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## **GIS of the Maya Canoe Paddle Site, K'ak' Naab'**



**Research Year:** 2005

**Culture:** Maya

**Chronology:** Late Classic

**Location:** Paynes Creek National Park, Toledo District, Southern Belize

**Site:** K'ak' Naab'

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## **Abstract**

K'ak' Naab', a Late Classic Maya salt works in Paynes Creek National Park, on the coast of southern Belize, is the site of the first known ancient Maya wooden canoe paddle. A FAMSI grant made possible complete survey and mapping of ancient wooden architecture and associated artifacts at this underwater site in 2005. This report describes the innovative underwater survey and mapping techniques developed for the project, as well as the results of type-variety and attribute analyses of pottery and the GIS spatial analyses of wooden posts and pottery. K'ak' Naab' was inundated by sea level rise, with the wooden structures preserved in mangrove peat below the seafloor. Wooden posts from two structures were associated with briquetage from the salt industry. Standardization of the briquetage indicates mass-production of the product, salt. The K'ak' Naab' canoe paddle was used in the transport of salt to inland cities, where this biological necessity was scarce. Ceramics, particularly the unit-stamped Warrie Red type, link K'ak' Naab' and the other Paynes Creek salt works to inland cities in southern Belize and adjacent Guatemala, notably Lubaantun, Seibal, Altar de Sacrificios, and cities in the Petexbatún region.

## **Resumen**

K'ak' Naab', una salina del Clásico Tardío maya en situada en el Parque Nacional de Paynes Creek, en la costa del sur de Belice, es el sitio del primer antiguo remo maya para canoa que se conoce. Una beca otorgada por FAMSI, en 2005, permitió completar el reconocimiento y mapeo de antigua arquitectura de madera y otros artefactos asociados de este sitio subacuático. Este informe describe el innovador reconocimiento subacuático y las técnicas de mapeo que se desarrollaron para el proyecto, así como los resultados de los análisis de tipo-variedad y atributos de la alfarería, y los análisis espaciales de GIS de postes de madera y alfarería. K'ak' Naab' quedó inundado por el crecimiento del nivel del mar, y sus estructuras de madera permanecieron preservadas en turbas de manglares bajo el fondo marino. Los postes de madera de dos estructuras estaban asociados con el briquetage de la industria salitrera. La estandarización del briquetage indica una producción masiva del producto, la sal. El remo de la canoa de K'ak' Naab' fue usado en el transporte de sal a ciudades del interior, donde este elemento biológicamente necesario escaseaba. Las cerámicas, en particular las que llevan el sello del tipo Warrie Rojo, vinculan a K'ak' Naab' y a las otras salitreras de Paynes Creek con ciudades del interior en el sur de Belice y la vecina Guatemala, particularmente con Lubaantun, Seibal, Altar de Sacrificios, y otras ciudades de la región del Petexbatún.

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Map 1. K'ak' Naab' in Belize.



**Figure 2. K'ak' Naab' Canoe Paddle.**

## **Introduction**

Preserved in a peat bog below the seafloor, the first ancient Maya wooden canoe paddle and wooden architecture were unexpectedly discovered during underwater survey in Paynes Creek National Park, in southern Belize in 2004 (McKillop 2005a). Wooden posts were found at 23 sites, including K'ak' Naab', the site where we found the canoe paddle (McKillop 2005a). The full-size canoe paddle resembles the shape of paddles depicted on incised bones from Burial 116 in Temple 1 at Tikal used by the paddler gods ([Figure 2](#), shown above) (Triak 1963). The antiquity of the K'ak' Naab' canoe paddle was verified by a radiocarbon date of  $1300 \pm 40$  years B.P. from a sample of the grip of the paddle. To two standard deviations and corrected for carbon 13 isotopes and calibrated, the age of the paddle is C.E. 680-880, placing it in the Late Classic period (McKillop 2005:5632). With a FAMSI research grant, we mapped the distribution of wooden architectural remains and artifacts on the surface of the seafloor at K'ak' Naab', in order to investigate the infrastructure of the ancient Maya salt industry on the coast of southern Belize (see [Map 1](#)).



**Figure 1. K'ak' Naab' Underwater Maya Site.**

### **Methodology for Underwater Survey of K'ak' Naab'**

Most underwater archaeological sites, be they deep water shipwrecks or inundated terrestrial sites of various depths below water, are located and mapped using scuba gear (see Green 2004). In deep water, archaeologists often follow ropes to keep on course while traversing a survey area. The cold water of many northern European underwater sites requires divers to use wet suits. Shallow underwater sites generally present the most difficulty for underwater archaeologists because of the difficulty of getting enough distance from the site without disturbing it.

New underwater archaeological survey methods were developed that were appropriate for the conditions at K'ak' Naab'. Apart from the difficulty of working underwater, the main problem was that every step left a depression in the seafloor and disturbed the blanket of silt covering the peat, which eliminated underwater visibility. There is no visibility of the seafloor during the rainy season, which extends from mid-June through February, because of the turbidity of the water caused from both rain and rivers flowing into the lagoon. However, on a clear day at the height of the dry season, when seas are calm, you can see the seafloor – and artifacts and wooden structures embedded in the

peat – from above the water. Survey of K'ak' Naab' was carried out under optimal conditions during the last two weeks of May 2005.



**Figure 3. Survey Team with RFDs (Research Flotation Devices).**

In order to avoid walking on the seafloor and to minimize disturbance of the veneer of loose silt on the peat at K'ak' Naab', we used Research Flotation Devices (RFDs) to float on the water surface. A team of archaeologists snorkeling shoulder to shoulder on RFDs traversed back and forth across the site, placing survey flags at the location of each find.



**Figure 4. Survey Traverse of K'ak' Naab'.**



**Figure 5. Traverse of K'ak' Naab'.**



**Figure 6. Completing Traverse of K'ak' Naab'.**

The first traverse was videotaped. Artifacts were visible on the surface and embedded in the seafloor. The tops of wooden posts were visible where they protruded from the peat through the silt.





**Figure 7. Artifacts on Seafloor.**

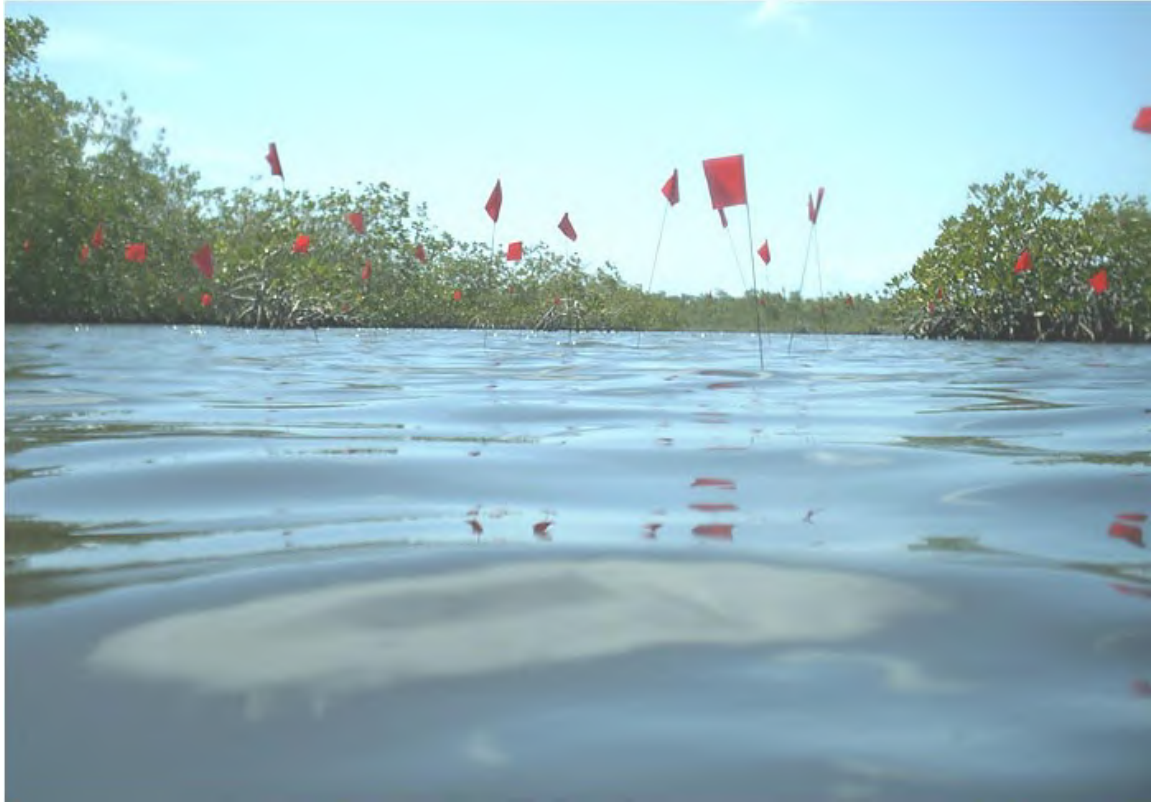


**Figure 8. Post visible on Seafloor.**

The flags marking the locations of artifacts were labeled with sequential numbers using an indelible marker pen, with different color flags used for wooden posts, which were numbered separately. Following the systematic traverses, the team searched for additional posts based on the location of known posts, by continuing searches where there was a line of posts and by searching in places where a missing corner of a rectangular structure was suggested by the location of known posts.



**Figure 9. Placing flag at K'ak' Naab'.**



**Figure 10. Flags show artifact locations at K'ak' Naab'.**



**Figure 11. Total Station at Main Datum.**

## Methods for Mapping the Underwater Site of K'ak' Naab'

A permanent datum marker was made on a nearby island that was dry at low tide. The location provided the necessary stable platform for the electronic total station, which did not take readings at our initial datum location on a mangrove clump beside K'ak' Naab'. The datum consisted of a 1-meter length of 2-inch diameter PVC pipe sunk into the center of a cement-filled hole, about 30 cm in diameter and 1 meter in depth. A Topcon Total Station was placed at the datum, with GPS location taken from a Trellis Garmin GPS waterproof hand-held unit.



Figure 12. Prism Pole at K'ak' Naab'.

Due to difficulties with the total station data collector, the total station was used like a transit, with distance and angle measurements recorded in a transit book. The data were entered into an excel spread sheet at a later date, and changed to coordinate data using the UTM coordinates of the datum as measured by the GPS. The coordinate data were attached to a GIS for the site created with the software Intergraph Geomedia 6.0. Artifact data were added to the excel spreadsheet following analysis. The GIS was used to store and display spatial data and to investigate the spatial patterning of activities as represented by the distribution of wooden structures and artifacts.



**Figure 13. Sampling a Post at K'ak' Naab'.**

Mapping required five people. The total station team consisted of one person taking readings and second recording. The team at the site consisted of three people. The team included a "wet hands" archaeologist and a "dry hands" archaeologist, in addition to the team member who carried the prism pole. The wet hands archaeologist placed the base of the prism pole on the center of each artifact or post. A prism pole person leveled the pole using the attached bubble level, and communicated this information by walkie-talkie to the total station team, who then took a reading. Communication between the total station and the prism pole was by hand-held walkie-talkie, as even with a short distance, the wind made communication otherwise impossible. The "wet hands" archaeologist recovered each artifact and handed it to the "dry hands" archaeologist who labeled plastic bags for each artifact and placed the bags in the PRS (portable research station). The PRS, a large inflatable dinghy tied to an RFD or archaeologist, was used as a repository for artifacts and post samples and to transport supplies that needed to stay dry, notably cameras, water, snacks, umbrellas, flags, bags, notebooks, markers, sunscreen, and zinc oxide.



**Figure 14. Posts kept wet in bags at K'ak' Naab'.**

The diameter and circumference of each wooden post were measured using a plastic metric sewing tape. Posts were sampled for species identification, radiocarbon dating, and dendrochronology using a sharp knife or machete to cut a cross-section of preserved post below the seafloor. Each wood sample was kept wet in a resealable plastic bag with seawater, changed to freshwater at the field lab to begin the conservation process of de-salinization.



**Figure 15. K'ak' Naab' Post for conservation.**



**Figure 16. Sharpened end of K'ak' Naab' Post.**

Digital images were taken using a SONY digital video DVD camera, an Olympus Camedia 5.0 still camera, and an underwater still camera. Field sketches and notes were recorded in "Rite in the Rain" notebooks using "Rite in the Rain" pens. All equipment was stored in resealable plastic bags. Digital images were downloaded to a field computer at the field station.



**Figure 17. Taking a photo at K'ak' Naab'.**



**Figure 18. Socket at K'ak' Naab'.**



Artifacts were sorted in the field lab into material classes and examined separately. Ceramics, which comprised the bulk of the collection, were classified by the type-variety system as well as the attribute analysis system previously used by the project of 25 discrete and measurement variables (McKillop 2002a). Artifacts were drawn and photographed in the field lab and then stored in 5-gallon plastic lidded buckets.



**Figure 19. Clay cylinder vessel support.**



**Figure 20. Pottery rim from K'ak' Naab'.**



**Figure 21. K'ak' Naab' Underwater Site.**

### **Results: Wooden Structures and Activities**

Underwater survey of K'ak' Naab' resulted in the discovery and mapping of 56 wooden posts protruding from the seafloor and 506 individually piece-plotted artifacts (Figure 21, shown above; [Figure 22](#), [Figure 23](#), [Figure 24](#), shown below). The wooden posts included two lines of palmetto palm posts, as well as two clusters of unidentified non-palm wood ([Figure 25](#) and [Figure 26](#), shown below). The cluster of posts on the north forms an amorphous rectangle of about 4 × 5 meters in size, possibly defining two rooms. The post cluster on the south may define the corner of a rectilinear structure. A line of palmetto palm posts extends obliquely NW to SE about 3 meters east of the east post cluster. A line of palmetto palm posts extends obliquely SW to NE about 4 meters from the west post cluster. Remains of palm fruits from three species of native palms were previously reported from waterlogged contexts at Wild Cane Cay, Frenchman's Cay, Pelican Cay, Orlando's Jewfish (McKillop 1994, 1996a). Wooden posts from buildings were first reported from K'ak' Naab', and nearby Sak Nuk Naj, Chak Sak Ha Nal, and other sites in Paynes Creek (McKillop 2005a).



**Figure 22. Entrance to Lagoon.**



**Figure 23. Palmetto Palms in background.**



**Figure 24. Flags marking Post locations.**

The distribution of the posts is a partial footprint of wooden structures, perhaps including interior room divisions and even furniture. Certainly the modern Maya use different size posts in different parts of buildings, with larger diameter posts used as support posts, for example (Wauchope 1938).

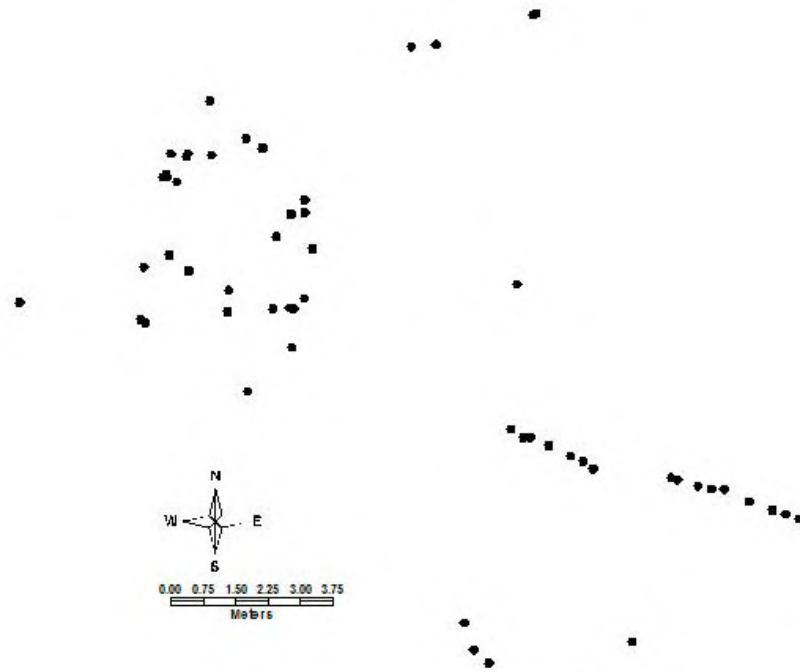


Figure 25. K'ak' Naab' Posts.

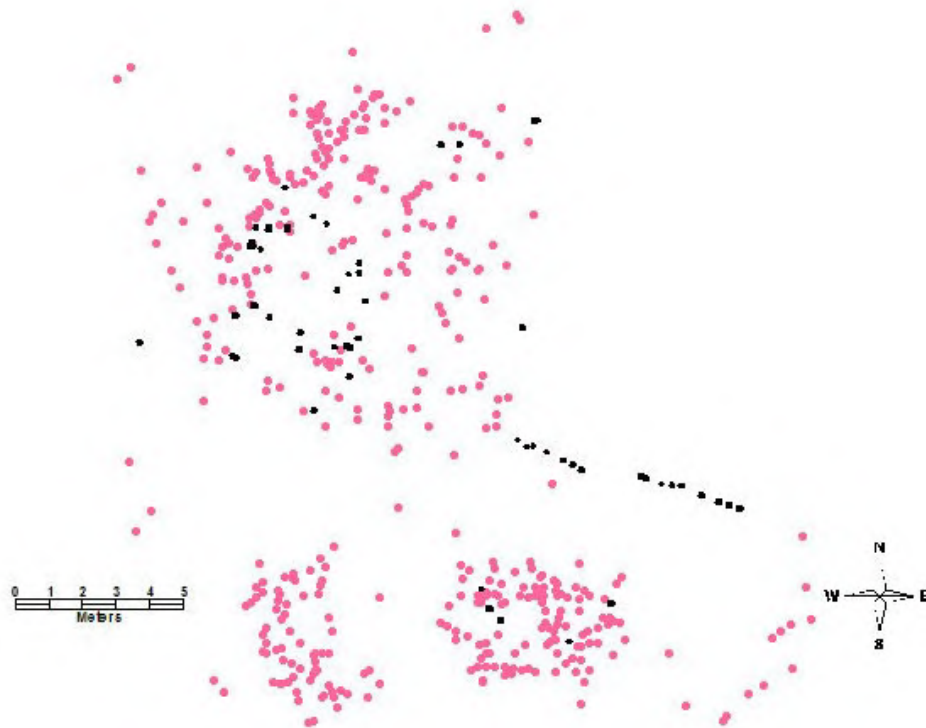


Figure 26. K'ak' Naab' Posts and Artifacts. (Posts are displayed black).

The lines of palmetto palm posts may form fences around salt compounds, but their spatial extent to the east is unknown since the posts continue under the dense mangrove roots. Elsewhere, such as at nearby Chak Sak Ha Nal, there is a cluster of wooden posts enclosed on three sides by lines of palmetto palm posts (McKillop 2005a). Some of the posts demarcate interior room divisions, whereas other posts may be the legs of tables or other furniture used in the salt production process, as noted ethnographically (Reina and Monaghan 1981).



**Figure 27. Punta Ycacos jar rim.**



Figure 28. Punta Ycacos jar rim.

### Type-Variety Classification

The pottery sherds were classified according to the type-variety system of Maya ceramic classification, using the types established from previous research at four salt works in Paynes Creek National Park (McKillop 1995, 2002a), Wild Cane Cay, Frenchman's Cay, and other sites in Port Honduras Marine Reserve (McKillop 2002b, 2005b, 1996b). The same five pottery types as discovered at the other salt works were represented at K'ak' Naab'.

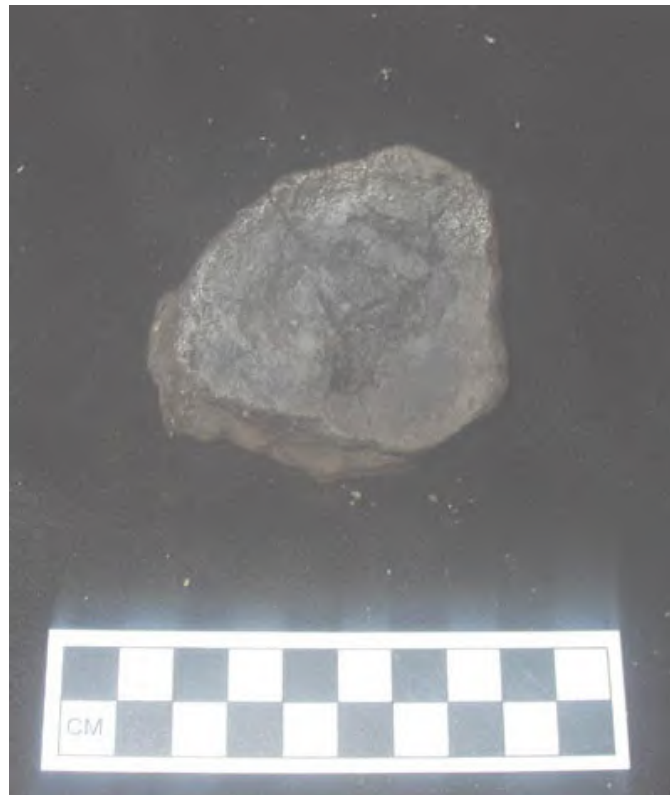
Punta Ycacos Unslipped includes jar, basin, and bowl sherds ([Figure 27](#) and [Figure 28](#), shown above), as well as clay cylinder vessel supports, sockets placed at the top of the cylinder where the vessel rested on the vessel support ([Figure 29](#), shown below) and spacers that may have been placed between jars while many vessels were placed over a fire ([Figure 30](#), [Figure 31](#), and [Figure 32](#), shown below). Also included in Punta Ycacos Unslipped are amorphous clay lumps, which are interpreted as the remains of

broken spacers and sockets, as well as by-products of pottery manufacture. Jars include necked and outcurved wall jars, with direct or exterior folded lips, of a variety of wall thicknesses. Basins are large, straight-walled vessels. There are several open bowls, including one sherd from a very shallow open bowl or dish. There is one tecomate with a very small orifice and one coiled handle. As containers, the vessels are poorly fired, with smooth interiors and roughened exteriors.



**Figure 29. Punta Ycos cylinder and socket.**





**Figure 30. Punta Ycacos spacer, bottom.**



**Figure 31. Punta Ycacos spacer, side view.**



**Figure 32. Punta Ycacos spacer, top.**

There are two types of water jars. Mangrove Unslipped jars include vessels with incurved walls and outcurved necks, with round, square, or grooved lips ([Figure 33](#), shown below). Warrie Red includes both jars and open bowls. One complete rim has an open oval stamp with comb stamping below on the vessel shoulder ([Figure 34](#), shown below). Other Warrie sherds include two jar rims without visible stamping, one bowl sherd with a basal angle, and a variety of body sherds, including one with an inset base. A Warrie sherd was used to make a perforated potsherd disk usually interpreted as Classic period spindle whorls ([Figure 35](#) and [Figure 36](#), shown below).



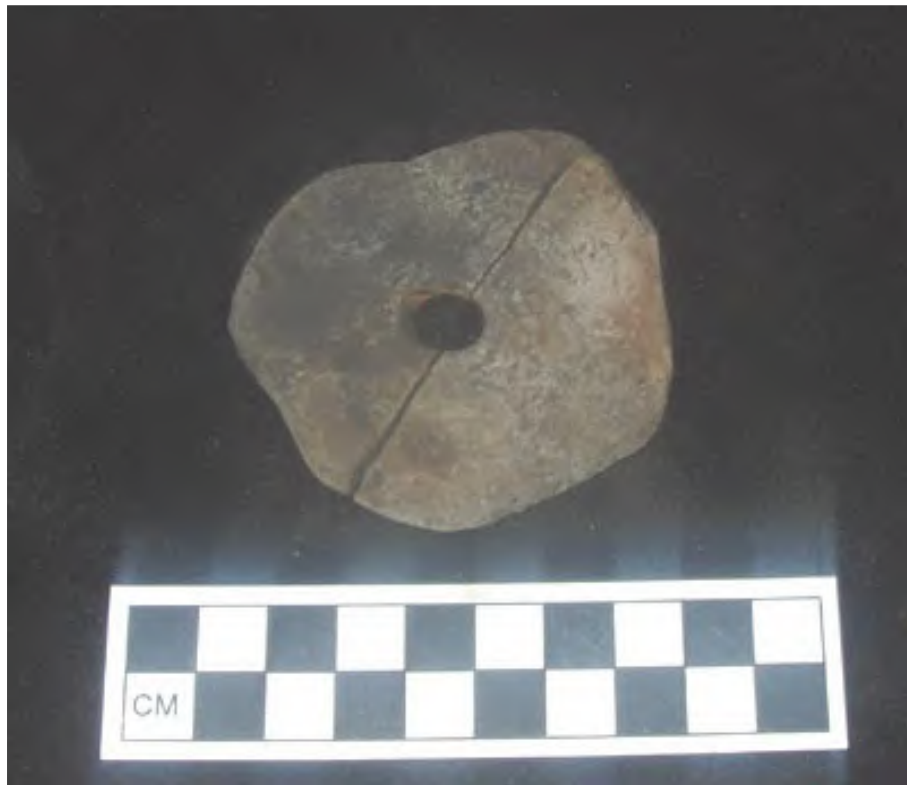
**Figure 33. Mangrove Unslipped jar.**



**Figure 34. Warrie Red Jar ("S" unit-stamping on vessel shoulder).**



**Figure 35. Perforated potsherd disk made from Warrie Red sherd.**



**Figure 36. Interior view of Figure 35.**

Moho Red pottery includes sherds from shallow dishes or bowls with basal break, including one with a notched angle. Moho Red is red-slipped, volcanic ash tempered type from the Port Honduras-Paynes Creek region of the coast of southern Belize (McKillop 2002a, 2002b) that resembles Belize Red from the Belize Valley (see Gifford 1976). One rim has a circumferential horizontal grooved line below the rim on the exterior, as well as an oblique grooved line on the wall. Another rim has two horizontal grooved lines on the bowl exterior, one below the rim and the other about 2.5 cm below. A variety of body sherds include a pedestal base ([Figure 37](#), shown below).



**Figure 37. Moho Red pedestal base sherd.**

One Village Farm Mold Made fragment of a figurine ocarina may be part of hair, with similar fragments from 2003 excavations at Village Farm by the author.

### **Attribute Analyses of K'ak' Naab' Pottery**

For an attribute analysis, measurements and observations were recorded for 25 characteristics of each sherd to search for variability within types. For example, vessel diameters and the diameter of the clay cylinder vessel supports were used as an index of how standardized the vessels were as containers used for salt production. Compared with everyday pottery vessels at Wild Cane Cay, the Punta Ycacos salt vessels from

previously discovered sites in the lagoon (McKillop 1995, 2002a) were standardized in dimensions, suggesting mass production of the product, salt. The average median variation (AMV) statistic was used instead of "co-efficient of variation" to gauge variability. AMV is useful for distributions that depart from normal, and also minimizes the effect of outliers. There were few sherds with measurable rim diameters from K'ak' Naab', apart from Punta Ycacos jar rims. The ten measurable rims have an AMV of 12.27. The 199 measurable clay cylinder vessel supports from K'ak' Naab' have an AMV of 7.99. Similarly low values for other Paynes Creek salt works, namely Stingray Lagoon, David Westby, Orlando's Jewfish and Killer Bee, contrast to the high values for Bedford Unslipped household pottery from Wild Cane Cay (McKillop 2002a). The low AMV indicates standardization of the containers and mass production of the product, salt.

### **GIS Spatial Analysis of Pottery at K'ak' Naab'**

Most of the pottery was briquetage associated with boiling brine in clay pots over fires to produce salt (McKillop 2002a). The briquetage included 81 Punta Ycacos Unslipped vessel sherds from jars and bowls that held brine ([Figure 38](#), shown below), 235 clay cylinder fragments from the vessel supports for the salt pots ([Figure 39](#), shown below), 31 clay sockets that were placed at the top of cylinders to form a concave surface on which the salt pots rested ([Figure 40](#), shown below), two spacers placed between pots over the fire ([Figure 40](#)), and 98 amorphous clay lumps ([Figure 41](#), shown below), the last consisting either of broken sockets and spacers or residue from pottery manufacture.

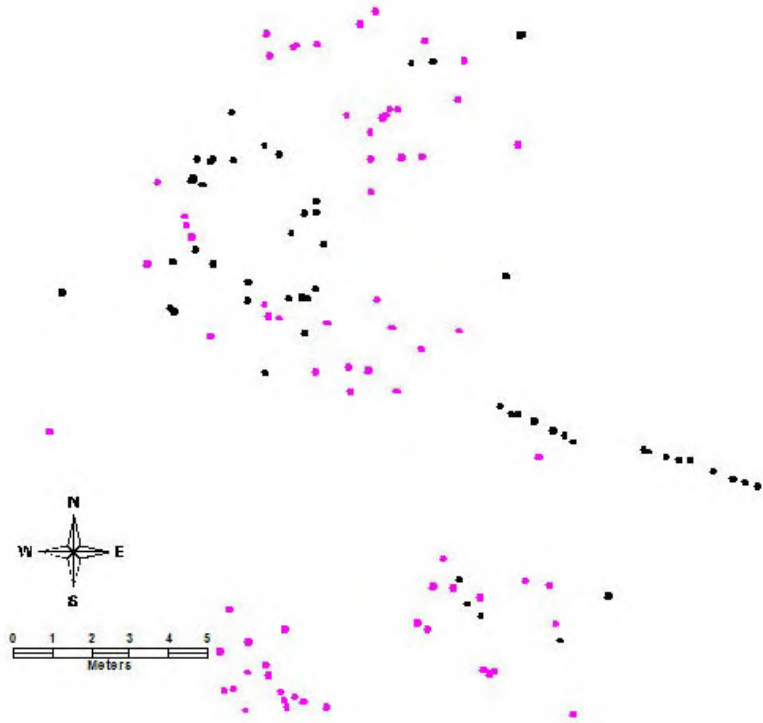


Figure 38. Punta Yacos Unslipped sherds.



Figure 39. Clay cylinder vessel supports.

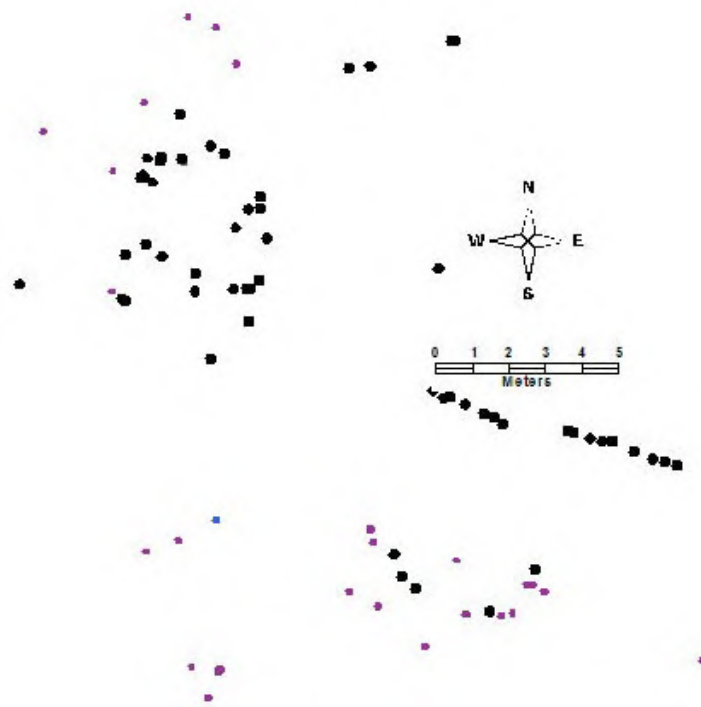


Figure 40. Sockets and spacers.



Figure 41. Amorphous clay lumps.



Water jars that held brine prior to the boiling process include 27 Mangrove Unslipped (Figure 42, shown below) and 14 Warrie Red (Figure 43, shown below) sherds. In addition to the briquetage, there were 14 Moho Red sherds from serving vessels (Figure 44, shown below), and one fragment of a figurine whistle of the type Village Farm Mold Made. One perforated potsherd disk also was found (Figure 45, shown below).

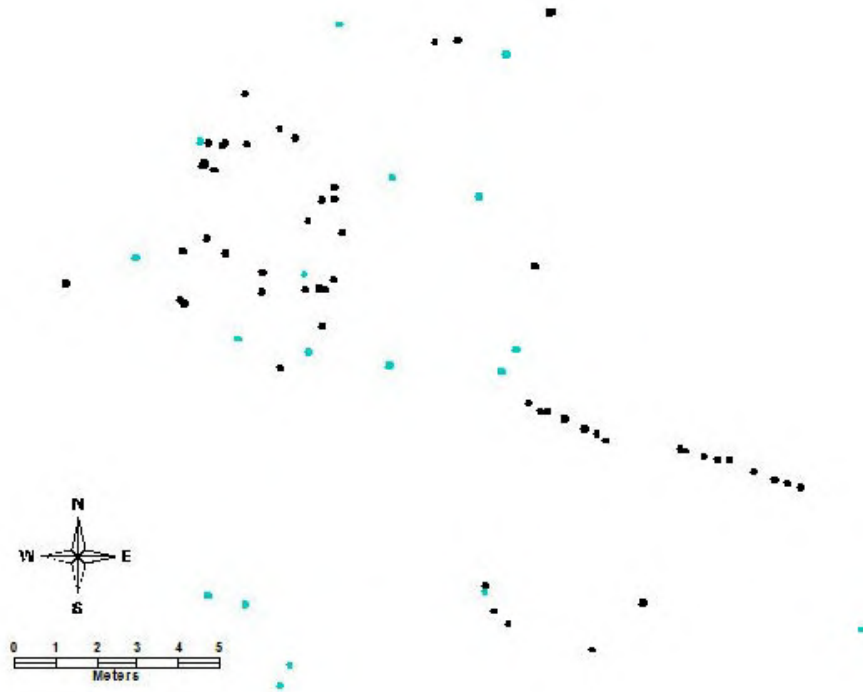


Figure 42. Mangrove Unslipped water jars.

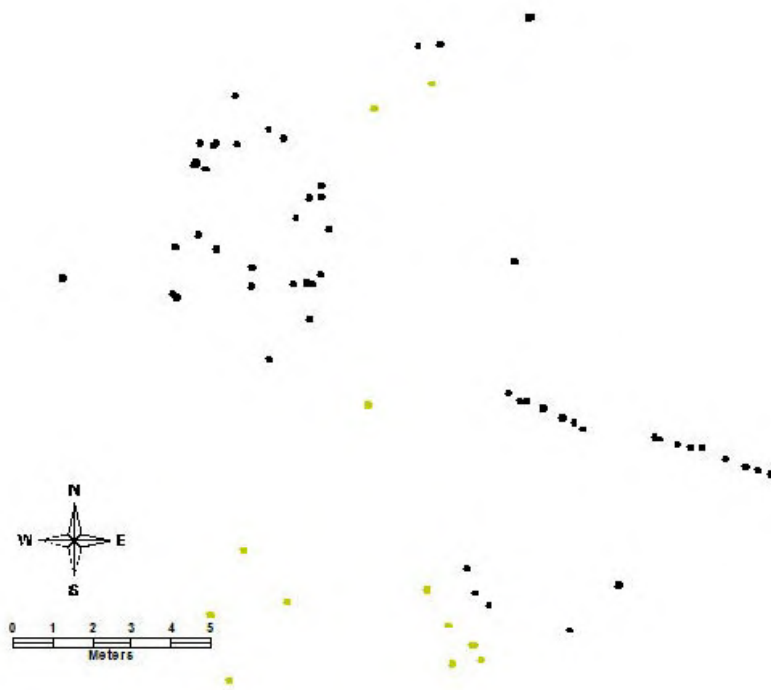


Figure 43. Warrie Red jars and bowls.

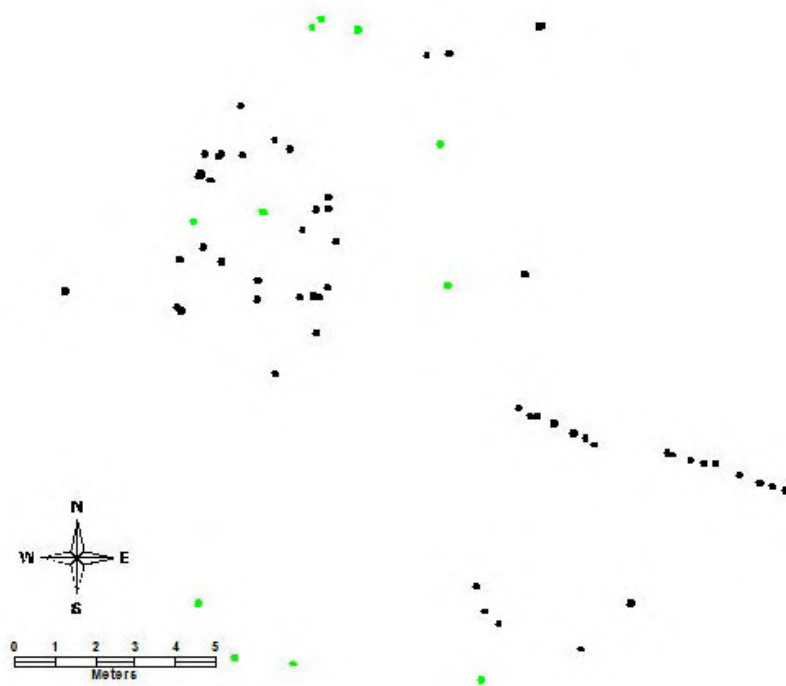
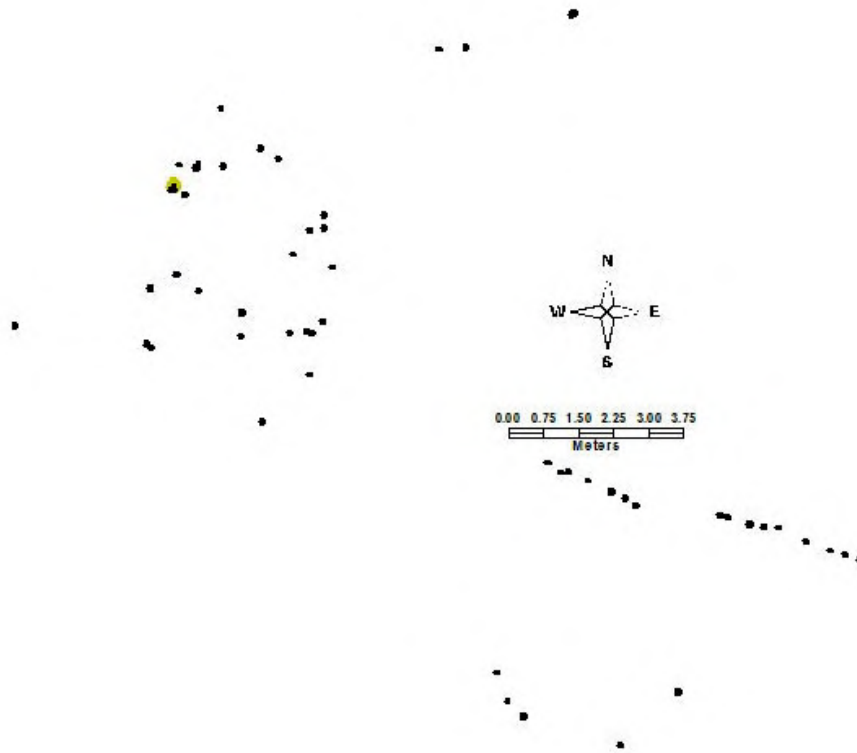


Figure 44. Moho Red bowls.



**Figure 45. Perforated potsherd disk.**

The spatial patterning of artifacts indicates two spatially distinct activity areas for salt boiling, each associated with a wooden structure. The briquetage associated with the north structure was outside the building, suggesting that the building was cleaned with the contents dumped outside ([Figure 46](#), shown below). Alternatively, salt boiling may have been carried on outside, with the building used for storing salt or for housing salt workers. The presence of a Mangrove Unslipped water jar sherd and a Moho Red serving bowl sherd suggest household activities or ritual feasting associated with the salt boiling. Since the south post cluster does not define a recognizable structure, the location of the artifacts in relation to the structure is undetermined.

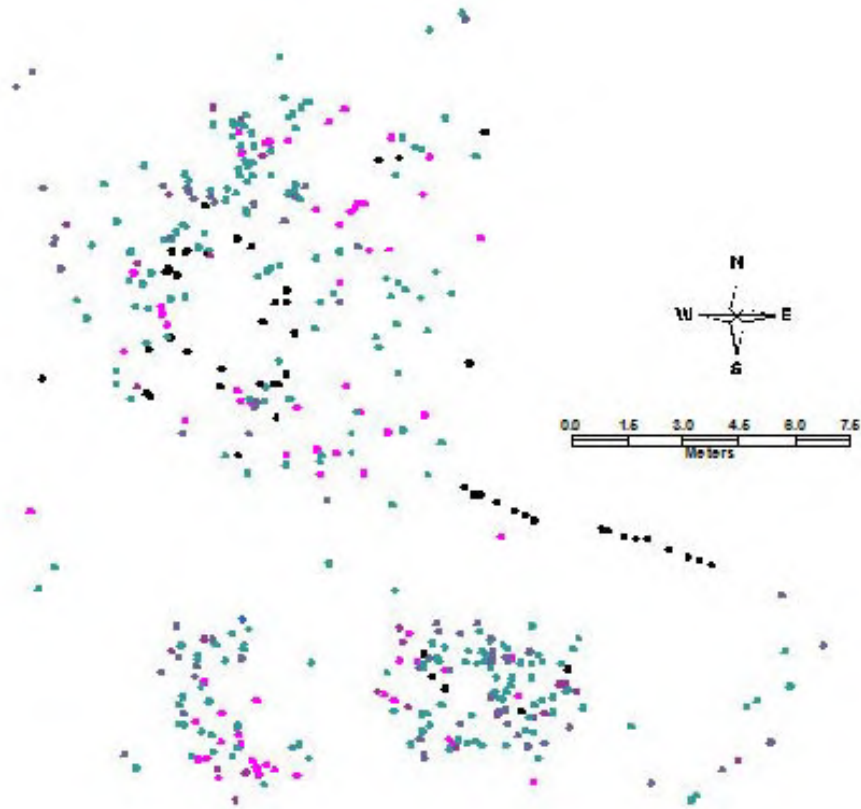


Figure 46. Briquetage from Salt Production and Wooden Architecture at K'ak' Naab'. (Sherds: pink; post sample. Cylinders: green; sockets: purple; spacers: light blue; clay lumps: blue; posts: black).



Figure 47. Heather McKillop holding a Post Sample from Paynes Creek National Park, Belize.

### **K'ak' Naab' and the Late Classic Maya Salt Industry**

Elsewhere I have suggested that salt production in Paynes Creek National Park was carried out by independent specialists beyond the direct control of the dynastic urban Maya, who were located at geographically distant cities (McKillop 2005a). The extent of salt production, by both evaporation and briquetage, was extensive (Andrews 1983; Graham 1994; McKillop 2002a). The wooden structures and canoe paddle at K'ak' Naab' indicate significant infrastructure was involved in the production, storage, and transportation of salt for the Late Classic Maya. Following the FAMSI project, a National Geographic Society grant in 2006 funded mapping wooden architecture at nearby Chak Sak Ha Nal, and associated salt works. A 3-year grant from the National Science Foundation (2005-2008) was received to locate and map wooden architecture elsewhere in Paynes Creek National Park. As of 2006, we have found extensive evidence of wooden structures associated with the salt industry. As well as documenting pole and thatch architecture dating to the Classic Maya times, the research contributes to our understanding of the ancient Maya salt industry and the economic organization of ancient states (Adshead 1992; McKillop 2006).

## Acknowledgements

The FAMSI project included a field survey team led by the author and including Bretton Somers and Mike Mirobelli (each at Louisiana State University), Mark Robinson (then at Essex University in the UK), and John Young of Punta Gorda, Belize. Dr. Jaime Awe, Director of the Institute of Archaeology, government of Belize, kindly granted a permit for the archaeological research and encouraged the research in many ways. John Spang and Tanya Russ generously provided room and board for the team, as well as endless assistance and encouragement, and engaged us in challenging discussions about the research. These and many people in Punta Gorda and elsewhere in Belize made the research in their country both exciting and possible, for which I am very grateful.

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