14 REDISCOVERING STINGRAY LAGOON

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The discovery, mapping, and excavation of Stingray Lagoon, an underwater site in the middle of Punta Ycacos Lagoon, Paynes Creek National Park, southern Belize indicated Late Classic Maya salt production contemporary with nearby inland cities such as Lubaantun and Nim Li Punit. Publications focused on briquetage—the pottery vessels and supports from boiling brine in pots over fires to make salt. Subsequent survey elsewhere in the lagoon system led to the unexpected discovery of wooden posts, preserved because of the peat bog below the seafloor. Was there wooden architecture at Stingray Lagoon, and if so, how was it not found during survey, mapping, and excavation?

Introduction

Archaeological research in Punta Ycacos Lagoon was guided by the scientific method of hypothesis testing with expectations of finding underwater sites submerged by sea-level rise (Figure 1). Previous survey and excavation on the cays and coast of nearby Port Honduras underscored widespread occurrence of inundated Classic Maya sites on land and offshore at known sites (McKillop 2002, 2005a). Boat survey designed to identify underwater sites with no dry land component led to the discovery of Stingray Lagoon (McKillop 1995). Mapping, excavation, and study of the artifacts indicated the site was used for salt production, with overwhelming quantities of briquetage—pottery used to evaporate brine over fires to make salt (McKillop 2002). When subsequent survey unexpectedly revealed wooden architecture at other submerged sites (McKillop 2005b), I wondered whether wood was present at Stingray Lagoon, and had we missed it because we weren't looking for it?

Discovery and Excavations at Stingray Lagoon, 1991

Boat survey in 1991 was initiated to answer two questions: Was Wild Cane Cay, where I had carried out excavations since 1982, an isolated trading port on a sea-trade route, or was it integrated into a coastal network of Classic and Postclassic period settlements (Figure 1; McKillop 1996)? Were there underwater sites in shallow water as suggested by excavation of archaeological deposits below the water table on Wild Cane Cay and from a systematic program of 172 offshore shovel tests around the island (McKillop 2005a)? In 1991 I initiated boat survey in the shallow coastal waters of Port Honduras and Punta Ycacos Lagoon, in southern Belize.

Port Honduras is a coastal bight with two lines of offshore cays paralleling the coast into which several rivers empty, including Deep River, Golden Stream, Middle River, and Seven Hills Creek, with the Rio Grande to the south. These waterways provide water access to Classic Maya inland communities, notably Nim Li Punit and Lubaantun. Punta Ycacos Lagoon is a large salt-water lagoon system north of the Deep River[1]. Apart from families living on Wild Cane Cay and Village Farm, and itinerant fisher folk, the coastal area was uninhabited (McKillop 2005a).

The modern vegetation on the cays and coast dominated by mangroves was inhospitable for settlement due to the lack of dry land and salty soils (Wright et al. 1959): Red mangroves (Rhizophora mangle) line the coast and shores of the cays, with their prop roots extending into the water and rivers up to 12 miles inland. Many of the cays are completing underwater. Some cays include tidal flats inland from the red mangroves vegetated by salt-tolerant black mangrove (Avicennia germinans) and white mangrove (Laguncularia racemosa), as well as other trees and plants that grow on land but are tolerant to salty soils, notably buttonwood (Conocarpus erecta) and palmetto palms (Acoelorraphe wrightii; Wright et al. 1959). This mangrove succession also characterizes Punta Ycacos

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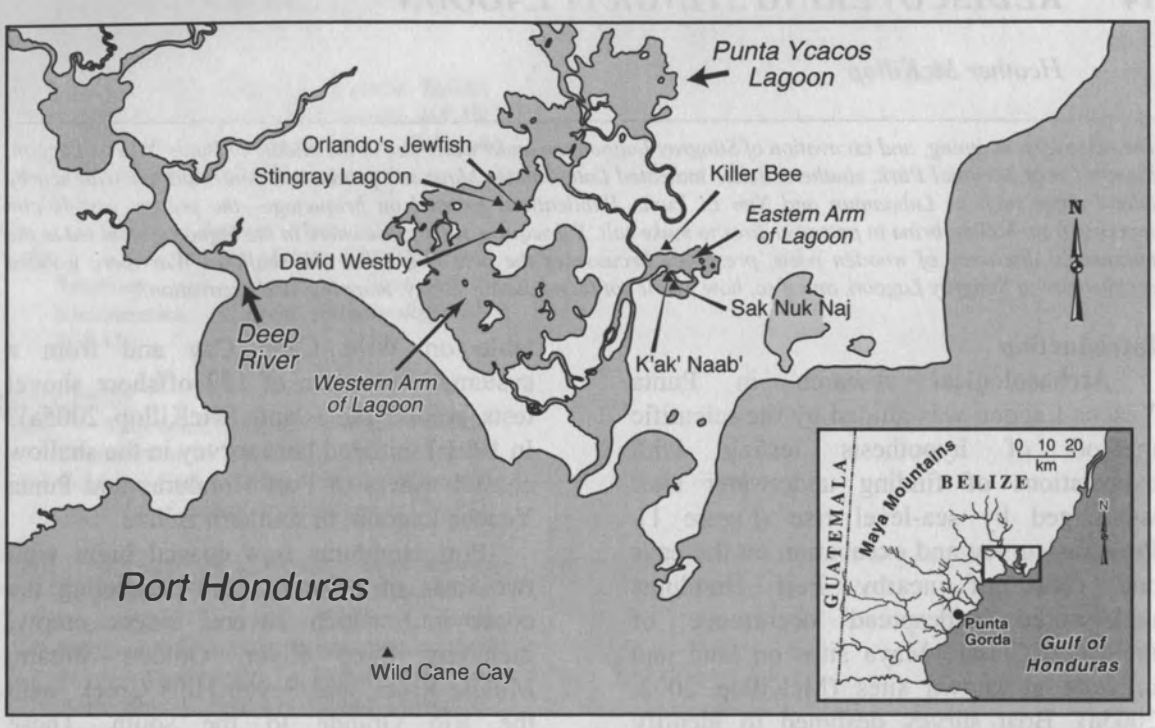

Figure 1. Map of Punta Ycacos Lagoon showing location of Stingray Lagoon and Other Sites, with Insert Showing Location in Southern Belize (Map by Mary Lee Eggart).

Lagoon, which is bounded on the north by pine savannah, grassland with scattered clumps of palmetto palms, pine Pinus caribaea, oak (Quercus oleaides), craboo (Brysonima crassifolia), and cutting grass (Scleria bracteata).

Regional boat survey was carried out in two ocean-going wooden dorys—large dugout canoes with planks raising the sides, operated with 20 HP engines. Both the Adel 2, at 32' in length, and the Seirrita, at 24' in length, were shallow-draft vessels, important for survey in shallow coastal waters. In the virtual absence of other boats, archaeological survey with two boats was insurance in case of boat trouble. For boat survey, the dorys traversed slowly back and forth across the lagoon, while we looked over the side of the boats for artifacts visible on the seafloor, about 1 meter below the water. Anyone seeing artifacts immediately jumped overboard to verify the find, with the knowledge that the boat driver would stop (McKillop 2002: Figure 2.5). Stingray Lagoon was discovered in the middle of the western arm of Punta Ycacos Lagoon, about 300 m from the closest shore (Figure 1). The surface of the site was about one meter below water. The site was completely submerged and did not extend on to land. Artifacts were embedded in the seafloor and continued to a depth of at least 20 cm, as discovered by subsequent excavations. Clearly, the site was "in situ" and not the result of shoreline erosion or redeposition, as at Canballam, Mexico (Dahlin et al. 1998).

A transit was set up at Stingray Lagoon for mapping the surface clusters of artifacts and for setting out excavations (McKillop 1995; 2002: Figure 2.6). Artifact clusters were flagged by a snorkeler, who also took underwater images (McKillop 2002: Figure 2.4). A fishing net was set out around the site to keep away stingrays that were attracted by the silt stirred up by our activities. A 2 x 2 m grid frame was made using red mangrove which sinks. The frame was held in place by stakes made from guava wood. Excavations proceeded using "dry land" techniques, basically ignoring the fact that we were standing in the sea.

Figure 2. Systematic Flotation Survey of Stingray Lagoon (Photo by H McKillop).

Figure 3. Fish Floats on Fishing Line Mark Posts at Stingray Lagoon (Photo by H McKillop).

Excavations were carried out in 4 subunits, using shovels and screening through ¼ " excavation box screens held in the sea (McKillop 2002: Figures 2.7-2.9). Artifacts and charcoal were placed in 100 lb plastic feed sacks. Material was exported under permit to LSU, sorted, analyzed, and returned to the Institute of Archaeology, Belize.

By ethnographic analogy to historic salt production (Reina and Monaghen 1981), Stingray Lagoon was identified as a salt work, characterized by an abundance of briquetage—the pottery vessels and supports used to evaporate brine over fires to make salt (McKillop 1995, 2002). By comparing the briquetage with household pottery from nearby Wild Cane Cay using the statistic "average median variation," I found that the Stingray Lagoon briquetage was standardized in dimensions indicating mass-production of the product, salt. The average median variation statistic calculates the variation from the median measurement, which in the case of the briquetage was the rim diameter and vessel support diameter. The salt jars (AMV = 10.5) from Stingray Lagoon were twice as standardized in vessel opening than household "Bedford Unslipped" pottery (AMV = 20.6) at Wild Cane Cay (McKillop 2002: Tables 4.2, 4.4).

Radiocarbon dating of wood charcoal from Stingray Lagoon indicated the site was used in the Late Classic period, contemporary with several known inland sites in southern Belize and adjacent Guatemala, where salt was in short supply. The radiocarbon date of A.D. 770 ± 50 (one sigma) provides a 95% likelihood that the sample age is somewhere between A.D. 670 and 870, in the Late to Terminal Classic period (McKillop 1995, 2002:52-53). The presence of Late to Terminal Classic ceramics includes Moho Red and Warrie Red types (McKillop 2002). Moho Red resembles Belize Red at Lubaantun (Hammond 1975) and at Belize Valley sites (Gifford 1976). Warrie Red is similar to Remate Red at Lubaantun (Hammond 1975) and Tinaja Red at Altar de Sacrificios and Seibal (Adams 1971; Sabloff 1975).

Elsewhere I have suggested that rituals took place to begin the salt-production season (McKillop 2002, 2010a), as at other salt works (Reina and Monaghen 1981). The material evidence of the rituals includes Moho Red serving vessel sherds, musical instruments (ocarinas), and localization of these ritual objects at certain sites. GIS of the surface mapped artifacts at Stingray Lagoon revealed the ritual objects were concentrated in Cluster A (McKillop 2002: Table 3.17, Figures 3.44-3.47). Overall at Stingray Lagoon, Moho Red (4.3%) and Warrie Red (14.3%) were present in small quantities, compared to the briquetage, which is Punta Ycacos Unslipped type (53.8%), and local water jars (27.1%; McKillop 2002: Figure 3.43).

Underwater Survey of Punta Ycacos Lagoon, 2004

Although the discovery, excavation, and study of material from Stingray Lagoon and three other sites demonstrated mass-production of salt likely for an inland market where salt was scarce (McKillop 2002), the four salt works could not have produced enough salt to meet the biological needs for salt of the nearby inland cities in southern Belize and adjacent Guatemala. In 2004 I began a systematic survey of Punta Ycacos Lagoon to address the extent of the salt production. I wanted to see whether there were more salt works, indicating a more extensive area of salt production that might have met the salt needs of inland consumers. Indeed, survey since 2004 has documented that salt production was extensive, with over 100 salt works in the Punta Ycacos Lagoon system (McKillop 2010a). The sites were marked by briquetage, as at Stingray Lagoon.

The 2004 survey technique consisted of pedestrian survey, with a team of three to four individuals walking side by side at arm's length, looking for artifacts on the seafloor. Walking disturbed the thick silt on the seafloor and reduced visibility. Still, underwater sites were located, some by artifacts visible on the seafloor, others by stepping on the artifacts. As is typical of swamps, there was wood in the lagoon and sometimes protruding from the seafloor. Since wood does not normally preserve in the tropical setting of ancient Maya sites, except under exceptional conditions, such as dry caves, cenotes, and dry temple rooms (Lentz and Hockaby 2009), I assumed the wood was a natural part of the swamp. Eventually, I decided we would excavate a piece of wood protruding vertically just above the seafloor. We freed the sediment from around the wood, by taking turns diving to the meter depth, holding onto the seafloor with one hand and digging with the other. After about a meter of digging, the wood was freed from the seafloor. Lifting the wood above the water, we saw the wood was clearly a post. The post was about one meter in length, straight, and with a pointed

Figure 4. Mapping Posts at Stingray Lagoon, with John Young holding Prism Pole and Bretton Somers on Walkie-Talkie to Total Station Person (photo by H McKillop).

Figure 5. Zoe Morris untangling Floats at Stingray Lagoon (photo by H McKillop).

end with large flake scars from cutting. That was site 15, which we renamed "Sak Nuk Naj." I wondered whether there were wooden posts at the other 14 sites found in 2004, or earlier, including the Stingray Lagoon site.

After locating a dozen more wooden posts at Sak Nuk Naj, which formed a rectilinear outline of what I termed a "salt shed" in my notes, we returned to site 14 to search for wooden posts. In addition to posts, we discovered a wooden canoe paddle, similar in design to the paddles used by the paddler gods on the incised bones from burial 116 at Temple 1 at Tikal (Trik 1963). We renamed Site 14, "K'ak' Naab,' meaning "Fiery Water Place." In fact, we found wooden posts at all the other sites in the East Lagoon that year. The wooden posts protruding minimally from the seafloor and

were discovered more by feeling the seafloor with our hands than by seeing them from above the water.

Still, the age of the wooden posts and the canoe paddle needed to be determined, even though they were associated with Late to Terminal Classic pottery and briquetage. Radiocarbon dating demonstrated the wooden posts and the canoe paddle were contemporary with the briquetage and other artifacts at the salt works (McKillop 2005b). More than just an old canoe paddle, the radiocarbon date of A.D. 660-880 indicated that the site 14 canoe paddle was the first known ancient Maya canoe paddle (McKillop 2005b). Renamed K'ak' Naab,' the artifacts and posts at the site were individually mapped using a total station from a cement datum placed on nearby land, revealing wooden structures with briquetage concentrated outside, perhaps from keeping the work area clean (McKillop 2007).

Mapping Posts Underwater, 2005-2009

A new survey project, "Mapping Ancient Maya Wooden Architecture on the Seafloor, Belize," was begun in 2005, with new survey techniques geared to finding wooden posts and preserving the integrity of the underwater sites (McKillop 2005b, 2007, 2010a). A team wearing masks and snorkels floated on "Research Flotation Devices" (RFDs), shoulder to shoulder, back and forth across sections of the lagoon in search of sites. Floating preserved the integrity of the seafloor, whereas sometimes walking created gaping holes. In addition, floating allowed greater visibility of the seafloor without stirring the loose silt that covered the seafloor. When a site was discovered, the systematic flotation survey was carried out at the site, flagging posts and temporally diagnostic or culturally significant artifacts. In shallow water we used surveyor's metal or plastic flags. In deeper water we used fishing line tied to fish floats, with the fishing line tied to a metal skewer and sunk into the seafloor by each find. Each flagged post and artifact was individually mapped using a total station. The digital data were transferred to the GIS Geomedia by

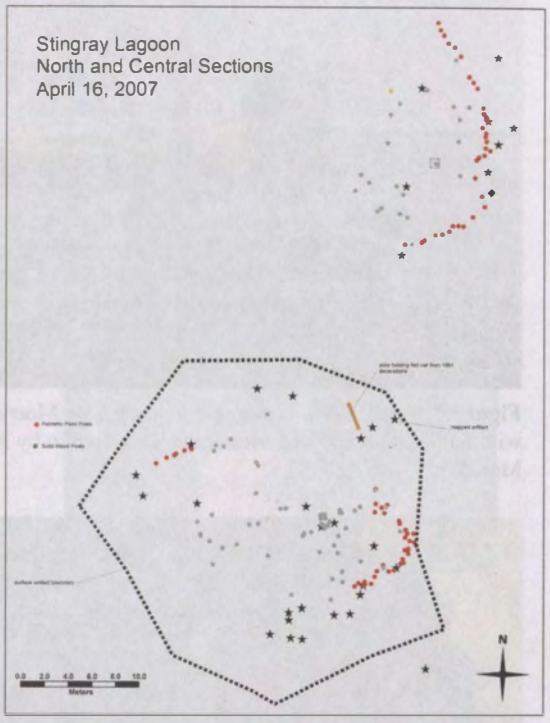

Figure 6. GIS Geomedia Map of Posts at Stingray Lagoon by Cory Sills.

Intergraph to create site maps (McKillop 2007, 2010a; Sills 2007; Somers 2007).

With the unexpected discovery of wooden posts demarcating buildings preserved in a peat bog below the seafloor in the eastern arm of Punta Ycacos lagoon (McKillop 2005b), I wondered whether we had missed finding wooden posts and artifacts in the western arm of the lagoon system, including at Stingray Lagoon and the other sites published in my *Salt* book (Figure 1; McKillop 2002). The lack of GPS coordinates, dramatic vegetation changes from 140 MPH winds from Hurricane Iris in 2001, and the fact that Stingray Lagoon was underwater and about 300 meters from the nearest shore, made relocating the site difficult. Despite several attempts to relocate Stingray Lagoon, it was not relocated again until systematic pedestrian survey in 2007, with a team of six archaeologists walking back and forth in the middle of the Western arm of Punta Ycacos Lagoon (Figure 1).

The three areas of Stingray Lagoon were relocated, along with abundant briquetage, poles with rope we used to string the

Figure 7. Post 18 Wood Sample held by Zoe Morris with Sampling Knife and Measuring Tape (photo by H McKillop).

Figure 8. Transverse Section of Stingray Lagoon Post 77 Sample Showing Preserved Wood Structure (photo by H McKillop).

protective fishing net during excavations, and guava stakes from our excavations. The red mangrove grid frame was later relocated at the Orlando's Jewfish site where we had excavated after Stingray Lagoon excavations in 1991. We began a systematic flotation survey to locate wooden posts (Figure 2). Ten-foot lengths of PVC pipe were used to mark survey lines, to assist keeping the survey team on course. The PVC pipes were moved as the survey team moved across the site. We used fishing line attached to fish floats (Figure 3). When our supply was depleted, we used plastic soda bottles and empty medicine bottles, with lids secured. Even though the lagoon is subject to micro-tidal variation of about 50 cm, the lengths of the fishing lines had to be adjusted during mapping to ensure artifacts were correctly located. The fishing lines often became tangled in the deep and rough water, which made mapping difficult (Figures 4-5).

A total of 151 wooden posts were discovered and mapped (Figure 6). There were lines of palmetto palm posts in the central and northern areas of the site. Solid wood posts formed the outlines of wooden structures. The post diameters were measured using plastic sewing tapes, with the measurements recorded in waterproof notebooks (Figure 7). Wood samples were taken for species identification and for experimental research on tropical tree-ring dating (Figure 8; McKillop 2006). In order to get a clean section of wood without the worms that ate the wood protruding above the seafloor, we cleaned the peat away from each post and cut wood from below the seafloor. Post samples were immediately placed in labeled plastic bags full of water to prevent them from drying out which would distort the wood structure and make species identification difficult. We placed the wood samples in fresh water to begin the conservation process of desalinization. The wood samples were periodically rinsed in fresh water, exported under permit to LSU, and where conservation continued.

Species identification of the waterlogged wood from Stingray Lagoon and other Paynes Creek underwater sites followed a different methodology than is typical for Maya sites where the wood is charred and dry. Normally wood charcoal from Maya sites is identified using a reference collection of charred wood. Even for wooden lintels at Tikal, the wood samples were charred in preparation for species identification (Lentz and Hockaby 2009). Instead of attempting to burn wet wood, I contacted wood anatomist Mike Wiemann and brought him to LSU under a grant, where he began species identification, using modern wood samples and thin-sections from the USDA Forest Products Lab in Madison, WI (McKillop 2006). Wood species identifications of posts are currently underway, with additional funding (McKillop 2010b). Beginning in 2010, we are sampling smaller pieces of posts and

Figure 9. Front View of Figurine Whistle from Stingray Lagoon North (photo by H McKillop).

Figure 10. Profile View of Figurine Whistle from Stingray Lagoon North (photo by H McKillop).

Figure 11. Front View of Stingray Lagoon Trickle Ware Bowl with Preserved Paint (photo by H McKillop).

Figure 12. Side View of Stingray Lagoon Trickle Ware Bowl with Preserved Paint (photo by H McKillop).

identifying the wood species at our field station (McKillop et al. 2010).

In addition to well-preserved wood, ceramics retained their surface finish and slip, albeit often discolored black. Thick silt, up to 15 cm in depth, covered the seafloor and made searching for posts in the underlying peat difficult. However, the deep silt preserved the surface finish and paint on ceramics, which was eroded at most of the other Paynes Creek underwater sites (Figures 9-12).

Discussion and Conclusions

How can I explain the fact that we did not find wooden posts during survey, mapping, and excavations at Stingray Lagoon in 1991 when they were indeed part of the site? Using the scientific method in archaeological research includes both inductive and deductive reasoning based on observations of objective reality. My initial deductive reasoning for survey in Punta Ycacos Lagoon was based on hypotheses with implications of what would be found to support or negate a hypothesis. I expected to find underwater sites, since we had found inundated deposits on land at Wild Cane Cay and deeply buried, in situ deposits by offshore shovel testing around the island (McKillop 2002, 2005)[2].

Based on knowledge of the lack of preservation of wooden architecture in the tropical landscape of ancient Maya sites, searching for wooden posts was not part of my research design for identifying salt works during the 2004 underwater survey in Punta Ycacos Lagoon. In fact, field survey was focused on locating new sites to identify the extent of salt production and collecting 30 measurable Punta Ycacos pottery rims and 30 measurable Punta Ycacos vessel supports to study variability in the standardization of salt production. During the 2004 systematic survey we did not find posts until site 15 of that year and only then because we repeatedly encountered what I initially considered wood that was part of the natural landscape. Even when we did find posts, most were difficult to find. Most posts barely protruded from the mangrove peat of the sea floor. Deep silt covered the seafloor and obscured visibility in most areas, although Hurricane Iris scoured parts of the lagoon floor in 2001, leaving artifacts and posts visible without a covering of silt. This was not the situation at Stingray Lagoon or in the East Lagoon where we found sites in 2004. After we knew posts were present, each new site survey built on the knowledge that posts were present at other sites and the knowledge that they formed rectangular patterns, with lines of palmetto palm posts located at a distance from solid wood posts. What more lies buried below the seafloor in Punta Ycacos Lagoon?

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[1]Punta Ycacos Lagoon and area was declared Paynes Creek National Park in 1994. The Port Honduras coastal and offshore area was declared Port Honduras Marine Reserve. Both protected areas are co-managed by TIDE (Toledo Institute for Development and the Environment), although archaeology remains under the mandate of the Belize government Institute of Archaeology.

[2]However, the inundated deposits had been an unexpected part of stratigraphic excavations in search of obsidian for identifying the timing and extent of long-distance trade at Wild Cane Cay (McKillop 2005).

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