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## **Excavation of Transect 4 at the Eleanor Betty Site, A Submerged Classic Maya Salt Work, Belize**

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Excavation of Transect 4 at the Eleanor Betty Site, A Submerged Classic Maya Salt Work,  
Belize

by

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Undergraduate honors thesis under the direction of

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the Upper Division Honors Program.

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## INTRODUCTION

In the study of ancient Maya activities associated with salt production and trade, modern archaeological techniques and field methods can be utilized to collect and analyze cultural material. Studying cultural remains in regards to what their purpose or function may have been, in addition to their location on a site in relation to evidence of structures can illuminate the actual function of an ancient Maya site. Not only can such research support salt making as the primary activity at a site, but it can also reveal how certain specific areas of that site may have functioned in the overall infrastructure of a Maya salt production outpost. The excavation of an archaeological transect positioned in relation to a supposed structure provides thorough means for the collection of cultural material and further research.

A transect was excavated at the underwater salt work site 67, Eleanor Betty, in Paynes Creek National Park, Toledo District, Belize in order to investigate ancient Maya activities, in association with salt production. This research, carried out during the summer season of 2011, is part of the Underwater Maya Archaeology Project in Paynes Creek, Belize under the direction of Dr. Heather McKillop. Previous seasons of field research in Paynes Creek lagoon revealed over 100 Maya sites (McKillop 2009) dating from the Early and Late Classic periods (AD 300-900). The past surveys, surface collections and excavations have revealed the underwater sites to be the remains of salt works with wooden architecture preserved in the peat bog of the shallow lagoon. This thesis focuses on the excavation of transect 4 at Eleanor Betty. I evaluate the cultural findings in relation to salt making. Do the types of artifacts found in the transect point solely to salt production or also some type of permanent or semi-permanent habitation at the site, and what does the positioning of cultural material inside or outside the wooden structure reveal about the organization of the site and the functionality of that structure? Analyses of the

locations, types, and quantities of the ceramics, charcoal and other cultural remains found, in addition to the investigation of a shell midden provide evidence for both a salt making workshop and a possible residence. When compounded and compared specifically with other research on Maya salt making, habitation, and shell middens, this study helps develop a deeper understanding of the major industry of salt production and trade during ancient Maya times.

## **SIGNIFICANCE OF RESEARCH FOR MAYA ARCHAEOLOGY**

Salt is a basic biological necessity essential to human survival. Ancient civilizations went to great lengths to acquire and distribute salt, establishing large industries to harvest the mineral and intricate trade networks to facilitate distribution. The Classic period Maya (A.D. 300-900.) were one such civilization, as salt production and trade brought the mineral to urban centers where salt was scarce (McKillop 2002). Archaeological research throughout the Maya area has revealed major zones of salt production along the northern coast of the Yucatán Peninsula, the Pacific coast of Guatemala, and the Belizean coast (McKillop 2002). The study of Maya salt work evidence in all of these zones provides insights into the process of salt workshop production, the trade of salt, and the importance of salt to the ancient Maya.

The Eleanor Betty site is one of many inundated ancient salt works found in Punta Ycacos Lagoon on the Belizean coast. The salt produced at this and other neighboring sites likely contributed directly to the salt trade of southern Belize and the major urban centers of the Maya lowlands. During previous research conducted at Eleanor Betty, an abundance of briquetage, or artifacts associated with the salt making process, and the remains of wooden architecture preserved in the peat bog confirmed the site as one associated with salt production.

My research follows these previous studies, yet focuses on a specific area of the site in order to investigate how such salt production sites were organized, and if all of the structures within a site served as salt making workshops, or perhaps had varying functions. Investigations into the specifics of a salt work site contribute to the broader archaeological study of Maya salt production and its significant role in ancient Maya culture.

## **BACKGROUND**

### **Research of Salt Production in Mesoamerica**

The role of salt production and distribution in the ancient Maya world and Mesoamerica in general has long been a focus of debate amongst scholars (see McKillop 2002). The lasting questions of how significant the mineral was to ancient Mesoamericans, how salt was made, and how various populations gained access to the resource have spurred research in several different fields of study. Such research confirms the existence of two main methods of salt production from antiquity up until modern times: evaporation from the sun or by heating in pots over fires. Although almost all examples of salt making can be attributed to one of these methods, the cultural, economic, and political implications of this vital resource extend beyond the means of production. In the quest to understand salt and the depth of its importance to ancient Maya civilization in particular, researchers have employed and pulled from several disciplines including modern ethnographic studies, ethnohistorical accounts, and archaeological field work and interpretation.

Ethnographic studies of modern Maya and Mesoamerican salt producers provide useful models for ancient salt making practices, techniques, and cultural connections. One such study was that of Eduardo Williams, who focuses on current salt production at Lake Cuitzeo, Mexico (1999). In his study, Williams describes the salt manufacturing process, which involves the leaching of brine through salt enriched soil into evaporation pans. These salt works are only in operation during the dry season, as the rain brings a halt to the solar evaporation process. Although the modern technique involves solar evaporation, Williams (1999) suggests that this technique might be a recent adaptation due to lack of firewood, implying that in the past salt may have been produced by evaporating brine in pots over fires.

Catharine Good's (1995) ethnographic research in Guerrero, Mexico provides an analysis of four modern salt work sites located in coastal lagoons near Acapulco. These salt works not only show how salt production can be carried out, but also how control of a salt work can be organized. Each salt work is small scale, independent, and controlled by one particular family. These cottage industries rely on family labor, with the women conducting the actual salt production. The men usually hunt or otherwise tend to the temporary household which is often constructed for salt production in the marshlands during the dry season. There is also a large permanent village within walking distance of the lagoon (Good 1995). Good's research shows how salt works may have been organized structurally and socially in the past.

The ethnographic study of modern Maya salt production in Sacapulas, Guatemala by Reina and Monaghan (1981) is perhaps the most significant example of a modern model which might be applied to ancient Maya salt works in Paynes Creek National Park. In Sacapulas, salt is made by evaporating brine in pots over a fire, but first the brine is poured through salt enriched soil to increase the salinity. Households in a specific area of Sacapulas specialize in this salt



production, with each family owning a *salina*, or salt work, down by the river. Both men and women often work at the *salina*, evaporating the brine in pots inside a permanent, specialized building. Salt making is culturally significant to the villagers of Sacapulas, as shamans perform ceremonies and rituals to ensure plentiful salt production (Reina and Monaghan 1981).

All of these ethnographic accounts provide valuable examples of salt making which can be applied as models by archaeologists studying ancient salt trade and production. However, caution must be taken in assuming modern practices and techniques are analogous with ancient ones (McKillop 2002). Instead, such models might prove useful when directly compared to existing archaeological data and evaluated from there.

When studying the complex relationship of salt to the ancient Mesoamerican world, researchers often utilize ethnohistorical accounts both as a small glimpse into ancient societies and as a link between modern ethnographic studies and archaeological investigations of prehispanic Mesoamerica. For instance, Reina and Monaghan (1981) compound their ethnographic research with ethnohistorical accounts regarding salt production. A Spanish report from 1574 describes how a lack of salt in the area around Sacapulas was a major problem. Sacapulas provided all the salt in the surrounding territory, and many Maya would often seek employment as laborers in the *salinas*, receiving quantities of salt as payment. An account from a Spanish mayor, Martin Alfonso Tovilla, in 1629 describes a salt making process run in the same Sacapulas province and with almost exactly the same techniques as today (Reina and Monaghan 1981). Williams (1999) also connects his modern ethnographic research with ethnohistory. Accounts from the 1500s describe several different salt works with various harvesting methods in the Lake Cuiteco area, including a lagoon site where workers collected congealed salt, a site using techniques similar to those found at Sacapulas, and a site where solar evaporation

processes similar to those at modern Lake Cuitzeo were employed (Williams 1999). All of these records are useful in linking modern salt making methods to the past and adding credence to their viability as models for ancient salt production.

Although Mesoamerican archaeologists often cite from such ethnographic and ethnohistoric sources, there has been a substantial history in and of itself of archaeological research in this area of scholarship. Within the last few decades, research and debate regarding salt trade and production in the Maya area has revolved around the hypothesis put forth by Anthony P. Andrews (1983). For him, the main source of salt for the Maya world came from the northern coast of the Yucatán. Salt was traded in bulk over long distances to the urban centers of the Maya lowlands. Since the introduction of Andrews' interpretation, archaeologists studying Maya salt production have declared hypotheses and shown research supporting, refining, critiquing or denying this prevalent theory. Researchers have also used archaeological evidence to infer how the salt was produced at various salt works and who exactly was producing salt.

In El Salado, near Veracruz, Mexico, Robert Santley (2004) found archaeological evidence of ancient salt making which gives insight into how the salt was produced and how the salt works were organized socially. The evidence at the site indicates a period of occupation during the Late Classic (AD 600-900). Salt was extracted through a process of boiling brine similar to that found at the modern Sacapulas sites. Santley (2004) argues that the limited range of artifacts found at the site points to limited involvement by elites at these salt works. Each salt work was instead controlled on a small scale by individual households. Although the El Salado evidence supports salt production on a limited household scale, in the Maya area some ancient salt works have been discovered which indicate salt making on a larger, industrial scale.

In 1989, J. Jefferson MacKinnon and Susan M. Kepecs (1989) introduced archaeological evidence of prehispanic salt making in coastal lagoons near Placencia, Belize. This evidence ran somewhat counter to Andrews' conjecture that the lowland Maya were importing supplies of salt in bulk from the distant *salinas* of northern Yucatán because there were no other substantial sources of salt available. At these coastal sites, the large majority of artifacts found were associated with salt making by the evaporation in pots over fires method including ceramic cylinders used for suspending pots of brine over fire. MacKinnon and Kepecs also found refuse middens which point to leaching before the boiling process to increase the salinity of the brine. Perhaps the most significant discovery at Placencia was that of shaped clay objects called sockets and spacers. The sockets were used at both the ends of the ceramic cylinders to hold the jars of brine in place over the fire and to anchor the tripods of cylinders to the ground. The spacers may have been used to separate and hold together a large number of jars over the hearths. These clay objects represent innovations in the salt making procedure and support the argument that salt production was occurring at a large, standardized scale at these sites. MacKinnon and Kepecs use the evidence from these sites to refine Andrews' theory rather than reject it, proposing that lower quality salt was produced at these sites and traded over short distances to Maya commoners whereas the higher quality salt from north Yucatán was brought in over long distances for consumption by the elites (MacKinnon and Kepecs 1989). However, since the discovery of salt works at Placencia, an even larger number of archaeological sites associated with salt production have been found all along the Belizean coasts. Among these, the huge number of salt works found in Punta Ycacos Lagoon of southern Belize point to a salt production and trade industry on an unprecedented scale (McKillop 2005). The discovery of these sites has redefined the previous notions of how and where the Maya were gaining access to their basic dietary necessity.

## Salt Works in Punta Ycacos Lagoon

Punta Ycacos Lagoon is located in the Paynes Creek National Park of southern Belize. Mangrove stands have dominated the landscape for thousands of years, creating vast tracts of peat found just below the surface of this shallow-water lagoon system. After underwater salt works were discovered in the area (McKillop 2005), sediment cores and columns were taken, revealing that sea levels were lower from the Early Classic through the Late Classic (McKillop et al. 2010). These lower levels allowed the Maya to construct salt works near the lagoons, which were later inundated by sea level rise in the Postclassic period (McKillop et al. 2011).

Research began in Punta Ycacos Lagoon in 1991 when evidence of Maya salt works was found underwater (McKillop 1995). Since that time, ongoing research has documented over 100 Maya sites connected to salt production in the lagoon system (McKillop 2009). Through surveys, surface collections, excavations, and artifact analyses the sites have been interpreted as salt production centers where brine was evaporated in pots over fires to produce salt. Artifacts associated with this type of salt making have been termed *briquetage* and include ceramic cylinders, sockets, spacers and unslipped, roughly worked pottery vessels. Through type-variety analysis, the majority of pottery found at the Paynes Creek salt works has been identified as Punta Ycacos Unslipped: utilitarian ceramic jars and bowls used for the boiling of brine (McKillop 2002). The Mangrove Unslipped type is also prevalent at these sites and was likely used to hold the salty brine before boiling. Most of the cultural material found at the Punta Ycacos salt work sites is directly associated with the salt making process, but a low percentage of fine-ware, ceramic whistles and other non-*briquetage* artifacts have been discovered as well (McKillop 2002). Some of these artifacts may have been associated with salt making rituals similar to those performed by the salt makers of Sacapulas (Reina and Monaghan 1981). The

only evidence of leaching to increase the salinity of brine was found in a slag heap at the partially inundated Killer Bee site. However, the conditions of an underwater environment may have eliminated such evidence from the other completely submerged sites (McKillop 2002).

In 2004, further research uncovered the existence of wooden architecture and artifacts preserved in the peat of many of the Punta Ycacos sites (McKillop 2005). Wooden architecture was discovered in the form of worked wooden posts embedded vertically and sometimes horizontally in the peat of the lagoon. These posts are often arrayed in rectangular patterns suggesting permanent structures. Some of these structures are quite large, such as one found at the Chak Sak Ha Nal site which contains 112 hardwood posts forming the exterior walls of a rectangular building measuring 21 X 12 m. More posts have been found within the structure itself, suggesting different rooms and compartments. At the K'ak' Naab' site a preserved Maya canoe paddle, the only one discovered in the region, was also recovered (McKillop 2005).

All of the evidence collected in the ongoing research in the Punta Ycacos Lagoon suggests a complex industry of salt production and trade was taking place during the Classic period on the Belizean coast. The limited variance in ceramic types at the salt works indicates a standardized manufacturing system going beyond the cottage industry systems found at many other salt production sites (McKillop 2002). The slight differences in assemblages at the various sites of the lagoon indicate that the salt works were controlled and run by different groups (McKillop 2002: 115-134). The abundance of large wooden structures supports a hypothesis of salt production on a large scale with a complex infrastructure. The canoe paddle supports trade of salt to nearby trade centers such as Wild Cane Cay by sea, and large inland sites by river (McKillop 2005). Compounded, archaeological data support a view of Maya salt production and

distribution not just centered on the salt works of the northern Yucatan, but also including the major salt making centers along the Belizean coast.

My honors thesis field research contributes to the understanding of the salt making infrastructure at the Punta Ycacos Lagoon salt works by concentrating on the excavation of a single transect at the Eleanor Betty site in the West Lagoon. Field research was carried out during the summer season of 2011 and with assistance of the entire LSU research team. Located to the west of a mangrove stand, site 67, otherwise known as Eleanor Betty Site, is situated in shallow water. With a microtidal variation, the water depth never exceeds one meter. Large accumulations of artifacts litter the silty floor of the site. Past surveys indicate that the site is associated with salt production. A curved line of palmetto palm posts, thought to have been a wall, runs north to south on the western edge of the site. The transect of which my research is concerned began within the palmetto wall and was positioned through a structure. The basic purpose of this transect was to estimate the function of that structure and the general area of the site. The findings of this research can be added to and assessed against prior research carried out on Maya salt works and the standing hypotheses derived from that research.

## **MATERIALS AND METHODS**

### **Setting Up the Transect**

Before excavations began, research members Heather McKillop, Mark Robinson and I discussed where the transect should be positioned and decided on a location. The placement of the trench directly correlated to the questions being asked about that area of the site and the site itself. The southern section of the Eleanor Betty site had many hardwood posts arrayed in ways

not typically seen at these salt work sites. The posts were not positioned in ways that clearly represented structural layouts such as rectangular forms with posts at each corner. Therefore, by running a transect through the posited structure in that area and studying the material collected through excavations, we hoped to ascertain whether or not it actually was a structure, and to assess its function in the southern area of the site.

The transect was originally set up with seven one by one meter units extending west to east into the site with a slightly southeasterly orientation. The team set the transect up using a metric measuring tape, with Mark holding the end of the tape at position 1, half a meter in from the line of palmetto posts that curves around the western portion of the site. I then rolled out the tape 7 meters to the east, placing position two there. We marked both ends of the transect with PVC pipes. While Heather and Mark held the ends of the metric tape taut, I traveled along the transect, sinking small PVC pipes with yellow flags inside at each meter mark, following a system carried out at other underwater sites. In this way, the seven units of the transect were clearly marked and visible above the water. Unit 0-1m is located about  $\frac{1}{2}$  a meter away from the line of palmetto posts around the entire western edge of the Eleanor Betty site. The supposed structure that this transect was put in place to investigate began around unit 2-3m, denoted by the presence of a hardwood post at the northwest corner of unit 2-3m. Unit 3-4m and onward were thought to extend through the center of the structure, based on the known locations of posts and the known artifact distribution in the area. Although the original transect layout included seven units, unit 6-7m was not excavated, and so the transect in effect ended at unit 5-6m. The one by one meter units were oriented south of the transect line denoted by wire survey flags and PVC pipes. With the transect arrayed in this way, we could commence excavations.



Figure 1: Yellow flags marked the transect units and pink flags denoted posts. The screening station can be seen in the water offsite. Photograph by Heather McKillop.

### **Excavations: Level 1**

Excavations began on the first level of the units, which reached a depth of 10 cm from the seafloor. In effect, excavation at this level was a surface collection, involving the excavation of silt and all artifacts or other material found above the peat layer. This matrix of silt and loose artifact material usually extended downwards about 10 cm. Beginning on unit 0-1m, I excavated the first level using predominately my hands, scooping up silt, artifacts and any other loose material not embedded in the peat and placing it in a rice sack. When the rice sack became full, I would either bring the bag to Mark offsite or he would come retrieve it.

Once offsite, Mark would begin screening the material with a 3 mm sized screen. As he screened, Mark would sort out ceramics, charcoal, shell and botanicals and place these in separate Ziploc bags. The bags were labeled with the site name, transect number, unit number, level, and usually a description of the bag's contents (i.e. "ceramics"). Any other items such as obsidian or chert were bagged separately. When Mark finished screening a rice sack full of material, he would bring the empty rice sack to me and bring back a new full sack to his



screening station. He had a portable research station (PRS) tied off nearby where he kept the dry unused Ziploc bags, the labeled bags filled with material, the water proof field notes, and any other necessary items such as water and sunscreen.

As I excavated unit 0-1m with my hands, I slowly worked my way eastward across the unit, until level 1 was cleared out and the smooth peat top of level 2 could be felt throughout the one by one meter unit. After completing level 1 excavations of unit 0-1m, I continued excavating the other units in the transect using the same methodology. Mark continued screening in the same way as well. While I completed excavations on level 1, Mark sketched a rough map of transect 4 and its positioning in Eleanor Betty in the waterproof Scuba Notes 1.

## **Excavations: Level 2**

For the second level of excavations, the methodology changed slightly. Level 2 extended from 10cm down to 20cm. The level predominantly consisted of the first layer of peat and whatever was preserved in this matrix. For excavating this level I used a trowel and my hand to cut pieces of peat out and place them in a rice sack for screening. First, I would cut out a segment of peat five centimeters down and remove it for screening. On Mark's advice, I had initially cut sections of the complete 10 cm to easily move the sediment from the seafloor to the bag and screen. However, my advisor said it was better to excavate by thin layers across the complete unit in order to discover any features. She said the maximum depth should be 5 cm. By dividing the level in half in this way, any features in the unit or changes in the matrix could be more easily distinguished. Of course I could miss any sediment changes that were less than 5 cm in depth. I excavated west to east in this way, making my way across the unit. In many of the units there was quite a lot of sandy material and small bits of briquetage which had to be scooped into the rice sack. For units 2-3m and 3-4m I used a small cup to scoop up the sandy matrix at the

bottom of each unit. Aside from this one adaptation to changes in the matrix consistency, my methods remained the same as I excavated level 2 of transect 4.



Figure 2: Taylor Aucoin excavating a unit in transect 4. Photograph by Heather McKillop.

Mark continued screening offsite with occasional assistance from Young, another team member. The thick consistency of the peat from level 2 slowed down the screening process, as the material was more difficult to push through the 3 mm screen. While excavating units 3-4m, 4-5m, and 5-6m the screening process slowed down considerably because of high amounts of charcoal and, in the case of 3-4m, shell deposits. Such small and numerous materials made the sorting process tedious and time consuming. When rare fine ware sherds were found in units 4-5m and 5-6m, Mark took photographs of them in addition to describing and sketching them in Scuba Notes 1. Throughout the excavation process for the entire transect, these Scuba Notes were updated daily. Observations were recorded in the notes about unit layouts, matrix composition, what materials were found and bagged from each unit, and any other pertinent information. Since the Scuba Notes were kept in the PRS at the screening station offsite, Mark would often write down these observations during excavations while I would frequently update them after an excavation was finished. Following the methods described here, Mark and I completed the excavations of transect 4.

During excavations of unit 3-4m level 2, a large deposit of shell was encountered starting at the 5 cm level. The midden began about 25cm into unit 3-4m and continued eastward for almost a meter, extending 15 cm into unit 4-5m. The amount of shell remained consistent in the north-south directions of the units. The midden was marked by a high amount of mangrove oyster shells embedded in the peat matrix accompanied by charcoal and small amounts of ceramics. There were very few shells found above the 5cm depth of level two. A sediment block was also later extracted from the north wall of unit 3-4m to determine the status of the midden outside of the transect excavations.

After excavations were done, I mapped the positions of posts in units 3-4m and 5-6m into the Scuba Notes with Spann's (another team member) assistance. We mapped the posts in the interior of the units by measuring each post's distance from the edges of the one by one meter unit using a metric measuring tape. Tamara held the end of the tape at the north side of the unit and then the east side and I recorded those two distances. I then drew out the units to scale in the notes and denoted the exact positioning of the posts within those units. I also measured the diameters of the two posts as well. Tamara and I then mapped out the location of the shell midden within transect 4. We measured where the shell deposits began in unit 3-4m and where they ended in unit 4-5m, sketching the map into the Scuba Notes.



Figure 3: Mark Robinson and John Young screening and sorting. Photograph by Heather McKillop.

## **Field Laboratory**

Materials were sorted through and processed by various members of the team at the Lagoon Lab set up in shallow water at the edge of the site. The bags of briquetage were first emptied upon a table to be cleaned and sorted. Water was poured over the artifacts, with the water draining into the sea, since the tables were tilted to allow drainage. Team members sorted the artifacts into cylinders, rim sherds, body sherds, fine-ware sherds, sockets, spacers and amorphous clay lumps (ACLs). Pottery sherds were sorted into different vessel shapes, namely jars, bowls, dishes, and plates. Heather McKillop revised the groupings and assigned them to known pottery types from previous research in the lagoon and elsewhere in the coastal area (McKillop 2002). Cory Sills would photograph the entire selection of artifacts, each group, and each individual rim sherd. Heather McKillop would then draw the rim sherds and calculate their diameter and thickness. Each group of artifacts would then be weighed using the scale balance set up on a separate table in the Lagoon Lab. Certain artifacts were kept for future analysis, particularly fine-ware or other unique specimens, which were exported under permit for chemical and petrographic analyses to estimate the composition of the clay and any temper additions that would allow assigning the pottery to its geological place of manufacture. All of the processing completed in the lab was recorded in field and lab journals. Some materials were also processed in a lab at Village Farm. For the bags containing charcoal, the material was first dried out in the sun, and then the total weight of charcoal per unit level was calculated using a scale balance. Shells were also dried out, but no weight was calculated. After, the charcoal and shells were re-bagged and kept for future analysis.

## RESULTS

### Excavations: Level 1

In the excavations for level 1 (0-10cm) of unit 0-1m, there was found a high density of artifacts with a large amount of potsherds and amorphous clay lumps. There was little silt and most of the first level consisted of briquetage. After screening, Mark bagged four large Ziploc bags of ceramics, a half bag of charcoal, one small lithic, and some botanicals including a seed, coyol and cohune. Upon first observation, Mark noted that although most of the ceramics were briquetage (directly related to salt production) there were also some Moho and Warrie fine ware sherds. Detailed observations and recordings were later made in the field lab.

The excavations for the 0-10cm level of unit 1-2m yielded much of the same results as the first unit, yet with an even higher concentration of artifacts. There was little silt found in the unit but a huge amount of briquetage. By the end of excavations for this unit, we had filled five large gallon-sized Ziploc bags with ceramics, with some pottery sherds but the majority being small amorphous clay lumps. We also collected some shells, botanicals (cohune and coyol), an obsidian blade and a bag full of charcoal.

In unit 2-3m level 1 there were a plethora of artifacts found on the surface including sherds, cylinders and other clay lumps. Excavations for this unit and level uncovered by far the largest amount of materials in the entire transect. There was nearly no silt in this unit as the material consisted almost entirely of briquetage. We filled 12 large gallon-sized Ziploc bags with ceramics, a half bag with charcoal and also found an obsidian blade. A post was located in the northwest corner of this unit, which had already been noted prior to excavations.

Findings for unit 3-4m level 1 differed from the first three units, with a smaller amount of artifacts and an increase in charcoal. The matrix in this unit was also sandier than in the previous units. While excavating eastward across the unit, oyster shells, both complete and fragmented were found starting about 25% of the way into the unit. These shells were markedly different than the smaller variety found in the other units. Mark and I postulated that we might find a larger concentration of these shells in the next level down. In addition to finding these shells, we also discovered a chert flake, 6 gallon-sized Ziploc bags worth of ceramic material, and a half bag full of charcoal.

In unit 4-5m level 0-10cm, we found a dramatic shift in the content of material as compared to the previous units of the transect. The amount of ceramics dropped considerably while there was an increase in the quantity of charcoal. The matrix in this unit was quite sandy, and the majority of briquetage found was corroded and broken. Only one gallon-sized Ziploc bag was filled with ceramics, differing drastically from the comparatively large concentration found just one unit before. In addition to an obsidian blade fragment, we also found enough the charcoal to fill 75% of a gallon-sized Ziploc.

Excavations on level 0-10cm of unit 5-6m revealed similar results to unit 4-5m, with a relatively small amount of ceramics and an increase in charcoal. The ceramics found were mostly small lumps, with little to no definable artifacts. The matrix of this unit was sandy and thick with charcoal. A small piece of calabash also was found. An entire gallon-sized Ziploc bag was filled with charcoal while just a little over one bag of ceramics was collected in the excavations.

## **Excavations: Level 2**

Excavations of level 2 10-20cm of unit 0-1m revealed similar results to the first level of the unit yet with generally less material collected over all. The matrix in the unit consisted of hard peat, which when broken up left behind large amounts of sand. While excavating and screening, three chert flakes, two obsidian blades, two seeds, a coyol and a cohune were found in addition to a good amount of ceramics and charcoal. The briquetage totaled about three gallon-sized Ziploc bags, while there was also a large amount of charcoal.

In unit 1-2m level 10-20cm, the findings proved to be very similar to those of unit 0-1m. Excavating through thick fibrous peat, I found there was an increase in artifacts as I neared the eastern wall of the unit, which also appeared to be near the beginning of a structure. The peat matrix also consisted of large amounts of clay and sand. We collected around the same amount of ceramics and charcoal as the unit before in addition to a chert flake.

Excavations in unit 2-3m level 2 uncovered copious amounts of artifacts and a large quantity of charcoal. This unit contained the most briquetage out of the second level excavations, with eight large Ziploc bags being filled. The matrix of the unit consisted of thick peat and sand with a concentration of clay surrounding the post in the Northwest corner. In addition to all the ceramics and a small piece of chert, we collected three small bags of charcoal from the unit.

The findings for unit 3-4m level 10-20cm were markedly different than those of the preceding three units, with a shift in content from ceramics to charcoal and shell. The first five centimeters of the level were similar to the other units of the transect with a matrix of thick peat mixed with ceramics and charcoal. However, the matrix of the lower five centimeters of level 2 was full of shell. These large shells were mangrove oyster shells typical of middens found at other nearby sites (McKillop, personal communication 2012). The deposits began about 25% of

the way into the unit and appeared to continue into unit 4-5m. The deposits also appeared to extend downward to level 3, 20-30cm depth. Two gallon-sized Ziploc bags were filled with these shells in addition to the three large bags of ceramics and one large bag of charcoal collected. During excavations, a small hardwood post was also found in the southeastern corner of the unit.

Unit 4-5m level 10-20cm contained some of the most unique findings in the transect excavations. While excavating from west to east, I found the first 25cm of the unit to be near identical in matrix and content to that of unit 3-4m with the lower 5 cm consisting of shell deposit. However, these shell deposits ceased abruptly about 25% of the way into the unit and gave way to extremely dense peat full of charcoal. The matrix also contained traces of clay with a blue pigment. Although there were relatively few ceramics collected from this unit, I did come across a rare find. Soon after beginning excavations, I found the rim sherd from a vase with a glyph incised upon it in the top five cm of the level. In addition to this sherd, two Ziploc bags of ceramics, an obsidian blade, a chert flake and some oyster shells were collected. This unit also contained huge amounts of charcoal as three large Ziploc bags were filled with the charred wood.



Figure 4: Mark Robinson screening excavated materials such as oyster shells, charcoal, and ceramics. Photograph by Heather McKillop.



Excavations of unit 5-6m level 2, (10-20cm) revealed analogous results to unit 4-5m with a small amount of ceramics and a huge quantity of charcoal. The matrix of this unit consisted of hard peat thick with charcoal and with some blue clay mixed in. In the center eastern portion of the unit, I discovered a medium sized post. Near this post I also found an incised bowl rim sherd with part of the base still attached. Other than this artifact few ceramics were collected, filling only one Ziploc bag. A chert flake was also collected in addition to three gallon-sized Ziploc bags of charcoal.

In regards to the entire transect, the results reveal a general trend associated with the outside and inside of the structure. There were large amounts of artifacts accumulated near the wall of the structure with the most being found just within the wall. As excavations moved farther into the interior of the structure, the amount of ceramics decreased while the amount of charcoal increased. This trend continued until the end of the transect, where the amount of charcoal found far outstripped the quantity of ceramic materials recovered. The interior of the structure was also marked by the unexpected finds of a shell midden, a rare glyph sherd, and two wooden posts. All of these findings prompt deliberate and meticulous analyses to determine the function of the structure and the related area of the Eleanor Betty site.

## DISCUSSION

The results of the excavations provide many opportunities to analyze and answer the questions pertaining to this research. By studying the materials found and comparing it to various sources, I test hypotheses as to the purpose of the partially excavated structure and its role in the salt works. In order to achieve such a hypothesis, the archaeological data should be examined in its relation to the known methods and organization of ancient Maya salt making, the typical evidence associated with permanent Maya settlements, the possible roles of fine ware and other prestige items, and the significance of shell middens.

Since the majority of discussion revolves around the function of the excavated structure, it is prudent to first give reasonable evidence that the hypothesized building is indeed a structure. In the southern portion of the Eleanor Betty site, the known hardwood posts are arranged in a rather confusing manner and do not form the rectangular outlines typically associated with buildings. Although the irregular positioning of posts makes the identification of structures impossible, there is ample evidence to support the existence of a building in the excavated area. The close proximity of the outer palmetto wall to the hardwood post marking the structure wall, and the lack of other hardwood posts between the two implies that the building could only feasibly extend north, south and east. By starting excavations outside the hardwood post found in unit 2-3m, and continuing in an eastward direction, I am confident that I was excavating the interior of a structure, no matter how oddly shaped. Furthermore, the discovery of two smaller posts within units 3-4m and 5-6m supports the existence of the structure, since smaller posts have typically been found within structures at the Punta Ycacos sites, usually indicating different rooms or even permanent furniture (McKillop 2005).

Surveys of the site and general knowledge of the cultural materials found at Eleanor Betty provide conclusive evidence that the Maya utilized the area for salt production. However, does the archaeological data retrieved from my excavations link the particular structure to salt making? At first glance the data do, because the majority of the ceramics found in the transect are briquetage. However, although the cultural material found definitely points to the site's function, several other factors must be analyzed before the structure's function can be securely determined. Chief among these factors are the positions of the salt making artifacts in relation to the inside, outside and deep interior of the structure. As stated in the results section, the largest assemblage of briquetage and other artifacts was discovered near the wall of the structure, with the most concentrated in the first unit inside the structure. The farther into the interior of the structure the excavations went, the smaller the amount of artifacts collected until unit 5-6m, where I bagged the least amount of artifacts. In contrast, charcoal, other cultural remains often directly linked to the salt production method, dramatically increased in quantity towards the interior of the structure.

The locations of the salt making materials indicate that either the Maya utilized the structure within the salt production system for storage, pottery manufacturing, or the actual brine boiling process, or they used it for activities not directly related to salt making such as habitation, performance of rituals, or food preparation and consumption. The clustering of artifacts around the structure wall could support the salt production argument since the modern Maya of Sacapulas boil brine indoors and place the debitage from the process around the inside and outside of the building's wall (Reina and Monaghan 1981). However, based on research conducted at other Paynes Creek sites, a structure associated with the boiling of brine should likely have evidence of the process throughout the building instead of just concentrated near the

walls (McKillop 2005). The building also could have been used for another purpose, with the Maya depositing debris around the walls to strengthen the structure. As for other salt related purposes, there is not much evidence to support either a storage building or a pottery workshop. Although the large amount of charcoal could be strong evidence for salt boiling within the structure, an abundance of charcoal could also support other hypotheses. A thoroughly researched answer cannot be reached by merely studying the artifacts excavated which directly relate to salt making. The obsidian, lithics, botanicals, fine ware, and shells discovered in the structure should also be examined.

In order to estimate if the evidence collected from inside the structure reflects habitation of some type instead of solely salt production, an examination and comparison to the archaeological remains usually associated with permanent Maya settlement is necessary. Archaeologists studying the settlements of Maya non-elites have identified several cultural markers associated with permanent or semi permanent habitation. Settlements are often revealed by a high frequency of plant remains and artifacts associated with food processing and storage. This material can include the stone manos and metates connected to corn processing. Stone tools for basic utilitarian use were also often produced in households, leaving behind chert flakes and bifaces. Obsidian blades are also common indicators of habitation, as are ceremonial vessels. Such vessels were often used in ritual practices (Robin and Yaeger 2004). The Maya typically buried deceased relatives under the floors of their houses, so a major marker of habitation would be the discovery of a burial or cache of goods (McKillop 2004).

Based upon the typical artifacts associated with Maya houses, some of the artifacts collected in the transect could support the hypothesis that the structure is associated with habitation of some kind. The chert flakes collected throughout the transect could be indicators of

small scale, need-based production of stone tools. Although no bifaces were found in these excavations, such stone tools have been recovered before from Punta Ycacos sites (McKillop 2002). Obsidian blades and fragments were also found within the transect, and although these and the stone tools could no doubt be useful in salt production, they are more commonly associated with habitation and utilitarian use (Robin and Yaeger 2004). The cohunes, coyols and shells found during excavation could represent food production, storage or at least consumption on some small scale. The existence of fine ware pottery in the structure might also be an indication of longer term habitation. Other evidence of food production, such as a *metate* has been found at other sites within the lagoon system. Although there has never been any evidence of burials at Eleanor Betty or any other salt work in the area, a burial would only likely occur at the permanent generational home of a Maya. If the findings from this transect point to habitation on any scale, it would only be semi-permanent seasonal occupation. Nearly all research on Maya salt works, ethnographic, ethnohistoric or archaeological, describes salt production as a seasonal occupation.

There is ample ethnographic and historic evidence of semi permanent habitation at modern and colonial period salt works. Salt workers or households near Acapulco often set up temporary camp sites complete with habitation and kitchen areas during the dry season, and return to their permanent homes when the rainy season begins (Good 1995). A semi-permanent habitation of the salt works at Eleanor Betty would not necessarily run counter to the factory scale production that the standardized salt making pottery indicates. Although the assortment of artifacts collected from within the structure could support a hypothesis of part time habitation in some ways, the evidence would not create a strong argument. However, a closer analysis of the

fine ware and rare pottery collected from the excavations and their cultural significance might shed some light on whether the excavations were in the area of a household

Moho Red and Warrie Red bowls, jars and dishes, and any other fine ware pottery found at the Punta Ycacos Lagoon sites, likely were associated with the practice of salt making rituals (McKillop 2002). However, when such ceremonial serving ware is uncovered at sites that are not involved in salt production, archaeologists typically view them as evidence of habitation and settlement (Robin and Yaeger 2004). The presence of serving bowls has also been connected to ritual feasts at other Punta Ycacos salt work sites (McKillop 2007). A ritual associated with salt could be viewed as a special case that needed to be performed near the source of the salt. The Maya salt makers of Sacapulas perform rituals associated with salt which always take place in the heart of the *salinas* (Reina and Monaghan 1981).

The discovery of a shell midden in units 3-4m and 4-5m was perhaps the most significant find in the excavations. The types, quantities and locations of all the other cultural material from the transect give clues as to the function of the excavated structure. The presence of the shell midden suggests other activities as well.

The transect 4 midden consists of mangrove oyster shells. Analysis of the collected shells revealed there are two species of oyster within the midden: *Crassostrea rhizophora*, which has a rough shell, and *Isognomum alatus*, which has a smooth shell (as identified by H. McKillop). These two species attach themselves to mangrove roots and can be found in abundance in Punta Ycacos Lagoon. The midden found within the transect is known to be about one meter in length from west to east. A sediment sample extracted from the northern wall of the transect unit determined that the midden does not continue north beyond the transect. However, the extent of the shell midden is not known without further excavations, since the shell deposits may extend

deeper down into the levels of the peat and also could extend horizontally to the south.

Archaeological studies have been compiled on the different uses of shell by the Maya and the various mussels from which the shells originate. Analyzing this data and comparing it to the shells found within the transect 4 midden will help determine the purpose of the shell midden and what it reveals about the structure and salt work site.

In E. Wyllys Andrews IV's (1969) comprehensive account of mollusks in the Maya archaeological record, he describes the different reasons the Maya might have kept deposits or collections of shells. The Maya sometimes used shells as votive offerings. However, such shells would only be found in burials and caches, of which there are neither in transect 4. Shells were also often used as ornaments, but in those cases the shells would display some evidence of being worked. None of the oyster shells in the Eleanor Betty midden show any evidence of modification. Finally, Andrews describes the most common Maya use of shellfish: food (Andrews, 1969). When the Maya ate mollusks, they often chose those species that they could find close by in abundance, so in the case of the Maya of Punta Ycacos Lagoon, that meant mangrove oysters.

The inhabitants of Eleanor Betty were not alone in consuming these species of oyster, as there is evidence of other Maya eating such shell fish. In an excavation of a large shell midden in Cancún, Mexico, Andrews (1965) documented 99 different species of mollusk consumed by the Maya settlers of that area. The *Isognomum alatus* species was found in that midden, and was also found in abundance in excavations of the northern Maya uplands city of Dzibilchaltun (Andrews 1969). Archaeological records of *Crassostrea rhizophora* have been found in the shell middens of Frenchman's Cay (McKillop and Winemiller 2004) indicating that the species was consumed by

the ancient Maya. There are also accounts of the mollusks being farmed and eaten in modern Brazil (Freitas 2006).

Since the Maya likely were eating the oysters found in the shell midden, what does that reveal about the structure the midden was located in and the site as a whole? In the highlands of Guatemala, the salt makers of Sacapulas keep the interior of their brine cooking “kitchens” filled only with salt production items (Reina and Monaghan 1981). The large amount of charcoal found in the interior of the building implies that something must have been cooked there, either salt or shellfish. Presumably, the Maya would have prepared the abundantly available seafood from the area, and could have eaten a variety of fish in addition to oysters, coyols and cohunes. The absence of preserved fish bones, or bones of any kind could be explained by the relatively high acidic content (pH5) of the peat (McKillop 2005). Bones often decay quickly in environments with high acidity, and one can see the proof of this in the lack of any animal remains in Punta Ycacos Lagoon.

Activities associated with the excavated structure include salt making and use of shells for food or other uses. With only a small shell midden and six units of excavations as data, I can only suggest the function of the structure. Further excavations near transect 4, at other locations in the Eleanor Betty site, and other sites in the lagoon could either strengthen the argument made from this research or refute the idea.



## CONCLUSIONS

Salt was a necessity to the ancient Maya, and as such the production and distribution of the resource was of great significance to their culture and civilization. Today, archaeologists (Andrews 1983; Mackinnon and Kepecs 1989; McKillop 2009; Valdez and Mock 1991) conduct research in Mesoamerica in an effort to unravel how salt was viewed, produced and traded by the Maya. Extensive research at ancient Maya salt works in Paynes Creek National Park, Belize has revealed the complexity and importance of the salt industry along the Belizean coast, particularly during the Late Classic period (McKillop 2008).

Focusing research on one area of a salt works site in Paynes Creek National Park allowed me to study the function of that particular area, thereby increasing my understanding of the site as a whole. By conducting excavations inside and outside of a structure at the Eleanor Betty site and analyzing the data collected, I have been able to hypothesize that the structure was connected to the preparation and consumption of food and salt production. The presence of a shell midden, cohune and coyol nuts, obsidian and stone tool fragments, and a large amount of charcoal in the interior of the structure connect the building to food and salt production. The structure may have been a salt works where people ate local food, allowing them to live on site during the salt production season. Further research and excavations at the Eleanor Betty site and other sites in the Punta Ycacos Lagoon are needed to strengthen or refute this idea on Maya salt works in the area. In particular, further excavations of the transect 4 shell midden could reveal its total size and extent, thereby giving clues to its significance to the salt work.

This research shows the advantages of using terrestrial excavation techniques at shallow underwater archaeological sites. Due to sea level rise during the Postclassic period (McKillop et al. 2010) many coastal Maya sites have become inundated and hidden from view and from traditional archaeological fieldwork. Searching for and researching such underwater sites can reveal much about the Maya world before the sea level rise. These sites represent important pieces in the puzzle of Maya studies, and they should be investigated.

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