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Invisible Architecture: Underwater Excavation of Site 77, Paynes Creek National Park, Belize

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INVISIBLE ARCHITECTURE:
UNDERWATER EXCAVATION OF SITE 77,
PAYNES CREEK NATIONAL PARK, BELIZE

A Thesis

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Master of Arts

in

The Department of Geography and Anthropology

by
Tekla Chantae Rudie
B.S., Truman State University, 2011
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Table of Contents

Acknowledgements	ii
List of Figures	v
Abstract	vi
Introduction	1
Objectives and Significance	1
Invisible Architecture	2
Maya Architecture	2
How Sites Become Invisible.....	5
Identifying Invisible Sites.....	8
Invisible Architecture in the Maya Region.....	9
Santa Rita Corozal.....	16
Punta Ycacos Salt Works	17
Site 77.....	22
Materials and Methods	23
Materials	23
Methods	24
Results	25
Survey.....	25
Sediment.....	25
Excavation.....	26
Artifacts	32
5-6m	32
6-7m	32
4-5m	33
2-3m	34
Architecture	35
Discussion	37
Conclusion	42
References	44
Vita	48

List of Figures

1. Maya house shapes based on Wauchope (1938); (a) apsidal, (b) flattened ends, (c) rectangular, (d) square	3
2. Archaeological sites described in text (adapted from McKillop 2004).	10
3. Salt-making artifacts on the sea floor, Punta Ycacos Lagoon, Belize, including cylinder fragments (top right and left center) and pot sherds. White lines are due to the reflection of light on the water. Photo by Tekla Rudie.	19
4. Overview of Site 77, Paynes Creek National Park, Belize looking southeast. Preserved wooden posts are marked by orange flags. Yellow flags mark Transect 1. Photo by David Susko.	23
5. Cory Sills, David Susko, and Patrick Vines screening sediment at an off-site location. Note project research station and plastic sand bags filled with sediment waiting to be screened in foreground. Photo by Heather McKillop.	27
6. Map of Site 77 including Transect 1, excavated units, and structure identification. Map adapted by Tekla Rudie based on GIS map by Heather McKillop.	29
7. Setting up excavation using metal frame to delineate unit boundaries. Note also the plastic bucket with holes (inverted at left) used during excavation and the author floating on an RFD. Photo by Heather McKillop.	30
8. Author screening sediment and bagging artifacts at an off-site location. Note MTDs in background. Photo by Heather McKillop.	31
9. Body sherd with red slip recovered from 6-7m, 10-20cm below surface. Photo by Tekla Rudie.	33
10. Posts in unit 6-7m, including a newly located post. Post A is the new post (located at 3, 44). Post B is the post that was broken (located at 100, 11). The northeast corner served as (0, 0). Sketch by Tekla Rudie.	34
11. Posts in unit 2-3m. Post A is located at 88.5, 31. Post B is located at 92, 47 and was broken during excavation. The northeast corner served as (0, 0). There are additional posts along the western wall of this unit not included in this figure. Sketch by Tekla Rudie	35
12. Site 77 map with structure outlines. Structure outlines drawn by Tekla Rudie on GIS map by Heather McKillop.	36
13. Site 77 with structure outlines (blue) and possible interior divisions (red and orange). Structure outlines drawn by Tekla Rudie on GIS map by Heather McKillop.	40

Abstract

This thesis presents research concerning invisible architecture and its importance to Maya archaeology. Maya architecture, mechanisms for the disappearance of sites, and strategies for their discovery are briefly discussed. Several examples of sites with invisible architecture are then put forth, including Santa Rita Corozal, where research has determined that as much as 50% of structures at the site may be invisible. Background on previous work at the Punta Ycacos salt works in Paynes Creek National Park is presented, followed by detailed description of recent excavations at Site 77. The site consists of preserved wooden posts in the sea floor and associated artifacts (including salt-making ceramics, charcoal, botanicals, chert, and obsidian). Two rectangular structures are suggested by the patterning of posts at the site. Artifact density at this site was markedly low. Preliminary analysis suggests that the structures at this site may have been used differently or for a shorter duration than other salt works sites in the lagoon.

Introduction

As archaeologists, we seek to uncover the past. However, certain parts of the past tend to garner the majority of our attention. For much of the history of Maya archaeology, the focus of research has been on monumental structures and the artifacts associated with them. Although this legacy has undoubtedly contributed important insight to Maya archaeology, important structures and artifacts have been overlooked (Aucoin 2012, Chase 1990, Johnston 2004, McKillop 2004, McKillop 2005, Sweely 2005). At sites throughout the Maya area, archaeologists have been uncovering hidden structures which previously went undocumented (Chase 1990, Cliff 1986, Gerhardt and Hammond 1991, Johnston 2004, Masson 1999, McKillop 2002, Sills and McKillop 2010, Sweely 2005, Valdes and Kaplan 2000). These “invisible structures” are impossible to find through regular surface survey due to the fact that they leave few or no surface traces (Johnston 2004).

Objectives and Significance

The main purpose of this report is to present new research conducted at one of these invisible sites: a Maya salt works (Site 77) in Punta Ycacos Lagoon, Paynes Creek National Park, Belize. To further understanding of invisible sites, their prevalence and their importance, information about Maya architecture, the processes by which sites become invisible, and methods for their discovery by archaeologists is reviewed, along with a brief discussion of invisible structures discovered at five sites in the Maya region. Additionally, the site of Santa Rita Corozal is examined in more detail as a comparative study; Santa Rita Corozal is critical to the discussion of invisible architecture in the Maya region due to the discovery of so many invisible structures there. A summary of previous research in Punta Ycacos Lagoon is then set forth. The sites presented differ in many ways, and thus demonstrate that invisible architecture

can occur in a variety of circumstances and throughout the Maya region. Recent research at Site 77 is then detailed.

The discovery of substantial invisible architecture shifts our understanding of Maya trade, populations, and lifestyles. As one of these invisible sites, Site 77 represents a plethora of new information. Current research includes excavation along a transect to investigate the presence of artifacts, activities inside and outside of the structures, and the wooden architecture itself. With further investigation, this site will contribute to our understanding of the Maya salt works in Punta Ycacos Lagoon, as well as our understanding of trade and workshop production throughout the Maya area.

For structures that seemingly vanished without a trace, invisible architecture has a huge impact on archaeology. Especially in the Maya region, where population is estimated based on the house-count or household method (Drennan 1991, Leventhal and Baxter 1988, McKillop 2004, Turner 1990), knowledge of the existence of such structures should fundamentally change the way archaeologists approach site interpretation. Survey and excavation in areas where invisible architecture is suspected will need to be altered to best facilitate the discovery of such structures. Archaeologists must at least begin to consider the possibility of invisible architecture if we truly wish to have as many pieces of the puzzle as possible.

Invisible Architecture

Maya Architecture

Before discussing the issue of invisible architecture, it is important to have an understanding of Maya structures. Prior to the discovery of sites in Punta Ycacos Lagoon, no preserved wooden architecture had been discovered in the Maya area. The tropical climate is one in which wood decays rapidly (relative to archaeological time scales), leaving little evidence of structures built from timber in the archaeological record (Wauchope 1938, McKillop 2004). The

existence of such perishable structures has long been inferred by archaeologists based on evidence of stone foundations, platforms, and post holes. Post molds (the decayed, buried remains of a post which have remained in situ) are not mentioned as evidence of perishable structures in the Maya region, although they are found in other parts of the world. From this evidence, archaeologists surmised that Maya structures are typically built on platforms in plazuela groups, and can vary significantly in size (McKillop 2004, Rice 1988, Sills and McKillop 2010). Plazuela groups consist of two or more structures built around a common plaza space. Excavation in the Maya region has revealed invisible structures that fit only some or none of these criteria (Chase 1990, Cliff 1988, McKillop 2002, Sills and McKillop 2010, Somers 2007, Wauchope 1938).

Not satisfied with this paltry evidence concerning perishable structures, Wauchope (1938) undertook a study of modern Maya houses and discusses their contribution to archaeological site interpretation. His work has since been used as an ethnographic comparison for ancient Maya houses (Leventhal and Baxter 1988, Ochoa-Winemiller 2004, Rice 1988, Sills

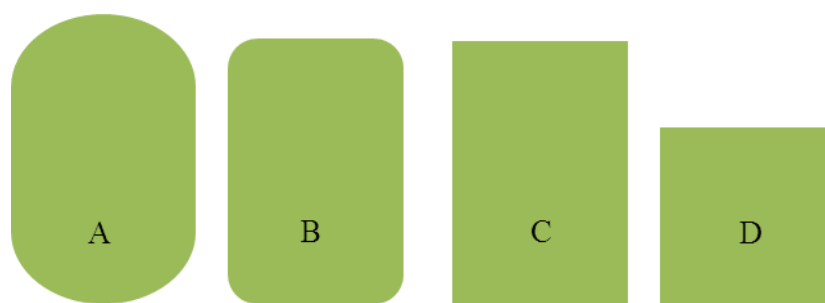


Figure 1. Maya house shapes based on Wauchope (1938); (a) apsidal, (b) flattened ends, (c) rectangular, (d) square.

and McKillop 2010, Somers 2007). Wauchope found that Maya houses tend to take one of four shapes: apsidal, flattened ends, rectangular, or square (Figure 1).

Wauchope observed house types throughout the Maya area, including villages in Mexico, Guatemala, and British Honduras (now Belize). In San Antonio, southern British Honduras, Wauchope found that ninety percent of houses were rectangular and ten percent were flattened. Across the port in Puerto Barrios, Guatemala, one-hundred percent of the observed houses were rectangular. Wauchope also observed that Maya houses generally have four mainposts, but may have more. An increased number of mainposts was linked to a decrease in the size of the mainposts. The size of the mainposts was also related to the amount of weight they would need to support. Post holes were generally 0.75-1.0m in depth, depending on bedrock depth and ground conditions (Wauchope 1938). In square and rectangular structures, the mainposts were aligned with the walls, whereas in apsidal or flattened end structures they were inset from the wall.

Walls constructed of perishable material were observed in three variations by Wauchope (1938): vertical poles, horizontal wattle, or vertical wattle. In the first, vertical poles (usually of cane) are lashed together to form the wall. Every sixth or twelfth pole is then lashed at its top to the frame of the structure. Horizontal wattle is achieved by weaving thin reeds between small upright supports spaced some distance apart. Vertical wattle is achieved by the same process, but the material is woven between horizontal supports rather than vertical ones. Walls are then daubed with mud mixed with grass, palm leaves, or cornhusks. Wauchope reports that mud-daubed walls were often covered with a lime whitewash (1938). This process is important because remnants of walls with impressions of wooden poles found at various archaeological sites can give insight into wall construction methods (Wauchope 1938, Whalen 1988)

Roofs are generally constructed of beams, rafters, and rods supported by two main A-frames. Additional A-frames may be used to add strength to the roof. Palm fronds or grass are generally used as thatch material (Wauchope 1938).

While Wauchope (1938) provides a good basis for discussion of ancient Maya houses, it is important to acknowledge the limitations of this ethnographic analog to ancient structures. Wilk (1991:39) demonstrated that households among the modern Kekchi Maya are “dynamic and changeable,” adapting to local conditions so that “each household can appear different” (Wilk 1991:35). While his is another ethnographic example, these insights should be kept in mind when discussing ancient houses and households as well.

How Sites Become Invisible

The formation of an archaeological site is a complicated matter involving a variety of processes both cultural and natural (Schiffer 1972, 1983). These processes have effects that archaeologists need to be aware of in studying sites: loss of information over time, potentially biased samples (taken from an unknown population), and transformation of artifacts and relationships between artifacts in the archaeological record (Schiffer 1983).

Cultural processes, such as use, reuse, and recycling, affect which artifacts enter the archaeological record, and in what condition. Artifacts made of more costly materials are more likely to be curated, reused, or recycled than those made of easily available materials, and therefore enter the archaeological record less frequently. Artifact properties such as size and material also may affect whether refuse is left in situ (primary refuse) or deposited elsewhere (secondary refuse). In general, smaller artifacts tend to be primary refuse, whereas larger or more hazardous artifacts tend to be deposited in secondary contexts. Additionally, site abandonment (quick versus slow abandonment and partial versus total abandonment) will have an effect on what artifacts are left to become part of the archaeological record (Schiffer 1972). Later cultural activity, such as plowing, scavenging, or looting, should also be considered in discussions of site formation (Schiffer 1983).

Natural processes also play an important role in site formation. Among these are fluvial and eolian actions (erosion and deposition), decomposition, bioturbation, carnivore damage, weathering, and others. Processes such as these can often be inferred from careful observation of archaeological deposits. Artifacts may be affected differently based on size, density, and shape. Orientation, condition, quantity, and distribution of artifacts may also be affected by formation processes. Additionally, sediment characteristics (such as color, texture, and compaction), the presence of various intrusive materials, geochemistry, deposit structure and context, and site morphology can all reflect site formation processes. Extant knowledge and analytical approaches can be useful in identifying specific formation processes which may have affected a site (Schiffer 1983). In order to properly interpret deposits at a site, it is crucial that archaeologists take into account formation processes.

Sites are arbitrarily bounded by archaeologists, and the distinction of what constitutes a site varies. Often sites are large and may contain multiple structures (each labeled as a feature of the site). Some sites are small and ephemeral, consisting only of a surface scatter of artifacts. In the case of Punta Yacacos Lagoon, sites were initially delineated based on artifact scatters on the sea floor. The discovery of preserved wooden posts altered site designations to some degree. Currently in the lagoon, a site consists of one or more structures and their associated artifact scatter. Sites boundaries are determined by the limits of the artifact scatter combined with structure outlines. Sites are generally separated by several meters of sterile sea floor.

A distinction between invisible sites and invisible structures should also be made at this point. "Invisible sites are composed entirely of buried architectural and nonarchitectural remains" (Johnston 2004:148) and therefore show no surface traces. "Invisible structures, in contrast, may be isolated...or they may be components of sites otherwise represented by mounded and visible remains" (Johnston 2004:148).

Various processes can contribute to the disappearance of all or parts of sites. These processes include alluviation, colluviation, bioturbation, sea level rise, cataclysmic environmental events, later construction, and the decay of perishable materials. A buildup of sediment covering sites, through alluviation or colluviation, is most likely in areas such as floodplains, river valleys, and along slopes (Johnston 2004, Voorhies and Kennett 1995). As sediments are moved by water, wind, or gravity, ongoing erosion and deposition occur, gradually changing landscapes. Over time, these processes can completely cover a site or structure. Upland areas, favored for Maya sites, often experience bioturbation, through which artifacts sink into the biomantle as sediment is moved around them (Balek 2002, Johnston 2004). Artifacts may be moved directly by flora or fauna, or may move as sediment shifts in response to bioturbation. In this case, as in the case of artifact movement by alluvial or eolian forces, artifacts tend to sort by size, resulting in a transformed archaeological record. Smaller artifacts are more easily moved than larger ones.

Later construction, whether of prehistoric or historic origin, can also obscure structures. At ancient Maya sites, it is not uncommon for earlier construction to have been partially or completely demolished before new structures were erected in the same place (Cliff 1986, Gerhardt and Hammond 1991). Alternatively, modern construction at sites may cover or destroy structure remains (Valdés and Kaplan 2000). Some structures leave little or no trace simply because the materials from which they were made were of a perishable nature and have not survived in the archaeological record. Wood, cane, thatch, and other common construction materials decay rapidly in the Maya region, and therefore leave almost no trace in the archaeological record (McKillop 2004, Wauchope 1938).

Other causes may also result in invisible sites or structures. Cataclysmic events such as volcanic eruptions can result in the burial of archaeological sites. Structures at the site of Ceren,

El Salvador, were buried under approximately 5m of overburden during a volcanic eruption about 1400 years ago (Conyers 2007). Additionally, some coastal areas have been subject to flooding as sea level has gradually risen during the Holocene (McKillop 2002, 2004). Many coastal sites have been completely or partially submerged in this way, including Punta Ycacos salt works, Pelican Cay, and portions of sites on Wild Cane Cay, Frenchman's Cay, and at Pork and Doughboy Point (McKillop 2002, McKillop et al. 2010).

Identifying Invisible Sites

Invisible sites or structures, by their nature, are difficult to locate and identify. Specialized survey and modified excavation methods are usually required to once again make these sites visible to archaeologists. Some of the various methods that can be employed in this effort are discussed briefly below.

Geophysical survey techniques, such as proton magnetometry (Hammond 1974), electromagnetic induction (Bevan 1983, Sweely 2005), ground-penetrating radar (Conyers 2007, Conyers and Cameron 1998, Valdés and Kaplan 2000), and electrical resistivity (Hammond 1974) allow archaeologists to look at subsurface composition without the toil of excavation. These procedures can be carried out relatively quickly and without extreme cost (Bevan 1983, Conyers and Cameron 1998, Valdés and Kaplan 2000). The most appropriate type of geophysical survey for a site will be determined by geological aspects such as soil composition and conductivity, as well as the type of archaeological remains expected. Electromagnetic induction survey is better suited to locating large earth features, accumulations of stones, and voids, whereas magnetometry is better suited to locating fired features in the subsurface (Bevan 1983).

Invisible architecture can also be discovered through excavation. Excavation techniques such as areal stripping (Chase 1990) and transect excavation (Cliff, 1986, Johnston 2004) are

well-suited to the discovery of invisible structures. Examination of cut banks (resulting from erosion or heavy machinery) can also reveal previously unknown sites (Cliff 1986, Johnston 2004, Voorhies and Kennett 1995). Random test pitting can also reveal invisible structures (Johnston 2004). Excavation seeking to uncover invisible architecture should be carried out in areas previously unexplored or considered empty as well as in areas with known architecture (Chase 1990). Identification of invisible sites relies on their recognition in profile or plan view as excavation is carried out (Johnston 2004). The appearance of sites will vary, and therefore careful attention is necessary throughout the excavation of these areas.

Invisible Architecture in the Maya Region

Invisible structures have been discovered at various sites throughout the Maya area including Santa Rita Corozal (Chase 1990), Cuello (Gerhardt and Hammond 1991), Ceren (Conyers 2007), Itzán (Johnston 2004), Pelican Cay (McKillop 2002), Chau Hiix (Sweely 2005), Nohmul (Pyburn 1990), Kaminaljuyu (Valdes and Kaplan 2000), Caye Coco (Masson 1999), Arvin's Landing (Somers and McKillop 2005), Cerros (Cliff 1986, 1988), Punta Ycacos Lagoon (McKillop 2005), Quirigua (Ashmore 1988), and others. Some of these sites feature significant numbers of known invisible structures. Some of the invisible structures are isolated, while others are associated with surface architecture while showing no surface traces of their own (Chase 1990, Cliff 1986). Unfortunately, invisible structures often have very brief descriptions in research reports and remain largely unstudied (Johnston 2004). A handful of these discoveries are brought forward here as evidence of the variety of invisible structures which exist in the Maya area (Figure 2).

In 1986, Cliff reported invisible structures discovered at Cerros, in northern Belize. The structures' remains were discovered due to erosion along the bank of Corozal Bay, which "...resulted in the exposure of a profile approximately 65 m long...that reveals the entire

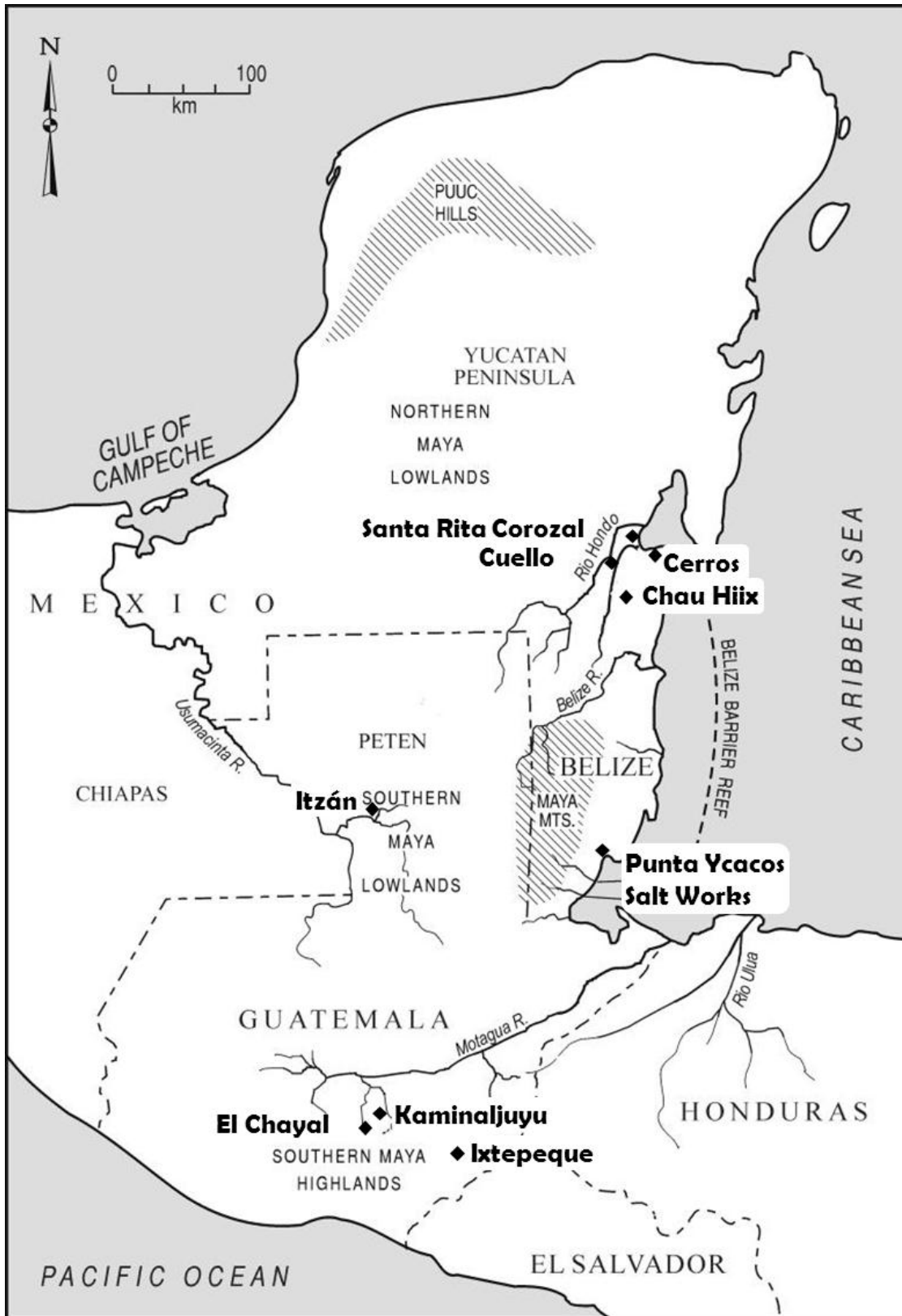


Figure 2. Archaeological sites described in text (adapted from McKillop 2004).

depositional history of this area” (Cliff 1986:45). Laminated lenses of midden covered by a thick layer of rubble ballast (with which the main plaza at the site was filled) were revealed in the profile. The erosion profile also revealed that structures were built directly on the ground surface, rather than on platforms, as is common at Maya sites. Based on these discoveries, excavations were carried out along and near this profile. Detailed recorded was made of the entire profile. The study also included three block excavations, burial salvage, test pits, and a 31m trench through the main plaza (Cliff 1986).

The three block excavations at the site revealed several construction episodes. This section of the site has been dated to the Late Preclassic period (300 B.C. – A.D. 300) based on ceramic evidence. Numerous floors were identified during excavation, with the dominant pattern being one of midden fill alternating with plaster floor. Walls and patios were also identified, as well as offerings associated with construction episodes. Cliff (1986: 52) identifies four “structure-locations” along the profile, each of which represent “a general location for repeated building activities”. Other artifacts include smashed pottery, small whelk shells (*Melongena melongena*), maize cobs and kernels, craboo (*Brysonima crassifolia*) seeds, fish bones (of multiple species), and large mammal remains (dog, fox, and deer). Trash pits, burial pits, hearths, and middens were also identified.

Cliff (1986:54) claims that this early occupation at Cerros represents a “nucleated village” with “perishable domestic structures.” He estimates that the deposits represent approximately 300-400 years of occupation. The inhabitants had houses with “floors of tamped and burned earth and marl...associated with plazas or patios of hard plaster” (Cliff 1986:54). Settlement appears to have been restricted to this central portion of the site at that time. Cliff (1986) also suggests that the later occupation at Cerros may have been deliberately positioned to

cover this earlier settlement, effectively obscuring these sites from recognition during surface survey.

Nearby at Cuello, Belize, invisible structures were reported in 1991 (Gerhardt and Hammond). The authors describe the ceremonial core of Cuello and report evidence of low platforms and perishable structures from the Middle and Late Preclassic (1000 B.C. – A.D. 300). Evidence of structures was discovered through excavation, as the remains are located below later construction. This earlier construction was evidenced by the discovery of low eroded platforms, which consisted of a low wall of limestone cobbles filled with small stones and earth and covered with plaster. “Post holes in [the] plaster floors indicate several successive timber-framed superstructures...” (Gerhardt and Hammond 1991:99) atop these low platforms. Daub from the walls of these structures show impressions from “...smaller wall posts, poles, or canes infilling between them, vine binders, vegetable matter mixed in as stiffening, and sometimes... impressions of the leaves used for thatch” (Gerhardt and Hammond 1991:102). The structures are interpreted as apsidal in shape (Figure 1) and constructed from local materials. Gerhardt and Hammond (1991) suggest that the structures may have been domestic or ancillary.

Cuello has a long history, and the site experienced several construction episodes during its early phases. The cobbled area around the structures was later extended to cover one of the structures, and several “firepits” were discovered in the area (Gerhard and Hammond 1991:99). A courtyard group was subsequently constructed, again with platforms remaining very low and post holes to indicate perishable structures. The layout was conserved when later structures “...were built directly over these buildings” (Gerhard and Hammond 1991:101). Eventually, the early structures appear to have been purposely demolished (either completely or partially) and buried during later construction. The patio surrounded by these structures was filled in, and the

entire courtyard was covered by the construction of a later platform (Gerhardt and Hammond 1991).

Valdés and Kaplan (2000) report using ground penetrating radar (GPR) at Kaminaljuyu, Guatemala to discover invisible architecture prior to its destruction by modern construction. The site of Kaminaljuyu is located on the edge of and underneath modern Guatemala City. Modern construction has destroyed much of the site, and archaeologists must work around and ahead of these advances. To this end, GPR was selected to aid in the rapid acquisition of data at the site. The authors' survey covered about 6,300m² in three sectors. Survey in Sector 1 was undertaken between small razed mounds. Survey in Sector 2 covered the areas in front of known mounds as well as a series of transects to the west of the mounds. Survey in Sector 3 consisted of several long transects in an area thought to have been used for agriculture. GPR was used in conjunction with conventional survey and test-pitting.

Analysis of GPR data revealed patterns found to represent numerous architectural features (including floors), ritual caches, and middens. Areas indicated as being of interest were further investigated through excavation. The authors report that “when excavated, [the areas] almost always revealed deposits of interest, sometimes dramatically so” (2000:339). In addition to Preclassic floors, a large midden was successfully identified in Sector 1 using GPR. Upon excavation the midden yielded several intact vessels, a pattern stamp for clothing or ceramics, and thousands of obsidian fragments and pottery sherds. In Sector 2, a deposit containing obsidian, figurine fragments, burned clay, lithic fragments, and almost 20,000 pottery sherds was discovered. Two cache pits were also found, containing zoomorphic effigies, pot sherds, intact vessels, pieces of figurines and spindles, and a fragment of a finely polished alabaster vase. The authors do not report any deposits discovered in Sector 3 (Valdés and Kaplan 2000).

Valdés and Kaplan (2000:339) emphasize that GPR was a valuable asset in this investigation due to the “critical, urgent salvage demands” at the site. The section of the site examined using GPR was designated for the construction of a large hotel. Without the rapid data acquisition available through GPR survey, important structures and artifacts pertaining to the Preclassic history of Kaminaljuyu would have been lost forever, without any idea of what had been lost.

Eight invisible structures were reported at the site of Itzán, Petén, Guatemala by Johnston in 2004. A large trench was bulldozed through a portion of the site in preparation for construction of a road. Johnston took advantage of the exposed profile and cleared area to look for evidence of sites. He observed several “flat, minimally mounded floors covered and surrounded by a thin layer of Classic period artifacts” (2004:152) in the profile. He also observed trash-filled pits in association with these floors. Johnston points out that these structures did not show surface traces and were a significant distance from the nearest known mounded remains. In profile, the structures were evidenced by “...thin, level lenses of small densely packed stones littered with ceramics, lithics, and groundstone fragments” (Johnston 2004:154). The observed structures were later excavated to determine layout and function. Through random test pit excavation, the author also discovered another structure in the vicinity of those observed in the profile.

Excavation revealed structures arranged in patio groups, high artifact density, and four burials (including one infant). Several large jar fragments were discovered at one of the sites, as well as ashy debris containing shell fragments, clay, and burned bones inside the “broken lower half of a large storage jar” (Johnston 2004:155). Johnston suggests that the jars were likely used for storing water. A large midden was also located at one site containing 163 obsidian blade fragments, 3,000 chert flakes, 27 chert tools or tool fragments, 70 chert cores and hammerstones,

7,400 pottery sherds, and groundstone and food remains, Based on layout, artifact assemblage, and the presence of burials, Johnston determines that these structures were domestic. He (2004:169) concludes his article with this statement: “The issue of invisible settlement is the fulcrum of population estimates, their reliability, and evaluations of the role of population dynamics in Classic Maya cultural development and change”.

Sweely (2005) reported finding invisible structures using electromagnetic induction (EMI) survey at the site of Chau Hiix, a secondary Lowland Maya center in northern Belize. The site was occupied from the Early Preclassic period (about 1100 B.C.) through the Late Postclassic period (later than A.D. 1500). Initially, survey of the site was undertaken using an intensive auger-testing systematic sampling strategy. EMI was implemented as a less physically demanding method to augment data from auger-testing. EMI survey was used to explore areas with surface architecture, but focused on vacant areas of the site. Three areas of the site were surveyed using EMI. Transects had to be cut through the vegetation to allow survey to proceed; transects were spaced at 5m, a distance believed to minimize the risk of missing structures. Known surface feature locations were also cataloged so that their impact on the conductivity data could be taken into account. The conductivity data collected were analyzed to identify anomalies that might represent subsurface features. Suspected features were auger tested. In particular, areas of localized low or high conductivity were subject to test excavations. Control excavations (in the form of auger-testing) were also carried out in areas not expected to contain cultural features based on the conductivity data (Sweely 2005).

Nonplatform, plaster floors and trash pits were indicated by the EMI survey, and test excavations confirmed these expectations in most cases. Sweely (2005) points out that the lack of cultural features in areas where they were not expected is equally important. Episodes of bedrock mining were also identifiable in the conductivity data. The author (2000:205) concludes

by emphasizing that invisible structures like the ones discovered at Chau Hiix "...could radically change views on settlement development..." and that "[a]ll types of dwellings need to be fully accounted for...". Sweely recommends EMI survey as a less labor-intensive and nondestructive method to acquire detailed information about subsurface features.

Santa Rita Corozal

The site of Santa Rita Corozal overlaps with the present-day town of Corozal in northern Belize, existing both around and underneath the town. The discovery of so many invisible structures at Santa Rita Corozal makes the site critical to discussion of invisible architecture in the Maya region. Due to its continuous occupation since the Early Preclassic period (1200-900 B.C.), Santa Rita Corozal presents an opportunity to study changes in population dynamics (Chase 1990). According to Chase (1990:199), "...most of [Santa Rita Corozal's] constructions are virtually invisible on the surface," and "...many of the buildings at Santa Rita Corozal were only slightly raised or not elevated at all above the surrounding terrain". The site is located on a bluff, and thus structures have not been rendered invisible due to alluvial deposition. The remnants of these invisible structures manifest themselves as line-of-stone foundations that become visible during excavation (Chase 1990).

The Postclassic (A.D. 1200-1530) occupation at Santa Rita Corozal is believed to have been extensive, with a high population during this time. Estimating the population for this site has been particularly problematic however, due to the discovery of significant numbers of invisible structures during excavation in areas that were previously thought to be vacant. A population estimate based on surface features would therefore greatly underestimate the population (Chase 1990).

The majority of the excavation at Santa Rita Corozal was carried out in areas that normally would have been considered empty, "...where there was no mounding or artifact scatter

on the surface to indicate construction below” (Chase 1990:208). Substantial areal stripping was used to expose large areas and discover previously invisible foundations. This excavation yielded significant evidence of occupation and showed that many seemingly isolated buildings were actually part of a group of structures, most of which had been rendered invisible over time. Excavation also revealed evidence that many of the invisible structures at the site were “...multiple-room, elite residences with remnants of base walls and spectacular cache and burial deposits dating to the Late Postclassic Period” (Chase 1990:208). Many structures also concealed earlier deposits below the Postclassic deposits which also would have gone unobserved without this extensive excavation (Chase 1990).

Santa Rita Corozal is unlikely to be unique in its combination of visible and invisible structures. Such an overwhelming discovery of invisible structures has led Chase (1990:201) to suggest that “...minimally 25% and more likely 50% of Maya structures are invisible to the archaeologist”. In this way, Santa Rita Corozal powerfully demonstrates that relying on surface features alone is not sufficient for reconstructing past occupation.

Punta Ycacos Salt Works

Punta Ycacos Lagoon is located in Paynes Creek National Park in southern Belize (Figure 2). The nearest city is Punta Gorda, and travel between the two is only by boat. Richard Wilk (1991:xi) described the region thus:

The far southern end of Belize, known as the Toledo District, is a distant and primitive place to the residents of Belize City, itself no great metropolis. Although Toledo is only 161 kilometers by air from the city, the long overland road is rough and sometimes impassible during the rainy season. Luxuries and amenities are few in Toledo, and its administrative center, Punta Gorda, is considered the worst posting in the civil service and police. It is rare to find a Belizean who has braved the ruts, potholes, and biting flies of the southern highway to visit Toledo, unless forced to go on business.

Toledo, in short, is an undeveloped hinterland; its inhabitants are considered conservative and traditional, isolates from the economic and political affairs of the rest of the country who preserve old ways of life.

Here, protected from destruction by law and by environment, the remains of ancient salt-making sites rest. They have been hidden by the waters of the lagoon and thus lay largely undisturbed on the sea floor (McKillop 2002). Since their discovery, these once invisible sites have left a lasting impact on archaeologists' understanding of Maya trade.

Investigation of the salt works in the Punta Ycacos Lagoon began in 1991, when a research team headed by Heather McKillop documented four sites (three underwater and one in the nearby mangrove swamp). Sites were identified by the presence of artifacts on the sea floor (Figure 3), mainly "...fragmentary remains of jars and bowls used to boil seawater to produce loose salt or salt cakes..." (McKillop 2005:5630) and by the presence of a mound in the adjacent mangroves. The initial investigation continued through 1994, with further survey and excavation of these sites (McKillop 1995, 2002). During excavation, a large hearth area was discovered at one of the underwater sites. Artifact analysis revealed that the ceramic vessels recovered from these sites were standardized in size and shape, indicating mass production (McKillop 2005).

In 2004, a systematic survey was undertaken beginning in the East Lagoon with the goal of identifying additional salt works in the area. The research team used a modified survey strategy which included "...walking or snorkeling on flotation devices at arm's length back and forth across the lagoon, looking for artifacts on the sea floor" (McKillop 2005:5631). Snorkeling was employed in an effort to maximize visibility due to the loose layer of silty sediment that covers the peat. This sediment is easily stirred up and clouds the water (McKillop 2005, 2009).

During the 2004 survey, a sharpened wooden post driven into the peat was found at one of the newly identified sites (Site 15). Upon further investigation, additional wooden posts were located at this site as well as at others. These wooden posts, preserved by the peat bog, represent the only preserved ancient Maya wooden structures discovered to date. Forty-one new sites were

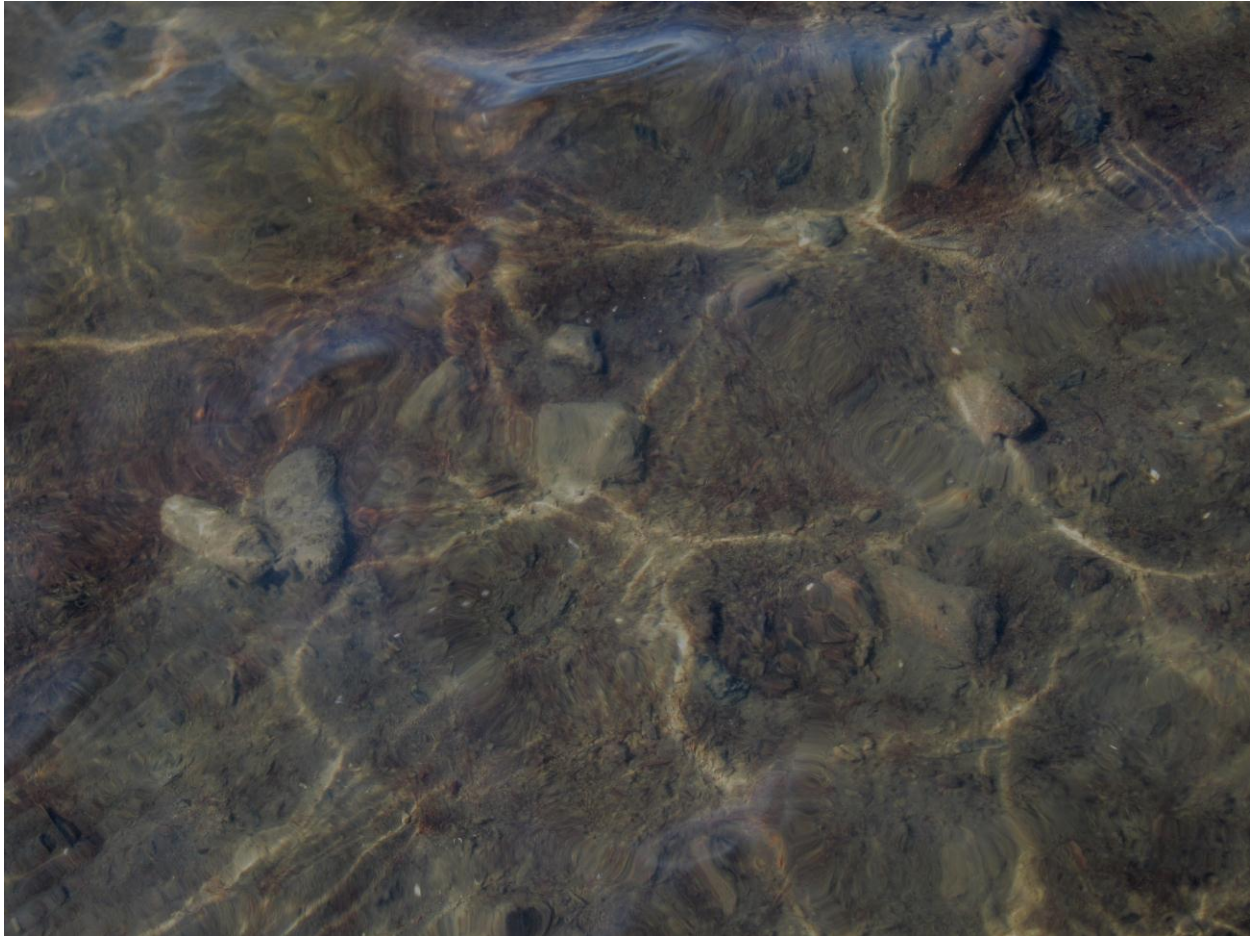


Figure 3. Salt-making artifacts on the sea floor, Punta Ycacos Lagoon, Belize, including cylinder fragments (top right and left center) and pot sherds. White lines are due to the reflection of light on the water. Photo by Tekla Rudie.

discovered during the 2004 survey, bringing the total to forty-five. Of these, twenty-three were found to have wooden structures associated with the briquetage visible on the sea floor. The largest of these sites was given the name Chak Sak Ha Nal and includes a structure represented by 112 wooden posts and measuring approximately 21x12m with interior room divisions. Radiocarbon dating combined with ceramic analysis place these salt works in the Late Classic period (A.D. 600-900) (McKillop 2005). Research in this area has been ongoing since that time. One hundred salt works sites had been documented by 2008 (McKillop 2008).

As part of the ongoing research in the lagoon, a sediment column was excavated near the site of K'ak Naab' to shed light on formation processes at work (McKillop et al. 2010). Samples from the column were subjected to loss-on ignition and microscopic analysis. The results showed that the sediment in this area has a high organic content composed mainly of red mangrove (*Rhizophora mangle*). Radiocarbon dates revealed that the column (which extended 1.5m below sea floor) represented 4000 years of environmental data, and that the area had been mangrove swamp for the entirety of that time. This is indicative of actual sea-level rise, since peat would have been "...deposited as *R. mangle* [kept] pace with rising seas" (McKillop et al. 2010:248). Based on this and archaeological evidence, it is suggested that the structures in the lagoon were constructed on dry land which was later inundated. Subsidence may also have contributed to the inundation of the salt works. Peat deposition continued until the Late Postclassic (A.D. 1060-1270), at which point it is hypothesized that rapid sea-level rise may have drowned the mangroves (McKillop et al. 2010).

Sites in Punta Ycacos Lagoon consist entirely of invisible elements. Sites were initially delineated based on artifact scatters on the sea floor. The discovery of preserved wooden posts altered site descriptions to some degree. In the lagoon, a site consists of one or more structures (in close proximity) and their associated artifact scatter. Sites boundaries are determined by the limits of the artifact scatter combined with structure outlines. Sites are generally separated by several meters of sterile sea floor. While these delineations are arbitrary and imposed by modern archaeology, they are useful to investigators in researching and describing the overall complex of sites in the lagoon.

As part of the effort to make these sites visible, posts were marked using survey flags or floats (in deeper water), and their locations mapped using GPS and a Topcon total station. These maps facilitated further survey to locate additional posts and better define structure outlines.

Mapping has revealed structures of various sizes which are rectangular at some sites. Interior walls were also discovered in some structures. Mapping has also shown that these structures are not arranged in the typical plazuela group formation found throughout the Maya world, but rather are aligned southeast to northwest, possibly along a previous shoreline (McKillop 2009, Sills and McKillop 2010).

The artifact assemblage from these sites is quite rich, and attests to the use of these sites for producing salt. Massive amounts of briquetage, including pot rims, pot sherds, cylinders, spacers, sockets, and amorphous clay lumps (ACLs); charcoal; and botanicals, including cohune (*Orbignya cohune*), coyol (*Acrocomia mexicana*), calabash (*Lagenaria siceraria*), plum (*Spondias* sp.), mangrove (*Rhizophora mangle*), and unidentified small seeds have been found throughout the lagoon (Aucoin 2012, McKillop 1994, 1996). Obsidian, chert, a pumice disc, ground stone axes, figurine whistles, an effigy whistle, a pottery stamp, incense burners, clay boat models, and a canoe paddle have also been found (McKillop 2002, 2005).

Salt was produced by the *sal cocida* (or boiling) method at these sites. Ceramic pots were filled with brine and supported over fires using cylinders (Figure 3) as legs. Sockets were used to hold the cylinders in place, and spacers were placed between the pots (McKillop 2002).

The presence of so many structures, combined with the standardization of ceramics and rich artifact assemblage indicate "...a significant infrastructure was involved in the production, storage, and distribution of salt, fuel, pots, and furniture in the ancient Maya salt industry" (McKillop 2009:279). The presence of these salt works suggests that salt would have been produced outside of state control and traded with inland Maya cities in Belize and Guatemala via canoe transport. This discovery also refutes the idea that salt was traded to this region from the north coast of the Yucatan Peninsula (McKillop 2009).

Site 77

Site 77 is located in the West Lagoon in Paynes Creek National Park, Belize. The site is inundated with sea water, which rendered it invisible. This site was chosen for excavation due to the presence of two, well-defined, rectangular structures (denoted by preserved wooden posts), which were discovered and mapped previous to the 2012 field season (McKillop 2008). Most of the other sites discovered in Punta Ycacos Lagoon lack such clear definition of structures. Although the majority of the structures have decayed (also contributing to the invisible nature of the site), the peat of the sea floor preserved the bottom portions of the ancient wooden posts. Salt-making artifacts are also associated with the site.

The rectangular alignments of posts at Site 77 suggest two structures. The structures are aligned southeast to northwest, as is typical of structures in Punta Ycacos Lagoon (McKillop 2009). The larger structure (Structure 1), which is to the south, measures approximately 6x5m. The smaller structure (Structure 2) measures approximately 2x3m. The difference in size between the two structures suggests differential use. Investigating structure function and possible activity areas were the main goals of this excavation. Units were chosen for excavation based on their potential to give insight into possible differential use of the two structures and explore interior versus exterior activities represented through the artifacts recovered. Artifact collection for future comparison with previous and ongoing excavation at other salt works sites was a secondary goal.

Materials and Methods

Materials

Site 77 is located in the West Lagoon in Paynes Creek National Park, Belize. The site consists of 78 preserved wooden posts as well as associated artifacts, both on the sea floor and buried in the sediment (Figure 4).



Figure 4. Overview of Site 77, Paynes Creek National Park, Belize looking southeast. Preserved wooden posts are marked by orange flags. Yellow flags mark Transect 1. Photo by David Susko.

Methods

Site 77 was re-surveyed at the beginning of the 2012 field season to relocate and flag posts using pin flags. Transect 1 was set up along the eastern edge of the two structures to guide excavation inside and outside of both structures. One-half inch pieces of PVC pipe were placed at every meter mark along the transect. Photographs were taken of the site at this stage.

The site was partially excavated in June 2012 by the author and David Susko under the advisement of Heather McKillop. Sediment was excavated by arbitrary 10cm levels in 1x1m units. All sediment was screened using ¼ inch mesh in a wooden frame. Materials were screened in the water and flotation was used to remove loose mangrove and preliminarily sort materials in the screen. Artifacts were hand-sorted into categories based on material (ceramic, charcoal, botanical, obsidian, chert) and placed in plastic bags labeled with provenience information to await cataloging.

All pin flags were removed at the end of the field season. PVC pieces marking Transect 1 were sunk into the subsurface leaving approximately ½ inch exposed above the sea floor. Backfilling was unnecessary due to the transitory nature of the silty sediment on the sea floor. This sediment naturally settles to the lowest point, thereby effectively filling in the excavated units.

Results

The salt works in Punta Ycacos Lagoon were reached by means of a boat (one with a shallow draft was selected to allow mooring closer to sites) and Research Flotation Devices (RFDs). RFDs allowed researchers to float over sites rather than walking through the lagoon on foot, which would result in the destruction of sites, stratigraphy, and artifacts. RFDs are also useful in areas without sites due to the tendency of the lagoon floor to sink under the pressure of walking, sometimes entrapping a researcher up to the knee or more.

Survey

Due to shallow water at Site 77, survey on RFDs was not possible. Researcher-laden RFDs would have scraped along the sea floor causing significant site disturbance. Researchers surveyed by carefully sitting in the water, placing the palms of their hands firmly on the sea floor, and moving them laterally. Researchers felt for posts and artifacts during this process, and both were marked with new pin flags. Survey of the site was completed in three passes with a crew of five researchers. Researchers moved as carefully as possible when advancing from one survey section to the next. The survey process was quite successful, in part due to the presence of previously placed flags which had been sunk into the sea floor inside of straws with about five centimeters left exposed. At times posts were difficult to differentiate from the peat of the sea floor, but with practice and the assistance of experienced crew members, survey proceeded smoothly.

Sediment

There is an interesting change in sediment color around Site 77. The sediment inside and around the structures is a dark grey color. Approximately 2-3m outside of the structures, the sediment changes and appears a tan color.

Sediment composition varied with excavation depth. Silty sediment with some loose peat comprised the first level (0-10cm). The second level (10-20cm) was composed of sandy peat. The remaining levels (20-30cm and 30-40cm) were a dense peat.

Excavation

Prior to beginning excavation at Site 77, the research team undertook excavation at a nearby site in the lagoon (Site 74). Here, under the careful guidance of experienced crew members, researchers new to underwater excavation (including the author) were taught the proper techniques for excavating in such conditions. This process included learning to excavate by feel rather than sight since a fine layer of silty sediment covers the peat of the sea floor. Disturbed sediments quickly cloud the water and render visual identification impossible. The silty sediments of the first level were removed using the archaeologists' hands and placed directly into plastic sand bags waiting nearby in Marine Transport Devices (MTDs). Subsequent levels (composed of a dense peat) were excavated using the archaeologists' hands and a trowel. Sediments were placed temporarily into a plastic bucket with holes (to allow drainage of water) and then transferred into plastic sand bags waiting nearby in MTDs. Despite the relatively large size of the holes in the buckets (about 2.5x2.5cm), no sediment was lost due to the extremely dense nature of the peat, which holds its shape after excavation. MTDs were used to ferry sediments to an off-site screening location, thus avoiding a need for constant treks across the site or lagoon. Preserved wooden posts located in units or along their edges were carefully excavated around and left in situ whenever possible. Unit and level depth were measured using plastic measuring tapes and marking depth on the researchers' arms (again, because it is impossible to see measurements on a tape measure in murky water). Researchers also gained experience in screening materials and recognizing artifacts from experienced crew members while working at Site 74 (Figure 5).



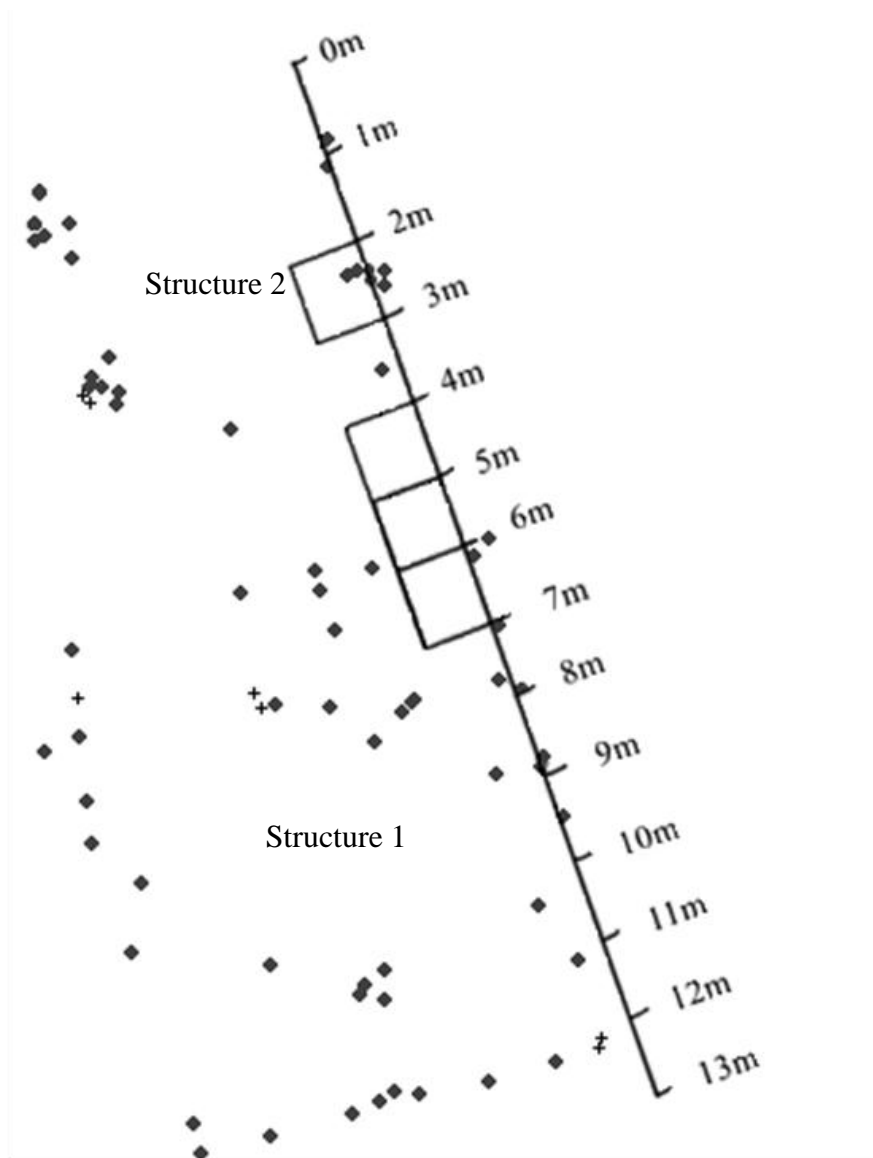
Figure 5. Cory Sills, David Susko, and Patrick Vines screening sediment at an off-site location. Note project research station and plastic sand bags filled with sediment waiting to be screened in foreground. Photo by Heather McKillop.

Once David and the author had gained a proficiency in underwater excavation and screening techniques, we began work at Site 77 while the other members of the research team continued working at other sites in the West Lagoon. Photographing the site was the first step. The site map (produced during a previous field season using a Topcon total station) was then consulted to aid in locating preserved wooden posts missed during the earlier survey work. Efforts were concentrated on the eastern walls of the structures, and the location of four additional posts allowed us to compare the site and map with confidence. There was some small difficulty with the scale on the map – it shows almost 4m between the structures and the distance

is actually about 2.5m – but the alignment and configuration of the posts was accurately reflected.

After consultation with the project director, Transect 1 (Figure 6) was set up along the eastern walls of both structures, running northwest to southeast (20 degrees west of north). Transect 1 is 13m in length. The transect was set up by sighting along the preserved wooden posts (marked with flags) in an effort to place the transect about in the middle of the line of posts. A tape measure was secured at its 1m mark (due to a missing portion of the tape from 0-10cm) to a ½ inch PVC pipe at the northwest end of the transect, and the other end of the tape was held tight at the southeast end of the transect. The tape was positioned so that the northeast corner of the larger structure would be at a meter mark (6m), since excavation was planned there first. All excavation was carried out on the western side of Transect 1. The transect was marked using short pieces of ½ inch PVC pipe placed at each meter mark along the transect with a labeled flag placed inside each PVC piece. The PVC marker at the 7m mark was slightly out of line due a post being where the PVC should have been placed. This misalignment was noted in the labeling of the flags. The post was used as the corner of the unit during excavation. Flags were labeled with their meters (subtracting 1 for the meter of tape sacrificed at the beginning), starting at the northwest end of the transect.

Four 1x1m units were excavated along Transect 1 (Figure 6). One unit was excavated inside of each structure. Two units were excavated in between the two structures. Units were excavated by arbitrary 10cm intervals to a depth of 40cm, where artifact density decreased dramatically. At first, excavation was carried out alternating between the two researchers, but when this was determined to be ineffective, one researcher took over excavating while the other screened. Excavation was carried out concurrently by both researchers, each in a separate unit,



Wooden Posts at Site 77

- ◆ hardwood
- + palmetto

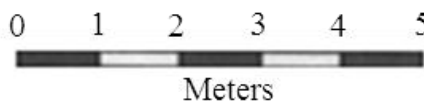


Figure 6 Map of Site 77 including Transect 1, excavated units, and structure identification. Map adapted by Tekla Rudie based on GIS map by Heather McKillop.

on the third and fourth days, and sediment was labeled for later screening and sorting. At the end of the fourth day, twelve bags of sediment remained to be screened. They were tied tightly shut and stored in the units so that they would remain submerged until screening could be accomplished. All sediment was screened prior to the end of the field season.

A 1x1m frame anchored by dive weights (Figure 7) was used to delineate units under the water. The water varied in depth from approximately 30-45cm, depending on tidal fluctuations.



Figure 7. Setting up excavation using metal frame to delineate unit boundaries. Note also the plastic bucket with holes (inverted at left) used during excavation and the author floating on an RFD. Photo by Heather McKillop.

The frame was necessary for unit identification due to the previously mentioned problem of low- to zero-visibility during excavation. The metal frame was easy to feel under the water, and

therefore greatly aided in maintaining clean, square units. The frame was also bright yellow in color, making it easier to see when possible. Excavation and screening followed the processes described previously. Some sediment was screened just outside of Site 77, and some was screened at alternate locations in the West Lagoon. All artifacts were collected after screening, sorted, and labeled as described previously (Figure 8).



Figure 8. Author screening sediment and bagging artifacts at an off-site location. Note MTDs in background. Photo by Heather McKillop.

Excavation was begun outside of Structure 1 in the unit at 5-6m. From there, excavation moved inside Structure 1 to the unit at 6-7m. The unit from 4-5m was excavated next, followed by the unit at 2-3m. The unit at 3-4m was not excavated due to its position partially inside and

partially outside of Structure 2. Extra care was taken in the measurement of depth in the latter two units due to the discovery that the sea floor was unlevel in these units (lower at the southeast wall of the unit than at the northwest wall). This was discovered due to the use of the metal frame and the resulting gap between the frame and the sea floor at the southeast end of the units.

Artifacts

Artifacts recovered from Site 77 included briquetage (cylinders, pot sherds, and ACLs), charcoal, botanicals (including a plum pit), a piece of chert, and three broken obsidian blades. The obsidian pieces were recovered from three separate units (4-5m, 5-6m, and 6-7m) and at two different levels (0-10cm and 10-20cm). None measured more than 3cm in length and 1cm in width. Artifact density at Site 77 was very low, with the majority of artifacts located in the first (0-10cm) and second (10-20cm) levels.

5-6m

This unit is in between the two structures, adjacent to the northern side of the larger structure (Structure 1). A piece of obsidian was found while screening sediment from the second level (10-20cm) in this unit. The obsidian is grey/black in color and appears similar to the obsidian found at Site 74. We also recovered a body sherd with faint incisions from this unit.

6-7m

This unit is inside Structure 1, in the northeast corner. Very little was felt while excavating the first level (0-10cm). The usual artifacts (ACLs, body sherds, charcoal) were recovered during screening. A large cylinder fragment was found in the second level (10-20cm), as well as body sherds, ACLs, and charcoal. Additionally, another piece of grey/black obsidian and a few unusually smooth pot sherds were found; one pot sherd appeared to still have a little red slip on it (Figure 9).

We found very little in the third level (20-30cm): some ACLs, charcoal and a few botanicals. Three to four larger body sherds were also found, including one that appears to have been ash tempered. A piece of wood that was likely part of a preserved wooden post was also recovered. A previously unmarked post was located in this unit while excavating the last level (30-40cm). It remains in situ. Its location is described below (Figure 10), as well as that of another post which is along the edge of the unit. The other post described (Post B) was partially removed (accidentally) during excavation. The broken piece was bagged in water and saved.



Figure 9. Body sherd with red slip recovered from 6-7m, 10-20cm below surface. Photo by Tekla Rudie.

4-5m

Typical materials (briquetage, charcoal, botanicals) were recovered from this unit. Another piece of obsidian (also grey/black) and a chert flake were discovered while screening

sediment from the first level of this unit (0-10cm). This piece of obsidian had a slight curve to one end.

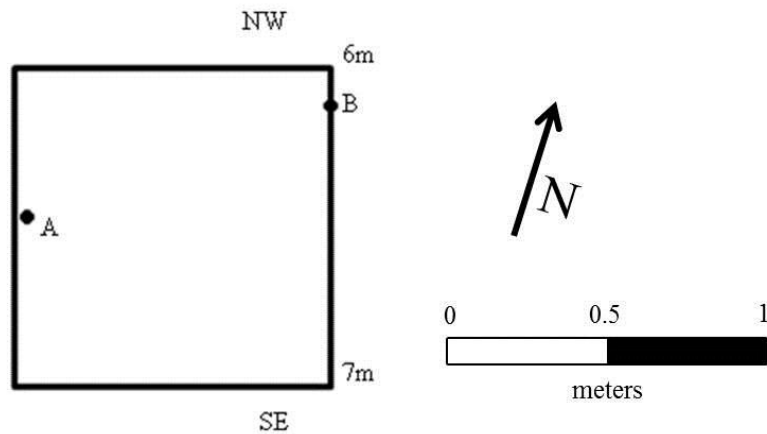


Figure 10. Posts in unit 6-7m, including a newly located post. Post A is the new post (located at 3, 44). Post B is the post that was broken (located at 100, 11). The northeast corner served as (0, 0). Sketch by Tekla Rudie.

2-3m

There was a higher concentration of artifacts in this unit than in the previous units, but the types of artifacts recovered remained typical. No obsidian was recovered from this unit. Some larger ACLs and a large cylinder were recovered from the fourth level (30-40cm). About 17cm of a preserved wooden post broke off during excavation (Post B in Figure 11). There are also additional posts along the west wall of this unit which are not shown in Figure 11.

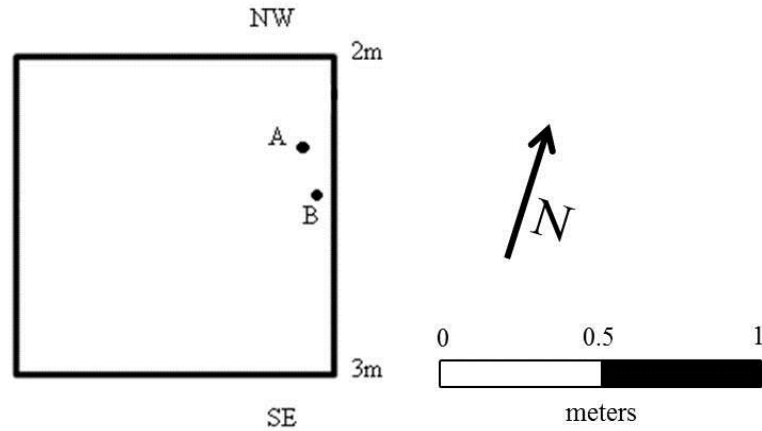
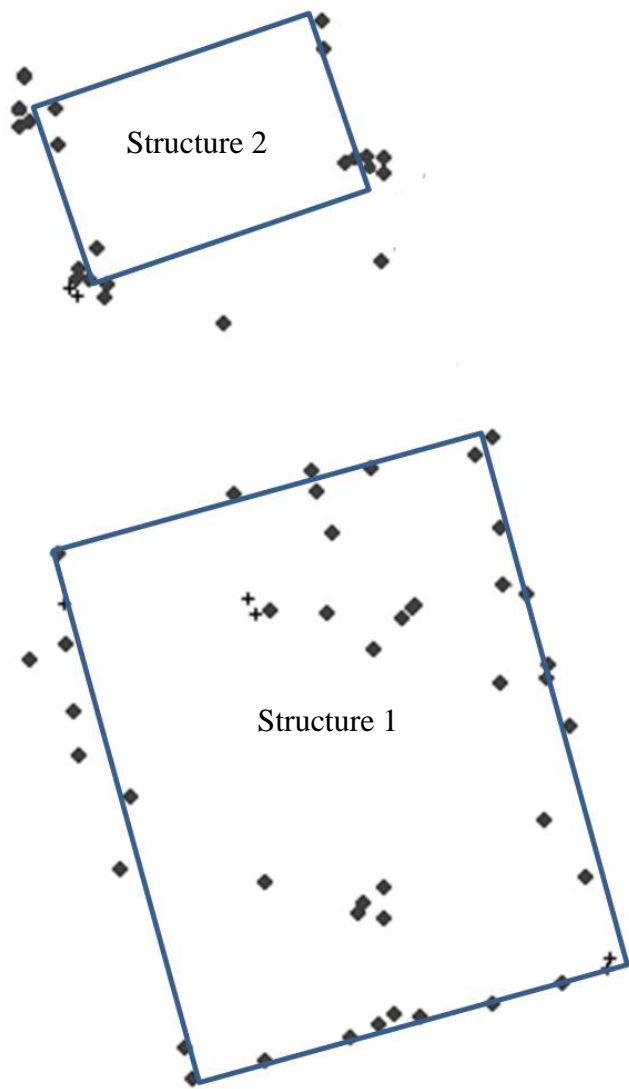


Figure 11. Posts in unit 2-3m. Post A is located at 88.5, 31. Post B is located at 92, 47 and was broken during excavation. The northeast corner served as (0, 0). There are additional posts along the western wall of this unit not included in this figure. Sketch by Tekla Rudie

Architecture

Excavation at Site 77 revealed one new post (as described previously). The preserved wooden posts at the site suggest two rectangular structures (Figure 12). The structures are aligned southeast to northwest. The larger structure (Structure 1), which is to the south, measures approximately 6x5m. The smaller structure (Structure 2) measures approximately 2x3m.



Wooden Posts at Site 77

- ◆ hardwood
- + palmetto

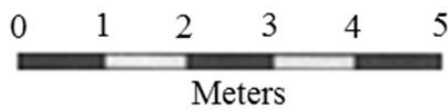


Figure 12. Site 77 map with structure outlines. Structure outlines drawn by Tekla Rudie on GIS map by Heather McKillop.

Discussion

Due to the limited scope of this excavation, only preliminary discussion of findings is possible. The data presented do however suggest certain potential patterns that deserve exploration through further study and excavation at the site.

The change in sediment color around the site is likely superficial and due to the lagoon environment. This change could be the result of changes in sea floor elevation, resulting in differential settling of sediment. The difference may also be the result of sediment disturbance during the surveying process. Further investigation will be necessary to determine the correct explanation.

The artifact assemblage was similar for all four excavated units; pot sherds, charcoal, and ACLs make up the majority of the artifacts. Very few botanicals were recovered at Site 77. This continuity throughout suggests that both structures at the site were likely used for at least some of the same activities, and that discard was uniform, at least within the area excavated.

Obsidian is not uncommon in this area (McKillop et al. 1988, McKillop 2002). The discard of broken obsidian blades suggests obsidian was not exclusively a luxury good, although it certainly would not have been as readily available as chert. Obsidian would have been easier to obtain in a coastal location such as this from sources in Guatemala, such as Ixtepeque and El Chayal (Figure 2), and may have been traded by sea (McKillop et al. 1988).

The low artifact density at Site 77 (when compared with other salt works sites in the area) is perhaps the most striking finding in this research. Artifacts are usually not only present but plentiful at Punta Ycacos salt works sites. Recent excavation carried out at the Eleanor Betty site (which is located in the West Lagoon), recovered as much as twelve gallon-sized Ziploc bags of briquetage from a single level in a single unit, with additional charcoal, botanicals, and shells recovered (Aucoin 2012). Excavation at nearby Site 74 also regularly yielded multiple gallon-

sized Ziplocs full of artifacts from a single level. Rarely did all of the artifacts from a single level in one unit at Site 77 fill a gallon-sized Ziploc bag.

The low artifact density at Site 77 is best explained by the inference that the site was used for a shorter duration of time or less frequently than other sites in Punta Ycacos Lagoon. Alternatively, this paucity of artifacts may represent a further argument for differential use of these structures. If the area was regularly cleaned, and trash deposited elsewhere, these structures were maintained differently than others in the lagoon. The clear outline of these structures suggests that they may have been more formalized than others in the lagoon.

The choice to excavate inside and in between the two structures may have also contributed to low artifact density, although excavation at Eleanor Betty and Site 74 suggest artifacts are usually found in the interior of structures as well. The space between the two structures may have been intentionally kept free of debris to allow passage between the structures.

Issues of preservation and representivity must also be considered; the units excavated represent only a small fraction of the total site, and therefore the artifact assemblage may not be representative. Preservation in the Punta Ycacos Lagoon is generally excellent, so it is less likely that artifacts are underrepresented at Site 77 due to poor preservation.

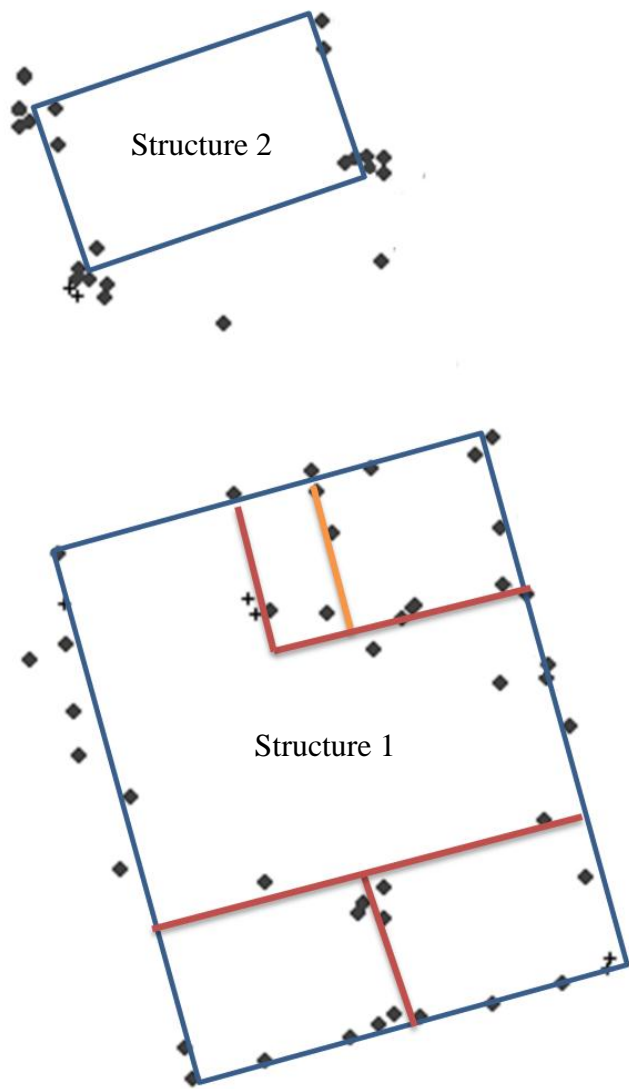
The general characteristics of the two structures at the site, combined with artifact data, allow a preliminary comparison. Structure 2 is significantly smaller than Structure 1. Structure 1 measures approximately 30m², while Structure 2 measures only approximately 6m². The unit at 2-3m is the only unit inside of Structure 2. The location of broken obsidian blades in the units at 4-5m, 5-6m, and 6-7m, but not in the unit at 2-3m, coupled with the higher general artifact density in the unit at 2-3m and the relative size of Structure 2, suggest potential differences in structure use. Structure 2 may have been set aside for a specific task (such as ceramic vessel

construction or drying), or may have been used for storage. Whether or not Structure 2 had its primary function as part of the salt-making process, the continuity in artifact assemblage (briquetage and charcoal) suggest the activities carried out there were related to the processes going on throughout the site, and at other salt works in the area.

The clearly rectangular nature of these structures matches Wauchope's (1938) findings concerning modern Maya houses in the region. The alignment of the posts suggests walls in-line with the mainposts of each structure. The clustering of posts at each of the corners of Structure 2 suggest either repeated construction at that location or the combination of several smaller posts to bear greater weight. Interior posts do not seem to clearly outline interior divisions. However, there may have been a division at the southeastern end of Structure 1. Another might be suggested the northeastern corner of Structure 1 (Figure 13). The discovery of additional posts (such as the one discovered in the unit at 6-7m) may clarify such relationships. Additional data on the size (diameter) of posts would allow further discussion of the construction of these structures.

Conspicuously absent from this site is the line of palmetto posts found at other sites in Punta Ycacos Lagoon. These posts have been suggested to have formed retaining walls, either for water or for maintaining dry land, with the latter seeming more likely (Sills and McKillop 2010, Somers 2007). The absence of such a feature at Site 77 may suggest that retaining water and/or land was not of concern at this site.

The combination of artifact and architectural evidence suggest that the structures at Site 77 may have been used differently than other structures in the area. The presence of typical salt-making artifacts such as briquetage and charcoal suggests that salt-making did go on at the site. The limited quantities of these artifacts suggest that salt-making was only carried out at the site for a short period of time. These structures, like many used by the Maya, may have been



Wooden Posts at Site 77

- ◆ hardwood
- + palmetto

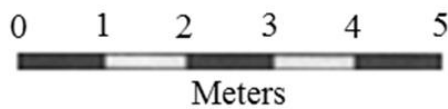


Figure 13. Site 77 with structure outlines (blue) and possible interior divisions (red and orange). Structure outlines drawn by Tekla Rudie on GIS map by Heather McKillop.

multifunctional (Leventhal and Baxter 1988). They may have been used in a domestic context or perhaps even for salt-related rituals. Evidence of fine pottery wares (such as the red slipped sherd in Figure 9) used in salt rituals have been found in greater quantities at other sites in the lagoon (McKillop 2002), and suggest that salt rituals were performed in the area. Given their different dimensions, each structure may have had a slightly different purpose. Determining other functions will require continued investigation.

Conclusion

This report has set out facts concerning the development and detection of invisible sites, drawn on examples of their impact on archaeological understanding, and presented the findings of new excavation at one such site. Although invisible structures have gained more attention in Maya archaeology in recent years, continued awareness and investigation into their prevalence, form, and function is needed. Invisible architecture is present throughout the Maya region. The application of geophysical techniques can greatly aid in such research. Modified survey and excavation procedures can also facilitate the discovery of such sites.

Excavation at Site 77 is one part of the process of deepening our understanding of salt production in Punta Ycacos Lagoon, but its impact goes beyond that. The identification of structure function and activity areas at Site 77 will allow further characterization of production techniques and processes for the salt works, and provide insight into other activities which may have taken place in the area. Although discussion of differential structure use and activity areas at Site 77 is limited for now, the data collected thus far suggest that there is patterning to the assemblage. Further investigation will allow more detailed discussion of this site and its place among the salt works of Punta Ycacos Lagoon.

An understanding of invisible architecture is crucial to Maya archaeology. Ancient Maya houses seem to conform generally to the house types outlined by Wauchope (1938), and this ethnographic analog is useful inasmuch as it is applied cautiously. At Maya sites, population is estimated using a count of house mounds. The overwhelming evidence of unmounded structures and invisible architecture at sites such as Santa Rita Corozal renders such estimations inaccurate. Unless invisible structures are taken into account, population estimates cannot be seriously considered. Punta Ycacos Lagoon presents a compelling illustration of the importance of invisible sites in understanding trade. The discovery of over one hundred salt works in this

previously unexplored area has led to changes in models of Maya trade, including an increased understanding of the importance of sea trade and travel by canoe (McKillop 2002, 2004, 2005). The location of these salt works on the coast, away from major political centers, also provides evidence for decentralized trade among the ancient Maya, although whether this indicates decentralization of power is still unknown.

Invisible sites and structures are also crucial to the investigation of lifestyles of the common ancient Maya. Much of the research in the Maya region has focused on monumental architecture (temples, palaces, stelae, etc.). While these elements may be more obvious, they contribute little to the understanding of the day-to-day activities of the common Maya. Invisible sites and structures can help fill this gap. While not all invisible structures are necessarily non-elite structures, there is a greater likelihood that they represent common activities.

Site 77, along with the myriad invisible sites discussed in this text, demonstrate that invisible sites matter. As archaeologists, we can no longer overlook them as trivial. Despite the added difficulty of identifying them, invisible sites are a vital part of the archaeological record and deserve careful consideration, both inside and outside of Maya archaeology.

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Vita

Tekla Chantae Rudie attended primary school in Washington and Missouri, graduating from Wentzville Holt High School in 2007. She enjoyed participating in band, choir, theater, speech team, and swim team during her time there. She continued her education at Truman State University, majoring in Sociology/Anthropology. She attended field school through the University of Utah in the summer of 2009, and there gained important experience in archaeology, as well as a desire to pursue research in the field. While at Truman State University, Chantae served as president of the Anthropology Club for two years. She also worked as a teaching assistant during her senior year. Membership in Phi Beta Kappa and Phi Kappa Phi were granted during her senior year as well. Chantae received her Bachelor of Science degree with departmental honors from Truman State University in May 2011, as well as being chosen for the “Outstanding Student in Anthropology” award. She next chose to attend Louisiana State University and enrolled in the MA program for anthropology. While studying at LSU, she has had the opportunity to work for the Division of Archaeology for the State of Louisiana as a student worker, on campus as a supplemental instruction leader, and as a graduate assistant for the Center for Academic Success.

Chantae will graduate with her Master of Arts degree in 2013. After graduation, she plans to continue working in archaeology.