Archaeological Investigations at the South Bank Site Providenciales, Turks and Caicos Islands

Advanced Laboratory Analyses Amplify Understanding of Lucayan Diet and Ceramics

Parts 1 and 2

Shaun Sullivan, Ph.D.
Anthropological Research Council
sullivans@anthrop.research.council.org

Michael Pateman, Ph.D.
Director, Bahamas Maritime Museum

Brittany Mistretta, Ph.D.
Candidate, Faunal Analyst, Fla. Museum of Natural History

Jenna Battillo
Microbotanical Analyst, Florida Museum of Natural History

Lisa Duffy
Microbotanical Analyst, Florida Museum of Natural History

Michael S. Smith, Ph.D.
Earth and Ocean Sciences, University of North Carolina-Wilmington, Wilmington, N.C.

Eleanora Reber, Ph.D.
Dept. of Anthropology, Univ. of North Carolina-Wilmington, Wilmington, N.C.

Charlene Dixon Hutcheson
Ceramic Basketry Impression Subject Matter Expert

Occasional Papers of the Turks and Caicos National Museum
Number 12
2024

CONTENTS

Discovery and Previous Investigations

Early in the 20th century Theodoor De Booy (1912) conducted archaeological research in the Turks and Caicos Islands in association with the Heye Museum of the American Indian. He recovered pre-Columbian artifacts in the caves above Juba Point, a few minutes' walk northeast of the South Bank Site. De Booy provided photographs (1912: 89-91) of recovered ceramics with decoration via broad line incision; wide dot punctation and one drawn illustration of a sherd with a line and dot motif. De Booy did not analyze the recovered ceramics for their mineral content, and thus did not differentiate between locally made shell tempered ceramics and igneous/metamorphic tempered imports from the Greater Antilles. However, many of De Booy's illustrated decorative motifs are consistent with late ceramic traits from the Greater Antilles generally associated with the Chicoid stylistic tradition, dating from approximately 1200 AD onward (Rouse: 1992: 52, 112). Chicoid ceramics have distinctive decorative elements, and these more elaborate and eye-pleasing Chicoid specimens may have been differentially selected for illustration by de Booy. These may thus be overrepresented in the presentation.

Sullivan visited the Juba Point caves and the shores of Juba Sound in the summer of 1976 and observed pre-Columbian ceramics and shell remains among distinctive grass beds just inland from the ironstone shoreline, on the eastern margin of the Sound. Much of the site had been disturbed by excavation of a channel to what became the Caicos Marina, but portions of the site remained undisturbed. The site was originally recorded as Providenciales-1 (P-1), but has since been re-named the South Bank Site (Figures 1 and 2). Surface collection of artifacts, preliminary excavations and screened sampling from a bulldozer back dirt pile were conducted in January 1977. Ceramics were analyzed at the University of Illinois and faunal bone remains from the site were assessed at the Florida Museum of Natural History by Elizbeth Wing and Sylvia Scutter (Sullivan, 1981: 325-332). As a result of those analyses the South Bank site was attributed to the Lucayan culture because of the presence of locally made Palmetto Ware ceramics; extensive contact with Amerindian cultures of the Greater Antilles was inferred from the presence of imported ceramics containing igneous and metamorphic tempering; faunal analysis documented extensive exploitation of finfish from nearby estuaries, banks and patch reefs, as well as land animals; i.e., hutia (Geocapromys sp.) and iguana (Cyclura sp.). A charcoal sample from a firepit encountered in the test excavation was radiocarbon dated at the University of Illinois, Illinois State Geological Service (ISGS 2732), producing a calibrated date of 1279 to 1377 AD (Freimuth and Sullivan 2017: 32). Part of the 1977 work at the South Bank site included mapping of local environmental zones and definition of resources within those zones (Sullivan 1980, 1981), see Figures 2 and 15.

Rediscovery and Renewed Research

Along with local Beluga Captain Tim Ainley. Sullivan revisited the site in the spring of 2018, noted that portions of the site remained undamaged. Longbay resident Katie Harrington, who wandered by with her dog, advised that the site was soon to be converted to housing and a marina. Concerned by the pending loss of cultural remains, the developers were contacted and outreach to the local community began.

Figure 1. The Island of Providenciales.

Coming to understand the value of the site to Turks and Caicos cultural heritage, Windward Long Bay Development Ltd, via Ingo Reckhorn, generously agreed to fund the bulk of the cost excavations and analysis to capture key information about the ancient culture -- while there was still time. Additional funding and support came from the Turks and Caicos Reef Fund, the Anthropological Research Council, and Sail Beluga, Blue Loo and TC Millwork. Enabled by a research permit from the Department of Environment and Coast Resources (DECR), and supported by the Department of Education, the Department of Culture, the Turks and Caicos National Trust, local volunteers, and students from British West Indies Collegiate, archaeological rescue excavations were conducted at the South Bank site in October, 2018. That happened to be Turks and Caicos "Heritage Month", a very fitting context for this research. Early in the project planning Dr. Michael Pateman, Director of the Turks and Caicos National Museum (TCNM) and Candianne Williams, Provo representative of the TCNM, were brought in as partners in the research. (Please see the "acknowledgements" section for individual credits to the people who helped with this endeavor).

Methodology

From the outset the 2018 excavations were a community effort. Turks and Caicos government officials provided permits and encouragement. Long Bay residents and students from BWI Collegiate composed the field crews, and Windward Long Bay Ltd. Provided facilities at the Caicos Marina to support the effort. The month before the dig began the TCNM hosted an evening lecture that brought in interested parties and provided a venue for discussion of the upcoming research at South Bank. Local print and radio media provided advance coverage of the pending dig. A vital sun shelter, that was the site of our field laboratory, was provided by TC Millwork,

South Bank Site

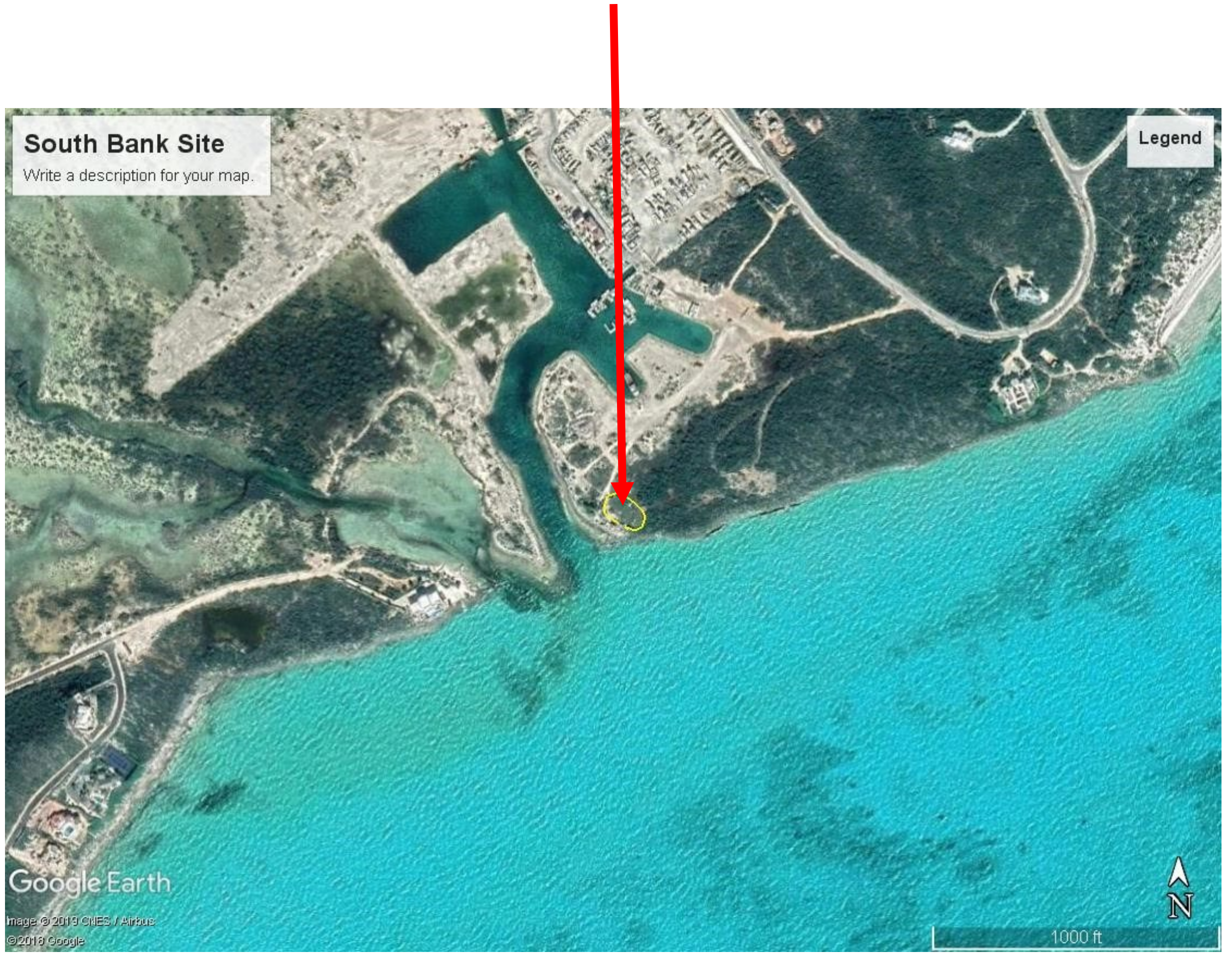


Figure 2. Location of the South Bank Site.

and an on-site porta-potty was provided by Blue Loo.

Each day of the dig began with a group discussion of topics related to the research at hand. Discussion themes included: ancient human migration into the Americas and the Caribbean; prehistoric Amerindian visitation and colonization of the Turks and Island, and the development of local Lucayan Culture; archaeology and anthropology as scientific disciplines; the role of museums in telling the story of local cultural heritage; and specific goals, strategies and team tasks for the excavations at South Bank.

Cued by the surface scatter of ceramics and shell, a site datum point was established about 15 meters north of the machine scrape back dirt pile, at approximately 21° 45' 41.87" N; 72° 10' 28.83W. Using datum as reference, a 5-meter interval grid of stakes was put in place. Subsoil testing began with digging shovel holes to determine the horizontal distribution and depth of cultural deposits (midden). The locations of the shovel tests are shown in Appendix A; all were within the area of site remnants (surface scatter) indicated in Figure 3. Concentrations of midden demonstrated by the shovel testing which we

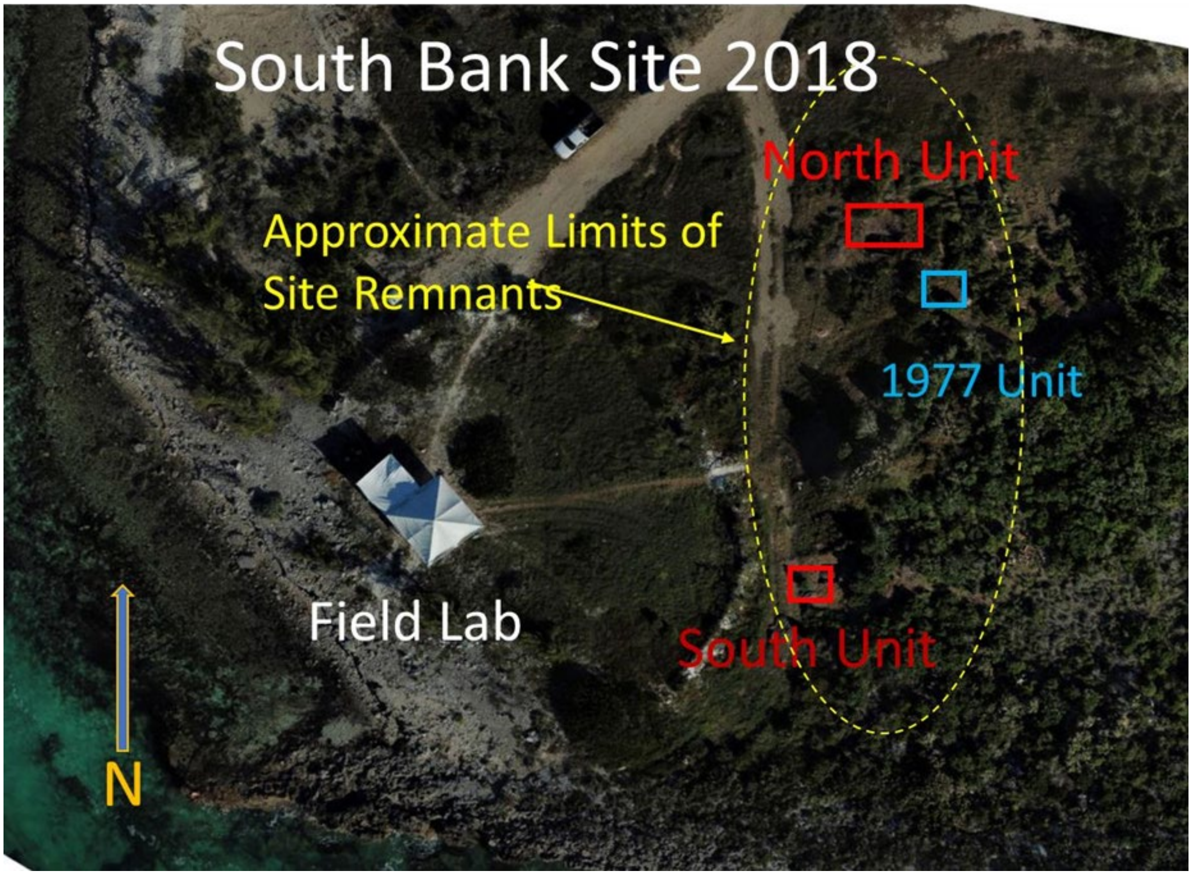


Figure 3. South Bank Site 2018.

used to choose areas for controlled subsurface excavation. Those excavation units were concentrated between 4.5-7 meters north of datum and 3.5 to 6 meters east (3.5-6 E) (Figure 4); as well as 24 to 26 meters south (24-26 S) and 4 to 6 east (4-6 E), with an adjunct small unit 24-24.5 S, 2.5-4 E (Figure 5). The excavation units were taken down in 10 cm levels, with adjustments to natural stratigraphy when that became evident. To conceptually link the two excavation phases, we note that the estimated position of the 1977 excavation (2 meters by 2 meters) was 2-4 N, and 9-11 E (Figure 3), based upon its relative position to the back dirt pile, as shown in a 1977 photograph. All excavated materials were screened through 1/4-inch mesh, with selective secondary sifting through window screen of some zones.

The field crews were taught excavation techniques; screening and selection of artifacts, charcoal samples, faunal bone; shell classification and analysis at the field laboratory, to include identification of the minimum number of individuals of specific shell and species (comparative collection provided by local resident Teres Rolle); preservation of charcoal for radiocarbon dating; classification, quantification and photography of local Palmetto Ware and imported ceramics; selection and preservation of bone, shells, ceramics and soil samples for subsequent analysis. Selected samples of ceramics, charcoal, soil and shells were provided to experts in specialized laboratories for follow on analysis. Special attention was given to *Codakia orbicularis* shells, which were

Figure 4. Michael Pateman, Local Volunteers and Students Northern Excavation Area, Black Earth Oven Feature, Unit 302-W.

preserved for edge wear and organic residue analysis. Figure 6 shows characteristic shell edge wear derived from use as a scraper.

Site Dating

Charcoal samples were provided to Beta Analytics laboratory in Miami Florida for radiocarbon dating. Appendix F contains the detailed Beta Analytics report. The key data from the report includes the following calibrated dates, with indicated probability.

These test results provide high confidence that the tested occupation layers at South Bank date between the late 1200s and early to mid-1400s AD (Table 1). Note that the earliest date range is for the sample 313, the deepest strata tested at 40 to 52 cmbs, which makes sense in terms of temporal stratigraphic succession. Thus, the earliest dated layer is also the deepest, which is logical in terms of the process of superimposition of cultural deposition through time. The earliest layer should be the lowest, and the latest deposits in the uppermost layer—assuming no digging occurred to disturb the original stratigraphy. Conforming well with the dates shown above is the calibrated radiocarbon date from the 1977 excavation at the site mentioned above, which was 1279 to 1377 AD. The actual span of occupation of the South Bank site may have begun somewhat earlier, and extended longer than the dates cited, but the general picture of occupation from the middle to late 1200s to early-mid 1400s AD is likely to hold true. The radiocarbon dates cited are from the portion of the site that survived construction disturbance. The site originally extended much further north along the eastern margin of Juba Sound, per reports from local residents in 1976, and there may have been earlier as well as later components to the site that were destroyed and hence are undated.

Figure 5. Student and Local Volunteer -- South Excavation Unit.

Part 2:

Indicators and Traces of Lucayan Diet

Several analytic approaches were employed to assist in characterizing the Lucayan diet, which is a reflection of their resource exploitation strategies and agricultural practices. Shell remains were analyzed on site, by genus, species and minimum individuals. Ceramics and selected shells were analyzed for biochemical traces, lipids principally. Microbotanical analysis of ceramics, shell and soil included identification of phytoliths; pollen and starch

Figure 6. Codakia Orbicularis Edge Wear—South Bank Site.

grains; bone remains were assessed by genus and species and for flesh equivalency, as were shellfish.

Microbotanical

Microbotanical analysis was conducted at the Florida Museum of Natural History (FMNH) by Jenna Battillo and Lisa Duffy. The full report is presented as Appendix B**.**

Starch Residues: one starch grain consistent with maize on shell

No starch was found in any of the ceramic sherd residues. A sample from shell (Codakia orbicularis) FS# 302 (5-7 N, 3-6 E. 10-20 cmbs) yielded a single starch grain. The characteristics of the grain; shape, size, hilum position and fissure pattern are consistent with maize.

Phytoliths: possible / equivocal traces of squash, sunflower, palm and arrowroot.

Few phytoliths were found; 15 tracheids, four echinate (spiny) spherical types (palm and likely arrowroot), two unknown perforate types, one panicoid grass phytolith, and one possible squash (Cucurbita) phytolith. It is very likely based on the pollen and phytolith evidence that sunflower seeds or other seeds/flowers from the family Asteraceae may have been associated with this midden and had economic significance, but since members of family Asteraceae are common disturbance

Field Serial No.	Probability	Date Range AD	Date Range BP	Depth
P1-SB 313	84.90%	1392-1443 cal AD	558-507 cal BP	40-52 cmbs
P1-SB 302	67.90%	1289-1370 cal AD	652-580 cal BP	10-20 cmbs
	27%	1380-1413 cal AD	570-537 cal BP	10-12 cmbs
P1-SB 304	95.40%	1298-1370 cal AD	654-541 cal BP	20-30 cmbs

Table 1. Radiocarbon Dates 2018.

plants, it could be that the pollen and phytolith associated with their inflorescences are a result of weedy growth on or near the midden. One phytolith also indicates the possible presence of squash and several phytoliths from the soil sample and one each from shell FS# 302E, 303, and ceramic FS# 303 are indicative of either palm fruit and/or arrowroot. Although the diminutive size of these phytoliths and potentially partial degradation made it difficult to see their features clearly, it appeared there were at least two different types of these round spiny phytoliths, so it is probable that they represent both palm and arrowroot use.

Pollen: <u>one maize pollen grain was identified in a soil sample</u>

The pollen that was found was poorly preserved. One maize pollen grain was identified from a soil sample. Two fragmentary high- spine type Asteraceae (sunflower family) pollen were found, one cheno-am pollen, one grass pollen. One fragment potentially consistent with Malvaceae (mallow family) was also encountered, but this was counted as not identifiable since less than half of the grain was recovered.

Faunal Bone

Faunal bone was analyzed by Brittany Mistretta, Ph.D. Candidate, Florida Museum of Natural History (FMNH). The complete report is contained in Appendix C**.**

Previous zooarchaeological research of faunal materials from the South Bank Site, conducted by Sylvia Scudder and Elizabeth Wing, determined Amerindian exploitation of catchment areas and environmental zones, including flats, reefs and flats, and tidal inlets (Sullivan 1981: 325-332) (Figure 1). In addition to aquatic fauna, Wing and Scudder also identified terrestrial fauna including hutia (*Geocapromys* sp.) and rock iguana (*Cyclura* sp.). Salvage excavations of the site's remaining midden area in 2018 provided the opportunity to contribute additional contemporaneous information to their findings. Mistretta identified a total of 15 taxa (10 vertebrates and 5 invertebrates) representing 11 Minimum Number of Individuals, (MNI) (See Appendix Tables 1 and 2). The assemblage of both units contained a total Number of Identified Specimens (NISP) of 113, with vertebrates making up 86.7% of the assemblage and invertebrates making up 13.3%. Vertebrates were only represented by fish taxa. No mammals, reptiles, or birds were identified, thus terrestrial environmental zones are not represented within the 2018 assemblage, with the exception of land crab, which is possibly intrusive. Unit 5-7N had the greatest NISP (108) and MNI (10) (Table 2).

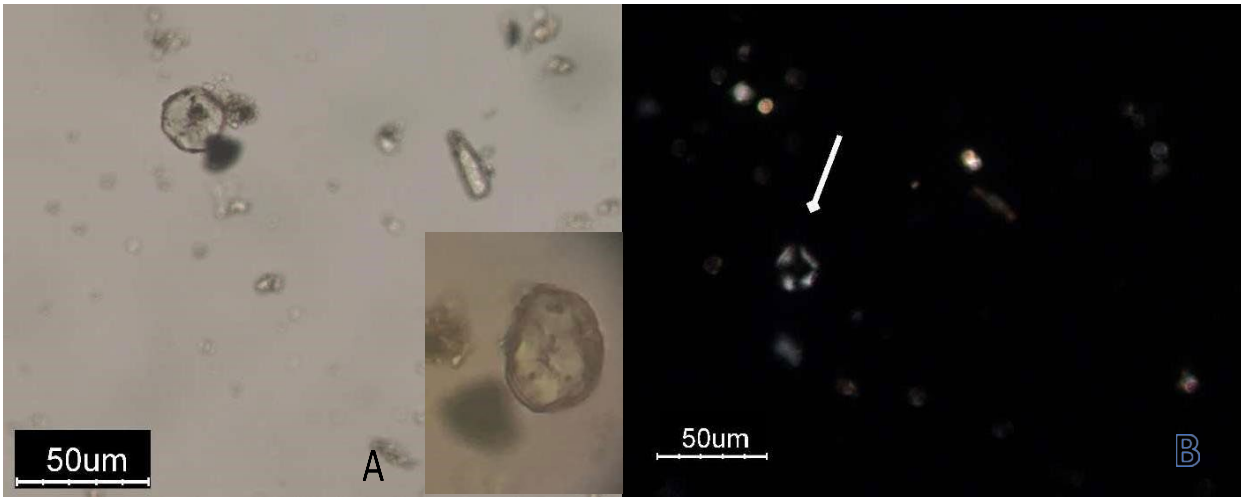


Figure 7. Shell FS# 302 "Special Shell" Starch Grain. A) Probable maize starch under plane-polarized light B) Grain under cross-polarized light.

Unit 24-26S had a very small NISP (6) and MNI (1) totals. Fish were only identified in Unit 5-7N and had the largest representation of all taxa in this unit (42.6%). Fish identified to genus or species represent three environmental zones including flats, reefs and flats, and tidal inlets, which aligns with Wing and Scudder's original analysis. Parrotfish (*Sparisoma* sp.), grouper (*Epinephalus* sp.), and spadefish (*Chaetodipterus faber)* reside in reefs and flats. Grunt (*Haemulon* sp.), snapper (*Lutjanus* sp.), surgeonfish (*Acanthurus* sp.) are found in reefs, flats, and tidal inlets, and porgies (Sparidae) are found among tidal inlets and flats. The South Bank site is situated in close proximity (~2 km) to the three represented environmental zones in the analyzed assemblage (Sullivan 1981: 329). Lucayan peoples would have easily accessed these prime locations for maximizing the exploitation of aquatic resources.

Elements of 45 fish were recovered from the South Bank site in 2018. Most of the identified fish were found in Unit 5-7N, except for 1 NISP identified in Unit 24-26S, and fish were the most frequently represented of all taxa in Unit 5-7N (42.6%), a pattern that is consistent between levels. Identified taxa include parrotfish (Sparisoma sp.), grouper (Epinephalus sp.), spadefish (Chaetodipterus faber), grunt (Haemulon sp.), snapper (Lutjanus sp.), surgeonfish (Acanthurus sp.), and porgies (Sparidae). Certain taxa were found only in the uppermost level (20-30 cmbs: Acanthurus sp., Haeumulon sp., Lutjanus sp., Scleractinia, Callinectes sapidus) and others only in the lower level (40-X cmbd: Chaetodipterus faber, Epinephalus sp., Cardisoma guanhumi), a difference that could be attributed to the low number of specimens or, possibly, to differences in fish use between time periods.

The Wing and Scutter analysis of faunal bone remains from the 1977 excavation identified finfish as estimated 96% of flesh in vertebrate remains, with land animals and birds as an estimated 4% of vertebrate flesh; e.g., hutia (Geocapromys sp.) and iguana (Cyclura sp.) (Sullivan 1981: 325-332). Shellfish contributions to diet

Faunal Bone - Fish Remains South Bank			
2018 flesh formula employed is:		**skeletal wt x 13.33 x .5**	
	2018	**2018**	
Genus species	**Skeletal wt**	**Flesh wt**	**Common name**
	grams	grams	
Vertebrata	10.94	72.92	
Acinoptergyii	6.13	40.86	Ray-finned fish
Acanthurus sp	0.05	0.33	Sturgeonfish
Chaetopidipterus faber	2.86	19.06	Spadefish
Scaridae	0.22	1.47	Parrot Fish
Sparisoma sp	3.6	23.99	Parrot Fish
Sparideae	0.13	0.87	Porgies
Haemulon sp	0.36	2.40	Grunt
Lutjanus sp	1.04	6.93	Snapper
Serranidae	0.5	3.33	Grouper
Epinephalus sp	0.18	1.20	Grouper
Total Fish		173.36	

Table 2. Fish.

were not quantified in the 1977 analysis, but are factored in here below, based upon 2018 collections and analysis. The vertebrate remains recovered in 2018 were exclusively fish. As reflected in Table 3 below, the fish bone recovered corresponded to 173 grams of flesh. From the 1977 excavations, Geocapromys (hutia) remains were 59 grams; Cylcura (iguana) 29 grams; Fish remains constituted 2,382 grams.

Shellfish

The shellfish remains recovered at the South Bank site in 2018 are remarkable for their lack of variety. *Lobatus gigas* (conch) constitutes the great majority of the shellfish excavated, composing a minimum of 198 individuals, which would have yielded more than 37 kilograms of edible flesh (Table 3). This stands in contrast to the relatively few other shellfish genus/species represented in the recovered remains, representing 22 individuals from 12 genus/species, shown in Table 4.

Regarding the predominance of *Lobatus gigas* (conch), traditional subsistence fishing for conch in these islands involved removal of the flesh from the shell over the side of the vessel or at the shoreline, with the shell left behind and the flesh taken to shore for preparation and consumption. Taking this as a likely practice of the Lucayans as well, the Lobatus gigas shell remains found on the site should represent a small percentage of the animals taken.

		Table Shellfish	Lobatus gigas				
FS No.	Provenience		Description				
	Meters N,S,E or W	centimeters	"ca" = circa, close to	Ceramics			
		below surface		L gig	L gig	L pug	L pug
2018		cmbs		MNI	grams	MNI	grams
	Northern Units						
306	4-5N, 2-4.5E	0-ca.8cmbs	excavation unit	11	3014		3014
309	5-7N, 2-3E	0-10 cmbs	excavation unit	1	986		986
300	5-7N, 3-6E	0-10 cmbs	excavation unit	7	4625		4625
310	5-7N, 2-3E	10-20 cmbs	excavation unit	1	1170		1170
302	5-7N, 3-6E	10-20 cmbs	excavation unit	12	3324		3324
302W	5-7N, 3-4.5E	20-30 cmbs	excavation unit	17	7272	1	15
302E	5-7N, 4.5-6E	20-40 cmbs	excavation unit	25	11538		11538
313	5-7 N, 4-5-6E	40-52 cmbs	excavation unit	7	4228		4228
319	SW corner, unit 302 W	20-ca 30 cmbs	excav feature	5	1564		1564
			Totals	86	37721	1	15.00
	198 grams flesh per ind		Minimum flesh	17028			
	Southern Units						
301	24-26S, 4-6E,	0-10 cmbs	excavation unit	12	6695	1	10
303	24-26S, 4-6E,	10-20 cmbs	excavation unit	38	6818		6818
304	24-26S, 4-6E,	20-30cmbs	excavation unit	15	3289		3289
305	24-26S, 4-6E,	ca 30 cmbs	excavation unit	22	2818		2818
305	Feature 1	ca 30 cmbs	NE corner of 305	1	88		88
311	24-26S, 4-5E	25-35 cmbs	excavation unit	4	2372		2372
307	24-26S, 4-5E	30-35 cmbs	excavation unit	1	140		140
308	24-26S, 5-6E	30-35 cmbs	excavation unit	4	456		456
314	24-26 S, 5-6E	35-40 cmbs	excavation unit	1	1494		1494
315	24-26 S, 4-5E	35-40 cmbs	excavation unit	0	0		0
			totals	98	24170		24170
	198 grams flesh per ind		minimum flesh	19404			
	Small Unit NW corner	S. Units					
316	24-24.5 S, 3.5-4E	0-10 cmbs	small excav unit	0	0		0
317	24-24.5 S, 3.5-4E	10-20 cmbs	small excav unit	1	822		822
318	24-24.5 S X, 3.5-4E	20-30 cmbs	small excav unit	3	722		722
320	24-24.5 S-3.5-4E	30-33 cmbs	small excav unit	1	434		434
	198 grams flesh per ind		Totals	5			
			Minimum flesh	990			

Table 3. Lobatus Gigas.

This distribution of shellfish remains at South Bank stands in strong contrast to the heavy exploitation of Citarium pica (West Indian Top Shell) at the Lucayan Cotton Cay site (Sullivan and Freimuth 2016: 6) near Grand Turk Island, and the very wide variety of shellfish species recovered from the midden at Lucayan site, MC-12, on the north coast of Middle Caicos (Freimuth and Sullivan, 2017: 23). Of note also is the absence of shell beads at the South Bank site. No Oliva sp. beads were recovered, and no circular cut shell beads were found. The absence of both is unusual for a Lucayan site. Many examples of Oliva sp shell beads were recovered from MC-6 (Sullivan 1981: 153) and MC-12 (Freimuth and Sullivan 2017: 23) on Middle Caicos. From the 1977 excavations one circular cult shell (mother of pearl) was recovered, but this appears to have been an inlay, not a bead.

Genus/Species	
Barbatia sp.	4
Braciodontis sp	4
Ceritium sp	1
Chione cancellata	1
Codakia orbiculata	2
Codakia orbicularis	9
Diodora sp	1
Laevicardium laevigatum	1
Nerita sp	1
Lobatus pugilis	2
Tectarius muricatus	1
Tuuva maculosa	1

Table 4. South Bank Other Shellfish.

Biochemical (Lipid) Analysis of Ceramics and Soil

Biochemical analysis of shell and soil samples were conducted by Dr. Eleanora Reber of the University of North Carolina, Wilmington. The complete report appears as Appendix D. Each of the samples tested contained plants, as indicated by plant sterols. Sample 304 (20-30 cmbs 24-26S, 4-6E) contained primarily fish/shellfish as well as plants, and a small amount of conifer resin. Sample 302 (10-20 cmbs, 5-7N, 3-6E) contained primarily a mixture of plants and meat or fish, with a small amount of conifer resin. Specimen 301 (0-10 cmbs, 24-26S, 4-6E) contained primarily plants, with fish/shellfish possibly present, as indicated by the fatty acids. There was no evidence of conifer resin in this residue. Contamination was present but did not noticeably affect the interpretations.

All residues contained an unusual series of 2-hydroxy and w-hydroxy fatty acids that could not be easily interpreted. They may originate from nerve lipids (cooking brains, for example), from an unusually large amount of bacteria, from tubers, from bark, or from another resource that has not been identified yet. Note: processing of tubers (e.g. manioc, leren, yamia, sweet potato) is one potential source of these fatty acids.

Overall Interpretations

Of the three sherds analyzed, all appeared to have been used to process plant resources. Two of them, 304 and 302 were also used to process meat and/or fish resources. Fish is more likely with 304, and meat more likely for 302. Sample 301 could not be interpreted as having been used to process meat, fish may have been present, but this is uncertain. These interpretations are based on the overall fatty acid composition, which in all samples were highly unsaturated and with the fatty acid C16:0 (palmitic acid) being the most abundant. This is typical of predominately plant based fatty acids. All residues in the project contained plant sterols, including sitosterol, which are biomarkers for the presence of plant resources. Two, 304 and 302, also contained cholesterol, which is a biomarker for meat and/or fish resources.

Terrestrial Animal Meat vs Fish Presence

Terrestrial animal meat appeared to be more probable than fish in 302 because of the lack of fatty acids typical of fish, noticeably the absence of isoprenoid fatty acids. 304 also lacked isoprenoid fatty acids. (Note: terrestrial meat sources, hutia and iguana, were identified in the 1977 faunal bone remains from the site analyzed by Wing and Scutter (Sullivan op.cit). Sample 301 did not contain cholesterol, but did have a remarkably unsaturated fatty acid profile., In addition, the unusual highly unsaturated fatty acid C20:4 (Arachidonic acid) was present in the residue. This fatty acid is rare in most resources except fish/shellfish, although it is not really a biomarker. This suggests that fish/shellfish was present, as well as plant resources, based on the plant sterols, but the interpretation is simply probable, and is not certain.

Presence of Conifer Resin

Small amounts of conifer resin were present in 304 and 302, in the form of dehydroabietic acid, a known oxidative byproduct of abietane and pimarane diterpenoids, which are biomarkers for conifer resins, and being most abundant in conifers from the Pinaceae family. Depending on the environment of the archaeological site, these compounds could have derived from several origins: 1) sealing the pottery vessel (Reber and Hart 2008); 2) processing of conifer resin as a flavoring agent, or 3) firing the pottery over large amounts of pine wood (Reber et al. 2019). It is worth noting that sample 301 did not contain any of these biomarkers, so that whatever uses were the origin of these compounds, they seem to have been present only in Samples 304 and 302.

Lucayan Diet analysis

<u>Invertebrates</u>

We are naturally bound by what remains we find on the site, which is a subset of the foods actually consumed. Accepting that constraint, shellfish, Lobatus gigas in particular, which was particularly important for the diet of the South Bank Lucayan inhabitants, provided a calculated 37,422 grams of flesh from the samples recovered in 2018. Crustaceans constituted 514 grams of flesh in the 1977 collection, and just over 12 grams for the 2018 excavations. Biochemical (lipid) analysis of ceramics indicates their probable use for processing shellfish.

<u>Vertebrates</u>

The vertebrate remains recovered in 2018 were exclusively fish. As reflected in Table 1, the fish bone recovered corresponded to 173 grams of flesh. From the 1977 excavations, Geocapromys (hutia) remains were 59 grams; Cylcura (iguana) 29 grams; Fish remains constituted 2,382 grams. Note: the vertebrate bone remains recovered in 2018 were almost exclusively from the northern excavation unit. In 1977 the bone specimens were recovered from within a nearby subsurface feature that may have been part of a structure, and this feature also produced the bulk of excavated ceramics. Biochemical (lipid) analysis of ceramics indicates their probably use in the preparation of fish, and possibly of land animals.

<u>Agriculture</u>

Microbotanical analysis demonstrated the presence of Zea Maize pollen on a Codakia Orbicularis shell and in a soil sample. Shell, soil and ceramics produced phytoliths indicative of the probable presence of arrow root (Zamia); the possible presence of squash (Curcubita). and of sunflower seeds or of other seeds/flowers from the family Asteraceae. Biochemical (lipid) analysis of ceramics is consistent with their use in association with processing plant products. The presence of 2-hydroxy and w-hydroxy fatty acids may be consistent with, but is not definitive of the processing of tubers (for example -- known indigenous tuber cultigens - manioc, leren, yamia, sweet potato).

Diet Overview

While the relative contributions of agricultural, shellfish and finfish to the diet cannot be satisfactorily modeled from these data sets, it is clear that all were components of the Lucayan diet at the South Bank Site. Shellfish, Lobatus gigas in particular, were vital contributors of flesh in Lucayan cuisine, with finfish and land animals as secondary and tertiary sources. Agriculture contributed carbohydrates, vitamins, and minerals to the Lucayan diet.

Ceramics --Petrographic Analysis

Thin section petrographic analysis of imported ceramic sherds from the South Bank site was conducted by Dr. Michael S. Smith, Department of Earth and Ocean Sciences, University of North Carolina Wilmington, Wilmington NC.

Summary

This petrographic evaluation suggests that two (2) broad groupings can be applied to the ten (10) ceramic sherds from the South Bank archaeological site. The Table below designates the grouping as well as the sherds that fall into these broad categories.

The variability among the two (2) groups is large. The key issue is the presence of mafic minerals such as pyroxene and amphibole, and to a lesser extent the mineral biotite. Pyroxene and amphibole represent igneous rock sources and may allow comparison to the work of Ting et al. (2016) in their study of the Meillacoid and Chicoid ceramics from the Dominican Republic. However, examination of that study finds that the petrographic subgroups presented are not specific enough in mineral (or rock) designation.

For example, although Ting et al. (2016) subdivides the sherds into groups based upon amphibole (or amphibole rock fragment; amphibole subgroup A to C) versus quartz (or quartz rock fragment; quartz or quartzite subgroups) criteria, he does not define the amphibole identity (ortho- versus clino-amphibole), nor does he define the identity of pyroxene (which in this study appears to be mainly orthopyroxene).

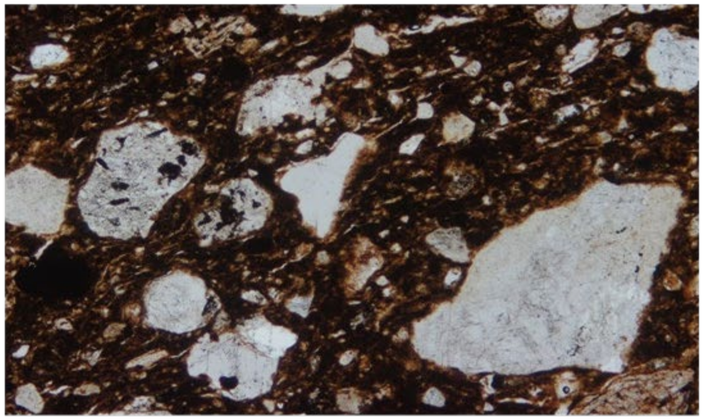
Furthermore, his quartz categories are a bit unclear, as the designation of a chert and a metamorphic quartzite are often easy to misinterpret without some formalized criteria (which is lacking in the Ting et al. (2016) report).

Dr. Smith has contacted Ting (at University of Cypress) to inquire about details of this petrographic classification and to see if it is possible to re-examine his petrographic thin-sections to delineate further the aplastic mineral and rock criteria for these ceramics.

Thus, at this time, Group II sherds are tentatively defined as having some characteristics that may suggest origin from the Dominican Republic. In particular, P1-SB-44, -48, -300, and 302W would fit within the Amphibole subgroup A and B (Ting et al. 2016, pp.379-380), whereas P1-SB-203 (with the abundant pyroxene and quartz) may fit with the Quartzite-Dolerite subgroup A (Ting et al. 2016, p. 381). Comparison of surface treatment and other archaeological criteria would be useful to determine if these suggestions for linkage are valid.

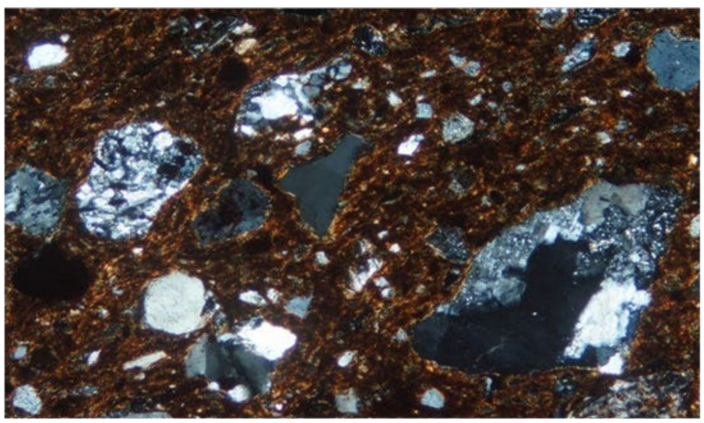
The Group I of this study could also fit the Ting et al. (2016) quartz groups. However, the Ting et al. (2016) criteria are not specific enough (with respect to the quartz and quartz rock fragment designations) so as to allow definite correlation. In addition, the Ting et al. (2016) study does not define whether the monocrystalline quartz mineral fragments have any inclusions (such as rutile needles) nor does this study indicate whether they observed potential volcanic recrystallized quartz fragments that are observed in some of this study's sherds.

Therefore, it appears that additional petrographic investigation is warranted to more fully define the variety of potential imported ceramics to the Turks and Caicos Islands. Selective examination of very well-defined pottery types would go a long way to providing more concise petrographic criteria to differentiate between these wares.



Red Scale bar = 0.2 mm

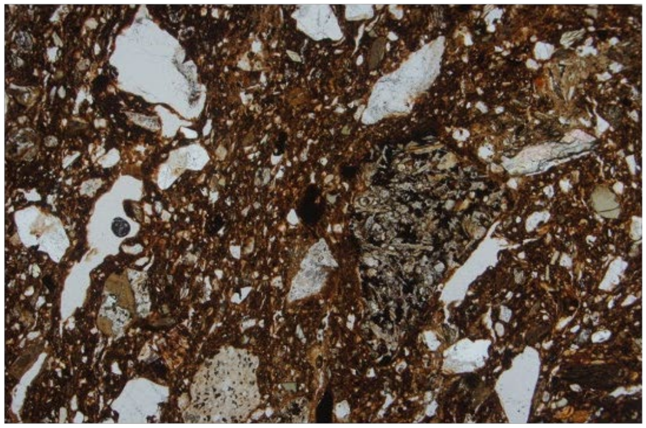
Figure 1A. Sherd P1-SB-10. 5X magnification. Plane polarized (PPL). Quartz mineral fragments (medium to fine), quartz rock fragments (upper left), quartz + feldspar rock fragment (lower right; subrounded), and elliptical clay clot (left) in a partially reduced paste interior.



Red Scale bar = 0.2 mm

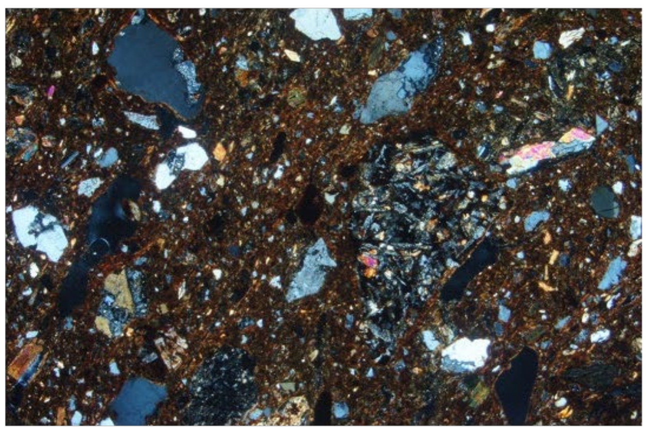
Figure 1B. Sherd P1-SB-10. 5X magnification. Cross-polarized (XPL).

Figure 8. Sherd P1-SB-10. 1977 Imported Sherd, 10, 10-17 cmbs, Feature 1 (probable Structure). Top: 5X magnification. Plane polarized (PPL). Quartz mineral fragments (medium to fine), quartz rock fragments (upper left), quartz + feldspar rock fragment (lower right; subrounded), and elliptical clay clot (left) in a partially reduced paste interior. The sherd mineral contents fall into the quartz/quartz rock fragment/quartz + feldspar ± fossil fragments group. Bottom: 5X magnification. Cross-polarized (XPL).



Red Scale bar = 0.4 mm

Figure 22A. Sherd P1-SB-302W. 2.5X magnification. Plane polarized (PPL). Pale pink/green pyroxene + feldspar rock fragment (right), weathered feldspar (laths) + opaque minerals + amphibole rock fragment (right of center), clay clots, quartz rock fragments, and quartz and feldspar (twinned; plagioclase) mineral fragments.



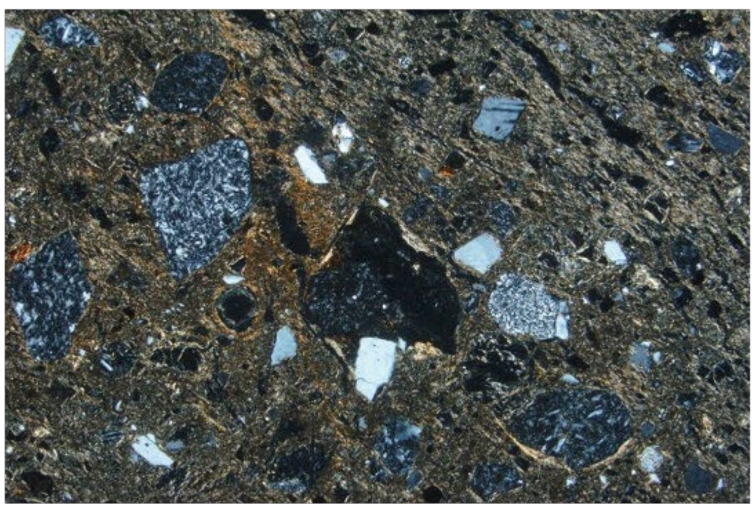
Red Scale bar = 0.4 mm

Figure 22B. Sherd P1-SB-302W. 2.5X magnification. Cross-polarized (XPL).

Figure 9. 302W (5-7 N, 3-4.5E, 20-30 cmbs, North Excavation Area) imported sherd -- is defined by the following aplastic components: Quartz + feldspar (plagioclase) + amphibole rock fragments, polygranular quartz rock fragments; quartz + feldspar rock fragments; with mineral fragments of quartz, feldspar (both plagioclase and alkali feldspar), biotite, amphibole, and opaque minerals. Many of the rock fragments are quite large (very coarse particle size) and several of the quartz rock fragments have quartz with inclusions of needle habit rutile crystals – not seen in any of the other samples). 302W (rim sherd) has an overall external sooty black (and grainy) appearance. At the macroscale, there can be observed a thin 'slip' on the exterior surface that ranged in thickness (< 1 mm). In thin-section, this 'slip' is an opaque (black; not isotropic – but opaque) layer which really looks like a thin glaze (with a maximum thickness of ~ 0.31 mm). The material is not uniform in thickness on this sherd, some places just a trace of the opaque (black) material. This is not likely to be a fire-blackening coating since the opaque material has tiny inclusions of rounded to elliptical (but a few are broken) pellets of carbonate material (the fine material in the more circular to elliptical pellets is somewhat concentrically zoned, but not like an ooid.) In addition, there are some angular to elongated tiny (much smaller than the carbonate pellets) that look like either spine or bone fragments (not isotropic.)

Red Scale bar = 0.4 mm

Figure 27A. Sherd P1-SB-302E. 2.5X magnification. Plane polarized (PPL). Feldspar (laths) ± quartz and feldspar + mica (biotite) + quartz rock fragments (center), quartz rock fragments (left) , blocky plagioclase (twinned) and quartz mineral fragments. Note the fine grained (XPL) micas (both biotite and muscovite) surrounding the rock fragments and within the paste.



Red Scale bar = 0.4 mm

Figure 27B. Sherd P1-SB-302E. 2.5X magnification. Cross-polarized (XPL).

Figure 10. 302 E (5-7N, 4.5-6 E, 20-30 cmbs) imported sherd -- has remnants of has an opaque coating, including carbonate pellets material, in one exterior location, and other exterior regions have opaque material adhering to the surface of the sherd. This sherd is defined by the following aplastic components: Feldspar (plagioclase) rock fragments (lathes of plagioclase with some interstitial quartz), feldspar (plagioclase) + quartz + bioitite mica rock fragments, polygranular quartz rock fragments (which are either recrystallized volcanic ash or chert – tough to tell); with mineral fragments of quartz (no rutile inclusions), feldspar (plagioclase) and opaque minerals. Note that the overall content is feldspar > quartz (in both mineral and rock fragments) and this sample has more paste than aplastic components (the paste is also mica-rich as compared to P1-SB302W). Note this sherd could be a rim sherd and some of the opaque material is on the curved rim portion (a bit of wear here).

Thus, based upon the aplastic components, these two sherds 302E and 302W are quite different petrographically and probably not manufactured in the same locale. The coating/surface feature is probably post manufacture and includes opaque material containing carbonate pellets; especially on the rim sherd – P1-SB-302W.

Imported versus locally made Palmetto Ware ceramics

The distribution of ceramics by import percentage and provenience is shown in Tables 5 and 6. For the 1977 excavations the comparison between Palmetto Ware and Imports was done via sherd count, not weight. Comparison with the 2018 collections in Table 5, where weight instead of count was used, is imperfect but roughly comparable. For the upper levels of the controlled excavation, 0-12 cmbs, imports averaged 27%. In the lower levels, 12-33 cmbs, imports averaged 57%. The percentage of imported ceramics (igneous and metamorphic tempered) vs locally made shell tempered Palmetto Ware was calculated using weight in 2018. The percentage of imports varied widely by location.

In the southern unit, 24-26S, 4-6E, imports are common in the upper (later) levels, and scarce in the lower levels. In this excavation zone imports averaged 33% in the upper 30 centimeters of midden, and Palmetto Ware was exclusively present below that level to sterile. In an adjacent small (.5 x .5M) unit extending from the northeastern corner of the unit, imports were 49% of the sample in the upper 30 centimeters.

In the northern unit, 4.5-7N, 2.5-6E, imports were in higher concentration in the lower levels. For ceramics in the upper levels, 0-30 cmbs, imports averaged 19%. For unit depths between 20 and 50 cmbs (some overlap with preceding) the import percentage was 32%; nearly matching the 33% of imports in the upper levels of the southern unit. The exception being a small feature (319) excavated separately, which contained just Palmetto Ware.

			Ceramics 2018				
FS No.	**Provenience**		**Description**				
	Meters N,S,E or W		"ca" = circa, close tc	Ceramics			
				PW	Imp	Sherd	Imp %
2018		cmbs		grams	grams	total	
	Northern Units						
100	Machine Scrape - West		Backdirt West	361	32	393	8.14%
100-B	Machine Scrape - East		Backdirt East	184	14	198	7.07%
306	4-5N, 2-4.5E	0-ca.8cmbs	excavation unit	60	0	60	0.00%
309	5-7N, 2-3E	0-10 cmbs	excavation unit	0	12	12	100.00%
310	5-7N, 2-3E	10-20 cmbs	excavation unit	36	14	50	28.00%
300	5-7N, 3-6E	0-10 cmbs	excavation unit	42	20	62	32.26%
302	5-7N, 3-6E	10-20 cmbs	excavation unit	112	30	142	21.13%
302W	5-7N, 3-4.5E	20-30 cmbs	excavation unit	206	30	236	12.71%
302E	5-7N, 4.5-6E	20-40 cmbs	excavation unit	250	114	364	31.32%
313	5-7 N, 4-5-6E	40-52 cmbs	excavation unit	34	18	52	34.62%
319	SW corner, unit 302 W	20-ca 30 cmbs	excav feature	50	0	50	0.00%
	Southern Units						
301	24-26S, 4-6E,	0-10 cmbs	excavation unit	460	346	806	42.93%
303	24-26S, 4-6E,	10-20 cmbs	excavation unit	342	28	370	7.57%
304	24-26S, 4-6E,	20-30cmbs	excavation unit	78	60	138	43.48%
305	24-26S, 4-6E,	ca 30 cmbs	excavation unit	16	1	17	5.88%
307	24-26S, 4-5E	30-35 cmbs	excavation unit	1	0	1	0.00%
308	24-26S, 5-6E	30-35 cmbs	excavation unit	12	0	12	0.00%
314	24-26 S, 5-6E	35-40 cmbs	excavation unit	20	0	20	0.00%
315	24-26 S, 4-5E	35-40 cmbs	excavation unit	12	0	12	0.00%
	Small Unit NW corner	**S. Units**					
316	24-24.5 S, 3.5-4E	0-10 cmbs	small excav unit	12	0	12	0.00%
317	24-24.5 S, 3.5-4E	10-20 cmbs	small excav unit	1	30	31	96.77%
318	24-24.5 S X, 3.5-4E	20-30 cmbs	small excav unit	62	44	106	41.51%
320	24-24.5 S-3.5-4E	30-33 cmbs	small excav unit	8	0	8	0.00%

Table 5. 2018 Ceramics.

		Ceramics 1977					
FS No.	Provenience		Description				
	Meters N,S,E or W		"ca" = circa, close tc	Ceramics			
				PW	Imp	Sherd total	
		cmbs		No.	No.	total	
44	ca. 2-3N, 9-11E	0-7 cmbs	above Feature 1	37	27	64	42.19%
14	ca. 2-3N, 9-11E	7-12 cmbs	outside Feature 1	20	16	36	44.44%
21	ca. 2-3N, 9011 E	7-12 cmbs	excav feature 1, L2	247	71	318	22.33%
48	3.3N, 10.05E	15 cmbs	sherd grouping	8	5	13	38.46%
10	ca. 2-3N, 9-11E	12-17 cmbs	excav feature 1, L3	29	45	74	60.81%
101	ca. 2-3N, 9-11 E	12-17 cmbs	outside Feature 1		1	1	100.00%
687	ca. 2-3N, 9-11E	17-33 cmbs	Feature 1	4	3	7	42.86%
18	ca. 2-3N, 9-11E	36 cmbs	bottom of firepit	1	0	1	0.00%
19	ca. 2-3N, 9-11E	35 cmbs	below feature 1	3	0	3	0.00%
20	Machine Scrape Pile		Backdirt pile	76	16	92	17.39%
45& 47	ca. 2, 9E	Shovel test	test hole	4	2	6	33.33%
46	ca. 2-3N, 9-11E	surf col	surf collection	0	2	2	100.00%
87	general surf col	surf col	surf collection	60	37	97	38.14%

Table 6. Ceramics 1977.

Figure 11 groups ceramic collections and associated strata into 10 or 20 cmbs intervals, varying with the original excavation controls. Each zone represented included ceramic samples of statistically significant 30 or more sherds. One recurring reading between the distinct excavation zones and seasons is that each area excavated had at least one stratum in the upper 30 cm below surface that had imported ceramics in the range of 42 to 44% of the recovered artifacts. Note is made that 1977 percentage is sherd count; 2018 percentage is by weight.

Basketry Impressions on Ceramics

Analysis of basketry impressions on South Bank ceramics was done by Charlene Dixon, and appears in full detail in Appendix E. The total number of Palmetto Ware sherds recovered with basketry impressions came to 31. Of these, the three types of basketry known to be woven by Lucayans in the Bahamas were found: twill weaving with an interlacing interval of two-over-two (2/2); simple plaiting (1/1), also called "plain" or "checkerboard" weave (Adovasio 1977); and wicker, a special case of simple plaiting using stiffer materials (Emery 1994). Additionally, one example of a fabric-like weaving was found. There was no evidence of sewn/coiled or twined basketry, which is consistent with the Bahamas Berman and Hutcheson 2000, Hutcheson 2001, 2008).

The weave breakdown included:

- 20 examples of 2/2 Twill. Of those, 18 were of flat elements with one very flat, one definitely Sable palmetto, possibly another as well. The other two impressions are of a Fibrous looking material, as yet unidentified.

- 4 sherds with impressions of 1/1 Simple Plaiting. The fabric-like impression does not have any knotting; therefore, it is not netting. It also does not appear to be spun, but rather a cohesive round strand.

- 2 examples of Wicker. These include use of possibly split reed or a type of split reed.

- 5 non-woven elements: no. 5. All of these impressions are flat; one is definitely Sable palmetto and another appears to be another type of palm, possibly Coccothrinax argentea locally know as Silver Thatch palm.

During analysis of the South Bank Palmetto Ware sherds, it became clear that some of the sherds were measuring harder on the Mohs Scale than sherds typically found in the Bahamas. Virtually all sherds in the Bahamas thus far studied are a 2 – 2.5 (thumbnail scratch) on the Mohs Scale (Berman and Hutcheson 2000, Hutcheson 2001, 2008, 2011, 2013, 2015). A number of the sherds from the South Bank site are harder. Most of the South Bank sherds were 2 – 2.5 (no. 15; 48.39%)), however there were only slightly less measuring at 3 (no. 13; 41.94%) and three (9.68%) measuring 4 on the scale. When checking the locations within the site from which these harder sherds came, no correlation was found between hardness and site placement. As far as the site is concerned, it appears to be random. There is also no correlation between hardness and sherd wear; it is absolutely evenly split. The differences are more likely to be due to the ceramics' placement within the fire and the intensity and duration of the firing process. The hotter the fire, and the longer the piece is fired, will increase the hardness as the clay comes closer to vitrification.

The South Bank ceramics and the basketry impressions are very much in line with those analyzed from of San Salvador, Bahamas, reflected in the studies by Dixon Hutcheson (2001, 2008, 2011, 2013, 2015).

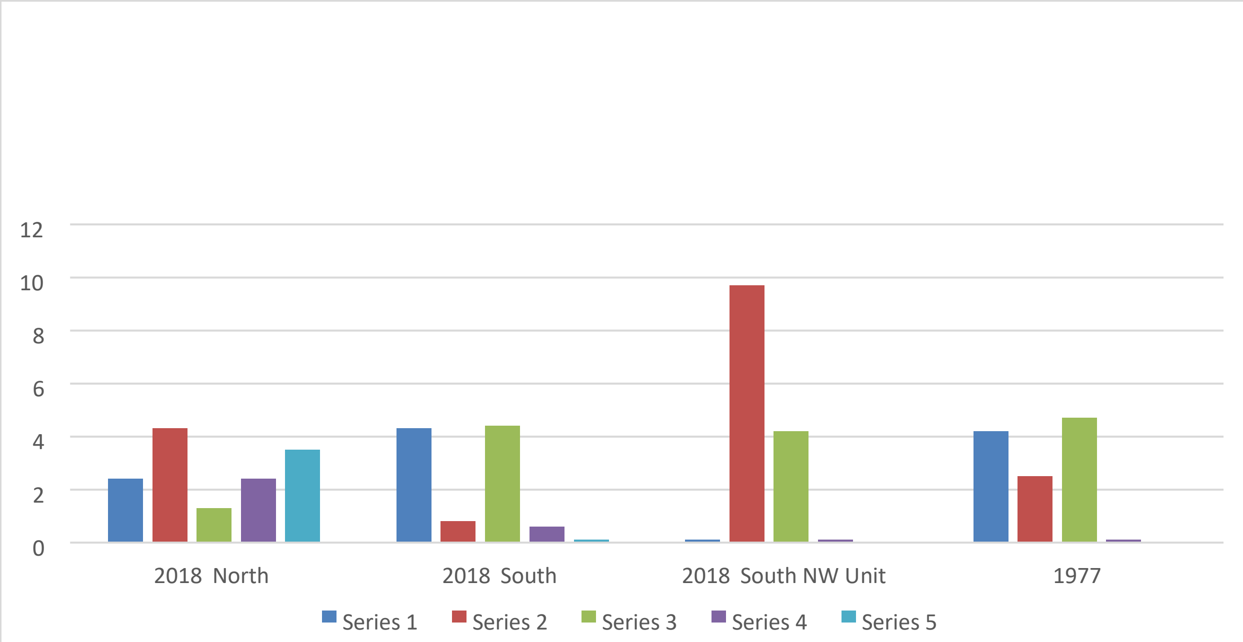


Figure 11. Imported Ceramics by Stratum. Upper to Lower Strata/Left to Right. Number to the left x 10 = %.

Ceramic decorative modes and stylistic series association

The ceramics from 1977 were washed. Those from 2018 were not and were kept with their original coatings to enable residue analysis. Among the washed, imported ceramics from 1977 decorative and design motifs were included: red slip, on interior or exterior; wide punctation on the outer shoulder, rounded or V-shaped; carinated (sharp angular shoulder bend) vessels, concave upper shoulder above rounded or carinated lower shoulder and many had a post-deposit caliche (calcium carbonate) film. 1977 Palmetto Ware recovered included 4 examples of broad line incision, on the rim or upper shoulder just below the rim. The red slip was more common among these South Bank samples than materials recovered from MC-12, which is a contemporary site based upon overlapping calibrated radiocarbon dates: 1266-1377 AD; 11351259 AD (Freimuth and Sullivan 2017: 32). The broad punctation on imports at South Bank is very similar to an example from MC-12 (Figure 24, Ibid: 29).

Vessel fragments with upper shoulder punctation, both rounded and V-shaped, were recovered from the South Bank site in 1977 (Figure 14), and very similar motifs are illustrated in De Booy (2012: 102 – Figure 13), recovered during his survey on Middle Caicos.

The broad punctation motif is known from transitional Meillacoid to Chicoid ceramics in northwestern Hispaniola. (Ulloa Hung, 2013: 334-5; 499-500). Whereas distinctly Chicoid imported ceramics are present at MC-12, they appear to be absent at South Bank, suggesting that if the sites are contemporaneous, as indicated by radiocarbon dates, they had geographically and stylistically distinct trading partners in the Greater Antilles. Further research involving petrographic and stylistic analysis of ceramics is needed in order to refine the

Figure 12. Left: Punctated Import MC-12; Right: Punctated Imports South Bank,1977(63) and 2018.

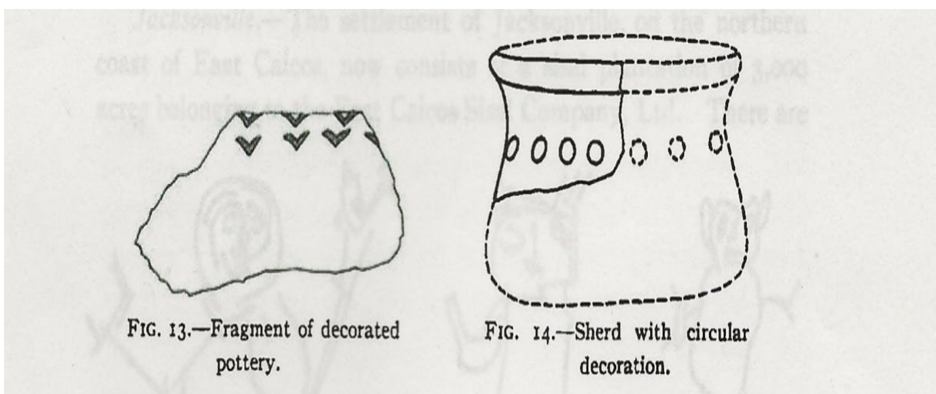


Figure 13. Punctated Ceramics from Grand (Middle) Caicos: De Booy 1912: 102).

location of the trading partners of the South Bank Lucayans. Present indicators are that the areas most likely to be fruitful in this regard are northwestern Hispaniola and western Cuba where transitional and mixed Meillacoid and Chicoid decorative styles are known to occur contemporaneous with the South Bank occupation.

Conclusions

<u>Environmental Zone Exploitation and Economic Practices</u>

The South Bank site was well situated to pursue a mixed economic strategy of agriculture, fishing for shellfish and finfish, and terrestrial gathering and hunting.

Flesh as a component of the diet came principally from shellfish, overwhelmingly from Lobatus gigas conch, followed in contribution by finfish. These shellfish and finfish can be caught and gathered in the nearby mangrove estuary channels (Zone T-VI), flats (A-II), and reef and bank areas (A-III). See Figure 15.

Agriculture was an important contributor to the diet and to the economic strategy. Crops could easily have been

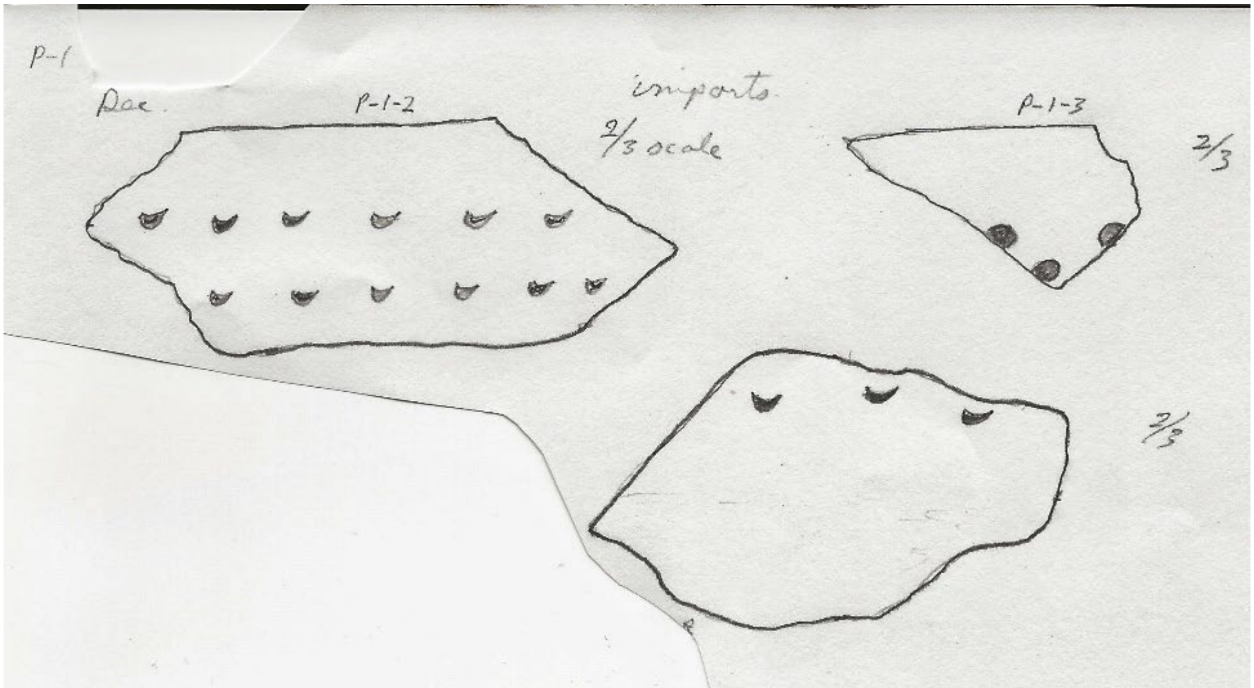


Figure 14. Punctated Ceramics from South Bank, 1977 Excavations (From 1977 Field data cards).

planted in the deep sandy soils of the South Bank site itself, as well as in the nearby hardwood forests (Swetenia Brushland on Rockland, Zone T-1) which is the traditional location of subsistence slash and burn agriculture in these islands.

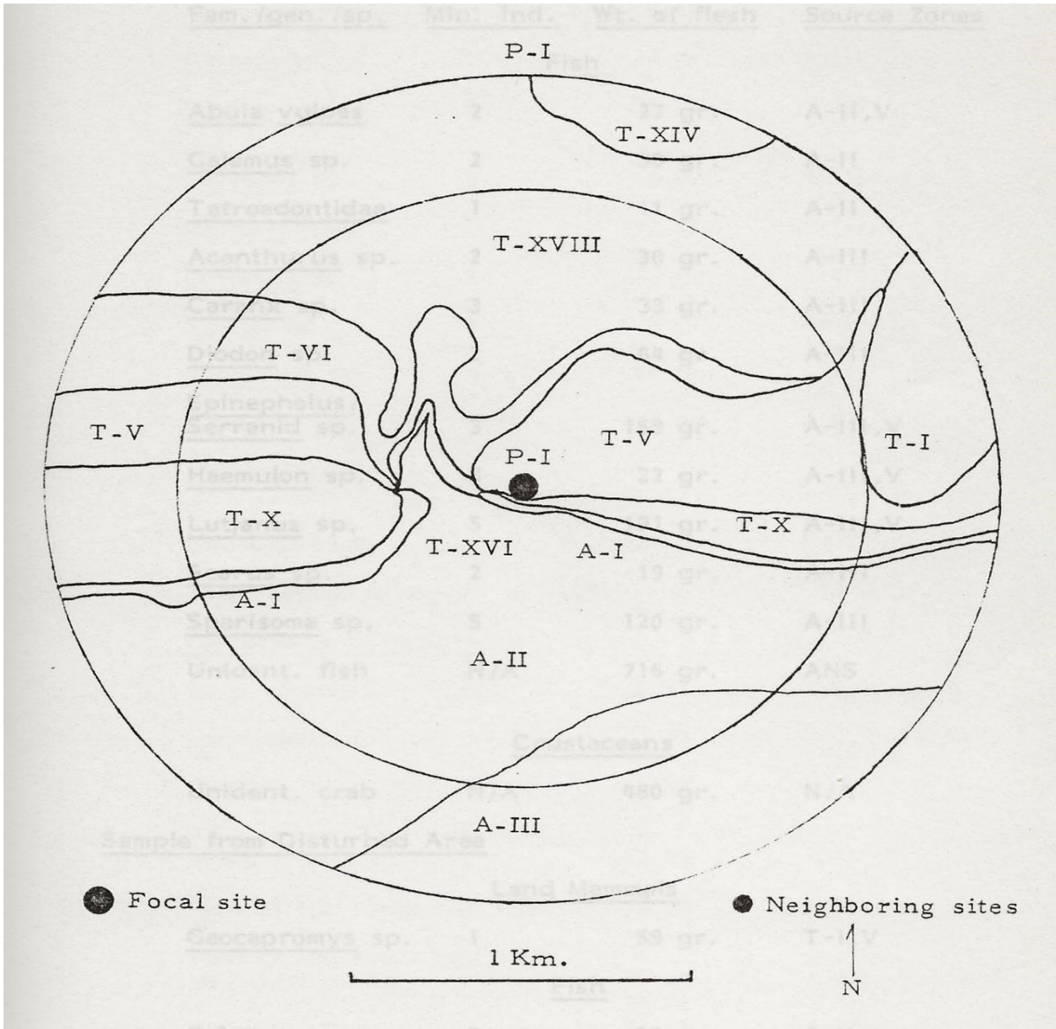
Cultural Affiliation

The South Bank Site was a Lucayan settlement, based upon the presence of locally made Palmetto Ware ceramics, which are hallmarks of the broader Lucayan cultural tradition. The extensive presence of imported ceramics sourced to the Greater Antilles reflects contact and trade with Amerindian contemporaries, and participation in a regional cultural and economic interaction sphere.

Findings, Significance and Recommendations

Distinguishing and important features of the South Bank Site and analyses of recovered archaeological materials include:

- The very focused interaction of these Lucayans with Amerindian trading partners in the Greater Antilles, as evidenced by the very specific and limited range of decorative motifs on imported ceramics at the site, to include shoulder punctation, carinated vessels, and red slip paint. This limited ceramic style variation should assist in identifying or narrowing down the location of the trading partner communities, which will help us map regional trade and cultural ties.
- Presence of highly carbon enriched soils in association with earth ovens, particularly in the 2018 northern excavation unit, the nature and purposes of which are not yet adequately understood.



Map. 63. P-I; catchment areas. T-I, Swietenia Brushland on Rockland; T-V, Dwarf Chrysobalanus Shrubland and Herbs and Grasses on Coastal Sand; T-VI, Mangrove; T-X, Coastal Rock Community; T-XIV, Salt Pond; T-XVIII, Tidal Flats; A-I, Wave Washed Rocky Shore; T-XVI, Sandy Beach; A-II, Flats; A-III, Reefs and Flats.

Figure 15. P-1 South Bank Site -- Environmental Zones (Sullivan 1981: 329).

• Biochemical (lipid) analysis of ceramics, soil and shell has demonstrated its relevance to definition of South Bank prehistoric food production and processing activities, with indications of the probable processing of plants, fish, shellfish, possibly of land animals, and the evident use of pine wood or resin.

• Microbiological analysis has documented the presence of the key cultigen Zea maize on shell and in soil indicating the probable or possible presence of other crops, to include sunflower, squash and arrow root through analysis of ceramics, shell and soil.

• Petrographic analysis of imported ceramics has established their mineral content, which can be used as comparative

Figure 16. Volunteers and Stakeholders South Bank Archaeological Project.

material for linkage to other geographic zones and to other pre-Columbian ceramic traditions. This will assist in defining the Amerindian interaction sphere (kinship and trade) encompassing the northern Caribbean and the Lucayan Islands in the late prehistoric period.

Recommendations

We strongly recommend renewed excavations at the South Bank site, while portions remain undisturbed, with particular focus on the further definition and sampling of carbon enriched earth ovens. The additional samples will provide supplemental test materials for microbiological, biochemical, and petrographic analysis, in addition to expanding the collection and analysis of imported ceramics. These samples and analysis will refine our understanding of the range and relative importance of Lucayan economic activities. Lucayan existing and future petrographic and stylistic traits of imported ceramics should be directly compared with similar materials from northwestern Hispaniola and Western Cuba to firmly establish the location of South Bank trade partner communities. If future excavations produce human remains at the South Bank or at related Lucayan sites and also at these matched trading partner locations in the Greater Antilles, they should be cross-checked through genomic studies to establish correlated kinship ties.

Acknowledgements

The success of the South Bank Site research effort is due to the collective efforts of many contributors. We wish to express our sincere appreciation to all involved, notably contributors of funds, facilities and materiel involved --Ingo Reckhorn and Windward Long Bay ltd; Don Stark, Kathleen Wood and Joshua Goldfarb of the Turks and Caicos Reef Fund; Tim Ainley of Sail Beluga; Stephane Gaudet of TC Millwork; Elizabeth and Nikki Turner of Blue Loos; Glen Garrard of Tip of the Tail Villa. We are indebted for research authorization to officials of the Department of Environment and Coastal Resources: Lormeka Williams, Eric Salamanca, Amy Avenant, Nicole Caesar. Much needed support was provided by Ludwina Fulford and Chrissy Williams from the Department of Culture, and Hon Karen Malcom Minister of Education, Youth, Sports, Culture and Library Services. Thanks are extended to: Sarah Sullivan who provided vital logistical and administrative assistance, to include report editing; Agile LeVin and Daniel LeVin for encouragement and logistical support; Christa Reckhorn and Gemma Hamby for project publicity via photography and authorship of articles on the research; Candianne Williams of the Providenciales office of the Turks and Caicos National Museum for hosting an evening seminar on the project at the Museum; Ethlyn Gibbs-Williams of the Turks and Caicos National Trust for guidance, and community networking support; John Galleymore for helpful dialog on Turks and Caicos archaeology; Jacinth Cote for logistical help; Jamie Pollon of Turks and Caicos Marina for assistance with needed facilities and supplies. Vital support through the organization of student volunteers was provided by Sylvie Wigglesworth and Ed Robinson of British West Indies Collegiate school.

Special appreciation is extended to the local adult and student volunteers who participated in the South Bank excavations, who were: Olivier Belanger, Guylaine Dupre, Jerry Budin, Loreen Haakonson, Kaia Haakonson, Logan Haakonson, Marie-Claude Joly, Teres Rolle, and Monique Allen.

We are particularly grateful to the student volunteers from British West Indies Collegiate, who worked hard and helped us see the project through fresh eyes: they were Manville Gardiner, Randal Gardiner, Maria Parker-Rauw, Danielle Smith, Thomas Stephens, Kristen Mack, Sydney Papachristou, Amanda Regan, Lyle Dannis and Ruthea Robinson.

We appreciated receipt of encouraging words and thoughtful questions from site visitors during the excavations, to include H.E. Governor Dr. John Freeman CMG, and teachers and students from local schools.

Bibliography

Adovasio, James M.
1977 *Basketry Technology*. Aldine Press, Chicago.

ArchaeoScience Community Group.
n.d. Phyto DB: phytolith images database. http://www.phytcore.org/phytolith/index.php

Berman, Mary J. and Charlene Dixon Hutcheson
1997 *Basketry-Impressed Sherds: To Weave and to Eat in the Bahamas*. Paper presented at the 62nd Annual Meeting of the Society for American Archaeology, Nashville, Tennessee.

Berman, Mary J. and Charlene Dixon Hutcheson
2000 Impressions of a Lost Technology: A Study of Lucayan-Taíno Basketry. *Journal of Field Archaeology* 27(4):417-35.

Brown, Robin C.
1994 *Florida's First People: 12,000 Years of Human History*. Pineapple Press, Sarasota.

Brown, Robin C.
2003 *The Crafts of Florida's First People*. Pineapple Press, Sarasota.

Bush, Mark B. and M.B. Weng
2006 Introducing a new (freeware) tool for palynology. *Journal of Biogeography* 34: 377-380. https://research.fit.edu/paleolab/pollen-database/

Cagnato, Clarissa
2017 Starch Grain Database. http://clarissacagnato.weebly.com/starchgrain-database.html

Carlson, Lisabeth A.
1999 *Aftermath of Feasts: Human Colonization of the Southern Bahamian Archipelago and its Effects on the Indigenous Fauna*. PhD Dissertation on file, Department of Anthropology, University of Florida., Gainesville.

Christie, William
2014 High throughput screening of organic residues in archaeological potsherds using direct acidified methanol extraction. *Analytical Methods* 6(5):1330-1340.

Correa-Ascencio, Marisol and Richard P. Evershed
2019 The Lipid Web. http://lipidhome.co.uk/index.html.

DiCaprio, Ninina Cuomo and Sarah Vaughan

1993 An experimental study in distinguishing grog (chamotte) from argillaceous inclusions in ceramic thin sections. *Archeomaterials*, 7(1):21-40.

Dunn, Oliver and James E. Kelley, Jr.

1989 *The Diario of Christopher Columbus's First Voyage to America, 1492-1493*. University of Oklahoma Press, Norman.

Emery, Irene

1994 *The Primary Structure of Fabrics: An Illustrated Classification*. Watson-Guptill, New York.

Evershed, R. P.

2008 Organic Residue Analysis in Archaeology: The Archaeological Biomarker Revolution. *Archaeometry* 50(6):895-924.

Freimuth, Glen and Shaun Sullivan

2017 *Placement of the Lucayan Site, MC-12, in Local and regional Context; Surveys, Surface Collections and Excavations 1976-2014*. Paper presented at the Proceedings of the International Association for Caribbean Archaeology (IACA) Congress, St. Croix.

Garrels, Robert M. and Charles L. Christ

1965 *Solutions, Minerals and Equilibria.* Harper & Row, New York.

Harvey, Virginia I.

1997 *The Techniques of Basketry*. University of Washington Press, Seattle.

Hutcheson, Charlene Dixon

2001 Reweaving the Strands: Continued Exploration into the Basketry Technology of Prehistoric Bahamians. In *Proceedings of the 18th International Congress for Caribbean Archaeology*. Volume 1, Gérard Richard, ed., pp. 185-198.

2008 A New Material to View the Past: Dental Alginate Molds of Friable Artifacts. In *Crossing the Borders: New Methods and Techniques in the Study of Archaeological Materials from the Caribbean*, Corinne L. Hofman, Menno L. P. Hoogland, and Annelou L. van Gijn, eds., pp. 69-77. University of Alabama Press, Tuscaloosa.

2011 From Whence They Came, Nobody Knows, Or Do We? Basketry Impressed Ceramics from the Wolper Collection. In *Proceedings of the 13th Symposium on the Natural History of the Bahamas*, Jane Eva Baxter and Eric Stephen Cole, eds., pp. 188-199. Gerace Research Centre, San Salvador, Bahamas.

2013 Decoration or Happenstance: Experimental Archaeology and Basketry Impressed Palmetto Ware. In *Proceedings of the 14th Symposium on the Natural History of the Bahamas*, Craig Tepper and Ronald V. Shaklee, eds., pp. 213-228. Gerace Research Centre, San Salvador, Bahamas.

2015 The Impressions of Long Bay: Basketry Impressed Ceramics from The Long Bay Site, San Salvador, Bahamas. *Journal of Caribbean Archaeology* 15:37-61.

Isaksson, Sven and Fredrik Hallgren

2012 Lipid residue analyses of Early Neolithic funnel-beaker pottery from Skogsmossen, eastern Central Sweden, and the earliest evidence of dairying in Sweden. *Journal of Archaeological Science* 39(12):3600-3609.

Kapp, R.O.

1969 *How to Know Pollen and Spores. The Pictured Key Nature Series.* Wm C. Brown Company Publishers, Dubuque.

LaPlantz, Shereen

1993 *Twill Basketry: A Handbook of Designs, Techniques, and Styles*. Lark Books, Asheville.

Moore, P.D., J.A. Webb, and M.E. Collinson.

1991 *Pollen Analysis,* Second Edition. Blackwell Scientific Publications, Oxford.

Morsink, Joost

2012 *The power of salt: a holistic approach to salt in the Prehistoric Circum Caribbean Region.* PhD Dissertation, Department of Anthropology, University of Florida, Gainesville.

Nesse, W. D.

2004 *Introduction to Optical Mineralogy*. Oxford University Press, New York.

O'Day, Sharyn Jones

2002 Late Prehistoric Lucayan Occupation and Subsistence on Middle Caicos Island, Northern West Indies. *Caribbean Journal of Science* 38(1–2):1–10.

PalDat

n.d. 2000 and onwards: *PalDat – a palynological database*. Society for the Promotion of Palynological Research in Austria (AutPal). www.paldat.org.

Perry, Linda

2015 *Starch Extraction Protocol*. Electronic document. http://fossilfarm.org/Methods/Methods/Protocol.html, accessed May 11, 2015.

Piperno, Delores R.
2006 *Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists*. AltaMira Press, New York.

Piperno, Dolores R. and Irene Holst
1998 The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. *Journal of Archaeological Science* 25(8):765-776.

Piperno, Delores, Irene Holst, Linda Wessel-Beaver, and Thomas C. Andres
2002 Evidence for the control of phytolith formation in Cucurbita fruits by the hard rind (Hr) genetic locus: Archaeological and ecological implications. *Proceedings of the National Academy of Science* 99(16):10923-10928.

Quinn, Sean Patrick
2013 *Ceramic Petrography: The Interpretation of Archaeological Pottery & Related Artifacts in Thin Section*. Archaeopress, Oxford.

Rapp, George and Susan C. Mulholland, eds.
1992 Phytolith Systematics: Emerging Issues. *Advances in Archaeological and Museum Science,* Vol. 1. Plenum Press, New York.

Reber, E. A., M. T. Kerr, H. L. Whelton and R. P. Evershed
2019 Lipid Residues from Low-Fired Pottery. *Archaeometry* 61(1):131-144.

Reber, E. A. and J. P. Hart
2008 Pine resins and pottery sealing: analysis of absorbed and visible pottery residues from central New York state. *Archaeometry* 50(6):999-1017.

Reedy, Chandra L.
2008 *Thin-Section Petrography of Stone and Ceramic Cultural Materials*. Archetype Publications, London.

Reichert, Edward Tyson
1913 *Differentiation and Specificity of Starches in Relation to Genera, Species, etc*. The Carnegie Institution of Washington, Washington, D.C.

Reitz, Elizabeth J. and Elizabeth S. Wing
2008 *Zooarchaeology*. Second edition. Cambridge University Press, Cambridge.

Rice, P. M.
1987 *Pottery Analysis. A Sourcebook*. University of Chicago Press, Chicago.

Rye, O. S.
1981 *Pottery Technology: Principles and Reconstruction*. Taraxacum, Washington, D.C.

Sauer, Carl Ortwin
1966 *The Early Spanish Main*. University of California Press, Berkeley.

Stoltman, J. B.
1989 A Quantitative Approach to the Petrographic Analysis of Ceramic Thin Sections. *American Antiquity* 54:147-160.

Sullivan, Shaun
1980a An Overview of the 1976 to 1978 Archaeological Investigations in the Caicos Islands. *Florida Anthropologist* 33: 120-42.

1980b *Prehistoric Patterns of Exploitation and Colonization in the Turks and Caicos Islands*. PhD Dissertation, Department of Anthropology, University of Illinois at Urbana-Champaign, Urbana-Champaign.

Sullivan, Shaun and Glen Freimuth
2016 *Report of Archeological Investigations at CC-2, Cotton Cay, Turks and Caicos Islands.* Report submitted to Turks and Caicos Department of Environment and Coastal Resources, and to the Turks and Caicos National Museum.

Sullivan, Shaun and Glen Freimuth
2019 Report of Archaeological Investigations at CC-2, Cotton Cay, Turks and Caicos Islands. *Occasional Papers of the Turks and Caicos National Museum*, Number 7. https://www.tcmuseum.org/projects/occasionalpapers/

Sullivan, Shaun and Glen Freimuth
2022 Final Report of Archaeological Investigations at Lucayan Site MC-12, Middle Caicos:1976-2014. *Occasional Papers of the Turks and Caicos National Museum*, Number 10. https://www.tcmuseum.org/projects/occasionalpapers/

Therin, Michael and Carol Lentifer
2006 A Protocol for Extraction of Starch from Sediments. In *Ancient Starch Research*, Robin Torrence and Huw Barton, eds., pp. 159-161. Left Coast Press, Walnut Creek.

Ting, C., Neyt, B., Hung, J. U., Hofman, C., and Degryse, P.
2016 The production of pre-Colonial ceramics in northwestern Hispaniola: A technological study of Meillacoid and Chicoid ceramics from La Luperona and El Flaco, Dominican Republic, *Journal of Archaeological Science: Reports*, 6, 376-385.

Ulloa Hung, Jorge
2013 *Archaeologia en la Linea Noroeste de La Espaniola, Paisaje, Ceramica e Interactiones*. Caribbean Research Group, Leiden University, Leiden.

Velde, Bruce and Isabelle C. Druc
2000 *Archaeological Ceramic Materials: Origin and Utilization*. Springer, Berlin.

Appendices

Archaeological Investigations at the South Bank Site Providenciales, Turks and Caicos Islands

Part 3 -- Appendices

--

Advanced Laboratory Analyses Amplify Understanding of Lucayan Diet and Ceramics

Appendix A

P-1 South Bank Field Serial Numbers--Numeric

Number	Provenience	Description
	Meters N,S,E or W	"ca" = circa, close to
100	Machine Scrape Pile West	Old machine scrape midden pile west
100-B	Machine Scrape Pile East	Old machine scrape midden pile east
200	2.5S, 2.5E	Shovel test
201	3N, 2E	Shovel test
202	7.5N, 2.5E	Shovel test
203	2.5N, 7.5E	Shovel test
204	2.5N, 12.5E	Shovel test
205	7.5N, 17.5E	Shovel test
206	12.5N, 18.5E	Shovel test
207	2.5N, 17.5E	Shovel test
208	3.2S, 17.5E	Shovel test

209	7.5N, 12.5E		Shovel test
210	7.5N, 7.5E		Shovel test
211	7.5N, 9E		Shovel test
212	7.5N, 15E		Shovel test
213	12N, 14E		Shovel test
214	25S, 4.86E		Shovel test
215	27.6S, 11.68E		Shovel test
216	not issued		
217	22.6S, 11.6E		Shovel test
300	5-7N, 3-6E	0-10 cmbs	excavation unit
301	24-26S, 4-6E,	0-10 cmbs	excavation unit
302	5-7N, 3-6E	10-20 cmbs	excavation unit
302E	5-7N, 4.5-6E	20-30 cmbs	excavation unit
302W	5-7N, 3-4.5E	20-30 cmbs	excavation unit
303	24-26S, 4-6E,	10-20 cmbs	excavation unit
304	24-26S, 4-6E,	20-30cmbs	excavation unit
305	24-26S, 4-6E,	30-ca.40cm	excavation unit
306	4-5N,2- 4.5 E	0-ca.8cmbs	excavation unit
307	24-26S, 4-5E	ca.40-ca 48 cmbs	excavation unit
308	24-26S, 5-6E	ca.40-ca 48 cmbs	excavation unit
309	5-7N, 2-3E	0-10 cmbs	excavation unit
310	5-7N, 2-3E	10-20 cmbs	excavation unit
311	24-26S, 4-5E	25-35 cmbs	excavation unit: rock, shell, carbon feature
312	24-26S, 4-6 E	25-35 cmbs	excavation unit: rock, shell, carbon feature
313	5-7 N, 4-5E	40-52 cmbs	excavation unit
314	24-26 S, 5-6E	30-ca 35 cmbs	excavation unit
315	24-26 S, 4-5E	30-ca 35 cmbs	excavation unit
316	24-24.5 S, 3.5-4E	0-10 cmbs	small excavation unit
317	24-24.5 S, 3.5-4E	10-20 cmbs	small excavation unit
318	24-24.5 S X, 3.5-4E	20-30 cmbs	small excavation unit
319	SW corner, unit 302	20-ca 30 cmbs	excavation unit, rock, shell carbon feature
320	24-24.5 S-3.5-4E	30-33 cmbs	small excavation unit

Appendix B

Report of Microbotanical Analyses of Residue and Midden Samples from the South Bank Site, Turks and Caicos

Submitted by:

Jenna Battillo (Analyst and report author)
Ph.D. Candidate
jbattillo@floridamuseum.ufl.edu

Lisa Duffy (Analyst and report author) Research Associate
Research Associate
lisagd@ufl.edu

and

Kitty F. Emery (PI)
Associate Curator
352-273-1919
kemery@flmnh.ufl.edu

Nicole R. Cannarozzi (co-PI)
Collection Manager
352-273-1962
ncannarozzi@floridamuseum.ufl.edu

Environmental Archaeology, Florida Museum of Natural History
Dickinson Hall, 1659 Museum Road
University of Florida
Gainesville, FL 32611

Submitted to:
Shaun Sullivan, Ph.D.
Anthropological Research Council
3379 Westphal Drive
Johns Island, SC 29455

1. Introduction

The South Bank Site, Turks and Caicos, originally called Providenciales-1 (P-1) was first found and excavated by Dr. Shaun Sullivan in 1976-1977 (Sullivan 1981). The site was occupied during the 14th century by the Lucayan Arawak and was unusually rich in Palmetto Ware ceramics also common in other areas of the Greater Antilles. Sullivan's early excavations revealed an undisturbed, dense midden, the zooarchaeological materials from which were analyzed by Scudder and Wing (Sullivan 1981:325-332). Sullivan's more recent 2018 excavations included two units, 5-7N, 3-6E and 24-25S, 4-6E, located near the original study area. These excavations recovered several shells and sherds with retained residues from use in food production or consumption. Plant materials have not previously been analyzed from the South Bank site, so Battillo and Duffy, archaeologists expert in microbotanical analysis, were contracted to process and analyze one soil sample for pollen, phytoliths, and starches, and residues from two Codakia orbicularis shells, one other shell, and three ceramics for starches and phytoliths. These analyses will provide a better understanding of plant use and diet at the site; the shell residues additionally inform on the potential use of C. orbicularis shells to scrape and process starchy foods, as has been noted at other sites in the Caribbean (Ciofalo et al. 2018). A portion of residue samples were reserved for possible later chemical analysis if these first analyses suggest the work would be warranted.

This report summarizes the methods, results, and interpretations of these microbotanical analyses and indicates that, overall, the South Bank Site has poor preservation for microbotanical remains. Neither starches, phytoliths, nor pollen were abundant in the analyzed samples. Regardless, we were able to recover important evidence of ancient plant use. Traces of maize from two lines of evidence were identified in these samples, and phytoliths consistent with palm and arrowroot were found in the midden soil sample, one ceramic, and one shell sample. Also apparent was evidence for burning (which may represent the impact of cooking) in the phytoliths from the ceramic samples.

2. Methods

The microbotanical analyses included starch and phytolith analysis of all six residue samples and the midden soil, as well as pollen analysis of the midden soil.

2.1. Residue Analyses

Residues from three ceramic sherds (FS# 301, 303, and 318) and three shells (FS# 302, 302E, and 303) were sampled for starches and phytoliths. To avoid contamination, this sampling was conducted by Battillo and Duffy in the clean lab of the Department of Anthropology, UF, called the "starch lab" because it is predominantly used for starch processing. This lab has limited access and specific protocols in place to monitor and avoid contamination with modern botanicals. A clean razor blade was used to scrape the residues from each specimen. Each artifact was photographed before and after sampling and enough residue was left on each artifact to sample for future analyses. Half of each sample was kept in the starch lab to be processed for starch residue analysis, the remaining half was taken to the Florida Museum of Natural History Paleobotany Lab for phytolith processing.

All pollen, phytolith, and starch slides were analyzed using high-magnification (400x) compound light microscopes with suitable camera attachments. Starch and phytolith samples were analyzed using a polarizing microscope. Each unique microbotanical taxa/type identified was photographed (these are provided as jpgs in the accompanying file). Raw data from microbotanical analyses was entered into an Excel workbook (provided as a spreadsheet file). Identifications were facilitated by direct comparison with microbotanical collections housed in the Florida Museum of Natural History, and images from text sources (e.g., Kapp 1969; Moore et al. 1991; Piperno 2006; Piperno and Holst 1998; Rapp and Mulholland 1992; Reichert 1913) and comparative image databases available online (e.g., the Florida Institute of Technology's Neotropical Pollen Database [Bush and Weng 2006], and PalDat Palynological Database [2000], Phytcore: New Phytolith Database [ArchaeoScience n.d.], Starch Grain Database [Cagnato 2013-2017]).

2.1 a. Processing and Analysis of Phytoliths from Residue Samples:

- Processing for phytoliths was conducted in the Florida Museum of Natural History Paleobotany palynology lab which has all required equipment and safeguards to avoid contamination of the samples. The methods used follow Piperno (2006: 90-93). Processing began by rinsing samples into beakers with distilled water and leaving them to soak in 5-10% hydrochloric acid (HCl) for 10 minutes; following this step to partially disaggregate them and break down calcium carbonates, samples were wet screened.

- After reconsolidation into centrifuge tubes, samples were put into a hot water bath with 10% potassium hydroxide (KOH) for 20 minutes and stirred approximately every 2 minutes to ensure full exposure of each sample to the chemical.
- The same procedure was followed for hydrogen peroxide treatment in laboratory grade (34-37% hydrogen peroxide).
- Following this, it was determined that the three shell residue samples (FS# 302,302E, and 303) were too small to warrant heavy-density separation, so they were transferred directly into vials with glycerin. The three ceramic residue samples (FS# 301, 303, and 318) were large enough for heavy-density separation, so these were floated using a sodium polytungstate solution at a specific gravity of 2.3, the light fraction was then pipetted off the top and transferred into vials with glycerin and later prepared as glycerin slides to allow movement and rotation of microfossils.
- At least one slide of each sample was scanned for phytoliths; any phytoliths present were photographed. Given the small size of the residue samples, no comparative quantification using tracer spores was attempted.

2.1 b. <u>Processing and Analysis of Starch from Residue Samples:</u>
The three pottery and three shell samples and one method blank underwent heavy liquid flotation in the starch lab with cesium chloride (CsCl) with a specific gravity of 1.8 following Perry (2015). To avoid contamination from modern starches, full personal protective equipment (PPE) was worn during processing (hair cover, lab coat, shoe covers, and powder free, non-latex gloves that were washed as hands).

- Approx. 1 ml of solution was added to each of the 7, 1.5 ml snap-cap vials containing the 6 samples and 1 method blank, and each was then vortexed for 1 minute.
- Vials were centrifuged at 1000 rpm for 3.5 min. then the effluent was poured into new, 15 ml centrifuge tubes. These steps were repeated for a total of 3 flotations per sample.
- After the flotations were completed, the remaining heavy fraction residues in the snap-cap vials were rinsed: 1ml of DIH2O (deionized ultrapure water) was added, and then vials were vortexed and centrifuged at 1000 rpm for 3.5 min. The effluent was poured off and discarded into an appropriate chemical waste disposal container. The residues were dried in an oven at 38 °C for storage.
- Next, DIH2O was added to fill each of the 15 ml centrifuge tubes containing the flotation solution (and starch) in order to wash the samples and remove the CsCl. This step dilutes the solution, lowering the specific gravity. The tubes were vortexed for approx. 30 seconds, then centrifuged at 1500 rpm for 10 min. The top 2/3 of the effluent was pipetted off and discarded.
- The above step was repeated twice, for a total of 3 washes. The final effluent was poured off completely, leaving just the pellet of residue in the bottom of the tube, with a very small amount of remaining water.
- Slides were prepared with a mixture of 1:1 glycerin-DIH2O residue mixture and coverslips sealed with nail polish creating a semi-permanent slide for study and curation by the Environmental Archaeology Program. Two slides were prepared from each sample.
- All slides were scanned for starches which were photographed and identified.

2.2. Soil Sample Analyses

One heavily organic soil sample taken from a midden (labeled P1-SB 300 5-7N, 3-6E, and referred to as FS#300 for short) was also subsampled for starches, phytoliths, and pollen. These subsamples were weighed out into small beakers. It was determined that 5g of sediment would be adequate for these analyses, however, since there were some small pebble inclusions, >6g of soil was sampled for the pollen and phytolith analyses and 5g of dry-screened soil was sampled for starches.

2.2 a. <u>Processing and Analysis of Phytoliths and Pollen from Soil Samples</u>

- Two tablets of Lycopodium tracer spores were immediately added to the pollen sample (both to facilitate counting and density estimates, and to test for damage to palynomorphs resulting from processing), then 10% HCl was added to both that sample and the phytolith sample. This soil was very reactive with HCl due to high amounts of calcareous inclusions, so the samples were left to digest for approximately 20 minutes instead of the usual 10 minutes.
- Following this, both samples were rinsed and then wet-sieved. After HCl treatment and wet-sieving, a solution of 5% KOH was added to both samples, which were then put into a hot water bath for 10 minutes and stirred every two minutes.
- Since these samples appeared to be heavy in clays, a 5% solution of sodium hexametaphosphate (a deflocculant) was added and samples were put back into a hot water bath for another 20 minutes (with periodic stirring), following this, the samples were centrifuged at 3000 rpm for 3 minutes, decanted, and rinsed three more times. At this point the processing methods for each sample diverged.

Pollen: Following sodium hexametaphosphate treatment, the pollen sample was put into 48% hydrofluoric acid (HF) overnight to digest silicates. After HF digestion, the sample was rinsed thoroughly and put through acetolysis and then put through heavy density separation (using a solution of ZnBr at a specific gravity of 2.0) as a final step.

Phytoliths: The phytolith sample was treated with hydrogen peroxide and then put into a heavy density solution of sodium polytungstate (2.3 specific gravity). Lycopodium tracer spores were added following processing.

Second Processing Attempt: Following this processing, it was determined that the sample was still not adequately free of detritus (primarily charcoal) for analysis. As such, the remainder of the sample was divided in half and processed attempting a different method in order to get a cleaner sample; the methods used for the second attempt are described below.

First the remainder of the sample was coarse sieved into two separate beakers; this amounted to 4.4g of sample each for pollen and phytoliths, the materials caught in the sieve were also rinsed with distilled water to remove any microfossils adhering to the pebbles. Lycopodium tablets were then added to the pollen sample. 10% HCl was added and the samples were left to digest. Following this both samples were floated in heavy density solution (2.0 specific gravity for pollen and 2.3 specific gravity for phytoliths) the heavy fraction was separated into smaller tubes and set aside and later checked for microfossils. Following this, the pollen sample was put into HF and left overnight. Both samples were processed twice in KOH and the phytolith sample was also processed twice in Schultz solution (nitric acid and potassium chlorate). The pollen sample was also put in Schultz solution once in the hopes that it would eliminate some of the charcoal crowding the slide. Following this the pollen sample was acetylated and the phytolith sample was processed in a hot water bath with hydrogen peroxide before Lycopodium tracer spores were added with a bit of HCl to help them dissolve.

Processed samples of both pollen and phytoliths were transferred to labeled vials with glycerin and later made into semi-permanent glycerin slides, both to be curated by the Environmental Archaeology Program.

2.2 b. Processing and Analysis of Starch from Soil Samples
South Bank FS#300 sediment sample was processed for starches following the method established by Therin and Lentifer (2006).

- Five grams of dry, sieved sediment was weighed out and placed in a sterilized 200 ml beaker to undergo deflocculation.
- Next, 20 ml of 6% hydrogen peroxide was added, and allowed to sit for 30 min. Then, another 20 ml of hydrogen peroxide was added, and allowed to sit for another 30 min.
- The sample was then wet sieved through a 250 µm screen and transferred into a 50 ml centrifuge tube.
- The sample was then deflocculated using 5% sodium hexametaphosphate, and centrifuged at 2500 rpm for one minute, and this step repeated several times until supernatant was clear.
- Next, DIH20 was added to the sample to rinse, and centrifuged at 2500 rpm for 2 min. A total of three rinses were completed, then the sample was dried in an oven at 38°C.
- Once dry, the sample underwent cesium chloride flotation as described in the previous section.
- A total of three slides were prepared from the sediment flotation sample.

3. Results

All phytolith, pollen, and starch raw data results are summarized and described in the text and tabulated in the spreadsheet appendix. Defining terms used in this description are also provided in the appendix including taxonomic, plant portion, and descriptive terms. All images are provided as a separate file. No secondary data analysis is provided because the number of microbotanicals recovered from these samples were too small for statistical validity. Phytoliths were sparse in the soil sample and a count of 400 Lycopodium tracer spores was reached prior to finding even 50 identifiable phytoliths. After counting two complete slides very few pollen grains were found. Numerous spores and other palynomorphs (items such as foraminifera that resemble pollen, but are not) were seen in the pollen sample, but the slides were mostly crowded with charcoal and detritus, and the pollen that was found was heavily degraded. The vast majority of the pollen noted was unidentifiable; grains were folded, torn and fragmentary, and surface features and other identifying features were often unclear or obliterated. Spores were in better condition, but they tend to preserve better and are generally produced in significantly larger amounts than pollen.

The addition of tracer spores is not standard for starch analysis, so none were added to any of the starch samples. Only two starch specimens were recovered from all seven samples, and only one of those was identifiable.

Table 1. Summarized Results of Identified Taxa

Artifact ID	Description	Starch	Phytoliths
FS 302 "special shell"	C. orbicularis	1 cf. Zea mays	17 specimens: 4 likely arboreal phytoliths, 1 sedge fruit phytolith, and 2 grasses
FS 302E South Wall shell	unidentified shell	0	15 specimens: 4 grasses, 1 sedge, 1 cf. Podostemaceae
FS 303 shell	C. orbicularis	0	13 specimens: 1 likely arboreal, 1 grass, 1 sedge
FS 301 sherd	palmetto ware	0	4 specimens: 1 burnt pooid grass, 1 other grass
FS 303 sherd	imported ceramic	0	12 specimens: 6 pooid grass phytoliths, a saddle-shaped chloridoid grass phytolith, and an arrowroot type (all burnt)
FS 318 sherd	palmetto ware	0	11 specimens: 3 grasses (burnt), and 2 sedge (burnt)
FS 300 sediment	sediment	1 UID	38 specimens: including 3 arrowroot, 1 palm, 1 squash-type, 1 panicoid grass (highly degraded), 1 Asteraceae, and 4 sponge spicules
		Pollen	
FS 300 sediment	sediment	411 specimens including 377 fungal/moss spores, 2 Asteraceae, 3 sedge, 2 cheno-am, and 1 grass	

3.1 Residue Analyses

3.1a. Phytolith Residues

Phytoliths in all three ceramic samples (FS# 301, 303, and 318) showed evidence of burning, see Table 1. These samples did not have good preservation and the level of burning suggests this could be a result of repeated degradation during cooking/use. Alternatively the poor preservation could be a result of poor overall preservation at the site or in the midden since the phytoliths from the soil and shell samples also showed poor preservation. In spite of the high charcoal content in the midden soils, it is not likely that these phytoliths were burned during midden burning since other phytoliths associated with the soil sample (0 of 38) and shell samples (9 of 45) did not show as much evidence of burning and the burnt phytoliths in those samples were different in appearance/alteration than those from the ceramics. The other samples included phytoliths that were dark brown, interpreted as possible evidence of burning as noted in the appendix, but this is different than the burning noted in the ceramic samples which turned the phytoliths partially or completely gray (Fig. 1 and 2), and appeared to cause cracking in one sample (Fig. 2); the dark brown associated with other phytolith samples, which was interpreted as potential evidence for burning seemed more likely to come from association with plant material burned as charcoal, brief burning at a lower temperature, or even staining than from cooking (Fig. 3).

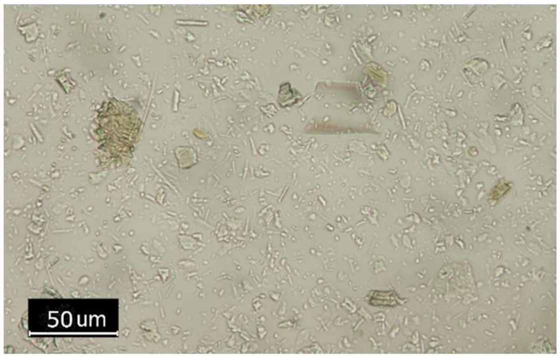


Fig. 1. Quadrangular, epidermal-type phytolith with evidence of burning from FS# 301.

The phytoliths from sample FS#303 (the imported ceramic) exhibit a pattern similar to those from FS# 301, they show strong evidence of burning and degradation/dissolution. Most of the identifiable phytoliths identified in this sample were simple small, rondel phytoliths consistent with the Pooideae subfamily grasses, a large group of over 4000 species of grasses that occur on every continent, some of which are native to the Neotropics. This group does include some edible cereal products such as wheat, oats, and barley.

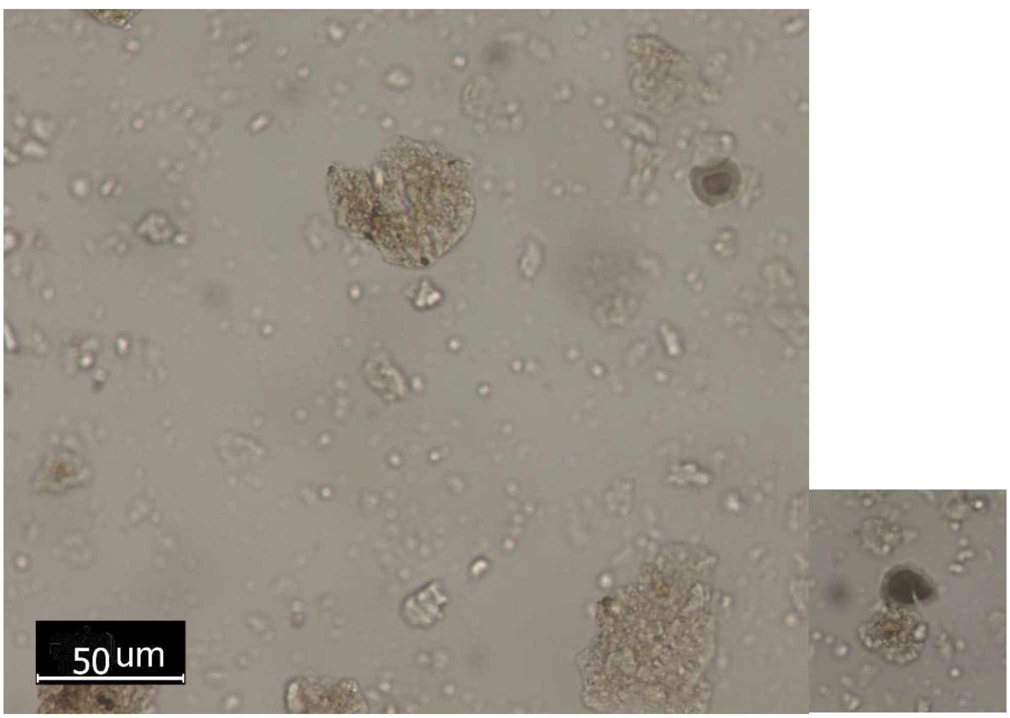


Fig. 2. Burned saddle phytolith associated with grasses from the subfamily Chloridoideae, common (C4) grasses that tend to inhabit warm climates (upper right corner); also pictured (right image) is an unidentified phytolith showing burning and cracking, both of these were associated with sample FS# 303. Other burned, smooth rondel phytoliths consistent with pooid grasses were also found in this sample and other non-specific grass phytoliths (Poaceae family) were also noted.

The phytoliths found in the residue sample from FS# 318 showed a different pattern. Although some showed evidence of burning, there were not as many grass-types and more unknowns.

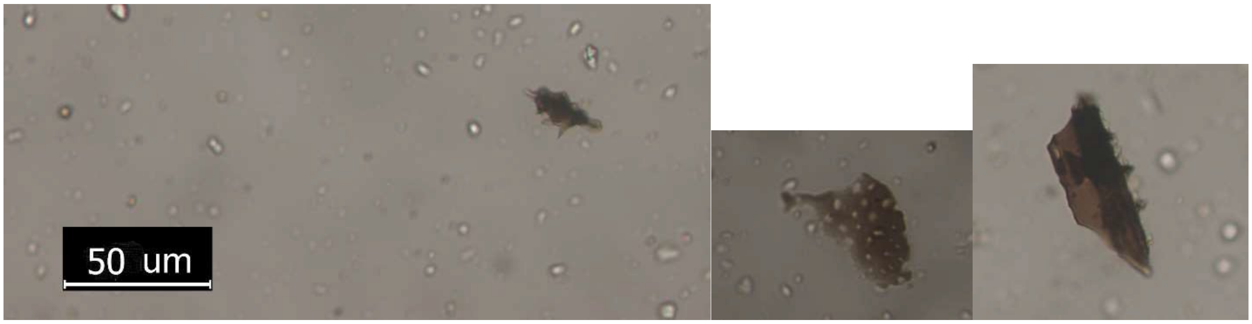


Fig. 3. Unknown phytoliths from FS# 318, and one elongate grass-type with projections (far right) that all show staining/possible evidence of burning.

Not many identifiable phytoliths were found in the shell residues. Several damaged, unidentifiable phytoliths were noted, as well as several that are not indicative of any particular plant group (including sclereid-types generally considered indicative of arboreal taxa). The "special shell" FS# 302 had the most phytoliths (17 counted), including four sclereids likely indicative of arboreal taxa. A burned and fragmented, possible stomatal phytolith was also associated with this sample (Fig. 4).

Fig. 4. Unknown phytolith (left) and possible fragmented stomatal phytolith (right) from residue sample of FS# 302.

3.1 b. Starch Residues

No starch was found in any of the ceramic sherd residues. The sample from shell FS# 302 "special shell" yielded a single starch grain. This grain was able to be fully rotated for a 3 dimensional view (Fig. 5). The characteristics of the grain; shape, size, hilum position and fissure pattern are consistent with maize.

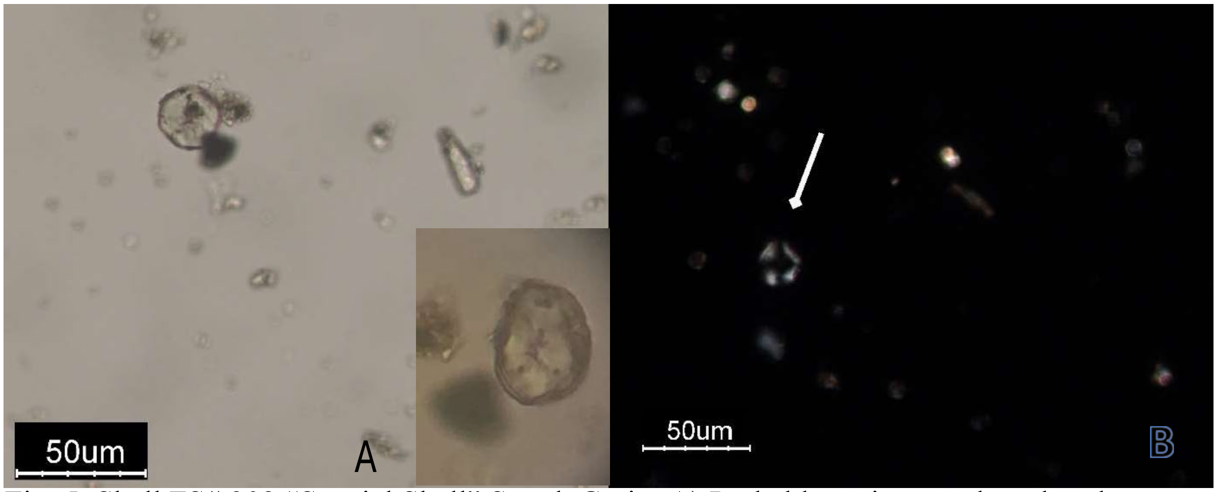


Fig. 5. Shell FS# 302 “Special Shell” Starch Grain. A) Probable maize starch under plane-polarized light B) Grain under cross-polarized light.

3.2 Soil Analyses

3.2a. Phytolith Results

Phytoliths were analyzed from the second processing attempt; two slides were scanned and in the course of these analyses 402 of the approximately 48,400 Lycopodium tracer spores added to the sample were counted (approx. 11,000 per gram of sample). Few phytoliths were found; 15 tracheids, four echinate (spiny) spherical types (palm and likely arrowroot), two unknown perforate types, one panicoid grass phytolith, and one possible squash (Cucurbita) phytolith. Ten other probable phytoliths were counted as either unidentifiable or unknown and likely unidentifiable/not taxonomically specific.

Tracheid phytoliths that are unfortunately not identifiable to plant group were the most common; some of these appeared to be fragmented and degraded. One degraded bilobate grass-type phytolith, consistent with those from panicoid (C4) grasses was noted.

Four sparsely echinate spherical phytoliths were noted; one of these showed signs of burning. These were small (only about 10 microns in diameter), at least one of these appeared similar to palm fruit phytoliths, but three are more consistent with the phytoliths from the family Marantaceae (arrowroot family). Although these phytoliths overlap in morphology with Bombacaceae (bombax family), the phytoliths in these samples more closely resemble comparative images of Marantaceae, so they were more specifically identified as such, in particular since my understanding is that no member of this family as it is currently identified[1] is native to this area (Fig. 6).

[1]Several former members of the family Bombacaceae have been reclassified into Malvaceae, including the genus Ceiba and others that include species native to Caribbean.

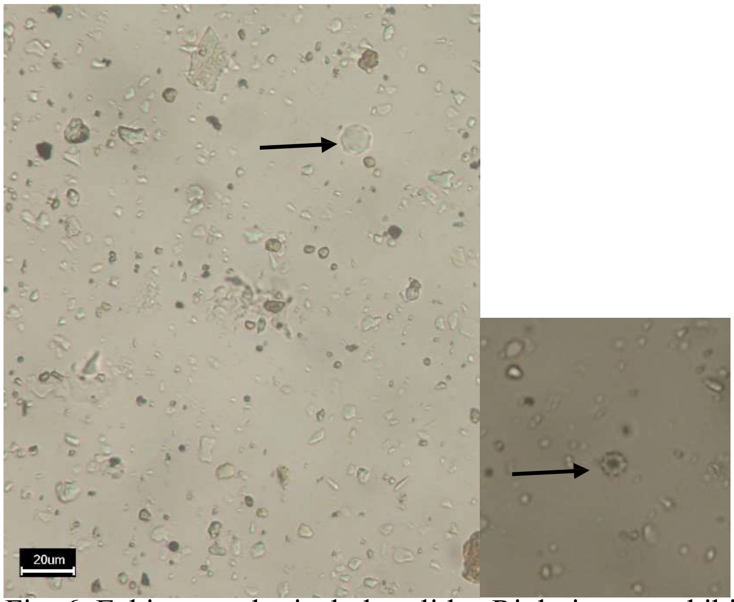


Fig. 6. Echinate, spherical phytoliths. Right image exhibits evidence of burning.

One elliptical phytolith with elongated scalloped sculpturing indicative of Cucurbita moschata (squash) was identified, however, this specimen is much smaller in size (only about 10-15 microns in length) than those described by Piperno and colleagues (2002, see Fig. 7). One opaque perforate platelet phytolith was also identified. These are diagnostic of Asteraceae (sunflower family) inflorescences, which is consistent with the fragmented high-spine type Asteraceae pollen also found in the midden soil.

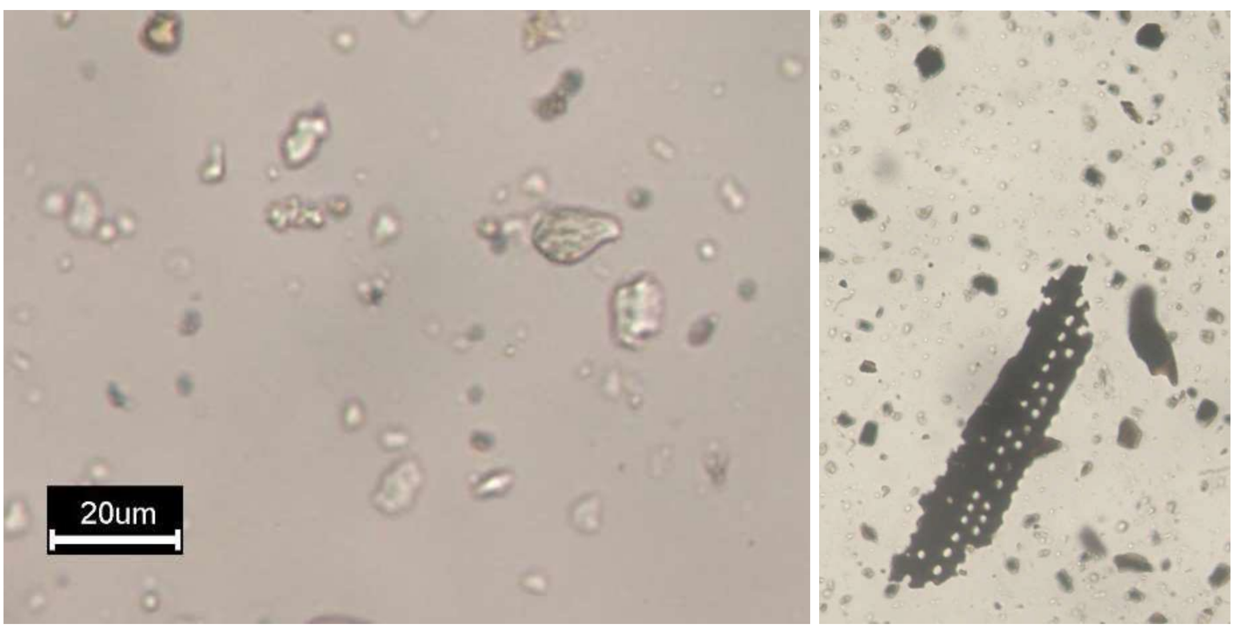


Fig. 7. Possible squash (Cucurbita) phytolith (upper right quadrant of left image); Asteraceae opaque perforate platelet phytolith (right).

3.2b. Pollen Results

Pollen was counted from the first round of processing because it was determined that the Schultz solution used to eliminate charcoal in the second soil processing attempt also damaged the pollen since none of the added Lycopodium tracer spores were found when scanning these slides. The vast majority of what was found in the pollen sample was spores and other palynomorphs discussed in section 3.3. The pollen that was found was poorly preserved. This is indicative of site preservation and could not have been a result of processing since the Lycopodium tracer spores added at the beginning of processing were in excellent condition. Two fragmentary high-spine type Asteraceae (sunflower family) pollen were found, one cheno-am pollen, one grass pollen, and five degraded tricolporate (or possibly tricolpate), tectate (with a relatively thick exine), reticulate/suprareticulate grains with indistinct pores were found (Fig. 8). One fragment potentially consistent with Malvaceae (mallow family) was also found, but this was counted as not identifiable since less than half of the grain was recovered. Pollen grains were degraded, many were torn and all were collapsed and folded. These grains could not be further identified because of their poor preservational condition and the lack of comparative materials for regional flora.

Fig. 8. Unidentified, tricolpate/tricolporate pollen approximately 30 microns in length and 20 microns wide.

Also of note, one Zea mays pollen grain was identified while conducting a quick scan of a temporary smear slide. Unfortunately, this was done in the processing laboratory on a microscope not equipped with a camera, so no image could be obtained.

3.2 c. <u>Starch Results</u>

A single unidentified starch grain that measured 25 μm in diameter was recovered from the sediment sample (see Fig. 9). For taxonomic identification, starch grains must be able to be rotated to view in 3 dimensions under the microscope. This grain was not able to be rotated, and had no diagnostic elements that were visible in the 2 dimensional view.

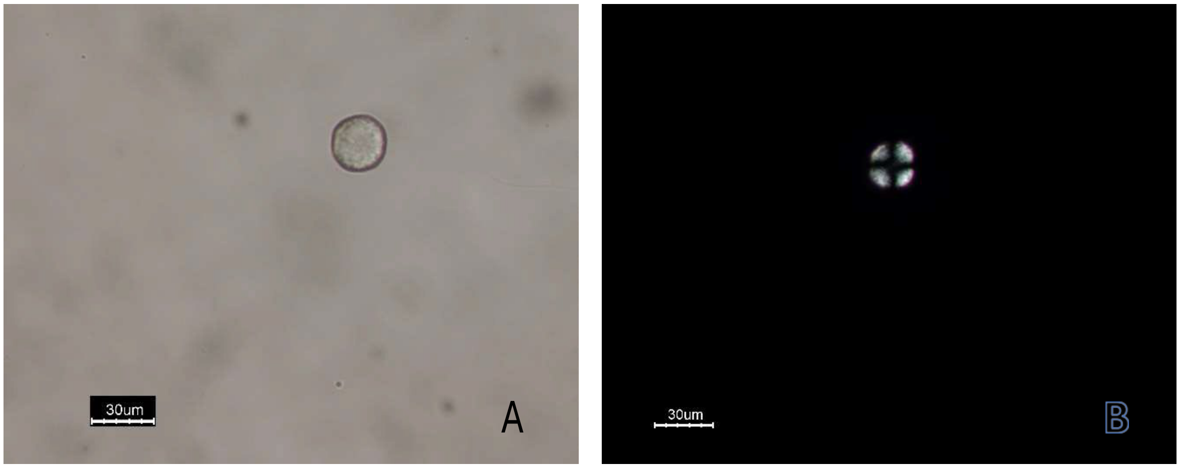


Fig. 9. Sediment FS# 300 A) Unidentified starch grain, 400x plane-polarized light B) Under cross-polarized light showing the extinction cross diagnostic of starch grains.

3.3 Other Findings

Segmented, coiled microfossils that we believe to be foraminifera (pictured below) were found in the soil and residue samples. Notably, these were found much more frequently in the shell residues than the ceramic residues, which is most likely indicative of their association with marine environments, although it is possible that this is a result of taphonomy as the calcium carbonate shell may have protected the foraminifera from dissolution. Parasite eggs were noted in the soil, but these were not identified to taxonomic level. Sponge spicules were noted in the phytolith samples, including some in the soil sample. Spores of various types including mold, mushroom, and mosses were found in the pollen sample. One microfossil found in the pollen sample appears consistent with certain types of dinoflagellates as described by Kapp (1969, see image below).

On a macroscopic scale, several small (approx. 2 mm in diameter), iridescent macrofossils with an almost metallic sheen were found in the soil samples. At first these were thought to be beads, but upon closer inspection it was clear that they each had only one hole. Furthermore, their shapes were too irregular and asymmetrical to be seeds. Although not positively identified, these are consistent with some beetle egg casings.

Fig. 10. Foraminifera from soil sample.

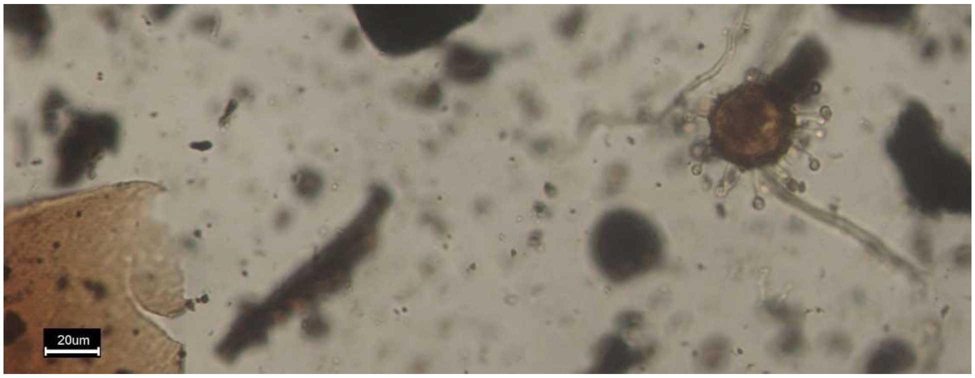


Fig. 11. Possible dinoflagellate from soil sample.

4. Interpretation

The microbotanical preservation at this site is poor, so although we feel confident in asserting the presence of maize based on starch and pollen evidence, we unfortunately cannot state much else regarding economic plant use. It is very likely based on the pollen and phytolith evidence that sunflower seeds or other seeds/flowers from the family Asteraceae may have been associated with this midden and had economic significance, but since members of family Asteraceae are common disturbance plants, it could be that the pollen and phytolith associated with their inflorescences are a result of weedy growth on or near the midden. One phytolith also indicates the possible presence of squash and several phytoliths from the soil sample and one each from shell FS# 302E, 303, and ceramic FS# 303 are indicative of either palm fruit and/or arrowroot. Although the diminutive size of these phytoliths and potentially partial degradation made it difficult to see their features clearly, it appeared there were at least two different types of these round spiny phytoliths, so it is probable that they represent both palm and arrowroot use.

Given the poor preservation of microfossils in the soil samples, the lack of microfossils (particularly starches) in the shell residues is not necessarily indicative of their lack of association with economic plant use, particularly since the only identifiable starch grain came from one of these samples. As such, it is possible that these were being used for scraping starchy foods, but without further samples this conclusion cannot be definitive.

The phytoliths associated with the ceramic sherds were likely partially embedded or stuck to the sherds themselves, providing a protective microenvironment from the factors that led to destruction of some of these microfossils in other samples. The burnt phytoliths identified from the ceramic residues potentially indicate why no starches were found associated with these samples, since heating at temperatures above 50 degrees Celsius destroys starch grains. Possible causes for the poor preservation in the midden soil include, but are not limited to cycles of repeated wetting and drying, pH levels not suited to microbotanical preservation, degradation resulting from fungus, or even insect consumption of organic remains in light of the (probable) beetle egg casings. Based on the very poor preservation of the pollen grains that were found, we think it likely that chemical processes or biochemical processes resulting from fungal growth are at least partially responsible for the lack of microfossils.

Based on the poor preservation we observed, we do not suggest the use of chemical residue analysis, unless the aim is to find targeted compounds such as nicotine, capsaicin, or chemicals associated with psychotropic drugs and the sample/residue is believe to be relatively well preserved or from a sealed deposit. However, we suggest that charcoal analysis and flotation analysis of the midden or other site deposits could be informative.

References Cited

ArchaeoScience Community Group. (n.d.) Phytcore DB: phytolith images database. http://www.phytcore.org/phytolith/index.php?

Bush, Mark B. and M.B. Weng. (2006) Introducing a new (freeware) tool for palynology. Journal of Biogeography 34: 377-380.https://research.fit.edu/paleolab/pollen-database/

Cagnato, Clarissa (2013-2017) Starch Grain Database. http://clarissacagnato.weebly.com/starch-grain-database.html

Kapp, R.O. (1969) How to Know Pollen and Spores. The Pictured Key Nature Series. Dubuque: Wm C. Brown Company Publishers.

Moore, P.D., J.A. Webb, and M.E. Collinson. (1991) Pollen Analysis, Second Edition. Oxford: Blackwell Scientific Publications.

PalDat. (2000 and onwards) PalDat – a palynological database. Society for the Promotion of Palynological Research in Austria (AutPal). www.paldat.org.

Perry, Linda (2015) Starch Extraction Protocol. Electronic document. http://fossilfarm.org/Methods/Methods/Protocol.html, accessed May 11, 2015.

Piperno, Delores R. (2006) Phytoliths: A Comprehensive Guide for Archaeologists and Paleoecologists. AltaMira Press, New York.

Piperno, Dolores R., and Irene Holst (1998) The Presence of Starch Grains on Prehistoric Stone Tools from the Humid Neotropics: Indications of Early Tuber Use and Agriculture in Panama. Journal of Archaeological Science 25(8):765-776.

Piperno, Delores, Irene Holst, Linda Wessel-Beaver, Thomas C. Andres (2002) Evidence for the control of phytolith formation in Cucurbita fruits by the hard rind (Hr) genetic locus: Archaeological and ecological implications. PNAS 99 (16) 10923-10928; DOI:10.1073/pnas.152275499

Rapp, George and Susan C. Mulholland, eds. (1992) Phytolith Systematics: Emerging Issues. Advances in Archaeological and Museum Science, Vol. 1. Plenum Press, New York.

Reichert, Edward Tyson (1913) Differentiation and Specificity of Starches in Relation to Genera, Species, etc. Washington D. C.: The Carnegie Institution of Washington.

Sullivan, Shaun Dorsey (1981) Prehistoric patterns of exploitation and colonization in the Turks and Caicos Islands. Doctoral dissertation, University of Illinois at Urbana-Champaign. (Order No. 8203607) ProQuest Dissertations & Theses Global. (303156881). Retrieved from https://search.proquest.com/docview/303156881?accountid=10920

Therin, Michael and Carol Lentifer (2006) A Protocol for Extraction of Starch from Sediments. In Ancient Starch Research, edited by Robin Torrence and Huw Barton, pp. 159-161. Left Coast Press, Walnut Creek, CA

South Bank Microbotanical Analysis Appendix 1 - Results

Jenna Battillo and Lisa Duffy, analysts and report authors

Kitty Emery and Nicole Cannarozzi, project directors and supervisors

FLMNH-EAP, May 2019

Midden Sample

Specimen Taxonomic ID	Specimen Description/Portion	FS# 300 phytolith sample	FS# 300 pollen sample	FS# 300 starch sample
Lycopodium Tracer Spores	**n/a**	**402**	**32**	**n/a**
Arecaceae (palm family)	echinate (spiny) spheroid phytolith, fruit or leaf	1		
Asteraceae (sunflower family)	opaque perforate platelet phytolith, inflorescence	1		
Asteraceae (sunflower family)	high-spine aster pollen		2	
Chenopodium/Amaranthus	cheno-am pollen		2	
cf. Cucurbita moschata (squash)	fruit (rind) phytolith	1		
Cyperaceae (sedge family)	pollen		3	
Marantaceae (arrowroot family)	verrucate (bumpy) spheroid phytolith	3		
Poaceae (grass family)	pollen		1	
Panicoideae grass (large subfamily incl. corn, sugarcane, etc.)	bilobate phytolith, leaf	1		
Zea mays (corn)	pollen		[1]**	
Various plant groups	tracheid phytolith	15		
Unknown/unidentifiable	prolate, tricolpate/tricolporate, reticulate grain phytolith		5	
Unknown taxonomic association	perforate phytolith	2		
Unidentifiable	pollen or phytolith too degraded to positively ID	10	21	
Unidentifiable	starch grain			1
Sponge	spicules	4		
Various fungal (mold, mushroom)/moss taxa	spores		377	
Total		**37**	**411**	**1**

** identified in a temporary smear slide, cannot be included in the total count

Ceramic Samples

Specimen Taxon	Specimen Description/Portion	FS# 301 palmetto ware phytolith sample	FS# 301 palmetto ware starch sample	FS# 303 imported ceramic phytolith sample	FS# 303 imported ceramic starch sample	FS# 318 palmetto ware phytolith sample	FS# 318 palmetto ware starch sample
Cyperaceae (sedge family)	cf leaf/stem phytolith					*2	
Marantaceae (arrowroot family)	verrucate spheroid, phytolith			*1			
Poaceae (grass family)	long-cell type, leaf phytolith	1				*1	
Poaceae (grass family)	elongate type, leaf phytolith			1		*2	
Chloridoideae grass (large subfamily incl. Bermuda grass)	saddle type, leaf			*1			
Pooideae (large subfamily incl. rye, oats, etc.)	rondel, leaf	*1		*6			
Unknown taxonomic association	quadrilateral epidermal phytolith	*1					
Unknown/unidentifiable	perforate types phytolith					*3	
Unknown taxonomic association	unknown portion type phytolith					*3	
Unidentifiable (poorly preserved, fragmented, damaged, etc.)	unknown portion type phytolith	1		*3			
Total		**4**	**0**	**12**	**0**	**11**	**0**

*Indicates evidence of burning

Shell Samples

Specimen Taxon	Specimen Description/Portion	FS# 302 special shell phytolith sample	FS# 302 special shell starch sample	FS# 302E shell phytolith sample	FS# 302E shell starch sample	FS# 303 shell phytolith sample	FS# 303 shell starch sample
Arboreal	sclereid phytolith, elongate with dendritic projections	*4		1		1	
cf . Burseraceae (torchwood family)	seed phytolith			*1			
Cyperaceae (sedge family)	cone-type phytolith			1		1	
Cyperus sp . (sedge)	achene (fruit) phytolith	1					
Marantaceae (arrowroot family)	verrucate spheroid, phytolith			1			
Poaceae (grass family)	elongate phytolith	1		1			
Poaceae (grass family)	elongate phytolith with projections			*3		1	
Poaceae (grass family, non-maize, wild grass type)	dendritic elongate phytolith	1					
cf . *Zea mays*	starch grain		1				
cf . Podostemaceae (riverweed family)	perforate type phytolith			*1			
Unknown taxonomic association	polyhedral possible epidermal phytolith			2			
Unknown taxonomic association	hair tip/leaf phytolith	1					
Unknown taxonomic association	epidermal phytolith					2	
Unknown taxonomic association	possible stomatal phytolith	*1					
Unknown taxonomic association	sheet element-type phytolith	1		1		2	
Unknown taxonomic association	tracheid phytolith					1	
Unknown taxonomic association	perforate type phytolith					*1	
Unknown taxonomic association	unknown portion type phytolith	3		*2		4	
Unidentifiable (poorly preserved, fragmented, damaged, etc.)	unknown portion type phytolith	4		1			
Total		**17**	**1**	**15**	**0**	**13**	**0**

*Indicates evidence of burning

South Bank Microbotanical Analysis Appendix 2 - Terms and Definitions

Jenna Battillo and Lisa Duffy, analysts and report authors
Kitty Emery and Nicole Cannarozzi, project directors and supervisors
FLMNH-EAP, May 2019

Table of Taxa with Scientific and Common Names

Arecaceae	palm family
Marantaceae	arrowroot family
Cucurbita moschata	squash/pumpkin
Chenopodium/Amaranthus 'cheno-am'	cheno-am' is used to refer to pollen from the family Chenopodiaceae (goosefoot) or genus *Amaranthus* (pigweed)
Asteraceae	sunflower family
Asteraceae 'high-spine aster'	sun-flower family 'high-spine aster' pollen with large spines (incl. *Helianthus annuus*)
Poaceae family (long-cell and elongate variations)	grass family generalized grass leaf phytoliths
Panicoid grass (Panicoideae sub-family)	large subfamily of C4 grasses common worldwide, includes corn, sugarcane, rice, Bermuda grass (bilobate phytoliths--dumbbell shape)
Zea mays	corn/maize (a Panicoid grass)
Chloridoideae grasses	large subfamily of common C4 grasses that inhabit warm climates worldwide (saddle phytoliths)
Pooid grass (Pooideae sub-family)	largest subfamily of grasses that includes thousands of species globally, example: genus *Triniochloa (New World tropics)* , and well known crops such as oats, wheat, usually C3 grasses (smooth rondel phytoliths)
Podostemaceae	(riverweed family) aquatic herbs that adhere to hard surfaces (generally rock) in rapids and waterfalls of rivers - found mostly in tropical and subtropical areas worldwide
Cyperaceae	sedges: grass-like flowering plants may be found growing in almost all environments, many are associated with wetlands, or with poor soils - cotton-grass (Eriophorum), spike-rush (Eleocharis), sawgrass (Cladium), nutsedge or nutgrass (Cyperus rotundus, a common lawn weed), and white star sedge (Rhynchospora colorata)
Cyperus sp . (sedge)	nutgrass, flatsedge type sedge, common throughout the Americas
Sponge (phylum Porifera)	marine animals
Various fungal taxa	mold and mushrooms [Kingdom Fungi], moss [plant]

Table of Plant Portion Terminology

sclereids	phytoliths from sclerenchyma cells (strengthening elements in mature plants), usually arboreal indicators, almost completely restricted to trees and shrubs
rondel	round phytoliths created by silicification of short cells in grass epidermis
stomata	pore structures on leaves through which plants take in carbon dioxide and release oxygen
tracheids	water conducting cell in plant xylem (stem)
inflorescence	the complete flowering head of a plant (including flower, stems, bracts)
epidermis	outer layer of plant stem or leaf
hilum	the nucleus or core of the starch grain
fissures	natural creases or depressions that occur as the starch grain forms
exine	outer layer of pollen grain

Table of Additional Terms Used

phytolith shape descriptors:	polyhedral, spherical/spheroid, elongate, bilobate (dumbbell shaped), quadrilateral, see also rondel above
descriptions of surface features:	echinate (spiny), verrucate (bumpy), psilate (smooth), dendritic projections (branching processing), scalloped
other descriptors:	perforate (includes multiple holes), sheet element type (part of a larger group of flat phytoliths that form a sheet), cone type (refers to a type of phytolith that occurs in some sheet elements)
pollen shape descriptors:	tricolpate (has three slit openings), tricolporate (has three slit openings that contain pores)
pollen surface descriptors:	tectate (has a complete outer layer), reticulate/suprareticulate (a pattern of empty spaces enclosed by ridges within the pollen wall), prolate (ovoid)

Appendix C

ZOOARCHAEOLOGY OF THE SOUTH BANK SITE, PROVIDENCIALES, TURKS AND CAICOS

May 09, 2019

Submitted by:

Brittany A. Mistretta (Analyst and report author) Ph.D. Candidate
bmistretta@ufl.edu

and

Kitty F. Emery, Ph.D. (PI)
Associate Curator
352-273-1919
kemery@flmnh.ufl.edu

Nicole R. Cannarozzi (co-PI)
Collection Manager
352-273-1962
ncannarozzi@floridamuseum.ufl.edu

Environmental Archaeology, Florida Museum of Natural History
Dickinson Hall, 1659 Museum Road
University of Florida
Gainesville, FL
32611

Submitted to:

Shaun Sullivan, Ph.D.
Anthropological Research Council
3379 Westphal Drive
Johns Island, SC 29455

Introduction

Shaun Sullivan found the South Bank site in mid-1976, and conducted test excavations there in early 1977. It was originally designated as Providenciales-1 (P-1), but has since been renamed. It is considered a long term settlement, affiliated with the characteristic Lucayan Palmetto Ware ceramics. Most of the site was found damaged due to construction. The remaining, intact area consisted of a dense midden measuring approximately 20 X 20 meters. A 2 X 2 meter unit was excavated during test excavations uncovering a feature with a possible wall trench and a pit below the midden with concentrations of carbonized wood, indicating the presence of a structure. Sylvia Scudder and Elizabeth Wing analyzed faunal samples that were collected from the dense midden and a disturbed midden pile from a bulldozed area. The goal of their analysis was to determine exploitation of catchment areas and environmental zones by Amerindians at the South Bank Site (Sullivan 1981: 325-332). Environmental zones are composed of terrestrial and

aquatic habitats noted during Sullivan's archaeological survey (e.g. (Sullivan 1981: 48). Catchment areas are composed of environmental zones and have high probability of resource exploitation that are usually within short distances of a site to maximize returns of desirable resources (Sullivan 1981: 48).

Sullivan revisited the South Bank site in 2018, along with Dr. Michael Pateman, to conduct more salvage excavations within the remaining midden area. A 3 X 2 meter unit (5-7N, 3-6E) was opened approximately 2 meters northwest of the 1977 excavation unit. An additional unit was excavated 24-26S, 4-6E. Fauna collected during the 2018 excavations provides the opportunity to contribute additional contemporaneous information about catchment areas and exploitation zones to Wing and Scudder's original analysis.

Zooarchaeological Materials and Methods

This analysis includes zooarchaeological materials excavated from the pre-Columbian South Bank Site on Providenciales during the October 2018 field season. The assemblage includes animal remains collected from ¼ inch screened samples from a 3 X 2 meter unit. Samples were washed before analysis was conducted. Standard analysis procedures were used as outlined by Reitz and Wing (2008). I identified specimens to the lowest taxonomic category possible. Identifications were facilitated by the direct comparison of zooarchaeological remains with modern osteological comparative specimens contained in the collections of the Environmental ArchaeologyProgram of the Florida Museum of Natural History, and in other related collections. As part of primary data collection, I recorded the Number of Individual Specimens (NISP), weight (in grams per element except for UID fragments and fish spines that are weighed together), age, sex, taphonomy, and anthropogenic modifications such as butchering, burning, and tool production (when applicable). During secondary data collection, I calculated the Minimum Number of Individuals (MNI) aggregated by contexts defined by the excavator (see Table 2). Multiple proveniences composed the 3 X 2 unit, therefore their NISP and MNI were combined by contiguous levels. The NISP provides a maximal estimate of the number of individuals represented but over-estimates animals with large numbers of elements (e.g. turtles with high numbers of carapace and plastron plates), highly diagnostic elements (such as certain fish elements), or particularly well preserved remains (e.g. mammal in comparison to bird bone),
All data was recorded in an excel spreadsheet and is provided as Appendix 1.

Results

A total of 12 non-overlapping taxa were identified (10 vertebrates and 5 invertebrates) representing 11 MNI (See Tables 1 and 2). The assemblage of both units contained a total NISP of 113, with vertebrates making up 86.7% of the assemblage and invertebrates making up 13.3%. Vertebrates were only represented by fish taxa. No mammals, reptiles, or birds were identified. Unit 5-7N had the greatest number of specimens with a NISP of 108 and an MNI of 10 (Table 2). Unit 24-26S had very small NISP (6) and MNI (1) totals.

The only anthropogenic modification observed was burning (see Appendix 1 for details per specimen). Burning evidence included a range of colors indicative of different degrees of heat exposure: brown, black, and grey-black in order of heat level. 26.8% of the assemblage from Unit 5-7N was burnt, but only one specimen was burnt in Unit 24-26S. Burnt identified elements mostly belonged to fish taxa, although two unidentified burnt skeletal portions were from crab and shellfish. Almost all of the assemblage was poorly preserved (exterior bone erosion and heavy fragmentation). Only 8.84% of the entire assemblage was identified as complete specimens. Most of these included dense elements that are more likely to preserve such as teeth, pharyngeal grinders, and crab dactyls. Orange and black staining and concretions were also observed. The black staining is distinguishable from burning, because the coloration changes are more superficially located and speckled on the bone. Concretions likely increased weight measurements and, along with the impacts of fragmentation and poor preservation, precluded the identification of 48 bone fragments that were categorized into the broader Vertebrata taxonomic category.

Most of the identified fish were found in Unit 5-7N, except for 1 NISP identified in Unit 24-26S, and were the most frequently represented of all taxa in Unit 5-7N (42.6%), a pattern that is consistent between levels. Identified taxa include parrotfish (*Sparisoma* sp.), grouper (*Epinephalus* sp.), spadefish (*Chaetodipterus faber),* grunt (*Haemulon* sp.), snapper (*Lutjanus* sp.), surgeonfish (*Acanthurus* sp.), and porgies (Sparidae). Certain taxa were found only in the uppermost level (20-30 cmbd: *Acanthurus* sp., *Haeumulon* sp., *Lutjanus* sp., Scleractinia, *Callinectes sapidus*) and others only in the lower level (40-X cmbd: *Chaetodipterus faber, Epinephalus* sp., *Cardisoma guanhumi*), a difference that could be attributed to the low number of specimens or, possibly, to differences in fish use between time periods. Out of 45 identified fish elements, 40 are located anterior in the body and are mostly skeletal elements of the head and jaw (See Appendix 1 for specific information on elements per specimen). The high number of anterior vs. posterior elements could reflect butchering practices in which fish heads were deposited separately from posterior portions. However, evidence of poor preservation may suggest that denser elements were more likely to preserve and possibly biasing element distribution. Invertebrates identified included crab, shellfish, and coral. Crab was represented by portions of their claws called dactyls and identified in both units, but are differently distributed between units. Blue land crab (*Cardisoma guanhumi*) was identified in both units 5-7N and 24- 26S, but Atlantic blue crab (*Callinectes sapidus*) was only found in unit 5-7N. In unit 5-7N, the two species were found in different levels. Small fragments of coral (Scleractinia) and shellfish (Mollusca) were also found in unit 5-7N and not in the other units. M Fish identified to genus or species represent three environmental zones including flats, reefs and flats, and tidal inlets. Parrotfish (*Sparisoma* sp.), grouper (*Epinephalus* sp.), and spadefish (*Chaetodipterus faber)* reside in reefs and flats. Grunt (*Haemulon* sp.), snapper (*Lutjanus* sp.), surgeonfish (*Acanthurus* sp.) are found in reefs, flats, and tidal inlets, and porgies (Sparidae) are found among tidal inlets and flats.

The South Bank site is situated in close proximity (~2 km) to the three represented environmental zones in the analyzed assemblage (Sullivan 1981: 329). They would have been easily accessible and are prime locations for maximizing the exploitation of aquatic resources. Although there are some differences between taxa represented in the upper or lower level, the exploitation of environmental zones over time is consistent except for the exploitation of terrestrial land crab during later periods. There seems to be a shift in what taxa were targeted or available for capture within the site's surrounding environmental zones, possibly due to overexploitation.

Wing and Scudder did not identify crab to species in their original analysis and therefore, did not consider their relationship to environmental zones within the catchment area of the South

Bank Site. Here, I've provided current biological data on their habitat distributions. Blue land crab (*Cardisoma guanhumi*) crabs live on land and close to shorelines often near estuaries. It is possible that the identified land crab remains are intrusive because they can burrow to deep depths and are still common in this region, although there was no indication of crab intrusion during excavation (WORMS 2019a). Atlantic blue crab (*Callinectes sapidus*) can live in salt and fresh water and is commonly found in estuaries (WORMS 2019b).

olluscs were found in both levels of unit 5-7N but coral was only found in the upper level

Discussion

Based on the identified taxa, Lucayan peoples at the South Bank Site exploited coastal and inshore environments including flats, reefs and flats, and tidal inlet environmental zones. This aligns with Wing and Scudder's original analysis. Sullivan (1981) defined these environmental zones in his dissertation:

> *Flats:* "Areas with low bottom gradients with a sandy or muddy bottom that may or may not be covered with eel grass. There may be occasional isolated low patched of coral growth." (Sullivan 1981: 82)
>
> *Reefs and flats:* "This is a mixed areas of flats and coral heads and reefs. The latter in this usage exceed 20 meters in some dimension but are discontinuous and are therefore distinguishable from barrier reefs that continue essentially uninterrupted for several kilometers and are subject to breaking action of ocean waves." (Sullivan 1981: 84)
>
> *Tidal Inlets*: The tidal inlets and ponds of the Turks and Caicos are virtually always flanked by mangroves. They normally have a sandy bottom, although marl and soft mud may be present…" (Sullivan 1981: 86-87)

In addition to marine fauna, Wing and Scudder also identified terrestrial fauna including hutia (*Geocapromys* sp.) and rock iguana (*Cyclura* sp.). However, these species were not identified in this analysis and terrestrial environmental zones are not represented, with the exception of land crab. The results of this analysis do support Wing and Scudder's original conclusions about exploitation of aquatic areas within the catchment areas of the South Bank site. Although the sample is small, identified taxa also appear very similar to what has been reported at other Late Ceramic Age sites in the region associated with Lucayan Palmetto Ware ceramics (Sullivan 1981; Morsink 2012: 412-436; O'Day 2002; Carlson 1999).

Future research that includes fauna from outside the South Bank site's midden context would provide an interesting comparative study and intra-site analysis, however site destruction through continued modern development would make this difficult.

References

Carlson, Lisabeth A.
1999 Aftermath of Feasts: Human Colonization of the Southern Bahamian Archipelago and its Effects on the Indigenous Fauna. Unpublished Dissertation, University of Florida.

Morsink, Joost
2012 The power of salt: a holistic approach to salt in the Prehistoric Circum-Caribbean Region. Unpublished Dissertation, University of Florida.

O'Day, Sharyn Jones
2002 Late Prehistoric Lucayan Occupation and Subsistence on Middle Caicos Island, Northern West Indies. *Caribbean Journal of Science* 38(1–2):1–10.

Reitz, Elizabeth J. and Elizabeth S. Wing
2008 *Zooarchaeology*. 2nd Ed. Cambridge University Press, Cambridge.

Sullivan, Shaun D.
1981 Prehistoric Patterns of Exploitation and Colonization in the Turks and Caicos Islands. Unpublished Dissertation, University of Illinois at Urban-Champaign, Urbana, Illinois.

WoRMS
2019a *Cardisoma guanhumi* Latreille in Latreille, Le Peletier, Serville & Guérin, 1828.

Accessed at: http://www.marinespecies.org/aphia.php?p=taxdetails&id=422183 on 2019-04-03

WoRMS
2019b *Callinectes sapidus* Rathbun, 1896. Accessed at: http://www.marinespecies.org/aphia.php?p=taxdetails&id=107379 on 2019-04-03

Table 1. List of identified taxa.

Taxa	Common Name	Source Zone
Vertebrates		
Actinopterygii	ray-finned fishes	
Acanthurus sp.	surgeonfish	reefs and flats
Chaetodipterus faber	spadefish	reefs and flats
Scaridae		
Sparisoma sp.	parrotfish	reefs and flats
Sparidae	porgies	flats and tidal inlets
Haemulon sp.	grunt	reefs, flats, and tidal inlets
Lutjanus sp.	snapper	reefs, flats, and tidal inlets
Serranidae		
Epinephalus sp.	grouper	reefs and flats
Invertebrates		
Scleractinia	hard corals	
Brachyura	crabs	
Cardisoma guanhumi	blue land crab	
Callinectes sapidus	Atlantic blue crab	
Mollusca	mollusks	

Table 2. NISP and MNI counts by provenience and level.

Provenience	**302E & 302W** Unit 5-7N, 20-30 cmbs			**313** 5-7N, 4-5E 40-X cmbs			**318** 24-24.5SX, 3.4-4E 20-30 cmbs			**305** 24-26S, 4-6E 30-ca.40 cmbs			**308** 24-26S, 5-6E ca.40-x cmbs		
Taxon	**NISP**	**MNI**	**Weight (g)**	**NISP**	**MNI**	**Weight (g)**	**NISP**	**MNI**	**Weight (g)**	**NISP**	**MNI**	**Weight (g)**	**NISP**	**MNI**	**Weight (g)**
Vertebrata	37		7.45	10		3.31	1		0.18						
Actinopterygii	22		3.97	5		1.97				1		0.19			
Acanthurus sp.	1	1	0.05												
Chaetodipterus faber				1	1	2.86									
Scaridae	1		0.22												
Sparisoma sp.	4	2	0.86	3	1	2.74									
Sparidae				1	1	0.13									
Haemulon sp.	2	1	0.36												
Lutjanus sp.	2	1	1.04												
Serranidae	2	2	0.18	1		0.32									
Epinephalus sp.				1	1	0.18									
Scleractinia	3		1.28												
Brachyura	2		1.84												
Cardisoma guanhumi				2	1	0.47							3	1	0.52
Callinectes sapidus	2	1	3.1												
Mollusca	5		2.47	1		0.38									
Total	**83**	**8**	**22.82**	**25**	**5**	**12.36**	**1**		**0.18**	**1**		**0.19**	**3**	**1**	**0.52**

South Bank Zooarchaeological Analysis Appendix 1 - Results

Brittany Mistretta, analyst and report author

Kitty Emery and Nicole Cannarozzi, project directors and supervisors

FLMNH-EAP, May 2019

Number	Unit	Level (cmbs)	Taxon	Common Name	Element	Whole/ Fragmented	Portion	Side	NISP	Weight (g)	Burning	Notes
302E	5-7N, 4.5-6E	20-30	Vertebrata	vertebrates	UID	Fragmented		Unknown	37	7.45		concretions
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	UID	Fragmented		Unknown	1	0.32		
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	spines	Various		Unknown	16	1.72		
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	brachiostegal ray	Fragmented	anterior	Unknown	1	1.13	brown	very large
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	palatine	Fragmented	maxillar process	Unknown	1	0.23		
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	cleithrum	Fragmented	medial portion with beginnings of exterior and interior crests	Unknown	1	0.22		
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	hypural	Whole		Axial	1	0.26		
302E	5-7N, 4.5-6E	20-30	Actinopterygii	ray-finned fish	vertebra	Fragmented	exterior of vertebral body	Axial	1	0.09		
302E	5-7N, 4.5-6E	20-30	*Sparisoma* sp.	parrotfish genus	pharyngeal grinder	Whole	anterior	Lateral	1	0.4		larger
302E	5-7N, 4.5-6E	20-30	*Sparisoma* sp.	parrotfish genus	pharyngeal grinder	Whole	anterior	Lateral	1	0.13		smaller
302E	5-7N, 4.5-6E	20-30	*Sparisoma* sp.	parrotfish genus	maxilla	Fragmented	anterior portion with internal process and palatine sulcus	Left	1	0.16		
302E	5-7N, 4.5-6E	20-30	*Sparisoma* sp.	parrotfish genus	dentary	Fragmented	anterior portion	Right	1	0.17		
302E	5-7N, 4.5-6E	20-30	Scaridae	parrotfish family	caudal,vertebra	Fragmented	centrum, haemal and neural arches	Axial	1	0.22		
302E	5-7N, 4.5-6E	20-30	*Haemulon sp.*	grunt	premaxilla	Fragmented	anterior portion with ascending process, articular process	Left	1	0.09	grey, black	
302E	5-7N, 4.5-6E	20-30	*Haemulon sp.*	grunt	quadrate	Fragmented	anterior portion with lateral and medial condyles	Left	1	0.27		
302E	5-7N, 4.5-6E	20-30	*Lutjanus sp.*	snapper	maxilla	Fragmented	anterior portion with internal process, premaxillary sulcus, external process, palatine sulcus	Right	1	0.38		
302E	5-7N, 4.5-6E	20-30	*Lutjanus sp.*	snapper	articular	Fragmented	posterior portion with quadrate facet, postarticular process	Right	1	0.66		
302E	5-7N, 4.5-6E	20-30	*Acanthurus sp.*	surgeon fish	caudal,vertebra	Fragmented	centrum	Axial	1	0.05		
302E	5-7N, 4.5-6E	20-30	Serranidae	grouper/seabass family	quadrate	Fragmented	quadratojugal process and medial and lateral condyles	Right	1	0.03	black	
302E	5-7N, 4.5-6E	20-30	Serranidae	grouper/seabass family	quadrate	Fragmented	quadratojugal process and medial and lateral condyles	Right	1	0.15	brown	
302E	5-7N, 4.5-6E	20-30	Mollusca	molluscs	UID	Fragmented		Unknown	5	2.47	black	
302E	5-7N, 4.5-6E	20-30	Scleractinia	hard coral	UID	Fragmented		Unknown	3	1.28		dark staining
302W	5-7N, 3-4.5W	20-30	*Callinectes sapidus*	blue crab	dactyl, movable	Whole		Unknown	1	1.92		
302W	5-7N, 3-4.5W	20-30	*Callinectes sapidus*	blue crab	dactyl, movable	Whole		Unknown	1	1.18		
302W	5-7N, 3-4.5W	20-30	Brachyura	crab	UID	Fragmented		Unknown	1	1.66		
302W	5-7N, 3-4.5W	20-30	Brachyura	crab	UID	Fragmented		Unknown	1	0.18	black	
313	5-7N, 4-5E	40-X	*Chaetodipterus faber*	spadefish	supra occipital	Fragmented	posterior portion, pneumatic bone	Axial	1	2.86	brown	
313	5-7N, 4-5E	40-X	Actinopterygii	ray-finned fish	spines	Various		Unknown	4	0.54	brown to black	
313	5-7N, 4-5E	40-X	Actinopterygii	ray-finned fish	brachiostegal ray	Fragmented	anterior	Unknown	1	1.43	brown	very large
313	5-7N, 4-5E	40-X	*Sparisoma* sp.	parrotfish genus	dentary	Fragmented	anterior portion	Left	1	1.05	brown	
313	5-7N, 4-5E	40-X	*Sparisoma* sp.	parrotfish genus	premaxilla	Fragmented	anterior portion	Left	1	0.71		

313	5-7N, 4-5E	40-X	*Sparisoma* sp.	parrotfish genus	pharyngeal plate	Whole		Axial	1	0.98		
313	5-7N, 4-5E	40-X	*Epinephalus* sp.	grouper genus	premaxilla	Fragmented	anterior portion with ascending process	Left	1	0.18	brown	
313	5-7N, 4-5E	40-X	Sparidae	porgies	canine, tooth	Whole		Unknown	1	0.13		orange color
313	5-7N, 4-5E	40-X	Serranidae	grouper/seabass family	vertebra	Fragmented	fragmented centrum	Axial	1	0.32	grey,black	cf posterior thoracic or anterior caudal
313	5-7N, 4-5E	40-X	*Cardisoma guanhumi*	blue land crab	dactyl	Fragmented	anterior tip	Unknown	1	0.1		
313	5-7N, 4-5E	40-X	*Cardisoma guanhumi*	blue land crab	dactyl	Fragmented	anterior tip	Unknown	1	0.37		dark staining
313	5-7N, 4-5E	40-X	Mollusca	molluscs	UID	Fragmented		Unknown	1	0.38		
313	5-7N, 4-5E	40-X	Vertebrata	vertebrates	UID	Fragmented		Unknown	10	3.31	brown	concretions
308	24-26S, 5-6E	ca. 40-X	*Cardisoma guanhumi*	blue land crab	dactyl, moveable	Whole		Unknown	1	0.15		
308	24-26S, 5-6E	ca. 40-X	*Cardisoma guanhumi*	blue land crab	dactyl, non-moveable	Whole		Unknown	1	0.12		
308	24-26S, 5-6E	ca. 40-X	*Cardisoma guanhumi*	blue land crab	dactyl, non-moveable	Whole		Unknown	1	0.25		
318	24-24.5SX, 3.4-4E	20-30	Vertebrata	vertebrates	UID	Fragmented		Unknown	1	0.18		orange color, eroded exterior surface
305	24-26S, 406E	30-ca.40	Actinopterygii	ray-finned fish	UID	Fragmented		Unknown	1	0.19	black	

Appendix D
Biochemical (Lipid) Analysis of Ceramics and Soil
South Bank Site
Dr. Eleanora Reber
Department of Anthropology
University of North Carolina, Wilmington

The takeaway is: All three residues contained plants, as indicated by plant sterols. Your 304 (my RL 468) perhaps contained primarily fish/shellfish as well as plants, and also a small amount of conifer resin. Your 302 (my RL 469) contained primarily a mixture of plants and meat or fish, with a small amount of conifer resin. Your 301 (my RL 470) contained primarily plants, with fish/shellfish possibly present, as indicated by the fatty acids. There was no evidence of conifer resin in this residue. Contamination was present, but did not affect the interpretations noticeably.

All residues contained an unusual series of 2-hydroxy and w-hydroxy fatty acids that I cannot easily interpret at the present time. They may originate from nerve lipids (cooking brains, for example), from an unusually large amount of bacteria, from tubers, from bark, or from another resource that has not been identified yet.

Overall Interpretations

Of the three sherds analyzed, all appeared to have been used to process plant resources. Two of them, 304 and 302 (my RL 468 and 469) were also used to process meat and/or fish resources. Fish is more likely with 304, and meat more likely for 302. One, your 301 (my RL 470) could not be interpreted as having been used to process meat, fish may have been present, but I couldn't be certain. These interpretations are based on the overall fatty acid composition, which in all samples were highly unsaturated and with the fatty acid C16:0 (palmitic acid) being the most abundant. This is typical of predominately plant-based fatty acids. All residues in the project contained plant sterols, including sitosterol, which are biomarkers for the presence of plant resources. Two, 304 and 302, also contained cholesterol, which is a biomarker for meat and/or fish resources.

Discussion of Meat v Fish presence

Meat appeared to me to be more probable than fish in 302 because of the lack of fatty acids typical of fish, noticeably the absence of isoprenoid fatty acids. 304 also lacked isoprenoid fatty acids. Using the criteria present in Isaksson and Hallgren (2012), however, fish may be interpreted in the absence of biomarkers if the ratio of C18:0/C16:0 is less than 0.48 and cholesterol is present. For 304, this ratio was 0.25, and cholesterol was present, making fish or shellfish a tenable interpretation, although it cannot be positive in the absence of biomarkers. The C18:0/C16:0 ratio for 302 was 0.52. Although cholesterol was also present in the residue, the fatty acid ratio was just too high for the fish/shellfish interpretation, making the presence of meat a more likely, but still not positive, interpretation.

Sample 301 did not contain cholesterol, but did have a remarkably unsaturated fatty acid profile, and also a C18:0/C16:0 ratio of 0.19. In addition, the unusual highly unsaturated fatty acid C20:4 (Arachidonic acid) was present in the residue. This fatty acid is rare in most resources except fish/shellfish, although it is not really a biomarker. This suggests that fish/shellfish was present, as well as plant resources, based on the plant sterols, but the interpretation is again, not positive.

Presence of Conifer Resin

Small amounts of conifer resin were present in 304 and 302, in the form of dehydroabietic acid, a known oxidative byproduct of abietane and pimarane diterpenoids, which are biomarkers for conifer resins, and being most abundant in conifers from the Pinaceae family. 304 also contained the diterpenoid Δ8 dihydroabietic acid, another oxidative byproduct of abietane diterpenoids. Depending on the environment of the archaeological site, these compounds could have derived from several origins: 1) sealing the pottery vessel (Reber and Hart 2008); 2) processing of conifer resin as a flavoring agent, or 3) firing the pottery over large amounts of pine wood (Reber et al. 2019). It is worth noting that sample 301 did not contain any of these biomarkers, so that whatever uses were the origin of these compounds, they seem to have been present only in Samples 304 and 302.

Amount of Resin, Contamination issues

All residues had interpretable amounts of lipids. The standard measure of sufficient lipid to interpret is 5 μg lipid/g of sample (Evershed 2008). All amounts of lipid are noted in Table 2, and range from 22 to 67 μg/g.

All residues had some contamination, with a % contamination calculated in Table 1. This number is obtained by dividing the amount of known contaminants into the overall lipids in the residues. Samples 304 and 301 were only slightly contaminated, with contamination percentages below 5%. Contaminants in 304 included DEET, from bug spray, plasticizers, and apparent salicylates, which are often found in both bug spray and hand cream. Contaminants in 301 and 302 did not include DEET, but did include plasticizers and salicylates. Sample 302 was about 8% contaminated. In general, the contaminants did not affect the overall interpretation of the sherds, except that an unusual tritpernoid was present in 304, which looked like either jasminol or oleanene. Given the known presence of DEET and salicylates in the residue, this triterpenoid appeared to be most likely to originate in an artificial fragrance. This compound was therefore not interpreted as deriving from archaeological use of the pots.

Notes on Soil Residues

In glancing over the soil residues, it contained several unusual long-chain compounds that I had been unable to identify in the pottery residues. I therefore (with some relief) interpreted them as possibly having been washed in from the soil, although this may not actually have been the case. The soil contained some DEET, more lipids than any of the pottery residues, which is typical, and was comprised primarily of fatty acids whose distribution generally included more long-chain fatty acids than the pottery residues; this is also typical of soil lipids. The soil lipids contained relatively few hydroxy-fatty acids, which were noticeably present in all the pottery residues, especially 304. The soil did contain the ω-hydroxy C26:0 fatty acid that was also present in all the residues. This will be discussed further below.

Preliminary and Uncertain, but interesting, Interpretation

Now for the most difficult interpretations: all the residues in the study contained unusual amounts of hydroxy-fatty acids, primarily in 2-hydroxy and ω-hydroxy forms, as can be seen in Table 2. These fatty acids are occasionally identified in residues, but not in the abundance and range found in these. Further research is needed before any more definitive identification can be attempted. Here are some preliminary ideas, however. 2-hydroxy-fatty acids are fatty acids in which the hydroxy group is present on the 2nd carbon after the carboxylic acid group typical of fatty acids. These sorts of compounds are noted as common in both animal sphingolipids and also bacterial lipids (Christie 2019). Sphingolipids are lipids found primarily in nerve cells. Either interpretation seems equally possible, at this point.

The ω-fatty acids are fatty acids in which the hydroxy group is on the opposite end of the fatty acid chain from the carboxylic acid group. These types of hydroxy fatty acids are usually noted as present in polymeric compounds such as suberin, which is often found in the surface of roots or tubers. Suberin, however, is also known to be comprised primarily of dicarboxylic C16:0 and C18:0 fatty acids, neither of which was in any of the residues in this study. Suberin therefore seems somewhat unlikely although not impossible. The compounds are also noted as present in byproducts of bark (Scifinder Scholar search), but not in a particularly definitive way. It is possible that these compounds derived from some sort of bark or tuber processed in the archaeological vessels, but this is very preliminary and uncertain.

It seems more intellectually satisfying to posit that the hydroxy acids in the residues, both 2- and ω- derive from the same resources. However, no resource that contains both types of hydroxy fatty acids has yet been identified.

Methods

Residues were extracted using the methodology developed by Correa-Ascensio and Evershed (2014), which allows for a more thorough extraction of fatty acids, especially isoprenoid and hydroxy fatty acids that might be chemically bound into the ceramic fabric. This method produces a single extracted residue that includes all neutral compounds (sterols, alkanols, alkanes) that are derivatized to trimethylsilyl esters, and fatty acids derivatized into methyl esters. This methodology also permits more accurate quantification of the amount of lipid present, but does not permit an analysis of the overall preservation of the lipids in the resiue. The overall degree of bacterial breakdown, oxidation, and hydrolysis of the total residue was therefore not possible.

Compounds were included in Table 2 as Tr (Trace) if they comprised 0.1-0.5 of the overall lipids in the residue, and the percentage amount was noted, rounded to nearest percentage point, if they comprised 0.5 or more of the overall lipids in the residue.

Table 1
Biochemical (Lipid) Analysis of Ceramics and Soil – South Bank Site – Reber
(see below)

						Table 1, Biochemical Analysis-South Bank Reber	
#	**Provenance**	**Sample (g)**	**µg Lipid/ g sherd**	**% Contam.**	**Laboratory description**	**Residue description**	**Interpretation**
RL 468	Pl SB 304 PW	2.774	30.3	3	Plain sand-tempered thick base sherd	Fatty acids primarily plant, no alkylphenyls, plant sterols and cholesterol present, DHA present, trace of Δ8 dihydroabietic acid, unidentified triterpenoid apparently similar to jasminol or oleanene?, 2-hydroxy fatty acids and long-chain omega hydroxy fatty acids. Some contamination from DEET, plasticizers, and salicylates	Primarily plant with meat or fish present, conifer resin present, Source of unusual hydroxy fatty acids present, possibly bacteria or something like a tuber or tree bark?? Small amount of contamination from bug spray and plasticizers.
RL 469	Pl SB 302 PW	2.262	22.3	8	Plain shell-tempered rimsherd, from a bowl?	Fatty acids primarily plant, no alkylphenyls, plant sterols and cholesterol present, DHA present, some 2-hydroxy and long-chain omega-hydroxy fatty acids. Moderate contamination from plasticizers and salicylates	Primarily plant with meat or fish present, conifer resin present, small amount of source of unusual 2- and omega-hydroxy fatty acids, possibly bacteria and tuber or tree bark? Moderate contamination from plasticizers

RL 470	Pl SB 301 JMP	2.02	66.8	4	Plain, grit-tempered bodysherd	Fatty acids primarily plant, no alkylphenyls, but C20:4 is present, plant sterols present, wide range of fatty acids present, small amount of unusual 2-hydroxy and long-chain omega-hydroxy fatty acids, some contamination from plasticizers and salicylates	Primarily plant or fish, some contamination from plasticizers

Table 2
Biochemical (Lipid) Analysis of Ceramics and Soil from the South Bank Site—Reber
(See Below)

Compound	RL 468	RL 469	RL 470
Cholesterol	Tr	Tr	-
Campesterol	1	-	Tr
Stigmasterol	Tr	Tr	-
Sitosterol	1	1	Tr
5α–stigmastanol	Tr	Tr	-
Dehydroabietic acid	Tr	Tr	-
Δ8 dihydroabietic acid	Tr	-	-
Triterpenoid 18.06	Tr	-	-
$C_{13:0}$	Tr	Tr	Tr
$C_{14:0}$	1	1	Tr
$C_{16:1}$	3	3	27
$C_{16:0}$	27	33	33
$C_{17:1}$	Tr	-	Tr
$C_{17:0}$	1	1	-
$C_{18:1}$	18	12	14
$C_{18:0}$	8	17	6
$C_{19:1}$	2	-	1
$C_{19:0}$	-	-	Tr
$C_{20:4}$	-	-	Tr
$C_{20:1}$	2	-	1
$C_{20:0}$	Tr	-	Tr
$C_{22:0}$	Tr	-	Tr
$C_{23:0}$	-	-	Tr
$C_{24:0}$	1	-	1
$C_{25:0}$	Tr	-	-
$C_{26:0}$	1	Tr	1
$C_{28:0}$	1	-	1
$C_{29:0}$	-	-	Tr
$C_{30:0}$	Tr	Tr	1
$C_{32:0}$	-	-	Tr
$C_{34:0}$	Tr	-	Tr
2-hydroxy $C_{16:0}$	Tr	-	Tr
3-hydroxy $C_{18:0}$	Tr	-	-
2-hydroxy $C_{19:0}$	Tr	Tr	-
3-hydroxy $C_{20:0}$	Tr	-	-
2-hydroxy $C_{22:0}$	-	Tr	-
2-hydroxy $C_{23:0}$	-	-	Tr
2-hydroxy $C_{24:0}$	1	1	1
24-hydroxy $C_{24:0}$	Tr	Tr	-
2-hydroxy $C_{25:0}$	Tr	Tr	Tr

Works Cited

Christie, William

2019 The Lipid Web. http://lipidhome.co.uk/index.html. Updated May 9, 2019.

Correa-Ascencio, Marisol and Richard P. Evershed
2014 High throughput screening of organic residues in archaeological potsherds using direct acidified methanol extraction. *Analytical Methods* 6(5):1330-1340.

Evershed, R. P.
2008 Organic Residue Analysis in Archaeology: The Archaeological Biomarker Revolution. *Archaeometry* 50(6):895-924.

Isaksson, Sven and Fredrik Hallgren
2012 Lipid residue analyses of Early Neolithic funnel-beaker pottery from Skogsmossen, eastern Central Sweden, and the earliest evidence of dairying in Sweden. *Journal of Archaeological Science* 39(12):3600-3609.

Reber, E. A., M. T. Kerr, H. L. Whelton and R. P. Evershed
2019 Lipid Residues from Low-Fired Pottery. *Archaeometry* 61(1):131-144.

Reber, E. A. and J. P. Hart
2008 Pine resins and pottery sealing: analysis of absorbed and visible pottery residues from central New York state. *Archaeometry* 50(6):999-1017.

Appendix E

Report Basketry Impressed Ceramics from South Bank Site (P1) Providenciales Turks & Caicos

Excavation: October 2018 **Charlene Dixon Hutcheson**

The research design for this portion of the South Bank project is to examine, evaluate, and compare the Lucayan ceramics with basketry impressions to those found in the Bahamas, particularly San Salvador Island, which has had the most extensive study.

South Bank Ceramics

The site excavation undertaken in October 2018 was small with only two trenches opened, although one was extended. The total number of sherds with basketry impressed and basketry materials recovered came to 31 examples. Of these, the three types of basketry known to be woven in the Bahamas were found, twill weaving with an interlacing interval of two-over-two (2/2), simple plaiting (1/1), also called "plain" or "checkerboard" weave (Adovasio 1977), and wicker, a special case of simple plaiting using stiffer materials (Emery 1994). Additionally, one example of a fabric-like weaving was found. There was no evidence of sewn/coiled or twined basketry, which is consistent with the Bahamas (Berman and Hutcheson 2000, Hutcheson 2001, 2008).

Total number of sherds examined with basketry or basketry material impressions is 31items.
Elements Overall:

Mean: 3.58mm	Median: 3.11mm	Mode: 2.45mm	Range: 9.15mm – 1.32mm
Depth of impression	Range: 0.09mm – 0.85mm		

The weave breakdown is as follows:

2/2 Twill: no. 20. All low relief, four have deliberate shifts, all full or part A Pattern shift mechanisms (see Figure 1) with one appearing to be a complex pattern, although it is very small and hard to tell with certainty. There is also one sherd with a diagonal twill weave impression. Of the 20 impressions, 18 were of flat elements with one very flat, one definitely Sable palmetto, possibly another as well. The other two impressions are of a Fibrous looking material, as yet unidentified.
Mean: 3.53mm, median: 3.32mm, mode: 3.17mm, range: 1.94mm-6.55mm, 64.52% of 31 total

1/1 Simple Plaiting: no. 4. The element shapes in this class consist of two with flat appearance, one was very flat, and one each appearing to be round and semi-round. The fabric-like impression does not have any knotting; therefore, it is not netting. It also does not appear to be spun, but rather a cohesive round strand (widths between 1.35mm to 1.78mm). Simple plaiting often has the widest elements, and two of these have the widest, one flat and one semi-round. Although, the other flat element has a very narrow width at 2.04mm -2.20mm.
Mean: 5.13mm, median: 5.0mm, mode: none, range: 1.35mm – 9.15mm, 12.9% of 31 total

Wicker: no. 2. Of the two sherds with wicker impressions, one is very small and semi-round (width 1.32mm to 1.89mm), while the other is thicker and flat (width 3.8mm to 4.6mm), possibly a split reed or a type of split cane.
Mean: 2.92mm, median: 2.69mm, mode: none, range: 1.32mm – 4.60mm, 6.45% of 31 total

Non-woven elements: no. 5. All of these impressions are flat; one is definitely *Sable palmetto* and another appears to be another type of palm, possibly *Coccothrinax argentea* locally know as Silver Thatch palm. Three of these non-woven plant material impressions are single elements coming onto the sherd from the edge. All of the sherds are quite small (1 to 6 cm^2), thus it is not impossible that they are part of a fully woven item. Broken and repaired weaving has been noted in the Bahamian impressions (Berman and Hutcheson 1997, 2000). One of these sherds is a rim with two parallel flat wide elements just down from the exterior rim surface. The sherd with three parallel impressed elements is only 4 cm^2, so it may well be part of a woven piece and the intervals of interlacing do not appear in the impression.
Mean: 5.14mm, median 4.19mm, mode none, range 3.11mm – 7.90mm, 16.13% of 31 total

There were six additional sherds examined, but these were removed from the analysis due to lack of any basketry material impressions. Four of these were rims, while one of the others was a griddle and the remaining sherd was from the body of a vessel.

While on site it became clear that some of the sherds were measuring harder on the Mhos Scale that I have typically found in the Bahamas. Virtually all sherds in the Bahamas thus far studied are a 2 – 2.5 (thumbnail scratch) on the Mhos Scale (Berman and Hutcheson 2000, Hutcheson 2001, 2008, 2011, 2013, 2015). I have found that a number of the sherds from the South Bank site are harder. Most of the sherds were 2 – 2.5 (no. 15; 48.39%)), however there were only slightly less measuring at 3 (no. 13; 41.94%) and three (9.68%) measuring 4 on the scale. When checking the locations within the site from which these harder sherds came, I could find no correlation between hardness and site placement. As far as the site is concerned, it appears to be random. There is also no correlation between hardness and sherd wear; it is absolutely evenly split. The differences are more likely to be due to the ceramics' placement within the fire and the intensity and duration of the firing process. The hotter the fire, and the longer the piece is fired, will increase the hardness as the clay comes closer to vitrification.

Comparisons between South Bank and San Salvadoran Basketry Impressions

The South Bank ceramics and the basketry impressions are very much in line with those of San Salvador, Bahamas, which consist of the bulk of my studies. I have adjusted some comparative tables from papers on the San Salvador impressions to include the South Bank data. As you will see the weaves fit into this data quite well. The other studies are all much larger than this one, but there are caparisons to be made.

Table 1. San Salvador and South Bank Site-by-Site Element and Weave Variability

		Element Width by Site		
Site	No. Sherds	Range	Mean	%BI Impressed
Long Bay	327	1.8-17.4	4.2	6
Palmetto Grove	205	1.0-13.7	4.0	6.8

Pigeon Creek	265	2.0-17.0	6.3	7.8
New World Museum	208	1.4-15.6	4.9	-
South Bank	31	1.3-9.15	3.6	-

Note: The very narrow element widths seen at Palmetto Grove and the New World Museum collection are due to the presence of spun thread woven into fabric. There is also a fabric-like impression from South Bank. The other narrow elements are predominately wicker. There is no percentage available for NWM or SB. All measurements are in millimeters. (Original table in Hutcheson 2015 p. 48)

The element width gives the basketry, and in this case the sherd surface, its appearance along with the materials used and the weave type selected. Table 1 shows us that while South Bank weavers chose to use narrower elements than the Lucayans on San Salvador, they are not so very far off. It may be that the sample size is too small to be totally representative, but it could also indicate a desire for a "prettier" basket surface or perhaps a stronger basket. The largest elements on San Salvador are all 1/1 simple plaiting predominately using what I call a "ribbed" element. This material does not thus far appear at South Bank. I believe cattail stalk (Typha sp.) is used for these baskets, or possibly large stemmed grasses (Poacea sp.) (Hutcheson 2001:191).

It is not possible to comment on the overall percentage of impressed sherds at the South Bank site because we have no idea how large the site is and so little has thus far been excavated. Nor do I have the sherd count for what has been excavated.

Table 2. Weave Type Data per Site with Corresponding Element Variation

	1/1 Simple			2/2 Twill			Wicker		
Site	No.	Range	Mean	No.	Range	Mean	No.	Range	Mean
Long Bay	20 /6.1%	3.4-17.4	8.3	219 /67%	1.8-8.2	3.4	45 /13.8%	1.8-6.5	3.3
Palmetto Grove	9 /4.4%	1.0-13.0	6.8	130 /63%	1.0-7.6	4.3	35 /17.1%	1.4-4.2	2.3
Pigeon Creek	68 /25.6%	2.8-17.0	7.0	159 /60%	2.5-12.5	5.7	29 /10.9%	2.0-5.5	4.0
New World Museum	18 /8.7%	3.6-15.66	9.1	161 /77%	2.0-9.2	4.5	13 /6.3%	1.9-4.8	3.1
South Bank	4 /12.9%	1.35-9.15	5.13	20 /64.5%	1.94-6.55	3.53	2 /6.45%	1.32-4.60	2.92

Note: All measurements are in millimeters. (Original table in Hutcheson 2015 p. 48)

When comparing South Bank with the sites on San Salvador in Table 2, we can see that percentage wise the difference presented by the disparity in actual numbers dissipates somewhat. The New World Museum is a near match to South Bank weave type to weave type. All of the sites have 2/2 twill as the most common form of weaving at nearly the same percentage across the board. Pigeon Creek is the outlier with far more simple platting than any other site, although South Bank is second. The overall range of element widths site-to-site for each weave type is comparable. It would seem the Lucayans of San Salvador and the South Bank site shared many of the same thoughts and practices in basket weaving.

Fabric construction shows similar sized materials being used in both locations, as well. It is as yet unknown what materials were utilized in these fabrics. The element sizes are nearly identical, although that does not mean they are the same. Robin Brown (1994, 2003) has experimented with numerous fibers available to the Lucayans. He found that not only local cotton as mentioned by Columbus (Dunn and Kelly 1989) could make comparable thread/thin cordage to that in the impressions. Agave and *S. palmetto* retted leaves make thread usable for fabric (Brown 2003, Sauer 1966).

The South Bank fabric-like impression is very loosely woven, so it would not hold its shape under any strain, but could be fabric for a garment. The more I look at the South Bank impression, the more I am convinced it is fabric. As noted above, the material does not look spun in the impression, but it still may be. The sherd has relatively light wear although the surface is worn. Fabric has been found in the Bahamas, but this one is a 1/1 simple plaiting whereas on San Salvador the two examples have been made from clearly spun fibers, one being compact counter twining from Palmetto Grove and the other twill weaving from the New World Museum collection, site origin unknown (Hutcheson 2001, 2011).

Table 3. Long Bay and South Bank Depth of Impression by Weave Type

Long Bay		Range	no. under 1 mm	no. over 1 mm
Simple Plaiting		0.29-1.46	14	6
Twill LR		0.19-1.52	176	10
Twill HR	"Peaks"	0.32-0.84	24	-
	"Valleys"	0.72-1.73	4	20
Wicker		0.29-1.4	41	4
South Bank		**Range**	**no. under 1 mm**	**no. over 1 mm**
Simple Plaiting		0.11-0.70	4	-
Twill LR		0.11-0.85	20	-
Wicker		0.28-5.7	2	-
Non-woven elements		0.14-0.74	5	-

Note: Twill high relief has an undulating surface; therefore, element depth was measured twice to reflect this variation. "Peaks" are the higher impressed areas; "Valleys" are the lower. South Bank had no high relief impressions. All measurements are in millimeters. (Original table in Hutcheson 2015 p46)

Depth of impression is important when trying to determine the types of materials utilized in the basketry production. As is the case with these artifacts, we are trying to describe, analyze, and identify construction materials of 3-dimentional objects from inverse impressions of the baskets in clay that has been fired. It is important to understand that all of the measurements given throughout this report do not accurately represent the actual baskets. They were impressed into wet clay, which then dried and was fired. Both of these actions removed physical and chemical water from the clay causing it to shrink. Therefore, we must use what we have, knowing that the original material was larger. The actual size of the material can be calculated if the clay's percentage of shrinkage is known (Hutcheson 2001, 2008). That said, the measurements are important because they give a guide to identification of materials. Grasses and vines will be rounder, palms will be flat, and split reeds and cane flat to semi-round. Each will make different depth of impression. All of these hints are important as there are precious few actual baskets available to study.

There is a striking difference between the San Salvador impressions and those of South Bank: the latter has no impression over 1mm deep. This, for example, would suggest they used more palm and thinly split reeds or cane than on San Salvador. The thicker the material, the deeper the impression.

The Ceramic Sherds

Table 4. Long Bay and South Bank Sherd Conditions.

		Size			Condition			Vessel[b]	
	Range	2-10	11-30	31-66[a]	Excellent	Moderate	Poor	Griddles	Bases
1/1 Simple	3-19	13	7		9	5	6	4	13
Twill LR	2-60	144	46	5	44	58	93	74	82
Twill HR	3-66	13	10	1	6	4	14	11	4
Wicker	2-16	41	4	8	14	23	16	19	-
Totals	2-66	211	67	6	67	81	136	105	118
Percentages		74.3	23.6	2.1	23.6	28.5	47.9	37.0	41.5

Note: Table includes only Long Bay sherds with identified weaves; N=284. All measurements are in cm^2. [a]66 cm^2 is the largest sherd. [b]Sixty-one vessel types (21.4 percent) were unable to be identified due to size, erosion or spalling. "Bases" include all vessel types except griddles.

South Bank

Sherd size	> 5 cm^2 = 17,	6 -10 cm^2 = 8,	11 -15 cm^2 = 2,	16 -20 cm^2 = 3,	21 up cm^2 = 1
Percentage	54.84%	25.81%	6.45%	9.68%	3.23%

Wear

Mohs	Light	Moderate	Heavy	No.	Percentage
2 -2.5	4	8	3	15	48.39%
3	5	4	4	13	41.94%
4	1	1	1	3	9.68%

Wear

	No.	Percentage of 31 sherds
Light	10	32.26%
Moderate	13	41.94%
Heavy	8	25.81%

(Original table in Hutcheson 2015 p. 47)

At Long Bay, 23.6% of the sherds were in excellent condition with light wear, 28.5% were in moderate condition, and 47.9% were in poor condition with heavy wear. Just over half of these sherds were in excellent to moderate condition with the other half in poor condition. At South Bank, 32.26% of the sherds were in excellent condition (light wear), 41.94% were had moderate wear, and 25.81% were in poor condition. Three-fourths of the sherds at South Bank were in good to moderate condition, or alternatively, three-fourths of them were in moderate to very poor condition. Many more of the South Bank sherds had either concretions on them or lumps of extra clay obscuring the impressions.

Sherd size is very comparable between Long Bay and South Bank. In both locations three-quarters of the sherds are less than 10 cm^2. Comparable calculations were not done for

Pigeon Creek and Palmetto Grove; the sherds at Pigeon Creek are on the whole larger and in better condition with clearer impressions than any other site investigated. Palmetto Grove is more in line with Long Bay and South Bank. I have hypothesized that being on the ocean side of the island and near the shore is a contributing factor to the smaller sherd size. Pigeon Creek site is on a tidal estuary and does not get the storm surges from the ocean, which may contribute to salt build-up in the soil. This, in turn, could be detrimental to the friable, unglazed, non-vitrified ceramics in deposition (Hutcheson 2011:194, 196). If this proves to be the case, it may help explain why three-quarters of the sherds at South Bank are so small and in relatively poor condition.

Weave Design

The primary technique for creating designs in the basketry is a shift or alteration to the interval of interlacing. In the Bahamas there is one predominate shift mechanism, I call the A pattern due to its appearance in the artifacts (Berman and Hutcheson 2000, Hutcheson 2001). Figure 1 shows a schematic breakdown of the intervals of interlacing in the A pattern shift. This shift mechanism is found at South Bank as well. I do not have any large sherds with extensive examples of this shift sequence, but it is present in four instances, in whole or in part. One impression appears to be a complex weave pattern, but it is too small and incomplete to determine what the pattern looks like. There are many examples of the A pattern creating a wide variety of weave designs on San Salvador. This shift sequence is used upright, inverted, and facing left and/or right, singly or in combinations to create some astonishing and complex patterns (Berman and Hutcheson 2000). I look forward to seeing what patterns the Lucayans on Providenciales have created.

Figure 1. Schematic of the A pattern shift mechanism.

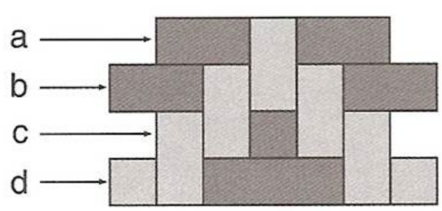


Figure 4. The "A" Pattern: a) 2 over/1 under/2 over (2/1/2), b) 2 over/3 under/2 over (2/3/2), c) 2 under/1 over/2 under (2/1/2), d) 2 under/3 over/2 under (2/3/20. In this pattern the over/under action is always carried out by the weft elements (horizontal). The warp remains constant in the 2/2 primary interval of interlacing. (Original Figure in Hutcheson 2011:192).

There were no other types of shift mechanisms noted in the South Bank assemblage.

In Conclusion

Despite the small sample set from the South Bank site, I have been able to determine that the Lucayans living there participated in the basketry grammar and technology of their cousins on San Salvador, and the Bahamas. They use the same three weave types: Twill and Simple Plating, and Wicker (see Berman and Hutcheson 2000). Their dominate interval of interlacing in the twill weaving is two-over-two, as in the Bahamas. Other areas, such as in South America use a primary interval of three-over-three-under (LaPlantz 1993, Harvey 1997). In neither area do they create coiled/sewn or twined basketry. Twill platting is the most common weave with the use of the A pattern shift to create designs in both areas. There are differences in the element size chosen by the South Bank Lucayans, in that they generally have more narrow elements, although they are not totally dissimilar from San Salvador. This variation in element data is somewhat skewed because of the vastly different data sets with South Bank being so much smaller. This is adjusted for by looking at percentages, which helps show a much more homogenous technology. The use of palm fronds as basketry materials is common throughout, as well as the probable use of split reeds and cane. Unfortunately, our knowledge of the materials utilized by the Lucayans in general is woefully lacking.

Fabric employing two production methods is documented on San Salvador: a loose twill weave and twined countered compact construction, both with spun thread (Hutcheson 2011). One impression at South Bank appears to be a woven fabric, although it is simple plating (1/1); it is, however, a loose weave. The impression is not clear enough to determine if the thread/fiber used has a spin to it.

Through the lens of their basketry, the Lucayans at South Bank fit well into the norms of their neighbors and relatives on San Salvador and the Bahamas.

.

Bibliography, Works Cited

Adovasio, James M. (1977). *Basketry Technology*. Chicago: Aldine Press.

Berman, Mary Jane and Charlene Dixon Hutcheson (1997). Basketry-Impressed Sherds: To Weave and to Eat in the Bahamas. Paper presented at the 62nd Annual Meeting of the Society for American Archaeology, Nashville, Tennessee.

Berman, Mary Jane and Charlene Dixon Hutcheson (2000). Impressions of a Lost Technology: A Study of Lucayan-Taíno Basketry. *Journal of Field Archaeology* 27(4):417-35.

Brown, Robin C. (1994). *Florida's First People: 12,000 Years of Human History*. Sarasota, FL: Pineapple Press.

Brown, Robin C. (2003). *The Crafts of Florida's First People*. Sarasota, FL: Pineapple Press.

Dunn, Oliver, and James E. Kelley, Jr. (1989). *The Diario of Christopher Columbus's First Voyage to America, 14921493*. Norman: University of Oklahoma Press.

Emery, Irene (1994). *The Primary Structure of Fabrics: An Illustrated Classification*. New York: Watson-Guptill.

Harvey, Virginia I. (1997). *The Techniques of Basketry*. Seattle: University of Washington Press.

Hutcheson, Charlene Dixon (2001). Reweaving the Strands: Continued Exploration into the Basketry Technology of Prehistoric Bahamians. In *Proceedings of the 18th International Congress for Caribbean Archaeology*. Volume 1, edited by Gérard Richard, pp. 185-198. l'Association Internationale d'Archéologie de la Caraïbe, Region Guadeloupe, Mission Archéologique, Guadeloupe, West Indies.

Hutcheson, Charlene Dixon (2008). A New Material to View the Past: Dental Alginate Molds of Friable Artifacts. In *Crossing the Borders: New Methods and Techniques in the Study of Archaeological Materials from the Caribbean*, edited by Corinne L. Hofman, Menno L. P. Hoogland, and Annelou L. van Gijn, pp. 69-77. Tuscaloosa: University of Alabama Press.

Hutcheson, Charlene Dixon (2011). From Whence They Came, Nobody Knows, Or Do We? Basketry Impressed Ceramics from the Wolper Collection. In *Proceedings of the 13th Symposium on the Natural History of the Bahamas*, edited by Jane Eva Baxter and Eric Stephen Cole, pp. 188-199. Gerace Research Centre, San Salvador, Bahamas.

Hutcheson, Charlene Dixon (2013). Decoration or Happenstance: Experimental Archaeology and Basketry Impressed Palmetto Ware. In *Proceedings of the 14th Symposium on the Natural History of the Bahamas*, edited by Craig Tepper and Ronald V. Shaklee, pp. 213-228. Gerace Research Centre, San Salvador, Bahamas.

Hutcheson, Charlene Dixon (2015). The Impressions of Long Bay: Basketry Impressed Ceramics from The Long Bay Site, San Salvador, Bahamas. *Journal of Caribbean Archaeology* 15:37-61.

LaPlantz, Shereen (1993). *Twill Basketry: A Handbook of Designs, Techniques, and Styles*. Asheville, NC: Lark Books.

Sauer, Carl Ortwin (1966). *The Early Spanish Main*. Berkeley: University of California Press.

Basketry Impressions Table 1

South Bank Site (P1), Providenciales, Turks & Caicos Islands

Basketry Impressed Palmetto Ware Analysis by Charlene Dixon Hutcheson, October 2018

page 1

Inventory No. / Year	Special Remarks	Sherd Size in Cm^2	Sherd Thickness Average in mm	Sherd weight in grams	Sherd Exterior Color (Munsell)	Sherd Exterior Color (Munsell)	Firing Oxidation or Reduction	Temper Material	Temper Size	Temper Angularity
P1SB 303 2018	Large sherd; ? Palmetto	58	10.38	46.0	10R/2.5/2	10R/4/2	R	Shell	Mixed	Very Angular
P1SB 216 2018	Tiny sherd, thick elem	3	6.38	1.0	7.5YR/5/3	7.5YR/5/3	R	Shell	Mixed	Very Angular
P1SB 10-12 '77		13	9.88	10.02	10R/3/1	2.5YR/4/8	R	Shell	Mixed	Very Angular
P1SB 10 1977		7	8.30	7.0	5YR/3/4	5YR/4/6	O	Shell	Mixed	Very Angular
P1SB 10 1977	Incised, poss palmetto	2	eroded	2.01	5YR/5/6	5YR/5/4	O	Shell	Mixed	Very Angular
P1SB 20 1977	Narrow elements	9	10.31	8.10	7.5YR/5/6	5YR/5/6	Ext Lt R/Int O	Shell	Small	Rd + Ang
	NO BI – see below									
P1SB 20 1977		4	11.65	4.21	5YR/4/4	5YR/4/4	O	Shell	Sm-Med	Angular
P1SB 20 1977	1 clear element, no weave	3	eroded	1.0	7.5YR/4/1	7.5YR/4/1	R	Shell	Small	Angular
P1SB 20 1977	Diagonal Twill	4	9.70	3.60	7.5YR/5/8	7.5YR/5/4	Ext O/Int R	Shell	Sm-Med	Angular
P1SB 20 1977	Part concertation, Tiny el	5	7.45	2.0	7.5YR/5/6	7.5YR/5/4	O	Shell	Sm-Med	Angular
P1SB 20 1977	v. worn; prob part A	3	8.90	2.20	7.5YR/4/4	7.5YR/5/6	O	Shell	Sm-Med	Rd + Ang
P1SB 20 1977	v. nice; tiny; ? a palm	3	7.75	2.0	5YR/4/3	5YR/4/6	Light R	Shell	Mixed	Angular
P1SB 20 1977		7	7.78	1.0	5YR/5/3	5YR/5/3	O	Shell	Mixed	Angular
P1SB 20 1977		2	eroded	1.0	5YR/5/4	5YR/5/4	O	Shell	Mixed	Angular
	NO BI – see below									
P1SB 301 2018	V wide Elem; Griddle	18	19.01	49.76	2.5YR/4/3	5YR/4/3	O	Shell	Med-Lg	Angular
P1 Provo 14 '77	Narrow Element, nice	4	8.72	4.57	5YR/5/6	2.5YR/5/4	O	Shell	Small	Angular
P1SB 44 1977	Nice, narrow-ish weave, poss. a palm	3	10.27	3.05	5YR/5/4	5YR/5/4	Light R	Shell + Sand	Very Small	Shell: Mix; Sand: Rd-Ang
P1SB 44 1977	Netting? Fabric? No knots	4	9.03	4.15	5YR/4/4	7.5YR/5/2	Light R	Shell	Small	Rd + Ang
P1SB 44 1977	V. thin elem, faint, extra clay on half of sherd	3	eroded	2.88	5YR/5/3	7.5YR/5/3	O	Shell + Sand	Very Small	Shell: Mix; Sand: Rd-Ang
P1SB 44 1977	RIM, 2 parallel Elements	6	8.19	7.40	2.5YR/4/3	5YR/5/3	R	Shell	Mixed	Rd + Ang
	NO BI – see below									
	NO BI – see below									
P1SB 44 1977	Extremely thin elem, faint	9	11.92	9.60	5YR/4/2	7.5YR/4/6	R	Shell	Small	Rd + Ang
	NO BI – see below									
	NO BI – see below									
P1SB 20 1977	Wide Elem, ? split reed	4	9.19	4.95	7.5YR/3/2	7.5YR/4/3	Ext O/Int R	Shell	Small	Angular
P1SB 20 1977	'smushed' extra clay, ? modeled face	17	10.40	21.37	7.5YR/4/4	7.5YR/4/3	Ext R/Int O	Shell	Mixed	Angular
P1SB 10 1977	2 wide Elements crossing	4	8.68	3.37	7.5YR/4/6	7.5YR/5/3	Ext O/Int R	Shell	Sm-Mix	Angular
P1SB 10 1977	Fibrous like Elem,	6	10.32	6.67	7.5YR/3/4	7.5YR/5/4	Ext R/Int O	Shell	Sm-Mix	Angular

Basketry Impressions
Table 2

South Bank Weave Type, Shifts, Element Shape and Width, and Depth of Impression

BI Study Inventory Number	Weave Type	Shift A / P Absent Present	Element Shape	Element Width Mean mm	Element Width Range mm	Depth of impression Mean mm
20	1/1 Simp (Net)	A	Round	1.50	1.78 -1.35	0.29
11	Wicker	A	Semi-Rd	1.59	1.89 -1.32	0.28
21	1/1 Simp.	A	Very Flat	2.13	2.20 -2.04	0.11
25	2/2 TLR	A	Very Flat	2.14	2.31 -1.94	0.09
34	2/2 T LR	A	Flat	2.45	2.50 -2.38	0.29
6	2/2 T LR	P (Apat)	Flat	2.56	2.69 -2.45	0.37
14	2/2 T LR	A	Flat	2.72	2.82 -2.61	0.28
19	2/2 T LR	A	Flat	2.76	3.47 -2.25	0.40
2	2/2 T LR	A	Flat	2.77	2.90 -2.54	0.85
31	2/2 T LR	PpA comp	Fibrous	2.98	3.08 -2.92	0.13
18	2/2 T LR	P pA	Flat	3.09	3.26 -2.91	0.34
9	1 visible elem	-	Flat	3.11	3.11	0.31
8	2/2 T LR	A	Flat	3.17	3.44 -2.82	0.21
15	2/2 T LR	A	Flat	3.17	3.43 -2.84	0.22
35	2/2 T LR	A	Flat	3.38	3.51 -3.14	0.32
13	2/2 T LR	A	Flat	3.42	3.80 -3.11	0.28
10	2/2 T LR	A	Flat	3.75	3.90 -3.50	0.26
22	Rim, 2 paral el	-	Flat	3.75	4.19 -3.30	0.14
1	2/2 T LR	A	Flat	4.0	4.89 -3.20	0.28
32	1 Palm element	-	Flat	4.13	4.13	0.14
33	2/2 T LR	A	Fibrous	4.16	5.01 -4.22	0.36
3	Wicker	A	Flat - thick	4.30	4.60 -3.80	0.57
5	2/2 T LR	A	Flat	4.32	4.70 -3.90	0.77
37	2/2 T LR	P (Apat)	Flat	4.46	5.60 -3.69	1 at 0.84, 0.11
12	2/2 T LR	A	Flat	4.5	4.90 -4.20	0.61
4	2/2 T LR	A	Flat	4.54	4.80 -4.40	0.54
29	2/2 T LR	A	Flat	5.87	6.55 -5.20	0.56
28	3 non-woven el	-	Flat	6.82	7.90 -5.74	0.15
36	1 broken elem	-	Flat	6.92	7.32 -6.38	0.74
30	1/1 Simp	A	Semi-Rd	7.96	8.08 -7.83	0.61
17	1/1 Simp	A	Flat	8.97	9.15 -8.60	0.70

Total number of sherds examined with basketry or basketry material impressions: 31
2/2 Twill: 20. All low relief, 4 have deliberate shifts, all full or part A Pattern with 1 complex, as well as 1 diagonal weave. 18 – flat (1 Very flat); 2 – Fibrous. Rang depth of Imp: 0.11mm-0.85mm
mean; 3.53mm median: 3.32mm mode: 3.17mm range: 1.94mm-6.55mm 64.52% of 31 total
1/1 Simple Plaiting: 4. Element shapes: 2 flat (1 Very flat); 1 each round and semi-round.
mean: 5.13mm median: 5.0mm mode: none range: 1.35mm – 9.15mm 12.9% of 31 total
Rang depth of Imp: 0.11mm-0.70mm
Wicker: 2. One is very small and semi-round, while the other is thicker and flat, possibly split reed or a type of split cane. Rang depth of Imp: 0.28mm-0.57mm
mean: 2.92mm median: 2.69mm mode: none range: 1.32mm – 4.60mm 6.4% of 31 total
Non-woven elements: 5. All are flat (1 is definitely Sable palmetto).
Mean: 5.14mm median 4.19mm mode none range 3.11mm – 7.90mm 16.13% of 31 total
Rang depth of Imp: 0.14mm-0.74mm

Overall Element Stats:

Basketry Impressions – Table 3
South Bank relationship between Mhos, Location, Sherd size and thickness, and wear with weave type

BI Study Inventory Number	Inventory No. / Year	Weave Type	Sherd Size in Cm2	Sherd Thickness Average in mm	Mhos Scale	Sherd Wear
9	**P1SB 20 1977**	1 elem, no weave	3	eroded	2 -2.5	Heavy
4	P1SB 10 1977	2/2 T LR	7	8.30	2 -2.5	Heavy
21	P1SB 44 1977	1/1 Simp.	3	eroded	2 -2.5	Light
34	P1SB 100 2018	2/2 T LR	6	14.93	2 -2.5	Light
14	**P1SB 20 1977**	2/2 T LR	7	7.78	2 -2.5	Light
13	P1SB 20 1977	2/2 T LR	3	7.75	2 -2.5	Moderate
15	**P1SB 20 1977**	2/2 T LR	2	eroded	2 -2.5	Moderate
12	P1SB 20 1977	2/2 T LR	3	8.90	2 -2.5	Heavy
32	P1SB 304 2018	1 Palmetto elem	1	eroded	2 -2.5	Moderate
5	P1SB 10 1977	2/2 T LR	2	eroded	2 -2.5	Moderate
8	**P1SB 20 1977**	2/2 T LR	4	11.65	2 -2.5	Moderate
30	P1SB 10 1977	1/1 Simp	4	8.68	2 -2.5	Moderate
36	P1SB 318 2018	1 broken elem	5	14.92	2 -2.5	Moderate
31	P1SB 10 1977	2/2 T LR	6	10.32	2 -2.5	Moderate
37	P1SB 315 2018	2/2 T LR	7	11.38	2 -2.5	Moderate
3	P1SB 10-12 77	Wicker	13	9.88	2 -2.5	Moderate
18	P1 Provo 14 77	2/2 T LR	4	8.72	3	Light
20	P1SB 44 1977	1/1 Simp (net)	4	9.03	3	Light
28	P1SB 20 1977	3 parallel elems	4	9.19	3	Light
22	P1SB 44 1977	Rim, 2 parallel elem	6	8.19	3	Light
35	P1SB 301 2018	2/2 T LR	11	12.44	3	Light
33	P1SB 304 (24S-4E) 2018	2/2 T LR	17	8.75	3	Light
2	P1SB 216 2018	2/2 T LR	3	6.38	3	Moderate
10	P1SB 20 1977	2/2 T LR	4	9.70	3	Moderate
11	P1SB20 1977	Wicker	5	7.45	3	Moderate
6	P1SB 20 1977	2/2 T LR	9	10.31	3	Moderate
29	P1SB 20 1977	2/2 T LR	17	10.40	3	Moderate
1	P1SB 303 2018	2/2 T LR	58	10.38	3	Moderate
19	P1SB 44 1977	2/2 T LR	3	10.27	4	Light
25	P1SB 44 1977	2-2 TLR	9	11.92	4	Light
17	P1SB 301 2018	1/1 Simp	18	19.01	4	Moderate

There does not appear to be any relationship between the Mhos hardness of the sherds and the factors listed above. The only possible exception is the heaviest sherd wear occurred at the Mhos 2 -2.5 level. All other categories are distributed throughout the range of hardness. The differences in the sherd hardness are more likely to be related to the location within the fire and the duration of the firing process. The hotter the fire and the longer the piece is fired will increase the hardness as the clay comes closer to vitrification (until it melts, of course).

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

REPORT OF RADIOCARBON DATING ANALYSES

Shaun	Report	January 25,
Anthropological Research	Material	January 15,

Appendix F
Radiocarbon Dating
Beta Analytics
(see below)

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

Beta Analytic
TESTING LABORATORY

ISO/IEC 17025:2005-Accredited Testing Laboratory

REPORT OF RADIOCARBON DATING ANALYSES

Shaun Anthropological Research

Report January 25, Material January 15,

Laboratory Number	Sample Code	Conventional Radiocarbon Age (BP) or Percent Modern Carbon (pMC) & Stable Isotopes	
Beta-515206	P1-SB 313	520 +/- 30 BP	IRMS δ13C: -24.1 o/oo

Calendar Calibrated Results: 95.4 % Probability
High Probability Density Range Method (HPD)

(84.9%)	1392 - 1443 cal AD	(558 - 507 cal BP)
(10.5%)	1324 - 1345 cal AD	(626 - 605 cal BP)

Submitter Material: Charcoal
Pretreatment: (charred material) acid/alkali/acid
Analyzed Material: Charred material

Analysis Service: RadiometricPLUS-Standard delivery
Percent Modern Carbon: 93.73 +/- 0.35 pMC
Fraction Modern Carbon: 0.9373 +/- 0.0035
D14C: -62.68 +/- 3.50 o/oo
Δ14C: -70.47 +/- 3.50 o/oo(1950:2,019.00)
Measured Radiocarbon Age: (without d13C correction): 510 +/- 30 BP
Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.

Beta Analytic
TESTING LABORATORY

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

ISO/IEC 17025:2005-Accredited Testing Laboratory

REPORT OF RADIOCARBON DATING ANALYSES

Shaun Report January 25,
Anthropological Research Material January 15,

Laboratory Number Number	Sample Code	Conventional Radiocarbon Age (BP) or Percent Modern Carbon (pMC) & Stable Isotopes Calendar Calibrated Results: 95.4 % Probability High Probability Density Range Method (HPD)		
Beta - 515707	**P1-SB 302**	**590 +/- 30 BP**	IRMS δ13C:	-24.3 o/oo

(67.9%)	**1298 - 1370 cal AD**	**(652 - 580 cal BP)**
(27.5%)	**1380 - 1413 cal AD**	**(570 - 537 cal BP)**

Submitter Material: Charcoal
Pretreatment: (charred material) acid/alkali/acid
Analyzed Material: Charred material

Analysis Service: RadiometricPLUS-Standard delivery
Percent Modern Carbon: 92.92 +/- 0.35 pMC
Fraction Modern Carbon: 0.9292 +/- 0.0035
D14C: -70.82 +/- 3.47 o/oo
Δ14C: -78.54 +/- 3.47 o/oo(1950:2,019.00)
Measured Radiocarbon Age: (without d13C correction): 580 +/- 30 BP
Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.

Beta Analytic Inc
4985 SW 74 Court
Miami, Florida 33155
Tel: 305-667-5167
Fax: 305-663-0964
info@betalabservices.com

Beta Analytic
TESTING LABORATORY

ISO/IEC 17025:2005-Accredited Testing Laboratory

REPORT OF RADIOCARBON DATING ANALYSES

Shaun | Report | January 25,
Anthropological Research | Material | January 15,

Laboratory Number Number	Sample Code	Conventional Radiocarbon Age (BP) or Percent Modern Carbon (pMC) & Stable Isotopes Calendar Calibrated Results: 95.4 % Probability High Probability Density Range Method (HPD)		
Beta - 515708	**P1-SB 304**	**600 +/- 30 BP**	IRMS δ13C:	-22.4 o/oo

(95.4%) **1296 - 1409 cal AD** **(654 - 541 cal BP)**

Submitter Material: Charcoal
Pretreatment: (charred material) acid/alkali/acid
Analyzed Material: Charred material

Analysis Service: RadiometricPLUS-Standard delivery
Percent Modern Carbon: 92.80 +/- 0.35 pMC
Fraction Modern Carbon: 0.9280 +/- 0.0035
D14C: -71.97 +/- 3.47 o/oo
Δ14C: -79.68 +/- 3.47 o/oo(1950:2,019.00)
Measured Radiocarbon Age: (without d13C correction): 560 +/- 30 BP
Calibration: BetaCal3.21: HPD method: INTCAL13

Results are ISO/IEC-17025:2005 accredited. No sub-contracting or student labor was used in the analyses. All work was done at Beta in 4 in-house NEC accelerator mass spectrometers and 4 Thermo IRMSs. The "Conventional Radiocarbon Age" was calculated using the Libby half-life (5568 years), is corrected for total isotopic fraction and was used for calendar calibration where applicable. The Age is rounded to the nearest 10 years and is reported as radiocarbon years before present (BP), "present" = AD 1950. Results greater than the modern reference are reported as percent modern carbon (pMC). The modern reference standard was 95% the 14C signature of NIST SRM-4990C (oxalic acid). Quoted errors are 1 sigma counting statistics. Calculated sigmas less than 30 BP on the Conventional Radiocarbon Age are conservatively rounded up to 30. d13C values are on the material itself (not the AMS d13C). d13C and d15N values are relative to VPDB-1. References for calendar calibrations are cited at the bottom of calibration graph pages.

BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(highest probability ranges: INTCAL13)

(Variables: d13C = -24.1 o/oo)

Laboratory number **Beta-515706**

Conventional radiocarbon age **520 ± 30 BP**

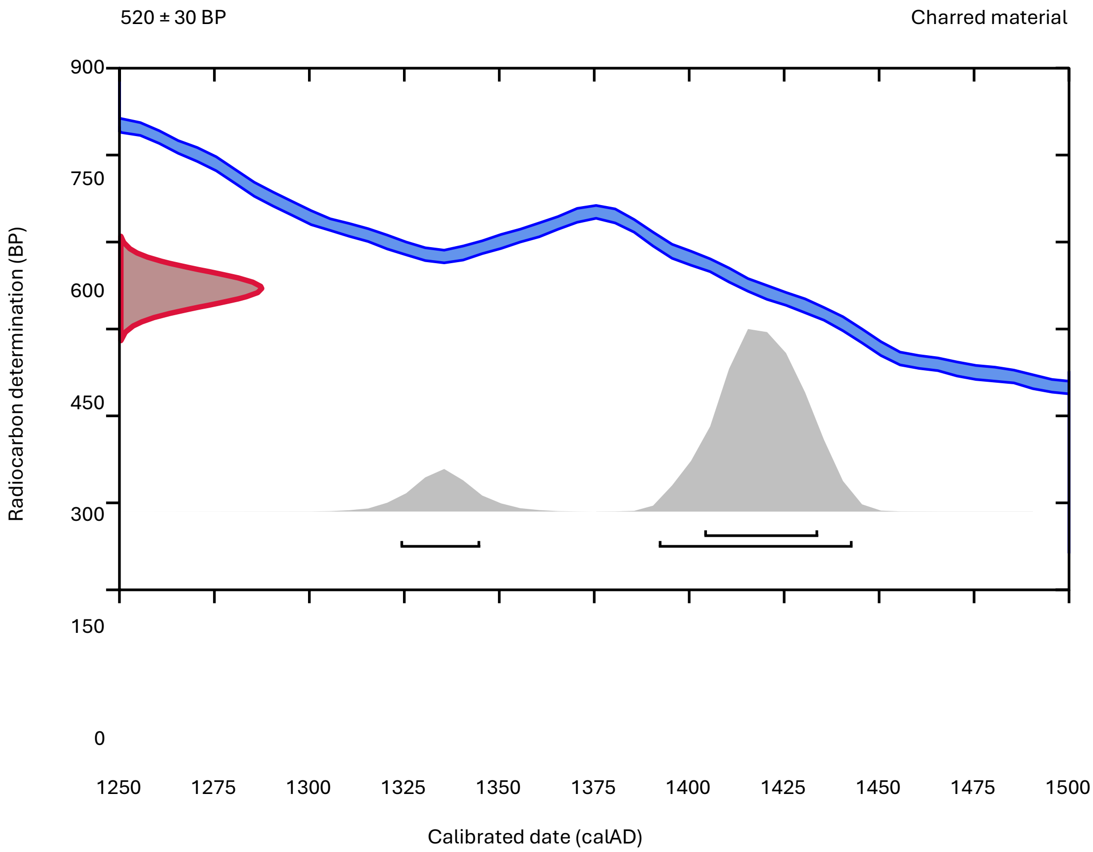
95.4% probability

(84.9%)	1392 - 1443 cal AD	(558 - 507 cal BP)
(10.5%)	1324 - 1345 cal AD	(626 - 605 cal BP)

68.2% probability

(68.2%)	1404 - 1434 cal AD	(546 - 516 cal BP)

P1-SB 313



Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

Calibration of Radiocarbon Age to Calendar Years

Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, Radiocarbon55(4).

BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

(High Probability Density Range Method (HPD): INTCAL13)

(Variables: d13C = -24.3 o/oo)

Laboratory number	**Beta-515707**
Conventional radiocarbon age	**590 ± 30 BP**

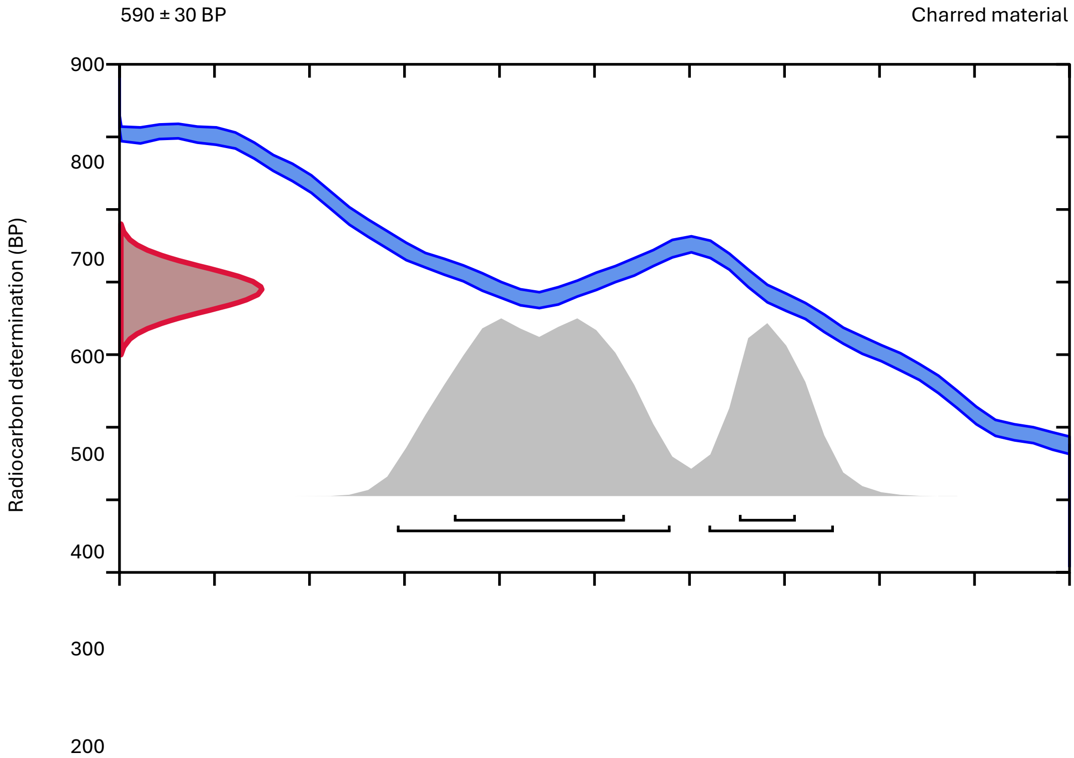
95.4% probability

(67.9%)	1298 - 1370 cal AD	(652 - 580 cal BP)
(27.5%)	1380 - 1413 cal AD	(570 - 537 cal BP)

68.2% probability

(51.5%)	1313 - 1358 cal AD	(637 - 592 cal BP)
(16.7%)	1388 - 1403 cal AD	(562 - 547 cal BP)

P1-SB 302



Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

Calibration of Radiocarbon Age to Calendar Years

1225 1250 1275 1300 1325 1350 1375 1400 1425 1450 1475

Calibrated date (cal AD)

Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, Radiocarbon55(4).

Calibration of Radiocarbon Age to Calendar Years

(highest probability ranges: INTCAL13)

(Variables: d13C = -22.4 o/oo)

Laboratory number **Beta-515708**

Conventional radiocarbon age **600 ± 30 BP**

95.4% probability

(95.4%)	1296 - 1409 cal AD	(654 - 541 cal BP)

68.2% probability

(55%)	1307 - 1362 cal AD	(643 - 588 cal BP)
(13.2%)	1386 - 1399 cal AD	(564 - 551 cal BP)

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

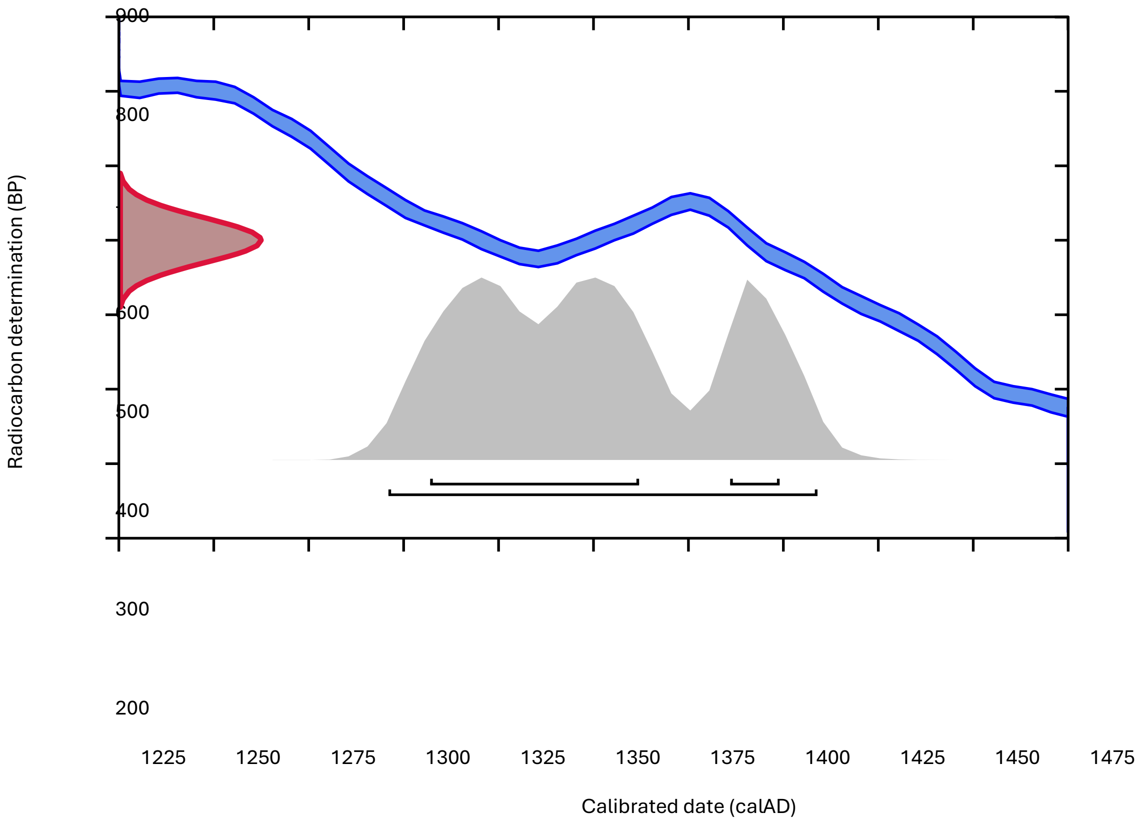
BetaCal 3.21

Calibration of Radiocarbon Age to Calendar Years

P1-SB 304

600 ± 30 BP

Charred material



Database used

INTCAL13

References

References to Probability Method

Bronk Ramsey, C. (2009). Bayesian analysis of radiocarbon dates. Radiocarbon, 51(1), 337-360.

References to Database INTCAL13

Reimer, et.al., 2013, Radiocarbo

Calibration of Radiocarbon Age to Calendar Years

93.73 +/- 0.35 pMC
0.9373 +/- 0.0035
-62.68 +/- 3.50 o/oo
-70.47 +/- 3.50 o/oo(1950:2,019.00)
(without d13C correction): 510 +/- 30 BP BetaCal3.21: HPD method: INTCAL13

Calibration of Radiocarbon Age to Calendar Years