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A Crab-Shell Dichotomy Encore: Visualizing Saladoid Shell Tools

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The Saladoid has been distinguished from the post-Saladoid Ostionoid based on the relative absence of mollusks in the former. We suggest that this so-called Crab-Shell Dichotomy devalues the importance of mollusks in Early Ceramic Age sites. Excavation of shell middens at the Main Street site, St. Thomas, USVI, documents the importance of mollusks, and especially a well-developed tool industry dating between A.D. 300-500. This article presents a detailed accounting of shell tools in the Main Street assemblage.

Los Saladoides se han distinguido de los Ostionoides post-Saladoides basado en la relativa ausencia de moluscos en los primeros. Sugerimos que esta llamada Dicotomía Cangrejo-Concha devalúa la importancia de los moluscos en los sitios de la Era Cerámica Temprana. La excavación de los caparazones de conchas en el sitio Main Street de St. Thomas, en Islas Vírgenes Estadounidenses, documenta la importancia de los moluscos y especialmente una industria de herramientas bien desarrollada que data de entre 300-500 años de la Era Común. Este artículo presenta un recuento detallado de las herramientas de concha en el montaje de Main Street.

L'absence de coquillages sur les sites archéologiques de l'époque saladoïde est généralement utilisée pour différencier ceux-ci des sites datant de l'époque post-saladoïde, nommée l'Ostionoïde. Nous suggérons que cette pseudo-dichotomie « crabes contre mollusques » tend à sous-estimer l'importance de la malacofaune sur les sites de l'époque céramique ancienne. Les fouilles archéologiques d'amas coquilliers sur le site de Main Street, Saint-Thomas, Îles Vierges américaines, révèlent l'importance des mollusques et, particulièrement, documentent l'existence d'une production élaborée d'outils entre 300 et 500 après J.-C. Cet article présente un compte-rendu détaillé des outils de coquillages de l'assemblage de Main Street.

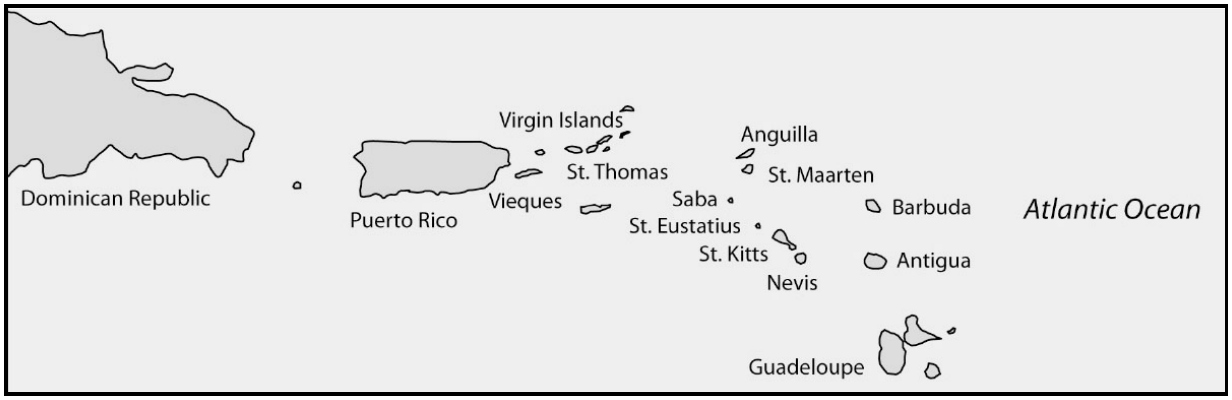


Figure 1. Northern Caribbean with St. Thomas at the center.

Introduction

During archaeological investigations in Puerto Rico in the 1930s, Froelich Rainey (1940) consistently observed a cultural horizon dominated by crab claws beneath a horizon dominated by mollusk shells (Rodríguez Ramos 1985:1). The former was associated with Saladoid pottery, while the latter contained Ostionoid pottery (Rouse 1992). Thus was born the Crab-Shell Dichotomy. Efforts to explain the shift from crabs to mollusks have suggested climate change, overexploitation of crabs, and diet breadth expansion (Carbone 1980; Goodwin 1980; Keegan 1989). Although ecologically minded archaeologists discussed crabs and shells as food, the primary focus was on changes in pottery styles, which Rouse interpreted as a smooth and direct evolution of Saladoid into Ostionoid (see Keegan and Hofman 2017; Rouse 1992).

Reniel Rodríguez Ramos (2005) inspired us to once again interrogate this topic. He recognized that the lithic components of Saladoid and Ostionoid had been ignored, so he gave a voice, "the lithics speak out," to the often *expedient* stone tools that span the divide. He concluded that Saladoid styles (i.e., Cedrosan and Cuevas) exhibited regularity and continuity in lithic technology, but he observed a marked discontinuity between Saladoid and Ostionoid. Rather than reflecting a smooth transition, he suggested that Ostionoid lithic and shell tool complexes showed greater similarity to what he calls "developed" Archaic tool kits (Rodríguez Ramos 2005:50-54). This change in perspective drew further attention to the significant role that Archaic Age communities played in the emergence of the Ostionoid series, and post-Saladoid societies (Keegan 2006).

We propose that a similar focus on the marine mollusks and shell tools will advance our understanding of Saladoid beyond pottery style (Figure 1). The area of the site excavation was a shell midden, which reflected broad-spectrum foraging of near-shore marine mollusks. A total of 7,575 individual specimens were identified. They represent at least 43 Families, 65 genera, and 71 species. West Indian top snail (*Cittarium pica*), here called by its local name – whelk (Figure 2), dominate the assemblage (48%; NISP = 3,653).

Given the notion of a Crab-Shell Dichotomy, we were struck by the abundance of shell at a site that contains only Cedrosan Saladoid pottery. Moreover, the high frequency of worked shell in the deposit also was unexpected. Expedient shell tools were identified in 47% of 156 Field Samples, and were manufactured from at least 20 different taxa. The tools exhibit a full range of activities from woodworking, plant processing, and gardening, as well as body ornaments.

Figure 2. West Indian topsnail or whelk (*Cittarium pica*).

The Crab-Shell Dichotomy devalues the importance of mollusks in Saladoid sites. At the Main Street site, complete whelk shells represent at least 11.3 kg of meat, which is a substantial amount in comparison to other biomass estimates (see Newsom and Wing 2004). Food value for mollusks in the Nain Street site is discussed in a separate article (Keegan et al. n.d.).

We begin with a description of the Main Street site and its excavation. Next we discuss the mollusks identified in the site. Our primary concern here is with the quantity and variety of the shell tools identified. Our objective is to provide an accounting of the shell tools, and to illustrate the types of replicate, expedient worked shell that elsewhere has been identified as tool types (see Dacal Moure 1978; O'Day and Keegan 2001; Serrand 2001). Use-wear analysis was not conducted. We conclude with a call for greater attention to mollusks, and especially expedient tools, in Saladoid sites. We hope that our photographs will contribute to the recognition of worked shell at Saladoid sites. Understanding Saladoid requires the recognition of the full range of activities including shell and lithic tools.

Main Street Kronprindsens Gade (KPG) Site (VAm3-49)

The Saladoid-period Main Street site was investigated as part of a data recovery excavation directed by David Hayes in 2014. The site is located in downtown Charlotte Amalie on the south-central coast of St. Thomas on the sheltered west lobe of Charlotte Amalie Bay (Figure 3). Work was sponsored by Federal Highways as part of a road resurfacing and utility upgrade project. Today, the site is in a very urbanized environment and is currently capped by at least three separate road fills, the deepest being the town's original 18th century pebble road encountered at 35 centimeters below surface. Only the midden portion of the site has been found to date. The village is likely just east or southeast of the midden. A water channel, called Savan Gut, once ran along what is now the road Gutters Gade, less than 100 meters to the east. The site is about 100 meters inland from the former shoreline, which was where Veteran's Drive is today.

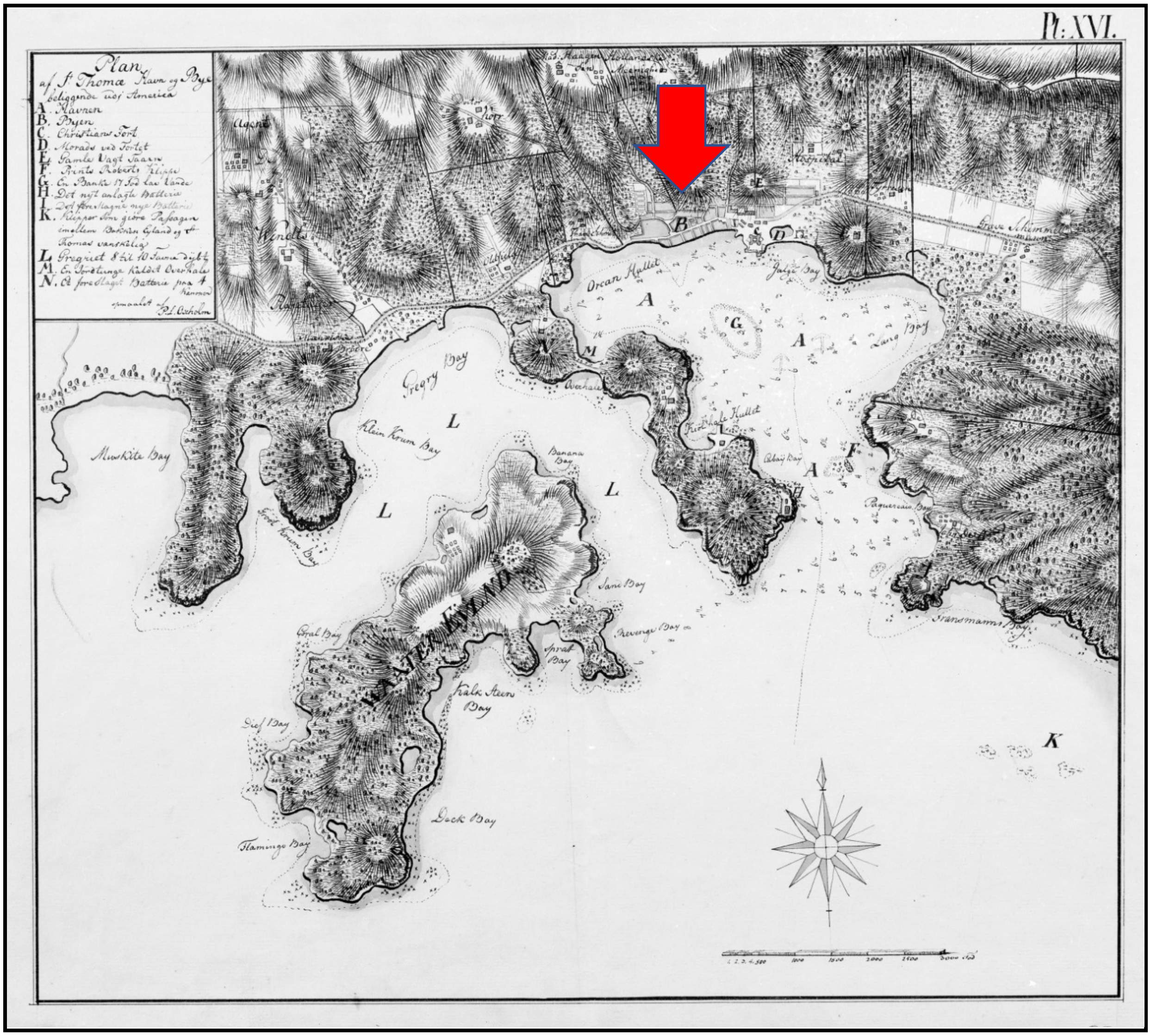


Figure 2. Oxholm 1780 map of St. Thomas harbor. Main Street Kronprindens Gade (KPG) Site is located at letter B.

The site was discovered in 1986, identified by thousands of large whelks, and rescue excavations were carried out. In 2013, the midden was again encountered during monitoring for utility upgrades and a Phase II evaluation was completed with data recovery work recommended (Hayes 2013). The 2014 mitigation began with the removal of the asphalt and the exposure of three utility lines reaching 60 cm deep (Figure 4). These pipes and builder's trenches limited the unit placement to about a one meter-wide undisturbed area. Thirteen contiguous units were placed in a trench formation. Only midden deposits were encountered during this excavation, and the only features identified were isolated secondary hearth deposits and discernible basket loads of shell midden debris.

The midden deposit is 40 cm thick with a mixed 30 cm of road fill overburden. Below the midden is 30 cm of subsoil with sporadic artifacts. Wetland clays and the water table are 130 cm below the road surface. The base of the midden is about 1 meter below the road. All the profiles were somewhat obscured by disturbances. Only the bottom half of the midden could be mapped along the north profile of the trench due to an extant pipe. The east and west profiles provided a narrow 75 cm snapshot of intact midden cut by builder's trenches on both sides (Figure 5).

Figure 4. Excavation of the Main Street site, January 2014.

In general, the midden shell occurred in pockets and was densest at the base of the site at 100 cmbs. The matrix surrounding the midden pockets contained pottery, bone, and shell. In some units the deposit gradually sloped or appeared to undulate. The original shell heaps have deflated and spread through time, intermixing with alluvial or fluvial sedimentation. There is modern disturbance and mixing with historic artifacts at the top of the deposit, but overall the excavations isolated an intact, single component Cedrosan Saladoid (Hacienda Grande style) site. The artifact assemblage is consistent from the top to the bottom of the midden. Not a single Late Saladoid (Cuevas) or Ostionoid artifact was recovered (Lundberg 2017).

Based on 28 radiocarbon dates the midden deposit has a date range of AD 300-500 (see Keegan et al. n.d.). The dates display a strong tendency around AD 400. There was no difference in the dates from the bottom to the top of the site and there were no significant stratigraphic changes through the site profiles.

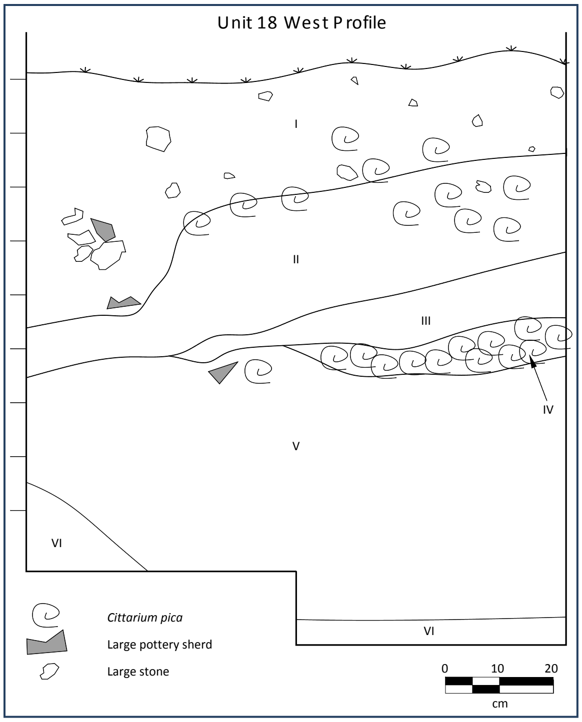


Figure 5. Unit 18 West profile.

As discussed below, whelks are the most common shell species at the site. Next in order are queen conchs, small rocky shore dove shells (Columbellidae), and two bivalve species (*Codakia orbicularis* and *Arca zebra*). The rocky intertidal shoreline, seagrass beds, and mud flats were all exploited. Worked shell is common in the midden, particularly tools made from queen conchs and larger bivalves (Keegan et al. n.d.); 20 different species of shell were modified in some way. Shell beads and ornaments were made from red jewelbox shell (*Chama sarda*), queen conch, olive shell (*Oliva* sp., tube worms (Vermetidae), pearl oyster, and thorny oyster. The most notable carved shell ornament is a queen conch frog (Figure 6).

Figure 6. Frog pendant (cf. *Lobatus gigas*).

Main Street Mollusks

The basic premise of the Crab-Shell Dichotomy is -- land crabs to the exclusion of marine mollusks during the Saladoid (circa 400 BC to AD 700), while marine mollusk exploitation was emphasized to the exclusion of crabs during the subsequent Ostionoid (post-AD 700). This distinction is not absolute, but rather one of degree. It is widely recognized that molluks do occur in Saladoid sites, but in low frequency. For example, Ivonne Narganes (2015) reports that the gastropods *Lobatus gigas*, *L. costatus*, and *Charonia variegata* are present as tools in Saladoid and la Hueca deposits at the Sorcé site on Vieques Island, as are *Lucina pectinata* and *Codakia orbicularis* bivalve scrapers.

Nevertheless, the noted archaeo-malacologist Natalie Serrand (2008:17) recently summarized the status of Saladoid mollusks:

> As for marine molluscs, bivalves were rarely exploited and the gathering focused mostly on gastropods, apparently collected at random in the productive ecological zones of the rocky shore and sea grass areas. While the most productive species of these ecotones (i.e. *Cittarium pica, Strombus gigas*) were collected in good numbers, there is little to suggest they were necessarily targeted. As these sites witness, the importance of land invertebrates (crabs/snails) decreases through time in favour of the marine gastropods from rocky shores (notably nerites and *Cittarium pica*) and sea grass beds (conchs, star and turban shells). In parallel, during that period, the shell industry is well developed and diversified with artefacts mostly related to the ornamental field but rather standardized from one site to the other: there is a clear homogeneous common background.

Mollusk shells and coral from156 field samples were transported to the Florida Museum of Natural History (University of Florida) for identification and study (Keegan and Delancy 2014). Shells were identified to lowest taxonomic unit, measured, weighed and counted by NISP and MNI. In addition, complete whelks were collected separately and processed in the field (n=3,143). A total of 104 mollusk taxa were identified distributed among Gastropoda or snails (n=58), Pelecypoda or bivalves (n=37), Patellidae or limpets (n=5), Polyplacophora or chitons (n=2), Cirripedia or barnacles (n=2) and Vermetidae or tube worms (n=1). A total of 4,432 individual mollusk specimens were identified in the lab (NISP), and an additional 3,143 whelks were recorded in the field (N=7,575). The identified taxa indicate that rocky shorelines and shallow seagrass and patch reef environments were the primary loci of foraging (Table 1).

The 2,832 identified gastropods represent at least 25 Families, 36 genera, and 42 species. As noted by Serrand (above), the gathering of gastropods is not unexpected. What is striking is the relative abundance of bivalves. A total of 1,396 bivalve specimens[1] were identified, representing at least 18 Families, 29 genera, and 29 species. The bivalves in the sample are found in shallow water, are not deeply buried in sandy and seagrass environments, and/or adhere to rocks, reefs and other hard substrates (e.g., mangrove roots). Some are

[1] The results reported here as number of identified specimens (NISP) because taxa are underrepresented by MNI in small samples. Every bivalve MNI has at least two NISP due to their morphology, and many bivalves have thin shells that easily fragment. MNI are reported in Table 1 for some of the more common taxa. These indicate that there is not a 2:1 ratio for bivalves in this sample.

easily collected from mangrove roots (e.g., *Isognomon alatus*), the sandy intertidal zone (e.g., *Donax* spp.), and Cardiidae can be drawn to the surface by vigorously raking the sand substrate (Humfrey 1975:245). The taxa present at the Main Street site are comparatively expensive sources of meat (Keegan 1989). What is more significant is their widespread use as tools, especially in the processing of other foods.

Table 1. Complete inventory of mollusk taxa identified in the lab.

Taxon	Common Name	NISP(MNI)[1]	Habitat[2]
PELECYPODA			
Anadara notabilis	eared ark	63(19)	bay, sand or muddy bottoms, seagrass beds
Anadara ovalis	blood ark	1	gulf and bay, muddy to sandy bottoms
Anodontia alba	buttercup lucine	2	shallow waters, inlets, bay margins, hypersaline lagoons, near-shore waters over, prefers muddy or fine gran sediments where they burrow to depths of 22 cm.
Anomalocardia sp.	pointed venus	1	estuarine and intertidal areas in mud and sand
Antigona listeri	princess venus	1	in sand in shallow water
Arca zebra	atlantic turkey wing	441(90)	gulf and bay, shell bottoms, reef areas
Asaphis deflorata	gaudy sanguin	15	present in sandy and gravel bottoms
Brachidontes sp.	mussels	2	intertidal on rock surfaces, commonly found washed ashore in clusters attached to other shells and seaweeds
Chama macerophylla	leafy jewelbox	22	attaches to hard substrates in coastal waters from the mean low tide to a depth 20 meters
Chama sarda	cherry jewelbox	148	shallow water
Chione cancellata	cross-barred venus	5	sandy subtidal zone
Chione paphia	king venus	1	present at sandy bottoms from 10 to 100 meter depths
Codakia orbicularis	tiger lucine	318(55)	gulf, sand or muddy bottoms, seagrass beds in moderately shallow water
Crassostrea rhizophorae	mangrove oyster	5	grows attached to the roots of red mangrove throughout the neotropics
Crassostrea virginica	eastern oyster	2	shallow estuarine, bay, usually occur as reefs
Dendostrea frons	frond oyster	7	estuarine waters, typically less saline than where crested oyster live. Attach to rocks, debris, or other oysters, in vast beds
Diplodonta sp.	diplodon	1	moderately shallow water in sand and gravel
Donax sp.	bean clams	46	shallow water, littoral zone
Donax denticulatus	common caribbean donax	14	shallow water, littoral zone
Euvola sp.	scallop	15	moderately shallow water.
Euvola ziczac	ziczac scallop	1	Forms small beds on sandy bottoms in areas of upwelling, an infaunal species
Glycymeris sp.	bittersweet clams	5	shallow burrower in fine shell-gravels or sandy-muddy gravels offshore
Isognomon alatus	flat tree oyster	25(9)	Colonies attached to mangrove roots
Laevicardium laevigatum	eggcockle	1	common in shallow water to 4 meters
Lucina pectinata	thick lucine	21(7)	inhabits mangrove swamps
Pecten laurenti	scallop	9	
Pecten sp.	scallops	62(5)	shallow seagrass
Periglypta listeri	princess venus	1	in sand, sponges bottom
Pinctada imbricata radiata	rayed pearl oyster	48	hard surfaces, attached to rocks and hard sandy plateaus, 10-20 meters deep, attach in clusters by byssus. Over years assemblages form consisting of dead pearl oyster shells, worm tubes, algal clumps and dead coral.
Pitar sp.	saltwater clams	2	

Plicatula gibbosa	Atlantic kittenpaw	5	gulf, attaches to hard substrates
Spondylus americanus	atlantic thorny oyster	3	lives on reefs , usually under overhangs or in recesses in depths from 12 to 40 meters
Tellina fausta	favored tellin	30(3)	shallow water, deeply burrowing in intertidal sand near seagrass beds
Tellina listeri	speckled tellin	3	clean subtidal sands in areas of moderately strong currents
Tellina radiata	sunrise tellin	25(6)	in sand from depths of 0 meters to 8 meters. The shells of dead animals are often found on beaches.
Trachycardium isocardia	even prickly cockle	9	shallow water
Trachycardium muricatum	yellow prickly cockle	2(1)	moderately shallow water
UID	small clams	34	
Total Pelecypoda		**1,396**	
GASTROPODA			
Bulla melampus	bubble	3	intertidal on coral reefs and rocky shores, under rocks and coral fragments
Bulla striata	striate bubble	11	intertidal on coral reefs and rocky shores, under rocks and coral fragments
Bursa granularis	cuba frogsnail	8	intertidal on coral reefs and rocky shores, under rocks and coral fragments
Cassis madagascariensis	cameo helmet	1	sandy bottoms of the infra-littoral zone
Cassis sp.	helmet	3	sandy bottoms of the infra-littoral zone
Cerithium eburneum algicola	middle-spined cerith	44	shallow waters, 0-18 meters
Chicoreus brevifrons	West Indian murex	2	mudflats in protected bays and lagoons. Commonly found near oyster banks and mangrove areas, shallow water
Chicoreus pomum	apple murex	39	mudflats in protected bays and lagoons. Commonly found near oyster banks and mangrove areas, shallow water
Chicoreus sp.	murex	119	mudflats in protected bays and lagoons. Commonly found near oyster banks and mangrove areas, shallow water
Cittarium pica	West Indian topsnail	511(378)[3]	rocky shores hiding in crevices and small holes. Large C. pica may inhabit more exposed areas where there is high wave energy, while juveniles inhabit protected areas such as bays
Columbellidae	dove snail	562	
Conus sp.	cone snail	1	
Coralliophila abbreviata	short abbreviate coral shell	1	coral reefs, especially on *Acropora*, *Agaricia* and *Montastraea* coral species
Crepidula plana	easternwhite slippershell	3	
Cymatium femorale	angular triton	1	shallow water on sandy bottoms with a cover of seaweed in the infra-littoral and circa-littoral zone
Cymatium muricinum	knobbed triton	14	intertidal on seawalls or leaving trails in muddy sand
Cymatium parthenopeum	giant triton	3	intertidal, on rocky and muddy shores on exposed coasts and in estuaries, down to 150 meters
Cymatium rubeculum	red triton	4	lagoon and seaward reef habitats, under rocks at depths of 5 to 20 meters
Cymatium sp.	triton	23	intertidal on seawalls or leaving trails in muddy sand
Cyphoma gibbosum	flamingo tongue	66	subtidally on shallow reefs. Commonly found individually or in pairs on sea fans and sea whips
Cypraea cinerea	atlantic grey cowrie	7	reefs, usually hides under overhangs, in depths ranging from 6m to 15m
Cypraea zebra	measled cowrie	1	intertidal and subtidal waters on coral reef or under rocks
Cypraecassis testiculus	Reticulated cowrie helmet	4	shallow, sandy substrates close to coral reefs
Fasciolaria tulipa	true tulip	16(16)	gulf and bay, sandy or muddy bottoms, seagrass beds
Haustellum rubidum	rose murex	26	sandy substrates to 25meter depths
Latirus brevicaudatus	Short-tailed	40	Relatively common under rocks, intertidal to 6 m

	latirus		
Leucozonia sp.	spindle snail/tulip snail	8	
Lithopoma caelatum	carved star snail	1	subtidal, intertidal and off shore coral reefs and reef lagoons, particularly on boulders, coral rubble, rock and sandy habitats, 0-10 meters
Lithopoma tectum	west Indian star snail	21	Common all over the Caribbean in seagrass beds and on reefs. depths from 0m to 10m.
Lithopoma tuber	green star snail	30	depths from 10m -30m
Lithopoma sp.	Star snail	129	
Lobatus costatus	milk conch	7(3)	shallow seagrass meadows, sand beds, algal flats, from 3m-20m.
Lobatus gigas	queen conch	374(101)	juveniles found in shallow , inshore seagrass meadows, adults found in deeper algal plains and seagrass meadows
Lobatus pugilis	West Indian fighting conch	11(11)	sandy, muddy bottoms and seagrass beds from the intertidal zone to 10m.
Lobatus sp.	conch	11	sandy, muddy bottoms and seagrass beds
Mitridae	miter shells	36	under rocks, intertidal
Nassariidae	Nassa	1	sand or mudflats
Naticidae	moon snails	1	sandy intertidal
Nerita fulgurans	antillean nerite	47	high rocky intertidal zones, sandy shores with associated seagrass beds, in mangrove and on muddy cobblestone shores. Prefers brackish water.
Nerita peloronta	bleeding tooth	55	intertidal, rocky shores, upper littoral
Nerita tessellata	checkered nerite	24	rocky intertidal, most abundant at or just below the water line
Nerita versicolor	four-tooth nerite	48	along rocky shores, in higher, less frequently inundated portions of the intertidal zone
Nerita sp.	nerite	60	intertidal rocky shores
Neritina virginea	virgin nerite	28	intertidal rocky shores
Oliva reticularis	netted olive	89	sandy or muddy areas near patchy reefs, from 2m to 10m.
Oliva sp.	olive	16	shallow sand or muddy bottoms
Phalium granulatum	scotch bonnet	1	on sand from intertidal zone to approximately 183 m, where ocean curents are strong
Polinices sp.	moon snails	1	shallow water, sand and mud flats
Purpura sp.	murex snail/rock snail	8	shallow rocky areas
Semicassis granulata	scotch bonnet	3	on sand from intertidal zone to approximately 183 m, where ocean currents are strong
Stramonita haemastoma floridana	Florida rocksnail	2	bay, on hard substrates such as rocks and oyster reefs
Tectarius muricatus	beaded periwinkle	5	intertidal
Tegula sp.	tegula	6	Intertidal to 3 m under rocks
Thais deltoidea	deltoid rock snail	240	rocky coastline and coral reefs
Tricolia bella	shouldered pheasant	1	intertidal zone at the water's edge
Trigonostoma rugosum	rugose nutmeg	1	subtidal zones on sand and muddy substrates
Trivia pediculus	Coffee bean trivia	1	shallow water
Turbo castanea	chestnut turban	8	crevices and holes of the reefs
UID	small gastropods	35	
Total Gastropoda		**2,822**	
Total Gastropoda (without C. pica)		**2,311**	
CIRRIPEDIA	barnacles	**16**	intertidal, rocky shores
PATELLIDAE	limpets		
Acmaea antillarum	Antillian limpet	88	
Diodora cayenensis	Cayenne keyhole limpet	16	intertidal splash zone on rocks and hard surfaces

Diodora listeri	keyhole limpet	18	shallow water in reefs, in and on the underside of rocks
Diodora sp.	keyhole limpet	4	intertidal splash zone on rocks and hard surfaces
Patellogastropoda	limpet	42	intertidal rocky shores
Total Patellidae		**168**	
POLYPLACOPHORA	chitons		
Acanthopleura granulata	west indian fuzzy chiton	1	littoral and sublittoral zone on hard substrates
UID chitons[4]	chitons	29(4)	littoral and sublittoral zone on hard substrates
Total Polyplacophora		**30(4)**	
Vermitidae	Worm shell	**(5)**	
GRAND TOTAL		**4,432**	

[1] MNI was calculated by the presence of one common element. In mollusks the umbo was used to distinguish right and left valves. The apex of the spire was used for gastropods. MNI was calculated for the entire assemblage; no distinctions were made based on unit location or level. MNI are reported only for taxa with a significant difference between MNI and NISP.
[2] See Humfrey 1975; Warmke and Abbot 1975.
[3] *Cittarium pica* in the lab sample were all broken and although MNI could be calculated because the apex was present, it was not possible to determine shell size.
[4] Because there is little difference in chiton species with regard to human foraging most were not identified to Genus and species.

Mollusks at the Tutu Archaeological Village site

The Tutu archaeological village is located about 3.5 km to the northeast of Main Street. Tutu was excavated under the direction of Dr. Elizabeth Righter beginning in 1990, and involved the participation of a variety of specialists and volunteers (Righter 2002). There were two phases of occupation at the Tutu site; the first between AD 650 to 900 and the second from around AD 1150 to 1500. The earliest occupation phase at Tutu is centuries later than the Main Street site. The two sites provide the opportunity to compare marine mollusk use at a site located directly on the coast (Main Street) and the other (Tutu) in an inland valley about 1.75 km from the coast.

The faunal remains at Tutu were identified by Elizabeth Wing, Susan deFrance and Laura Kozuch (Wing et al. 2002). They report essentially the same taxa of mollusks found at Main Street, which is consistent with St. Thomas Harbor being closest to both. Most of the mollusks were small rocky intertidal gastropods and a few bivalves and gastropods that frequent shallow seagrass and patch reef habitats (Wing et al. 2002:Table 4.3). Comparison of previous samples from Main Street and Tutu produced a percent similarity of 84%. The comparison of shells identified in this report with those reported for Tutu and Main Street confirm a very high degree of similarity consistent with the exploitation of similar habitats. At both Tutu and Main Street the most common mollusk is the whelk. However, it is reported that the *C. pica* from the later phase occupation at Tutu were half the size of those recovered at Main Street (Wing et al. 2002:158-159). This may reflect resource depression due to long-term harvesting in the harbor, or a change in procurement strategies.

The major difference between the sites is that very few shell tools are reported for the Tutu site. This is likely due to the difficulty in recognizing expedient tools and debitage from tool manufacture (see Lammers-Keijsers 2008; O'Day and Keegan

2001; Serrand 2001). Righter (2002:70-83) reported two *Lobatus gigas* celts, one celt preform, one awl, one graver/scraper, a tear-drop shaped "spatula," and several nodules (Righter 2002:Figure 1.33a, 1.33b, 1.34a). Five complete and two broken *Cypraea zebra* "scrapers or spoons" were recovered. Of these all but one of each came from the early phase occupation (Righter 2002:Figure 1.35a). Only two *Cypraea zebra* fragments were identified at Main Street, and both come from relatively deep deposits (Unit 15, 90-100 cmbd; Unit 16, 65-75 cmbd. One had the outer whorl removed like those from Tutu and the other was a section of the aperture lip. Righter also reports six rectangular shell plaques with drilled holes, a number of *Oliva* sp. pendants/tinklers, and 46 disc beads with no apparent debitage.

Worked Shell at the Main Street Site

The quantity of worked shell at the Main Street site is remarkable (Table 2). In some cases the evidence for modification is from use rather than manufacture. Modified shells occur in 47% of the Field Samples. With the exception of small gastropods, most other shells appear to have been used as expedient tools (see Dacal Moure 1979, 1997; O'Day and Keegan 2001). Because expedient shell tools have received limited attention, we aired on the side of caution when identifying possible worked shell. Our inventory most certainly includes some objects that were not tools, and excludes some tool debitage. In this section we illustrate some of the objects in which we are most confident.

Table 2. Modified-shell objects in the Main Street site.

Tool Type	Shell Type	Quantity
Scraper	*Codakia orbicularis*	31
	Lucina pectinata	11
	Tellina fausta	6
	Tellina radiata	3
	Asaphysis deflorata	1
	Arca zebra	2
	Pecten spp.	1
	Anadara notabilis	5
Scoop/Scraper	*Cittarium pica*	95
Net Weight	*Arca zebra*	7
	Anadara notabilis	1
Lip	*Lobatus gigas*	2
	Lobatus costatus	2
	Cassis spp.	3
Lip (waterworn)	*Lobatus gigas*	1
Tip/Knipper	*Lobatus gigas*	20
Hammer	*Lobatus gigas*	5
	Lobatus pugilis	1
Pick	*Lobatus gigas*	12
	Lobatus pugilis	1
Short pick	*Lobatus gigas*	1
Bowl	*Lobatus costatus*	1

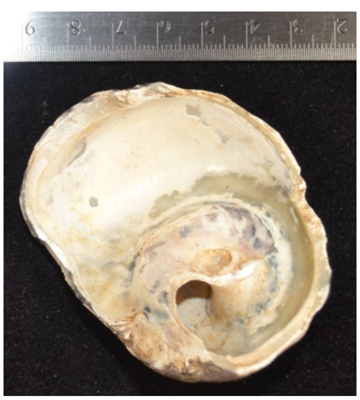
Gouge	*Lobatus gigas*	7
Scoop	*Lobatus gigas*	5
Hoe	*Lobatus gigas*	2
Columella	*Lobatus gigas*	5
Body section	*Lobatus gigas*	9
Fishing Lures	*Cypraecassis testiculus*	2
	Cyprae zebra	7
	Cyphoma gibbosum	15
Total		**264**
Ornaments		
Frog	cf. *Lobatus gigas*	1
Rectangle	cf. *Lobatus gigas*	1
Beads	Vermetidae	4
	Oliva spp. (small)	21
	Acmae antillarum	1
Bead blank	*Chama* spp.	5
	cf. *Lobatus gigas*	5
Bead scrap	Vermetidae	1
	Chama spp.	14
	Spondylus spp.	2
Pendant	*Oliva sayana*	2
Pendant (broken)	*Oliva sayana*	1
Unmodified (pendant/bead)	*Oliva sayana*	1
	Oliva spp. (small)	23
Shaped	*Lobatus gigas*	6
	Tellina radiata	1
	Pinctada radiata	3
Drilled	*Lobatus gigas*	1
Total		**93**

***Cittarium pica* (West Indian Topsnail, whelk, *burgao*)**

Whelks comprise 48% of the mollusk assemblage (MNI=3,654). Prior experience indicated that a variety of tools and ornaments were made from the C. pica shell (see Serrand 2001). In addition to fishhooks, the shell was fashioned into a variety thumbnail scrapers or preforms (Figure 7) or spoons (Figure 8) and possibly It is possible that some of our sample is simply the remains of shattered shells. Nevertheless, the whelk shell fragments exhibit a recurrent form, which may indicate that they are tools or preforms. We identified 95 possible scrapers, spoons, and/or preforms, and set them aside for further study. No fishhooks or fishhook blanks were observed, but some of the "scrapers" could be used to make fishhooks. Finally, the shell has a nacreous layer beneath the outer prismatic layer. The nacreous layer is used in some locations to make ornaments and fishing lures (see Keegan et al. 2011; Serrand 2001).

Figure 7. Possible *Cittarium pica* "scrapers" or preforms (FS 172).

Figure 8. *Cittarium pica* "spoon."



Lobatus spp. (Conchs, formerly *Strombus* spp.)

Queen conch (*Lobatus gigas*) are represented by a substantial number of identified specimens (NISP=374), but comparatively fewer MNI (=101). It has been suggested that large heavy adult shells were discarded on the beach or where they were procured, and only those destined for use were brought to the site (Bird et al. 2002; O'Day and Keegan 2001; Torres 2003) Given its size, weight, and sharp breakage edges it is the most common source for a variety of tools. The *L. gigas* shell from the site included nine body fragments and five columella fragments that may be debitage, or of some undetermined use (e.g., bead and plaque production). There were a total of five lips, most unmodified (Figure 9); five hammers; five scoops (Figure 10), 12 picks (Figure 11), including a small one with semicircle cut for handle attachment (Figure 12), one short pick (Figure 13), and one with a ground edge (Figure 14); seven gouges (Figure 15); 19 tips/knippers (Figure 16); one *L. costatus* bowl (Figure 17); one possible *L. pugilis* hammer; a *L. pugilis* pick, and three *L. pugilis* with a section of the outer whorl removed. There were also ornamental uses of the *Lobatus* shell, and these are discussed in a separate section.

Figure 9. ***Lobatus gigas*** **lip (FS 307).**

Figure 10. ***Lobatus gigas*** **scoop (FS 62).**

Figure 11. ***Lobatus gigas*** **pick (FS 51).**

Figure 12. *Lobatus gigas* with semicircular hole in columella for hafting a handle (FS 130).

Figure 13. ***Lobatus gigas*** **short tip (distinguished by distance spire extends beyond the columella) (FS 161).**

Figure 14. ***Lobatus gigas*** **pick with ground edge (FS 251).**

Figure 15. Broken *Lobatus gigas* gouge (FS 52).

Figure 16. ***Lobatus gigas*** **tips and possible gouge fragment (right) (FS 203).**

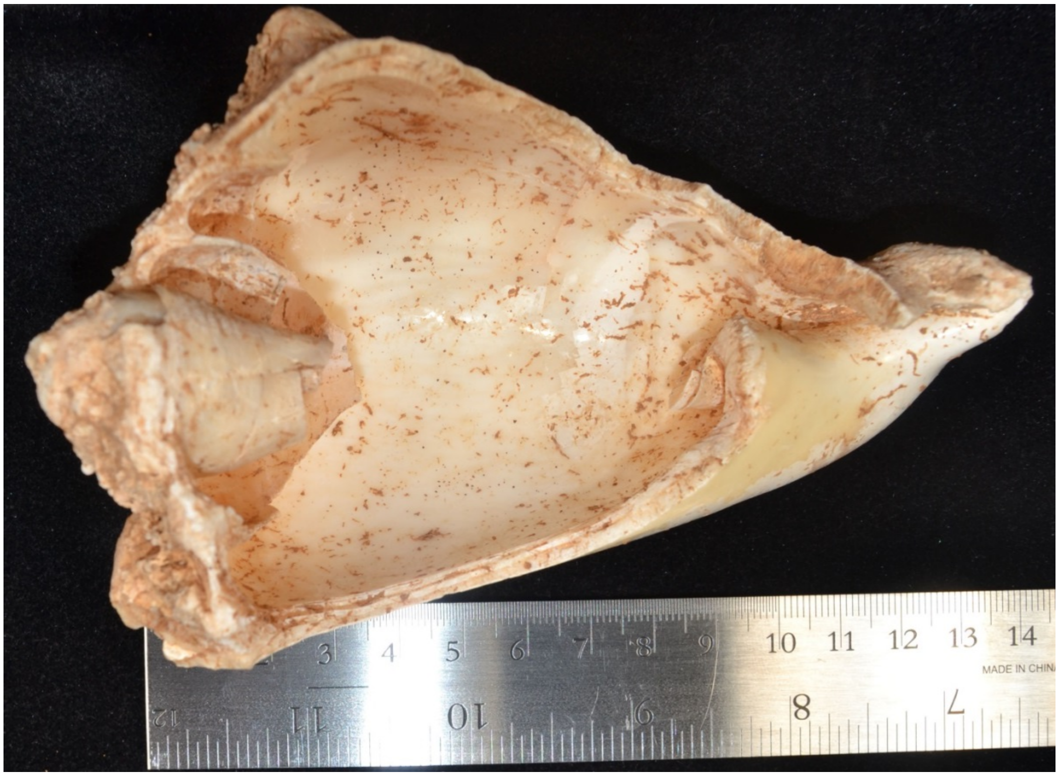


Figure 17. ***Lobatus costatus*** **bowl.**

Cassis cf. _madagascarensis_ (Emperor Helmet)

The Emperor Helmet is a large snail that can reach 30 cm in length (Figure 18). It inhabits seagrass and sand habitats. It is far less common than *L. gigas* because it is a carnivore. It has been reported at depths of less than 60 cm in the Virgin Islands, and adults may be exposed at extreme low tides (Rosenberg et al. 2009). Cassis shell tools have been identified throughout the Caribbean, and may be more common than recognized because broken shells are easily confused with *L. gigas* (Negrete Martínez 2015; Serrand 1997).

Only 3 Cassis spp. fragments were identified, including a complete lip in the backdirt (Figure 19), and a modified section of lip in the excavation (Figure 20).

Figure 18. _Cassis madagascarensis_.

Figure 19. _Cassis_ cf. _madagascarensis_ lip (FS40).

Figure 20. Worked Cassis spp. lip (FS 62).

***Cypraea zebra* (Measled Cowry)**

Figure 21. *Cypraea zebra* shell, ventral view, with predator kill hole (FS 85).

At the Tutu site, Righter (2002:72) recovered one unmodified and two modified *Cypraea zebra* shells, along with five sections cut from the outer whorl. Such cuts appear to have been made carefully, and the resulting curved rectangle of thin shell could be modified into a variety of ornaments. No dorsal sections were recovered at the Main Street site. There was one unmodified shell with a predator drill hole.

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Figure 23. *Cypraea zebra* lip, notice cut to remove dorsal section of shell (FS 42).

Although a single hole may not be sufficient to kill the organism (Vermeij et al. 1989), it is possible that this shell was scavenged from the beach (Figure 22). A smaller cowry has a hole punched in the dorsal surface (Figure 21). Lastly, a lip section was recovered (Figure 23). This is the debitage created when the dorsal section of the shell is removed (e.g., modified shells at Tutu from which the dorsal section was cut). Righter's modified shells are similar to octopus lures used on some Pacific islands (Davidson 1979:92; Emory 1979:216-217; Hornell 1950; cf. Spennemann 1993).

Figure 22. Small *Cypraea zebra* with predator hole (FS 124).

***Cypraecassis testiculus* (Reticulated Cowrie Helmet)**

A total of four *Cypraecassis testiculus* shells were recovered. One had the apex removed (Figure 24), and another had the entire spire removed. The result is similar to that observed on *Oliva* shells. The opening appears intended for attaching the shell to something (e.g., suspended as a pendant). Righter (2002:79) identified two modified *C. testiculus* at the Tutu site. Emory (1979:217) includes a photograph of a Tahitian-style octopus lure that appears to have a *Cypraecassis* spp. shell attached.

Figure 24. *Cypraecassis testiculus* shell with the apex removed (FS 353).

Figure 25. *Charonia variegata* fragment.

***Charonia variegata* (Triton's trumpet)**

Only one body fragment of *Charonia variegata* was recovered (Figure 25). Trumpet shells served a variety of purposes, including as a trumpet as their name implies. Circular cutouts of the outer whorl of Triton's trumpet were recovered at the Governors Beach site on Grand Turk (Carlson 1993). The piece found at Main Street does not exhibit worked edges, but could be a scrap saved for future use, especially because there is little other evidence for the use of trumpet shells in the deposits.

***Cyphoma gibbosum* (Flamingo Tongue Snail)**

A substantial number of Flamingo Tongue snails (*Cyphoma gibbosum*) were present in the excavated sample (n=15). These include shells with rough holes (n=7) and unmodified shells (n=8). It is hard to imagine that these shells were collected for food. A better explanation is that they were used as fishing lures (Keegan and Carlson 2008). The shells could have been collected from the beach, or more likely were retrieved in shallow water from the gorgonians and sea fans on which they feed. Many of these shells have a rough hole punched in the shell, which might suggest that they were strung as beads or pendants (Figure 26). However, given the attention to detail exhibited in the drilling of other beads, it is more likely that the rough holes reflect expedient technology in which the quality of the modification was not an issue. In this case it is more likely that they served as fishing lures. Their most common predators are pufferfishes (Tetraodontidae), rock lobster (*Panulirus argus*), hogfish (*Lachnolaimus maximus*), all of which have been identified in archaeological deposits at other sites in the Caribbean.

Figure 26. *Cyphoma gibbosum* shells with and without punched holes (FS 251).

Bivalve Scrapers and Net Weights

In the preceding section the tool forms were restricted primarily to one type of mollusk; such that the morphology of gastopod shells limited the use to which each taxa was put. In comparison, multiple bivalve taxa were put to the same general use. It is possible that the different qualities of each shell were selected for specific tasks, but more use-wear experiments are needed.

The most common worked bivalve shells are generically called "scrapers." Yvonne Lammers-Keijsers (2008:77-82), conducted a variety of experiments to determine the use-wear patterns produced by different worked materials. A recent analysis of *C. orbicularis* scrapers from Long Island, The Bahamas, revealed maize (*Zea mays* L.), manioc (*Manihot esculenta* Crantz), and marunguey (*Zamia* spp.) starch grains on a single scraper (Ciofalo et al. n.d.). All of these shells show a variety of modifications that suggest they were used to process soft and fleshy materials, and the starch-grain analysis indicates that a single scraper was

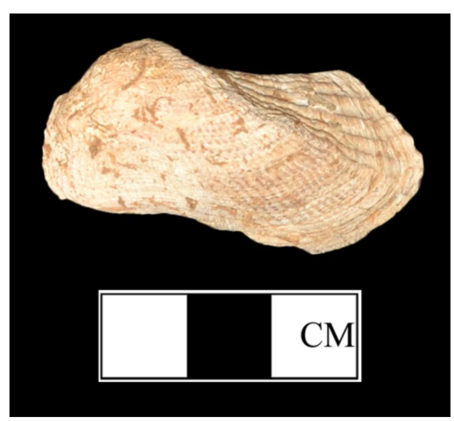

Figure 27. *Arca zebra* scraper (FS 105).

Figure 28. *Codakia orbicularis* and *Lucina pectinata* (far right) scrapers (FS 105).

that a single scraper was used for multiple tasks. We identified a total of 62 scrapers made from a variety of different shells (Figures 27 and 28). Given the soil conditions it is possible that some of these are misidentified and may not have been used, and that others that were used could not be identified. The worked shells we identified are: *Codakia orbicularis* (n=31), *Lucina pectinata* (n=11), *Tellina fausta* (n=6), *Anadara notabilis* (n=5), *Tellina radiata* (n=3), *Arca zebra* (n=2), and *Asaphis deflorata* (n=1). As mentioned, Narganes Storde (2015) reported the first two at Saladoid and la Hueca sites at Sorcé, Vieques Island.

Bivalve Net Weights

Although not as clear-cut as examples from Florida and Puerto Rico (Keegan et al. 2011). A total of eight possible shell net weights were identified. There was a total of seven *Arca zebra* shells (Figure 29) and one *Anadara notabilis* shell with a large hole in the body (Figure 30). Hoffman (1967) described these as shell tinklers. We suspect that these recurrent forms are not often recognized as possible net weights.

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Figure 29. *Arca zebra* net weights (FS 85).

Figure 30. *Anadara notabilis* net weight (FS 595).

Shell Ornaments

The manufacture of ornaments from a variety of sometimes exotic shells is well documented at Caribbean sites from this time period. At the Main Street site a total of five bead blanks and six, small, shaped shell were identified as *Lobatus* sp. based on the white color and thickness of the material. Although flat pieces of worked shell with drilled holes were recovered at the site, there were no blanks for their manufacture.

Chama sarda shell was represented by five bead blanks and 14 pieces of scrap (Figures 31 and 32). One rough blank had a droll hole. There were no finished beads. The absence of finished may reflect their production for exchange, or the nature of the deposit that was excavated (i.e., midden).

Figure 31. *Chama sarda* bead blank (FS 149).

Figure 32. *Chama sarda* fragments (FS 338). These are similar to scrap found at the beadmaking workshop, Governors Beach site on Grand Turk (Carlson 1993).

Vermitidae Tube Shell and Beads

There were four beads made from Vermitidae shells and a small quantity of unmodified tubes (Figures 33 and 34). Given their small size it is possible that additional examples may have passed through the screen or not been recognized during screening.

Figure 33. Vermitidae Tube bead (FS 203).

Figure 34. Vermitidae Tube bead and cut worm tube (FS 105).

Oliva **sp. (Olive Shells)**

Olive shells are the source of one of the most common ornaments in Caribbean sites. There were 38 modified *Oliva* shells recovered from the Tutu site. Of these 12 were beads and eight were tinklers (Righter 2002:Table 1.6). Olive shell beads are described as unperforated shells with the spires ground to create a hole; while tinklers or pendants also have a narrow groove that perforates the shell at the distal end. At the Main Street site there were two sizes of *Oliva*. The larger variety often is reported as *Oliva sayana* (Figure 35). A total of seven incompletely modified or broken shells, 23 beads, and three tinklers were recovered.

Figure 35. *Oliva sayana* shells. Large bead (left), unmodified shells (3 center), small bead (right).

Other Ornamental Shell

Although there were no complete shells, there is evidence that *Pinctada radiata* (Atlantic Pearl Oyster) and *Spondylus americanus* (Atlantic Thorny Oyster) were used to make ornaments. Four shaped pieces of the former and one fragment of the later were identified (Figures 36 and 37).

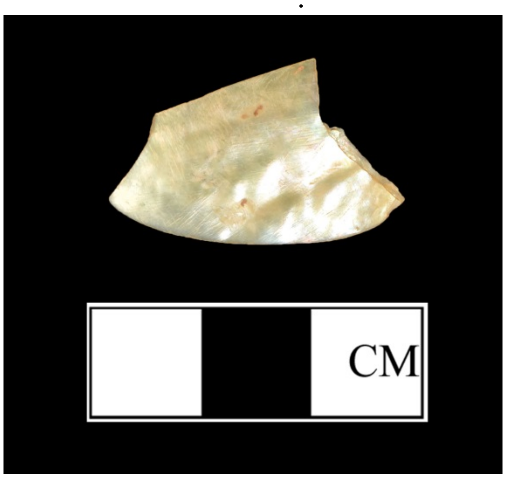

Figure 36. Shaped *Pinctada radiata*.

Figure 37. Shaped *Pinctada radiata*.

Finally, a variety of modified small shells is presented in Figure 38 to facilitate comparisons.

Figure 38. Bottom from left: *Oliva* bead, broken *Oliva*, cut *Cyphoma*, broken *Cyphoma*. Top from left: cut *Acmaea antillarum*, UID polished shell with hole, Vermitidae tube shell bead.

Conclusions

Marine mollusks contributed animal protein at the Main Street site, but they were far less important than other animals. A sample of the analyzed fauna consisted of 1105 MNI from 5694 bone and crab remains. Crab made up 74% of the sample by MNI, followed by fish at 23% by MNI. The dominant fish was jack followed by a variety of reef fishes. The remaining 36 MNI were mammals, reptiles, and birds including hutia, manatee, dog, iguana, and sea turtle.

The most important contribution of mollusks at the Main Street site was as a source for tools. Shell and stone tools occur together at Saladoid sites, which indicates that shell was not simply a substitute for stone when the latter is unavailable (Rodríguez Ramos 2010). Shell has qualities that should make it the preferred material for particular activities.

The high frequency of worked shell in the Main Street deposit documents the importance of marine mollusks during the Saladoid. Expedient shell tools were identified in 47% of the Field Samples, and were manufactured from at least 20 different taxa. The tools exhibit a full range of activities from woodworking, plant processing, gardening, as well as body ornaments (O'Day and Keegan 2001). *Chama sarda* scrap, along *Lobatus* sp. and *Chama sarda* bead blanks, indicate that beads were being made at the site, albeit ornaments and jewelry were a relatively minor component of the worked shell found in the midden. In addition, several shells with predator kill holes and water-worn surfaces suggest that at least some shells were scavenged from the beach. This activity highlights the value of shell as a raw material, and perhaps the rarity of some living animals.

In sum, the Main Street site represents a "broad spectrum" use of mollusks for food, and a well-developed shell tool industry by AD 300-500. It is possible that Saladoid colonists became familiar with mollusks through interactions with already established "developed" Archaic Age inhabitants (Keegan and Hofman 2017) in the same way that they adopted lithic protocols (Rodríguez Ramos 2005, 2010).

As Rodríguez Ramos (2005:49-50) noted in his study of lithics from the Paso del Indio site in Puerto Rico: "The single site perspective limits the degree to which issues at the level of series or even subseries may be addressed." We do not claim that the modified shell from the Main Street site characterizes all of the Cedrosan Saladoid. What we do promote is a more sophisticated appreciation of the Saladoid that can only be obtained by "seeing" mollusks and "listening" to stones.

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