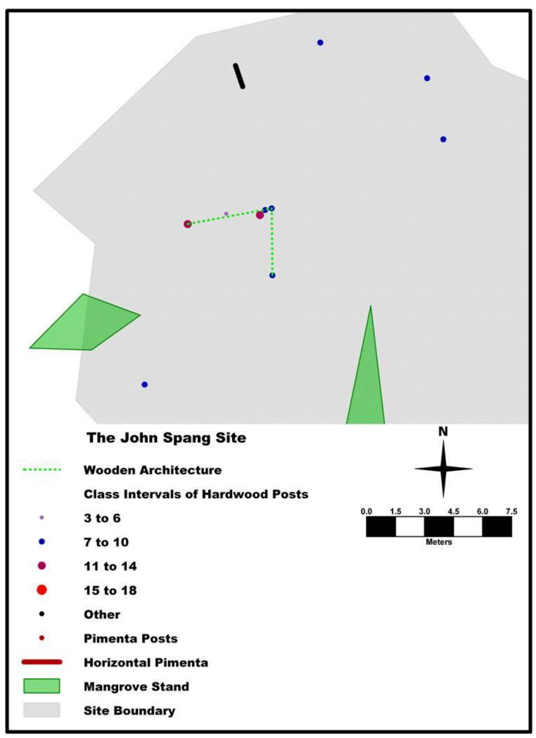


Figure 30. Possible Wooden Architecture in the Northwestern Portion of the Site.

Unfortunately this area is similar to the area of five posts in that not enough remains to make assumptions regarding the structures that would have been present during the use of this site. Out of the 11 hardwood posts present in this area one post is within the class interval of 3to 6 , seven posts are within 7 to 10, two posts are within 11 to 14, and there are no posts within the class interval of 15 to 18. The one horizontal hardwood present in this area does not have measurements. A right angle can be formed by connecting three of the posts within the $8 \leq 14$ call interval. An abundance of briquetage was observed during the survey indicating that this area was heavily utilized in the process of boiling brine.

Thematic Based on Wauchope

A second ranged thematic was conducted based on Wauchope's 1938 analysis of modern Maya houses. Wauchope mentions mainposts to houses are between 12 to 18 cm in diameter and wall posts are 4 to 8 cm in diameter. However, the more mainposts added to a house can decrease the size of the mainposts. The class intervals entered into Geomedia in the ranged thematic were based on these two divisions. The thematic map divided the class intervals by color and size. The smaller circles represent all diameters between 4 to 8 cm and the larger circles represent all diameters between 12 to 18 cm. Hardwood posts with no diameters or those hardwood posts that fall in-between the two class intervals are displayed in Geomedia with small black circles. The pimenta lines were not added into this category and are displayed by burgundy circles (Figure 31).

Out of the 32 vertical hardwood posts and one horizontal hardwood post in the southern portion of the site, 15 are within the class interval of 4 to 8, 12 are within 12 to 18, and six are classified as others (Figure 32). By basing the thematic on diameters presented by Wauchope (1938) variations are visible as compared to those from the previous thematic in the southern

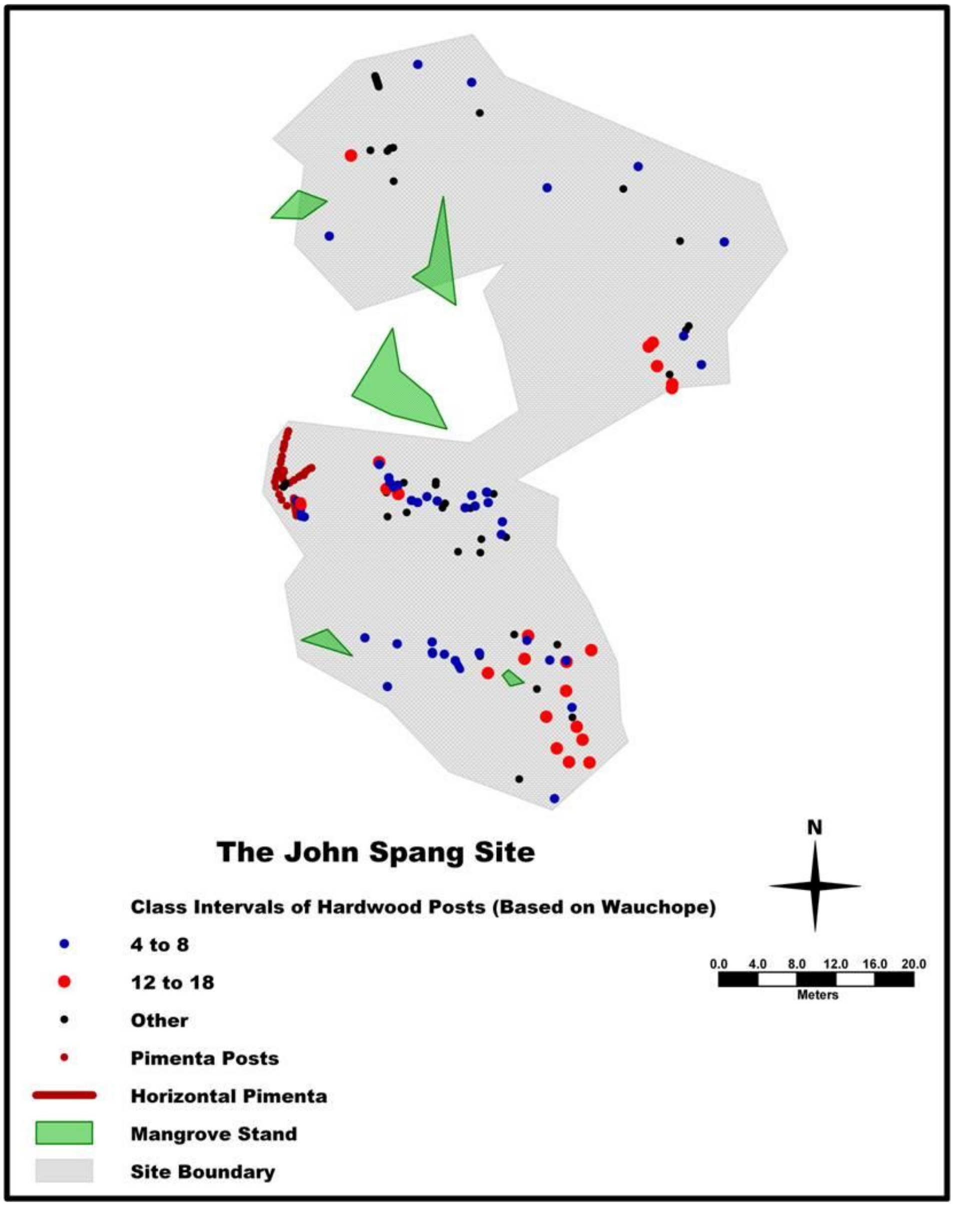


Figure 31. Ranged Thematic of Hardwood Posts at the John Spang Site Based on Wauchope (1938).

portion of the John Spang site. The rectangular structure, previously described, is still present but the size has changed. The possibility of a patio or awning has disappeared and there seems to be only one rectangular structure. This structure is approximately 14.7 m in length and 2.7 m in width at the narrowest point and 3.7 m in width at the widest point.

Other structures are also observed in this portion of the site (Figure 32). West of the

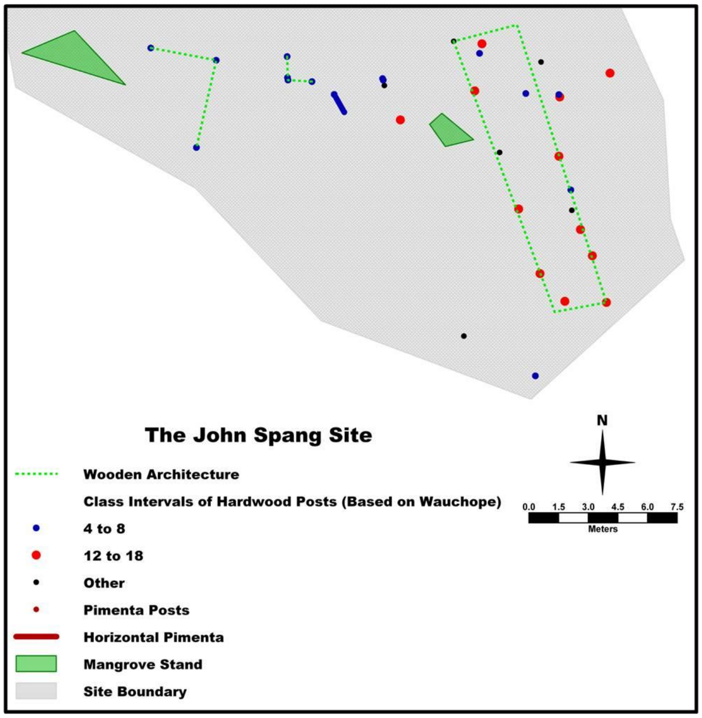


Figure 32. Possible Structures in the Southern Portion of Site Based on Wauchope.

rectangular structure are two clusters of posts that form separate right angles. These posts all fall into the class interval of 4 to 8. Posts within this category are not considered to be mainposts, but smaller posts which could be used for saltmaking apparatuses.

The central portion of the John Spang Site displayed in a Wauchope thematic does not differ from the previous thematic (Figure 33). Out of the 37 hardwood posts in this area, 17 are within the 4 to 8 class interval, three are within 12 to 18, and 18 are displayed as others. There are only three weight bearing posts in this area suggesting that the structures present are not buildings but possible platform and leaching facilities for boiling brine. There are less possibilities to divide the structures using Wauchope's thematic than those from the previous thematic. The larger rectangular structure is more visible. Also, the smaller structure to the east and the line of hardwoods to the south are still present in this thematic. The posts within the rectangular structure could possibly be the remains of furniture, such as, table and small platforms. Given the considerable size of this structure with main posts located pretty much at the corners I doubt it is a building but rather an apparatus for saltmaking. If it is a building then it is constructed with smaller diameters than mentioned by Wauchope.

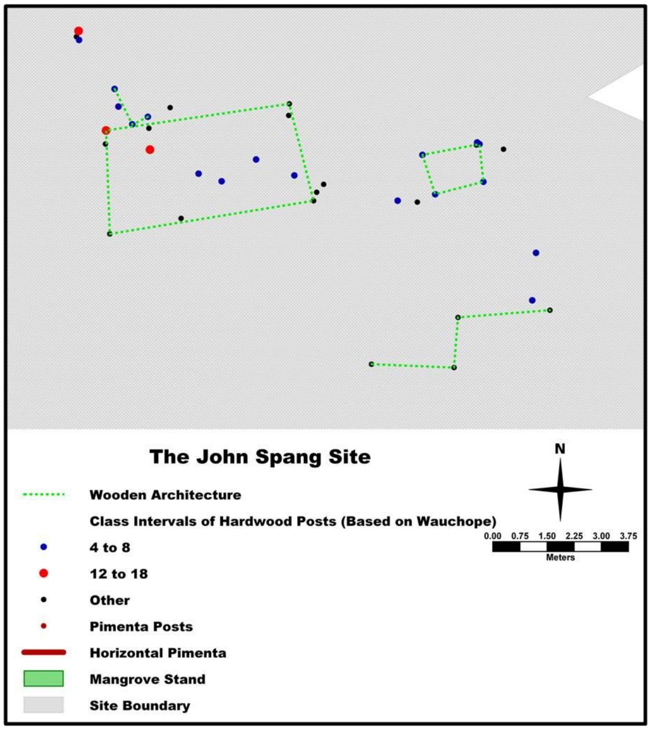


Figure 33. Possible Structures in the Eastern Central Portion of the site Based on Wauchope.

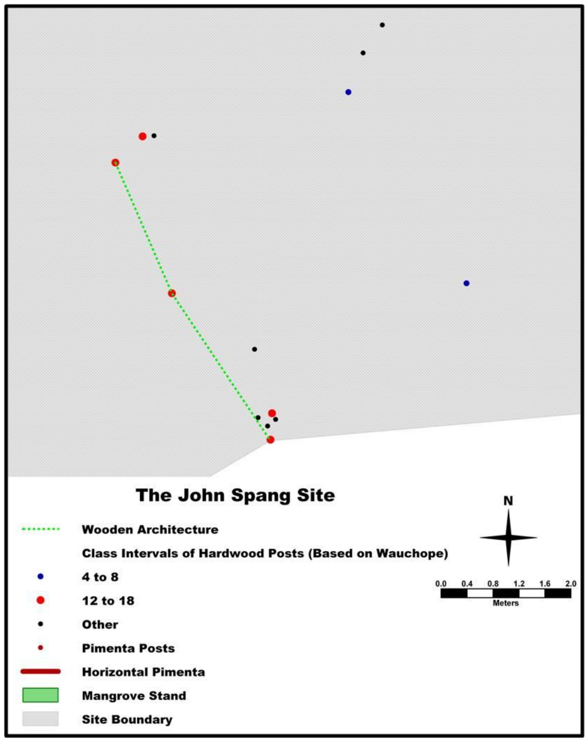
The portion of the John Spang Site to the northeast of the central portion is the area of 14 hardwood posts. Out of the 14 hardwood posts, two are within the 4 to 8 class interval, 5 are within the 12 to 18 class interval, and the remaining 7 are described as other (Figure 34). The hardwood posts between the diameters of 12 to 18 form a line, approximately 4.9 m in length along the northwest to southeast axis. The Wauchope thematic differs slightly from the previous thematic. Instead of exhibiting properties to indicate a rectangular structure the thematic indicates that there may be more than one structure in this portion of the site. Given that there are no posts to support the walls for a building I suggest this structure is a possible platform for saltmaking or a saltmaking apparatus for leaching. If there are missing posts in this area then there is the possibility of a building rather than a structure.

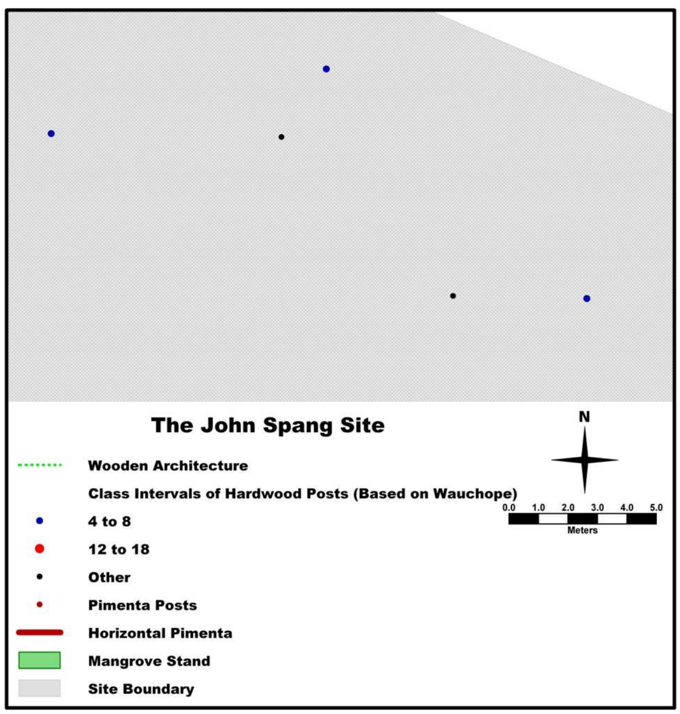
There is no change between the loose cluster of five hardwood posts previously examined and the Wauchope thematic (Figure 35). Out of the five hardwood posts in this area, three are within the class interval of 4 to 8 cm, and two are described as other. There are no load bearing mainposts in this portion of the site as described by Wauchope (1938). I believe there is possibility of two different structures in this area. Unfortunately, there are not enough hardwood posts in this portion of the site to make assumptions about the possible architecture that could have been present.

Out of the 11 hardwood posts present in the northwestern portion of the John Spang Site, three are within the class interval of 4 to 8, one is within the class interval of 12 to 18, and seven are described as other (Figure 36). This area is similar to the one presented with the first thematic. Basing the diameters on Wauchope shows that there are few load bearing mainposts in this area suggesting the structures present in this portion of the site are most likely saltmaking apparatuses and not buildings.

The Pimenta Post Lines

As mentioned previously in Chapter III, the pimenta lines form a backward y shape (Figure 37). No artifacts were observed surrounding this area. The pimenta lines are located on the western portion of the site away from the sea and toward the Maya Mountains. They are spatially separated from the hardwood structures to the north, south, and east. The lines encompass an area approximately 9 m north to south. The north to south axis of the site is 80 m. The small portion of the site encompassing the pimenta lines, the location of the lines away from





Figures 34 and 35. Possible Structures in the Area of 14 Posts and the Area of Five Posts, Based on Wauchope.

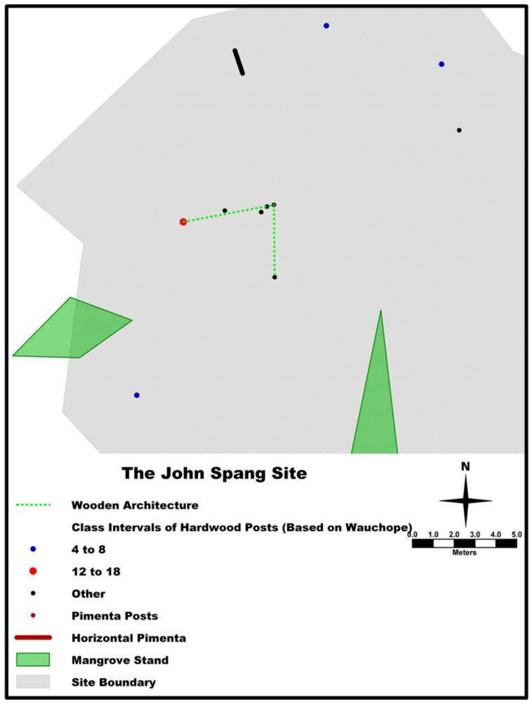


Figure 36. Possible Structures in the Northwestern Portion of the Site, Based on Wauchope.

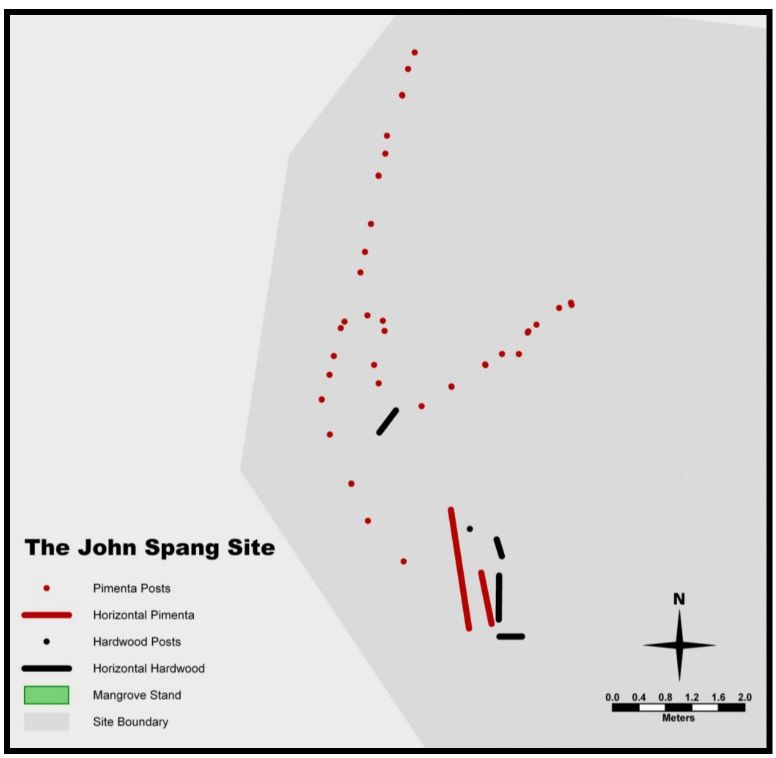


Figure 37. Pimenta Post Lines at the John Spang Site.

the other structures, suggest that the lines do not serve as a wind break. Given that this area contains no artifacts and is not located on the side to be a sea break, there are a couple of possibilities as to what these lines might be. Andrews (1983:23) describes the salt pans of the Yucatan as being "shallow rectangular pans located on the shores of the lagoons". While the pimenta lines do not form rectangular pans, they could form a holding area for brackish salt water from which the water is then collected to be placed within an apparatus on which to leach the soil. Alternatively, the pimenta post lines could be a retaining wall for water or a place to leach the soil. The evidence at the site suggests that salt was made using the sal cocida or briquetage technique. However, the sal solar method could also have been taking place. The combination of two techniques has been suggested by Dillon et al. (1998) at the Salinas de los Nueve Cerros in southern Guatemala. Salt at this archaeological site was primarily made using the sal cocida technique but due to the presence of a salt flat the salt could have also been harvested during the dry season.

The John Spang Site

No plazuela groups, the basic unit of Maya architecture, are visible at the John Spang Site suggesting the site's alignment was not designed the same as historic and modern domestic house sites. The absence of a plazuela group indicates that not all structures built by the ancient Maya are designed with the same basic principle of a central courtyard as suggested by Cliff (1988). Other possibilities regarding the alignment of the wooden architecture at the John Spang Site suggest the structures were erected during one occupation or the structures are aligned to follow the shoreline to the west in the lagoon.

The analysis of hardwood post diameters using two different ranged thematics show the ancient Maya preferred certain post sizes over others. The mean hardwood post size at the site is

9 cm in diameter, accounting for 15.5 percent of all hardwood posts. According to Wauchope (1938), post diameters for mainposts should fall within a range of 12 to 18 cm in diameters. The hardwood posts at the John Spang Site do not conform to Wauchope's observations. Instead, there is a greater range of what was preferred for mainposts at the John Spang Site. The reason for this could be that these structures were not built to last as long as household dwellings or the ancient Maya preferred smaller sizes of posts depending on the availability of hardwoods. However, the various shapes and techniques, described by Wauchope (1938), are useful in determining the shape of the buildings. This analysis shows that although there is continuity from the past to the present in regards to shapes, hardwood post sizes and the sizes of structures are variable in the past as they are in the present.

Chapter 5
Ancient Wooden Architecture At The John Spang Site

Wooden structures are preserved at the John Spang Site and other saltworks recorded within Paynes Creek National Park. The saltmaking sites in the lagoon yield the only ancient wooden architecture found in the Maya area. Due to poor preservation in the Maya area, and elsewhere in the tropics, the archaeological data recovered from sites usually contain only the remnants of where a perishable structure once stood. Some environmental conditions have preserved perishable materials at sites in the Maya area. A volcanic eruption has preserved perishable materials not usually observed in the archaeological record. However, the remains at Ceren are casts of the originals. At the John Spang Site, environmental conditions, such as, mangrove peat and sea-level rise have preserved the wood.

Architecture based on perishable remains are seldom recovered in the archaeological record. In the Maya area the majority of research concerning architecture is based on the non-perishable remains of stone. From the stone remains, such as platforms, and the remains of postmolds that are observed by the evidence of burned wood, charcoal, or stains in the soil interpretations are made concerning the perishable buildings that once stood upon them. Interpretations regarding ancient Maya wooden architecture are also extrapolated from modern ethnographic studies of the Maya. The information regarding perishable structures comes from either their stone remains at the base of a structure or from modern studies and not the ancient structures themselves. Our understanding of perishable structures is still limited. However, the wooden posts at the John Spang Site and other wooden remains found in Paynes Creek allows the opportunity to study the ancient structures themselves and not their decayed remains.

What is known from the literature concerning ancient Maya architecture is variable. Methods of construction, size, and shape of buildings differ throughout the Maya area. Wauchope's (1938) investigations on modern Maya houses focuses on their domestic households including miscellaneous house plot buildings and structures. These investigations were conducted in order to interpret the findings at ancient Maya sites. Although the size and shape of structures by ancient and historic Maya are variable, the methods for salt production using the briquetage technique are not. The same methods of staging areas, leaching the soil, and boiling the brine are the same in the ethnographic and archaeological records. Although the same methods were employed, variability exists in the structures used to carry-out the processes related to saltmaking. Even at individual saltmaking sites and amongst those in close proximity variations occur in the placement and spatial distribution of buildings and saltmaking apparatuses (Andrews 1983; Good 1995; Nance 1992; Parsons 1989; Santley 2004; Williams 1999).

The purpose of my research was to study the patterning and significance of the preserved wooden posts at the John Spang Site and to compare and contrast the modern and historic wooden architecture in regards to the saltmaking industry, both historic and modern. This research includes fieldwork and analysis of the spatial distribution of wooden posts in a GIS.

The John Spang Site is located within a salt water lagoon on the seafloor. Previous research conducted by Dr. Heather McKillop indicates that sea-level rise, of at least 1 meter, occurred sometime after the Late Classic, and inundated this coastal lagoon (McKillop 1995, 2002, 2005b). Investigations conducted at the site include a complete systematic flotation survey to located wooden posts and to delineate and define the boundaries of the site. After the survey was completed the site was mapped with a total station and then the coordinates and locations were entered in Geomedia.

The use of GIS in displaying and analyzing the wooden architecture at the John Spang Site allow the opportunity to visually display the diameter attributes of the wooden posts to discover patterns and to compare these patterns with ethnographic and archaeological investigations. Only diameters and not circumferences were analyzed in order to keep with the literature available on the subject. The hardwood post diameters recovered from the John Spang Site were divided into even class intervals and these intervals were displayed in Geomedia using a thematic. The class intervals based on the data were compared to a thematic created on Wauchope's (1938) observations of the range of mainposts and wall post diameters of modern Maya houses.

By comparing the archaeological evidence against the ethnographic data patterns emerged about the size and distribution utilized at the John Spang Site. In the southern section of the site both the thematic based on class intervals of hardwood post diameters and the thematic created by Wauchope's (1938) observations show the possibility of a large rectangular structure. However, the post diameters of the thematic based on equal class intervals creates a larger structure with a possible awning or patio and room divisions. Using only the Wauchope specifications for mainposts excludes the possibility of these extra rooms and buildings. Also, west of the rectangular structure the class interval thematic forms a different three post right angle than the Wauchope thematic. These posts are small and are classified as wall posts according to Wauchope's observations. However by forming a right angle the posts could form the corners of a building or a saltmaking apparatus.

In the central portion of the site, the thematic based on Wauchope once again shows a limited amount of mainposts for buildings. Instead, the majority of the posts that form structures are represented by smaller diameters. In the area of 14 posts, the thematic for those based on the class intervals and Wauchope is limited. Only the thematic based on the class intervals display's posts forming a right angle. Both thematics for the area of five posts are problematic in that no outright structures are observed except that there is a possibility of two structures in the area instead of one large structure. The same can be interpreted for the northwest portion of the site where both thematics show one right angled structure. The line of pimenta (palmetto palm) posts may be a land retaining wall or the remains of a salt pan.

Patterns were discovered in the analysis of wooden post diameters at the John Spang Site. There is a preference for hardwood wooden post diameters within the range of 7 to 10 cm at the site. Also, 27 hardwood posts are within the range of 11 to 14 cm in diameter. Larger sized posts greater than 15 cm in diameter are not frequent with only one post each for the diameter of 17 and 18 cm. Some architectural techniques common at Maya sites were not observed at the John Spang Site. There is not a plazuela group and no platforms or non-perishable remains of stone architecture. The post diameters at the site differ from Wacuhope's observations. However, Wauchope did not compile his study based on saltmaking sites. During the Late Classic period at the John Spang Site, smaller post diameters could have been utilized due to these structures being temporary workshops, not intended to last as long as dwellings. The larger species of hardwoods might not have been as abundant in the past and the builders used the wood most available. Or, the ancient Maya culturally preferred the smaller posts for these saltmaking apparatuses and buildings. There is a clear separation spatially between the hardwood and pimenta posts. The pimenta posts are only found in the central western portion of the site. The spatial distribution between these two preliminary classifications of posts can be interpreted as serving two different functions. Although the post diameters of wooden hardwood posts differs at the John Spang Site from Wauchope the shapes of buildings is quite similar. Buildings and structures at the John Spang Site seem to be rectangular.

There are rectangular shaped buildings as described by Wauchope (1938). However, the size of the buildings and structures at the site show variability. There is also an abundance of briquetage indicating that the structures were used in salt production. The possibility also remains that the salt was produced by a combination of two methods “sal solar” and “sal cocida”. Modern studies of saltmaking by Andrews (1983), Reina and Monaghan (1981), Williams (1999), and others, show wooden structures used in the salt production process and not specifically as buildings.

This research at the John Spang site and other saltworks in Punta Ycacos Lagoon expands our knowledge regarding ancient Maya political economy, trade, and wooden architecture. This research is ongoing. By exploring ancient Maya architecture through statistics and GIS the past confers information forming and reforming our perceptions on how the ancient Maya negotiated their economy and landscape. Further research is needed in order to address who worked these salt workshops and who controlled them.

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Vita

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