

Report on the 2016 Investigations at Lamanai

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The 2016 Investigations at Lamanai

Elizabeth Graham, Institute of Archaeology, University College London (UCL) With contributions by Karen Pierce, Arianne Boileau, Alec McLellan, and Christophe Helmke. Report to the Institute of Archaeology, Belize

Introduction to the Report

Activities for the 2016 season spanned mid-May to the end of July. The purpose of the 2016 season was the restoration of proveniences and rehousing of the Lamanai on-site collections in July. Other tasks comprised: keying Str. N10-77 and N10-12 into the map of the Ottawa group; continuation of the Lamanai-Kakabish survey; faunal analysis; and monument photography. Two planned tasks (included in the permit application) were not undertaken. These were the installation of a new storage unit in the Old Museum, and residue sampling of vessels in the bodega at Marco Gonzalez (owing to illness of researcher). The roles of participants are summarised below:

Name	Citizenship	Institution	Role						
Elizabeth	U.S.A.	UCL	P.I. and overall director; rehousing of						
Graham			artefact material in zinc boxes						
David	Canadian	UCL	Co-P.I. Rehousing of artefact material in						
Pendergast			zinc boxes						
Karen	U.S.A.	Independent	Filling in information on Ottawa Group						
Pierce			records (maps, sections)						
Christophe	French	University of	Monument study and photography						
Helmke		Copenhagen							
Arianne	Canada	University of Florida,	Faunal analysis						
Boileau		Gainesville, Ph.D.							
		student (under H.							
		Haines's permit for							
		2016)							
Alec	Canada	UCL, Ph.D. student	Lamanai-Kakabish survey						
McLellan		(under H. Haines's							
		permit for 2016)							
Gabi Dziki	Poland	UCL undergraduate	Rehousing artefact material; Ottawa						
			recording						
Ella Bekesi ¹	Hungary	UCL undergraduate	Rehousing artefact material; Ottawa						
			recording						
Victor			Rehousing artefact material						
Yanes									
Enrique			Rehousing artefact material						
Ruano									

¹⁰UCL students in addition to those listed above, all of whom came for only limited periods: Maya Howard, Phelan Gowing-Mikellides, Lauren Bell, Alasdair Chi, Jessica Lakey, Nicholas Parker, Deborah Sartori, Josh Day, Eli Belleza. Also Ellen Taylor (Oxford) and Emiliana Donadi Sanchez from Mexico. Cameron Thomas is a student at another university in the U.K.

Rehousing the Bodega Material

(ca. 4 July to 3 August 2016)

We continued in 2016 with the work begun in 2015, which was to rehouse the Lamanai artefacts originally stored in buckets and later in sugar sacks by placing the artefacts and related material in zinc boxes. As described in earlier reports, the material from the 1974 to 1986 excavations had no provenance, owing to the decay of the pigtail buckets themselves, the plastic bags containing the various materials (sherds, bones, obsidian, etc.), and their labels. During the 2002-2004 IDB work, efforts were made by my team to salvage the material from the buckets by placing it in sugar sacks, but collapse of the buckets had resulted in mixed lots, and most of the labels had decayed. In a few circumstances, Pendergast was able to place the sherds in context from memory, but unfortunately many contexts have been lost. All primary material, midden material, and special artefacts (Small Finds) were originally processed separately by Pendergast from the general lots, therefore the lost contexts apply only to sherds and other material from mixed contexts, such as construction core.

Our procedure was to select a numbered sugar sack and empty the contents onto screens (Figures 1-3). By this method, excess dust and dirt were removed. The contents were then divided by material: ceramics, chert, obsidian, fauna, shells, ground or other stone, metals. Historic material (ceramics, metals, iron, etc.) was stored separately from Precolumbian material. What were previously labelled Small Finds (mostly from the TDP—Tourism Development Project—work) were stored together, but these will eventually be re-examined and re-sorted and many may be put back with their respective material (e.g., ceramics, chert), and the records adjusted. We still used plastic bags with plastic labels as containers (Figures 4, 5), but our plans are to replace these at some point in future with zinc boxes and aluminium tags.

The zinc boxes were labelled with lot numbers, where lot numbers were known (Figure 6). Bag numbers (on the sugar sacks) were also written on the zinc boxes in the event that the contents are found to form a meaningful lot. Otherwise the bag numbers have no lot significance and will eventually be eliminated. Sharpies were used for temporary labelling of the boxes. There were 214 sacks left to process at the end of the 2015 season. This did not include the sacks of stucco, or material in wood boxes and other miscellaneous containers, which will be processed in 2017. Approximately 180 sacks were processed in 2016.

Where it was not possible to recover information on provenance (that is, where lot numbers were lost), only samples of ceramics (the full spectrum of well preserved sherds, both fine and coarse wares) from the sugar sacks were kept. Given that provenance was unknown and the sherds could have originated anywhere on the site, the procedure seemed reasonable given time and storage constraints. Other materials (bone, lithics, etc.) were kept in their entirety.

Once the sorted material was placed in zinc boxes, these were placed either in the bodega (Figure 7) or in the Old Museum (Figure 8) to await final processing, when their contents will be re-housed in small zinc containers rather than plastic bags.



Figure 1. Mike Pendergast, David Pendergast, Emiliana Donadi, Ellen Taylor, sieving.



Figure 3. Sieving & sorting: Victor, Deborah Sartori, Elle Bekesi, Josh Day, Liz Graham.



Figure 5. Rebagging: Sherman Horn, Victor Yanes, David P., Don Antonio Esquivel.



Figure 7 (left). Bodega with shelved boxes.

Figure 8 (right). Old Museum. Zinc boxes were stacked on & below shelves lining the walls.



Figure 2. Enrique Ruano & Victor Yanes sorting bags and retrieving legible tags.



Figure 4. Brenda Arevalo, Emilana, David rebagging.



Figure 6. Bodega shelves with re-bagged sherds to be packed in the zinc box.



Ottawa Group Tasks (Checking measurements, section drawing, keying in Str. N10-77) (early July)



Figure 9. Ottawa Group N10[3], south side.

stairs (Figure 10), including Str. N10-77 (Figure 11), to the N10[3] Ottawa courtyard. Measurements and notes were taken on the relationship between the N10-12 platform that had been exposed atop N10-77, and the portion that overlay N10-78. When Mark Shelby arrived later in the season (Shelby wrote a Master's dissertation on the stucco frieze of Str. N10-28), he assisted Pierce in completing a section extending from the N10[2] plaza north to the N10[3] courtyard at the east end of N10-77. These will be included in the final report on the Ottawa excavations.

The mapping and recording tasks were originally to be undertaken by Claude Belanger with assistance from Karen Pierce. Belanger had been working earlier in the season with Helen Haines but decided to return to the U.K. Karen Pierce, along with two UCL students who had been on Helen's field team (Gabi Dziki and Ella Bekesi), undertook to set up mapping lines and proceeded with mapping the south side of Ottawa (Figure 9). Karen and the students also produced a section extending from the N10[2] Jaguar Plaza north through the central





Figure 11. Gabi taking measurements, N10-77.

Figure 10. Central stairs leading from Jaguar Plaza to the Ottawa Group. View looks North.



Figure 12. N10-12 Terminal Classic platform over N10-78. View is from courtyard looking southwest.

The Lamanai-Ka'Kabish Survey

(End of May to end of June)

Alec McLellan is a Ph.D. student at the UCL Institute of Archaeology, studying under my (Elizabeth Graham) supervision. Alec worked at Ka'Kabish with Dr. Helen Haines for several

years before undertaking a survey of the lands between Lamanai and Ka'Kabish as part of his doctoral research. (His documents are included in the 2016 Permit Request of Helen Haines, owing to the fact that the survey had to be carried out in the dry season, prior to my arrival, and Dr. Haines consented to supervising Alec in the field.) In addition to the land between the two major sites, Alec's study will also examine the chronology of settlement at Ka'Kabish and Lamanai. Alec's



field research was completed in 2016, and the Ph.D. thesis/dissertation will be submitted to UCL in September of 2018. The report by McLellan on the following pages covers the results of the 2016 field season.



One of the zones at Lamanai, P8, showing the structures studied by McLellan for which the chronology was available.

2016 Report on the Lamanai-Ka'Kabish Survey

Alec McLellan

Introduction

At Lamanai and Ka'Kabish, two pre-Columbian centres in northwestern Belize, archaeologists have concentrated their research on the environment, architecture, and long-term occupation of the civic and ceremonial centres (e.g. Graham 1987, 2004; Haines 2013; Howie 2012; Metcalfe et al. 2009; Rushton et al. 2013; Pendergast 1981, 1985, 1986.) The sites' rural or hinterland populations, however, which were presumably critical to the support of the centres, have not been studied. These populations are key to an understanding of the sites' long histories and especially to our understanding of how Lamanai and Ka'Kabish survived the Maya collapse (A.D. 600-900), flourished during the transition to the Postclassic period (AD 900-1500) and continued to be a focus of settlement in the Spanish colonial period. Only two small-scale studies have shown interest in the domestic occupation of the larger region, namely Baker (1994) and Patterson (2007), and these studies have been restricted by funding and time, leaving a massive gap in an otherwise robust and important comparative dataset. My research focuses on the nature of the settlement in the hinterlands between Ka'Kabish and Lamanai and also seeks to shed much-needed light on the processes that promoted the unique continuity in evidence in this region.

Research Questions

- What is the character of the settled landscape between Ka'Kabish and Lamanai (number of structures, patterns and distribution of settlement; modifications to the natural environment)
- 2) How does the chronology of the inter-site settlement zone compare with the chronology within the core of these major centres?
- 3) How does the distribution and density of occupation in the inter-site settlement zone change over time, and how does this compare to occupation of the centres?
- 4) To what extent is there consistency or variation in the material culture—as represented in the surface material—within and between these two major centres?

Methods

Archaeologists have surveyed several areas of occupation between Ka'Kabish and Lamanai, collecting information on the location, distribution, and organization of pre-Columbian Maya structures (Baker 1994; McLellan 2010, 2011, 2013; Patterson 2007). While some of this research is based on earlier documents (Baker 1994; Patterson 2007), the majority was conducted as part of the Ka'Kabish Archaeological Research Project. Archaeologists specifically and opportunistically chose to survey certain sections between Ka'Kabish and Lamanai in that areas were slash-and-burned, cleared and ploughed beforehand. Mennonite populations are vigorously expanding their landholdings in the inter-site settlement zone. To exploit the value of their holdings they often clear the tropical forest, plough a thin layer of top soil, and plant corn. While their extensive clearing is detrimental to local plant and animal populations, it is conducive to revealing pre-Columbian structures and land-use practices. It is important for archaeologists to survey these fields as soon as possible after clearing, as repeated seasons of farming activities threaten to destroy, or obscure, domestic structures and landscape modifications. After several seasons the productive potential of the field starts

to fail, and when it does, the field is used for cattle grazing. These uses of the land make it difficult to identify archaeological materials. Figure 1 shows the locations of the inter-site survey for the Ka'Kabish Archaeological Research Project. Figure 2 shows the location of earlier projects (Baker 1994; Patterson 2007). The fields surveyed by Baker (1994) are shown in dashed lines because the original GPS coordinates are incomplete. Some of these fields may need to be revisited to verify their locations. Figure 2 also shows the fields (HF) that were surveyed in the 2015 season.



Figure 1: Areas of Survey between Ka'Kabish and Lamanai



Figure 2: Areas of Survey between Ka'Kabish and Lamanai, including Patterson (2007) and Baker (1994)

At Lamanai, the survey was conducted by a group of 3 archaeologists, who systematically walked in 5-meter intervals, using pin-flags to identify and assess the distribution of artifacts across the landscape. Figure 3 shows the conditions of the field that was surveyed.



Figure 3: East Facing View of HF

A handheld GPS – Trimble Nomad – was used to record the position of concentrations of material culture. In most cases, these concentrations were located on easily identifiable 'mounds,' or ruined structures, remnants of limestone platforms commonly used by Maya populations to raise their residences above the surface of the ground. Archaeologists collected 100% of the artifacts on the surface of these structures, using the edges of the debris field to demarcate the extent of the collection. Sometimes archaeologists pin-flagged and collected a concentration of materials that was not associated with a mound; such a concentration was referred to as an 'artifact scatter'. It was thought at first that these artifact scatters represented pre-Columbian structures that were built directly on the surface of the ground, without platforms. However, based on observations in the field, it seems that these concentrations are mostly indicative of damaged or destroyed buildings. In some cases, Mennonites are known to use heavy equipment to bulldoze archaeological features because ploughing is particularly difficult in areas that once supported densely occupied, pre-Columbian settlements. In these fields with the remains of past dense settlement, limestone, ceramics, and lithic materials are distributed across the landscape, making it difficult to identify individual structures.

Data

The Inter-Site Settlement Zone

In total, 87 structures were identified in the inter-site settlement zone 2.5 km northwest of Lamanai. Figure 4 shows the size, orientation, distribution, and organization of these structures. The field is roughly 0.55 square kilometres in size. Most of the structures are dated to the Terminal and Early Postclassic Periods. Most notably, there is a drop-off in density of structures in the northwestern section of this field. This drop-off, similar to other areas of settlement in the Lamanai-Ka'Kabish corridor, is correlated with decreased elevation. Of particular interest is the relatively small, lower-lying structures in this area. Webster et al. (2000:82-83) have argued that these smaller, low-lying structures were used as 'field huts' by farmers at Copan for various agricultural purposes, such as storage. These huts were found further away from other domestic residences and lacked archaeological indicators of domestic activities. However, although these structures at Lamanai may have served a similar purpose, many of the platforms are arranged in plazuela groups and accompanied by domestic artifacts, such as manos and metates.



Figure 4: Inter-Site Settlement identified 2.5km Northwest of Lamanai

Excavations

Archaeologists conducted excavations in four locations in the settlement zone (Figure 5). These structures are referred to as HF1-18, HF1-27, HF1-M36, HF1-52. They represent 5% of the sample. A random stratified sample was used in the Lamanai survey zone. Each structure was placed in a category, with 3 distinct groups chosen based on their length, width, and height. This sampling technique was chosen to limit the chance that excavations only represented a particular segment of the population, as archaeologists sometimes argue that the labour invested in structures is representative of socio-economic class (Arnold and Ford 1980). At each structure, archaeologists excavated 1x1m units along the primary (front-to-back) axis of the platform. These excavations were dug as far as the bedrock, roughly 1m to 1.5m in depth. Most of the excavations encountered construction core, overlain by black and dark grey clays, with a sandy textured limestone bedrock, with nodules of dense limestone, similar to excavations in the civic and ceremonial centre of Lamanai (Howie 2012). At one of the structures, excavations revealed a plaster floor.



Figure 5: Location of Excavations in the fields 2.5km from Lamanai

One of the structures that was excavated was represented by a mound less than 1m high. At this structure, HF1-M36, archaeologists encountered only the corner of the platform, as it was difficult to identify the center of the debris field (Figure 6). Several cut stones appear in the mid-to-left section of the profile. Many ceramics were found in the black and dark grey clay level, but were mostly too eroded to recover. The only type that was identified was Dumbcane striated, which dates to the Terminal Classic to Early Postclassic periods. At each of these excavations, archaeologists expected to identify earlier periods of occupation. However, in every case, early periods were represented only by the ceramics found on the surface. Most of the profiles and plans of these excavations will be recorded in a PhD thesis for University College London (UCL).



Figure 6: Excavation of a Structure Northwest of Lamanai (HF)

The Ceramic Assemblage

In the 2015 season, we collected 4,032 ceramic sherds from the fields northwest of Lamanai (HF). Another 2749 sherds were collected from the surface of artifact scatters and structures, while excavations uncovered another 1283 sherds. Sagebiel and Haines (2015) conducted the analysis of the artifacts, and also reanalyzed artifacts collected during previous seasons. Some of the types were redefined based on their character and composition. For example, Blue Creek striated, which is similar to several wares in the greater Maya region, is referred to as Dumbcane Striated, which is likewise dated to the Terminal Classic period.

Some of the earliest pottery types belong to the Late Preclassic and Early Classic periods. The most commonly identified type is Sierra Red, the sherds of which are dated to the Late Preclassic period (Gifford 1976). Another common type from this period is referred to as Aguila Orange, a ware that postdated Aguacate Orange in the Protoclassic (Adams 1971:142), a period from the Late Preclassic to the Early Classic that witnessed changes in ceramic styles (Brady et al. 1998). Aguila Orange ware is attributed to the Early Classic period.

For the Late Classic to Terminal Classic, the most abundant type is referred to as Cambio Unslipped (Rice 2006). This type was found at several structures in the settlement zone immediately southwest of Lamanai.

Most of the ceramic assemblage from the inter-site zone is dated to the Terminal and Postclassic periods. The most common type is Dumbcane striated. Another common type is referred to as Red Neck Mother striated (Chase 1982), which dates from the Terminal to Early Postclassic Periods. It is one of two specific types of the Chambel ceramic group (Chase 1982:75). Red Neck Mother striated was first identified at the Maya site of Nohmul, in

northern Belize. Chase (1982:75) described it as comprising large, wide-necked jars, or *ollas*, with outflaring necks. Figure 7 shows a comparison of the rim profiles found at Ka'Kabish and Nohmul (Chase 1982:67).



Figure 7: Comparison of Red Neck Striated Profiles at A) Nohmul and B) Ka'Kabish

Lithic Assemblage

The lithic assemblage in the inter-site settlement zone comprises mostly domestic forms of ground and chipped stone tools. The most common types of artifacts are manos and metates, which are used to process grains and seeds. Figure 8 shows an example of some of the manos we found in the settlement zone southeast of Ka'Kabish (GFW). We also discovered various type of metates made from limestone, basalt, and granite. Figure 9 shows an illustration of some of the metates found in the settlement zone southeast of Ka'Kabish (GFW). In the intersite settlement zone at Ka'Kabish and Lamanai, we discovered several examples of 'bark beaters,' which were used to prepare paper. Figure 10 shows a bark beater from the settlement southeast of Ka'Kabish.



Figure 8: A) Mano, Rectangular Variety (Willey et al. 1965:458) B) Mano, Rectangular, Thick Variety (Willey et al. 1965:461) C) Mano, Rectangular, Thick Variety (Willey et al. 1965:461)



Figure 9: Metate, Large Variety (Willey et al. 1965:455)



Figure 10: Rectangular B Variety Bark Beater Fragment (Willey et al. 1965:471)

Several types of chipped stone tools were found in the inter-site settlement zone. For example, in the inter-site settlement southeast of Ka'Kabish, we discovered several varieties of artifacts. Figure 11 shows a bifacial tool with a tapered stem. Figure 10 shows another type of bifacial tool identified southeast of Ka'Kabish.



Figure 11: Tapered Stem, Long Blade Variety (Willey et al. 1965:421)



Figure 12: Laural-Leaf, Unstemmed, Bifacial Blade (Willey et al. 1965:421)

In comparison to the inter-site settlement northwest of Lamanai, the lithic assemblage at Ka'Kabish comprises a wider variety of types and materials. Most of the chipped stone tools northwest of Lamanai (HF) are standard bifacial choppers. In particular, we identified chipped stone tools manufactured from chalcedony materials southeast of Ka'Kabish, whereas, northwest of Lamanai we only identified chert. While these observations are preliminary in nature, it seems that the settlement at Ka'Kabish may have been more involved in the procurement and manufacture of stone tools.

Discussion

By combining the spatial and temporal data from the inter-site settlement zone northwest of Lamanai, several trends, or cultural dynamics, can be assessed (Figure 13-21). The area of settlement northwest of Lamanai was founded as early as the Middle Preclassic, and experienced periods of expansion from the Late Preclassic to Early Classic. By the Late Classic, the settlement seems to demonstrate a period of stagnation, with little to no growth in the number of occupied structures. By the Terminal to Early Postclassic periods, almost every structure in the settlement zone has evidence of occupation, seemingly demonstrating an apex of population. Following these periods, the settlement underwent steady decline, culminating in an almost complete abandonment by the Spanish Colonial period.



Figure 13: Middle Preclassic occupation in the inter-site settlement zone (in red)

0



Figure 14: Late Preclassic occupation in the inter-site settlement zone (in red)



Figure 15: Early Classic occupation in the inter-site settlement zone (in red)



Figure 16: Late Classic occupation in the inter-site settlement zone (in red)



Figure 17: Terminal Classic occupation in the inter-site settlement zone (in red)

0



Figure 18: Early Postclassic occupation in the inter-site settlement zone (in red)



Figure 19: Middle Postclassic occupation in the inter-site settlement zone (in red)



Figure 20: Late Postclassic occupation in the inter-site settlement zone (red highlights)



Figure 21: Colonial Period occupation in the inter-site settlement zone (red highlights)

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Faunal Studies

(4 June to 2 July)

Arianne Boileau is a Ph.D. student at the University of Florida, Gainesville, studying under the direction of Dr. Kitty Emery. The results of her field research that focused specifically on turtles was included in my 2015 report to the IA. In the 2016 field season, Arianne analysed the Terminal Postclassic to Early Colonial period faunal remains, mainly from Darcy Wiewall's work. Her report on animal resource exploitation follows. It covers turtles, and shell and bone artifacts. Appendix A includes the forms used in her study.

In Animal Resource Exploitation at Lamanai, Belize during the Terminal Postclassic-Early Colonial Period: Preliminary Results from the 2016 Lab Season

by Arianne Boileau Department of Anthropology Florida Museum of Natural History University of Florida

Under the direction of Dr. Elizabeth Graham, Lamanai Archaeological Project University College London and Dr. Kitty F. Emery Florida Museum of Natural History



Report Submitted to the Institute of Archaeology National Institute of Culture and History Belmopan, Belize

Animal Resource Exploitation at Lamanai, Belize during the Terminal Postclassic-Early Colonial Period: Preliminary Results from the 2016 Lab Season Arianne Boileau (University of Florida)

This report presents the results of an analysis of 1,476 turtle remains, 99 shell artifacts, and 31 bone artifacts recovered from Terminal Postclassic-Early Colonial (AD 1450–1650) deposits at the Maya site of Lamanai, Belize. Following a first season of zooarchaeological analysis in 2015, I returned to Lamanai in 2016 to complete the faunal analysis of lots LA2789 and LA2790. These lots were recovered during excavations at Feature N25/E50 by Darcy Wiewall (2009). The main goal of the zooarchaeological analysis of turtle remains was to provide information on the exploitation and possible trade of turtles by the Lamaneros. I also analyzed bone and shell artifacts recovered from a series of excavations in the Terminal Postclassic-Early Colonial zone of Lamanai (Pendergast 1986 a, b, c; Simmons 2004, 2005, 2006; Simmons and Howard 2003; Wiewall 2009). The main goals of the artifactual analysis were to gain insight into the procurement, manufacture, and use of shell and bone artifacts and determine what this implies about life at Lamanai during the Terminal Postclassic-Early Colonial transition. All the faunal remains analyzed during the 2016 lab season are part of a larger zooarchaeological project that investigates the impact of Spanish contact on traditional Maya economic and political roles at Lamanai.

This paper first reports the taxonomic composition and skeletal distribution of two faunal assemblages alongside an analysis of taphonomic agents that potentially affected the animal remains. Implications for the trade and possibly husbandry of turtles are discussed. The report then presents the typology used to describe shell artifacts as well as the taxonomic identification, taphonomic analysis, and detailed description of these artifacts. A technological and functional analysis constitutes the core of the discussion. The same format is used for the section about bone artifacts. It should be noted that all results presented here are considered preliminary because taxonomic identification has not been completed for all lot numbers.

LOCATION

Lamanai is a large Maya center located in northern Belize (Figure 1). Forty years of research at the site by David Pendergast (1981, 1985, 1986a, b, c, 1991, 1993), Elizabeth Graham (2000, 2004, 2006, 2008) and Scott Simmons (2004, 2005, 2006; Simmons and Howard 2003), among others, has documented a long occupation sequence extending from the Early Preclassic (ca. 1500 BC) to the Historic period (16th century) (Graham 2011). Lamanai developed into an important social and economic center in the Late Preclassic and thrived as a trading center during the Classic period (Pendergast 1981). The site survived the social and political turmoil of the Terminal Classic that spelled the end of many Maya communities and remained a dynamic community throughout the Postclassic (Pendergast 1981, 1986a, 1990). The site is also one of very few providing evidence for continuity of settlement at the time of Spanish contact (Graham 2011; Graham et al. 1989; Jones 1989; Pendergast 1991, 1993).

The site of Lamanai stretches over four kilometers on the western shore of the New River Lagoon and covers six square-kilometers (Pendergast 1981). Its prosperity was likely tied to its location on the New River Lagoon, which allowed for trade with the Caribbean Coast and Belizean interior, both in pre-contact and colonial times (Pendergast 1981, 1986a). The site's residents had access to a diverse set of environmental zones, including broadleaf forest, pine ridge, marshes, and lagoon (White and Schwarcz 1989:453). This provided the Lamaneros opportunities to exploit a wide range of species, including deer, peccary, tapir, turkey, fish, turtles, crocodiles, and mollusks, to name a few.



Figure 1. Map of Belize showing the location of Lamanai (Simmons and Shugar 2013:Figure 1).

ZOOARCHAEOLOGICAL ANALYSIS OF TURTLE SPECIMENS

Excavation History

The faunal remains from LA2789 and LA2790 were recovered during excavations by Darcy Wiewall (2009) in one large houselot (Feature N25/E50). The houselot area corresponds to a 30 m² grid (Figure 2). Excavations were conducted following arbitrary levels of 20 cm to maintain horizontal control, with most units not exceeding a depth of 50 cm (Wiewall 2009). All deposits were screened using one-eighth inch sieve to improve artifact recovery (Wiewall 2009:159). Two distinct areas were located during excavations at Houselot N25/E50. The first one consists of a large leveled platform located to the east of a retaining wall (Feature II). The platform was probably used as a patio or high traffic area. It supported a semicircular structure (Feature I) that may have been used as a storage space (Wiewall 2009:246–254). Radiocarbon dating of a Christian burial (AD 1514–1586) associated with Feature I suggests that it was used during the 15th century or later (Wiewall 2009:440–443). Three stratigraphic levels were present on this section of the houselot: 1) a midden in the upper 10 cm, when present; 2) a light to dark brown sticky clay; and 3) a decomposing limestone bedrock. The second area, to the east of the retaining wall, is lower in elevation and covered by a large midden that runs parallel to the New River Lagoon shore. Wiewall argues that the midden was used by multiple households given its size and density. Artifacts accumulated in a short span of time, probably during the Contact period. LA2789 and LA2790 were recovered in this midden. Feature III, also found in this section of the houselot, is interpreted as a garden area (Wiewall 2009:246–254).

Methodology for Analysis of Turtle Specimens

During the summer 2016, all turtle specimens were identified to the lowest taxonomic level possible, ideally to genus or species. The remains were identified in the Lamanai laboratory facility in Belize with the use of a turtle identification guide that I created under the supervision of Dr. Kitty Emery (Environmental Archaeology Program, Florida Museum of Natural History). The identification guide details diagnostic osteological features and includes high-definition photos of carapace and plastron elements of turtles present in the study region: Central American river turtle (Dermatemys mawii), Tabasco mud turtle (Kinosternon acutum), white-lipped mud turtle (Kinosternon leucostomum), scorpion mud turtle (Kinosternon scorpioides), Mexican giant musk turtle (Staurotypus triporcatus), narrowbridged musk turtle (Claudius angustatus), Mesoamerican slider (Trachemys venusta), and furrowed wood turtle (*Rhinoclemmys areolata*). For each species, photos were taken of one or more modern turtle specimens curated by the Herpetology Division and Environmental Archaeology Program of the Florida Museum of Natural History. Photography and development of photos in Photoshop were performed with the help of R. Scott Hussey. In an effort to standardize the identification guide, photos were preferentially taken of the left side; the right side was used when left elements were not complete. Each turtle species is represented by ventral and dorsal views of complete articulated carapace and plastron. Individual elements of the carapace (i.e., neurals with nuchal, suprapygal and pygal; pleurals; and peripherals) are presented both articulated and disarticulated. Articulated and disarticulated elements of the plastron are also pictured. The 2016 identification guide also includes new photos such as cross-section views of the peripheral bones. The guide currently only contains photos of carapaces and plastrons but it is planned to include cranial and appendicular elements.



Figure 2. N11 and N12 quadrants at Lamanai showing the location of Houselot N25/E50 (circle) (scale 1 cm = 25 m) (modified from Wiewall 2009:Figure 7.2).

Taxonomic identification was also completed using an archaeological specimen of *Dermatemys mawii* and a modern specimen of *Staurotypus triporcatus* available on site for comparison. It should be noted that the Mesoamerican slider and furrowed wood turtle have similar osteological features. Although they are part of two distinct families, identification was sometimes limited to the combined family level Emydidae/Geoemydidae. Similarly,

identification of *Kinosternon* turtles was often limited to genus level because the three species of mud turtles are difficult to differentiate osteologically. Taxonomic nomenclature is based on the most recent annotated checklist of turtles developed by the Turtle Taxonomy Working Group (2014) and most recent accepted nomenclature available from the Integrated Taxonomic Information System (http://www.itis.gov).

In this study, bones of the carapace are described as neural, pleural, peripheral, nuchal, suprapygal, and pygal, while bones from the plastron are identified as epiplastron, entoplastron, hypoplastron, and xiphiplastron (Figure 3). The section of the hyoplastron and hypoplastron connecting to the peripherals is called the "bridge." On average, turtles have eight pairs of pleurals and 10 or 11 pairs of peripherals, with the addition of one nuchal, one or two suprapygals, one pygal, and six to eight neural bones placed on the central axis. Most turtles have two epiplastra, two hypplastra, two hypplastra, two xiphiplastra, and one entoplastron. However, mud turtles (Kinosternon spp.) do not have an entoplastron. An effort was made to identify carapace and plastron bones to specific elements, side and, location (e.g., left tenth peripheral). Due to the difficulty of identifying specimens to specific neural, pleural, and peripheral bones of the carapace, some specimen were identified to two or three bones that share similar characteristics. For instance, it is difficult to distinguish between the fourth and seventh peripheral bones of the Central American river turtle. Therefore, an identified element could be described as a "fourth-orseventh peripheral." The same situation prevails for the ninth, tenth, and eleventh peripherals, the second, fourth, and sixth pleurals, the third and fifth pleurals, and many others. The method of skeletal identification used in this study should provide a more accurate tally of elements and individuals present in the assemblages than if elements were only identified to broad skeletal categories (e.g., neural, pleural, peripheral, carapace, and plastron).

Data recorded for every specimen include taxon, skeletal element, element side, element portion and completeness, length (in mm), and weight (in grams). When possible, the estimated age and sex of the specimen were noted. Because turtles continuously grow throughout their life, biologists define sexual maturity based on the length of the carapace (Legler and Vogt 2013). Consequently, age was based on the size of the specimens and was broadly defined as juvenile or adult. Older adults could sometimes be identified when bones of the carapace had fused together (Legler and Vogt 2013:74–75). Surface modifications were also observed and include: surface preservation (scored as intact, slightly damaged, damaged, or very damaged), estimate of preserved surface (in increments of 10%), presence of natural modifications (e.g., exfoliation, sheeting, root etching, staining, and cracking), edge abrasion (scored as intact, slightly abraded, abraded, and very abraded), burning (defined as browned, charred, or calcined), gnawing (e.g., carnivore, rodent) and its extent (described as marginal, limited to one section, or covered), butchery marks (e.g., cut marks, scrape marks, chop marks, and spiral fractures) and location on the specimen, and other artifact modification. All remains were observed with a magnifying glass (10X) under light to facilitate the identification of surface modifications. Specimens displaying cut marks, percussion marks, and gnawing marks were photographed with a Nikon D3200, using an 18–55 mm VR lens. Other archaeological specimens may have been photographed if displaying, for instance, particular patterns of fragmentation or complex examples of refitting.



Figure 3. Dorsal view of carapace bones and ventral view of plastron bones (modified from Landon et al. 2014).

Each identified specimen was attributed an identification number formed of the lot number given during excavation and a number from 1 to *x* in ascending order (e.g., LA-lot number-X). Faunal remains were bagged in 4-mil zip-lock bags with two plastic labels, one with the lot number and another with the taxonomic identification, skeletal element, and identification number. Small bags were grouped by lot number into larger 4-mil bags. All taxonomic identifications and taphonomic analyses were reported on a standard zooarchaeological identification form (see Appendix A). Data was later entered into a spreadsheet in Microsoft Excel. Forms were also scanned as a PDF document.

Quantification of the faunal remains includes the number of identified specimens (NISP), the minimum number of elements (MNE), and the minimum number of individuals (MNI). The NISP is a direct tally of identified specimens and, in this analysis, takes into account all specimens identified to the class level. This quantification method is simple and easily replicable between analysts (Grayson 1984; Klein and Cruz-Uribe 1984; Lyman 2008). However, it tends to over-represent taxa whose bones are numerous or easily identified (e.g., armadillos and turtles) and under-represent elements or taxa whose bones tend to be fragmented or easily destroyed (Grayson 1984; Klein and Cruz-Uribe 1984; Lyman 2008; Marshall and Pilgram 1993; Ringrose 1993). NISP also does not account for the problem of interdependence, that is, the fact that multiple specimens identified to a taxon may be from a single individual (Grayson 1984; Lyman 2008; Reitz and Wing 2008). This problem can be mitigated by refitting. Attempt was made to conjoin specimens found within the same lot, which sometimes can have spectacular results (Figure 4). Refitted fragments were counted as one and weighed together.





The MNE provides a count for the number of elements represented by all faunal specimens of a given taxon (Lyman 2008). The use of this quantification method is necessary to control for the drawbacks of NISP. This is particularly important in the case of turtles because their shells are formed of many bones (e.g., the carapace and plastron of *Dermatemys mawii* are formed of 49 and nine bones, respectively) and these are easily identified, even when very fragmented. This means that NISP counts for turtles tend to over-represent a taxon compared to its initial abundance in the deposited assemblage. The MNE ensures that each element will not be counted twice and helps to circumvent the problem of differential fragmentation (Lyman 2008). The MNE was used to quantify each element of the carapace and plastron rather than the carapace and plastron as a whole.

The MNI is derived from the MNE. In this study, MNI was calculated on the basis of the most common anatomical element for each taxon, taking into account age and sex (Klein and Cruz-Uribe 1984; Lyman 2008). The MNI avoids counting the same individual twice. Unfortunately, MNI (and MNE) is affected by sample aggregation (Grayson 1984; Lyman 2008; Plug and Plug 1990). The MNI count of an entire site will likely differ from MNI values calculated for multiple aggregates of the same site. This is problematic in cases of food sharing because the parts of an animal may be shared among several households within the same community. MNI (and

MNE) was aggregated at the lot level in this study; lots that were part of the same context (e.g., midden or post-abandonment accumulation) were combined.

General Characteristics of the Midden Assemblages

The turtle specimens were recovered from two lots: LA2789 and LA2790. These lots are part of a large midden dating from the Colonial period identified on the side of the New River Lagoon. A total of 1,476 bones were analyzed during the 2016 lab season, representing a minimum of 183 skeletal elements, and a minimum of 21 individuals, for a total of 2,444 grams. The specimens represent one order, four families, two subfamilies, and five genera.

The Central American river turtle dominates the assemblages of LA2789 and LA2790, accounting for 79.6% of the NISP and 47.6% of the MNI (Table 1). This turtle is the largest available in Lamanai's vicinity (45–50 cm in length, 10–15 kg in weight; Legler and Vogt 2013:68; Vogt et al. 2011). It used to be common in the New River Lagoon before local populations were decimated by overexploitation. In fact, many Belizeans have assured me that the river turtle continues to be hunted for its meat and is considered a delicacy by many. The abundance of the river turtle at Lamanai suggests that this was also the case in the past. Younger individuals may have been captured by diving off a boat or a baited hand line; however, adult individuals are more successfully captured with traps or nets (Legler and Vogt 2013:71–72).

Taxon	Vernacular Name	NISP	%NISP	MNE	%MNE	INM	INW%	weight	%weight
Dermatemus mawii	Central American river			12				225	
Dermaternys mawn	turtle	5	79.6	0	65.6	10	47.6	2	92.1
Kinosternidae	Mud and musk turtles	5	0.3	1	0.5			2	0.1
Kinosternon scorpioides	Scorpion mud turtle	2	0.1	2	1.1	2	9.5	2	0.1
Kinosternon spp.	Mud turtles	25	1.7	24	13.1	2	9.5	28	1.1
Staurotypinae	Neotropical musk turtles								
Staurotypus triporcatus	Mexican giant musk turtle	14	0.9	12	6.6	2	9.5	15	0.6
Emydidae/Geoemydida e	Pond turtles	6	0.4	2	1.1			3	0.1
Trachemys venusta	Mesoamerican slider	20	1.4	9	4.9	2	9.5	27	1.1
Rhinoclemmys areolata	Furrowed wood turtle	11	0.7	10	5.5	3	14.3	16	0.7
Testudines	Unidentified turtles	218	14.8	3	1.6			99	4.1
		147	100.	18	100.		100.	244	100.
Total		6	0	3	0	21	0	4	0

Table 1. Combined taxonomic abundance for LA2789 and LA2790 by NISP, MNE, MNI, and weight (in grams).

Small mud turtles (*Kinosternon* spp.) are the second most common turtles in these assemblages. Because species of mud turtles are difficult to distinguish osteologically, there are considered here as one unit. They represent 1.8% of the NISP, 14.2% of the MNE, and

19.0% of the MNI. These turtles are the smallest present in Belize (generally less than 20 cm in length); therefore, it is not clear why their numbers are so important in the Colonial midden formed by LA2789 and LA2790. However, mud turtles can easily be captured when emerging from aestivation and can also be raised in captivity if supplied with a well-varied diet (Berry and Iverson 2011).

The ranking of other turtle species is less clear because they are all present in small numbers. The proportions of the second and third largest turtles, the giant musk turtle and Mesoamerican slider respectively, are similar (giant musk turtle: NISP = 0.9%, MNE = 6.6%, MNI = 9.5%; Mesoamerican slider: NISP = 1.4%, MNE = 4.9%, MNI = 9.5%). Both are generally found along the shorelines of slow rivers, in depth of 1 to 3 m (Legler and Vogt 2013:93, 267). They were likely available in the New River Lagoon and its surrounding marsh areas. Similar to the small mud turtles, the Maya may have taken advantage of the end of aestivation to hand-capture these two turtle species. They may also have been caught with nets or traps.

The furrowed wood turtle is a medium-sized turtle, also present in small numbers (NISP = 0.7%, MNE = 5.5%, MNI = 14.3%). In Belize, this semi-terrestrial turtle is commonly found in lowland pine ridges (Legler and Vogt 2013:342; Vogt et al. 2009), such as the one located on the eastern shore of the New River Lagoon, across from Lamanai. In Yucatan, this turtle is often husbanded because it adapts well to captivity and grows quickly if well fed (Legler and Vogt 2013:342; Vogt et al. 2009). The low abundance of the furrowed wood turtle in the assemblages does not suggest that it was frequently captured or raised in captivity.

The narrow-bridged musk turtle (*Claudius angustatus*) and Central American snapping turtle (*Chelydra rossignonii*), two species also found in Belize, are absent from the LA2789 and LA2790 assemblages. To date, only one specimen of the narrow-bridged musk turtle was found in the Lamanai assemblages, during the 2015 lab season. The snapping turtle has not yet been identified in the Lamanai assemblages, most likely because it is only found in southern Belize, far from Lamanai.

Detailed Taxonomic Composition and Skeletal Distribution of the Faunal Remains

This section presents the taxonomic composition and skeletal distribution of the Lamanai turtle remains for two lots from Feature N25/E50: LA2789 and LA2790 (Table 2). Specimen descriptions are based on NISP counts and include taxon, skeletal element, age, and presence of natural and human modifications. Sex of turtle specimens could not be determined because of lack of bones displaying sexual dimorphism. The presence of individuals is also noted, generally based on differences in age.

Taxon	Vernacular Name	LA2789						LA2790						
		NISP	%NISP	MNE	%MNE	MNI	NM%	NISP	%NISP	MNE	%MNE	INM	WNN%	
Dermatemys mawii	Central American river turtle	526	81.2	48	64.9	3	37.5	649	78.4	72	66.1	7	53.8	
Kinosternidae	Mud and musk turtles	5	0.8	1	1.4									
Kinosternon scorpioides	Scorpion mud turtle	1	0.2	1	1.4	1	12.5	1	0.1	1	0.9	1	7.7	
Kinosternon spp.	Mud turtles	12	1.9	11	14.9	1	12.5	13	1.6	13	11.9	1	7.7	
Staurotypus triporcatus	Mexican giant musk turtle	6	0.9	5	6.8	1	12.5	8	1.0	7	6.4	1	7.7	
Emydidae/ Geoemydidae	Pond turtles							6	0.7	2	1.8			
Trachemys venusta	Mesoamerican slider	12	1.9	5	6.8	1	12.5	8	1.0	4	3.7	1	7.7	
Rhinoclemmys areolata	Furrowed wood turtle	2	0.3	2	2.7	1	12.5	9	1.1	8	7.3	2	15.4	
Testudines	Unidentified turtles	84	13.0	1	1.4			134	16.2	2	1.8			
Total		648	100	74	100	8	100	828	100	109	100	13	100	

Table 2. NISP, MNE, and MNI for all turtle taxa, divided by family level, for LA2789 and LA2790.

LA2789 and LA2790 were recovered in Unit N1.5/W2, which was placed near the edge of the lagoon to excavate a large midden identified during previous surveying of the area (Wiewall 2009). The midden dates to the Colonial period. LA2789 represents the sediments recovered between 0 and 20 cm. A minimum of three individuals of Central American river turtle were identified in this lot. One adult individual is represented by one first neural, one browned second-or-fourth neural fragment, one browned third-or-fifth neural fragment, one browned fourth neural, one right second peripheral, four first-second-or-third peripheral fragments, two third-or-eighth peripheral fragments (one is burned), two fourth-to-seventh peripheral fragments, one browned right fifth peripheral, one browned fifth-or-sixth peripheral fragment, one left and two right eighth peripherals, one ninth-or-tenth peripheral fragment, one burned right ninth-to-eleventh peripheral fragment, seven ninth-to-eleventh peripheral fragments, one left and one right eleventh peripherals (both are burned), two browned left and one unburned right first pleurals (the right pleural displays carnivore gnaw marks on both dorsal and ventral surfaces), one browned left second-or-fourth pleural fragment, one charred and one unburned right second-fourth-or-sixth pleural fragments (the unburned specimen has carnivore gnawing on the ventral surface), five second-fourth-or-sixth pleural fragments, one browned third-or-fifth pleural fragment, one browned left sixth pleural with a set of fine cutmarks on the ventral surface, one burned and one unburned pygals, one browned right epiplastron, one browned right xiphiplastron, and three xiphiplastron fragments, one of which is burned.

At least one older adult individual was identified based on the presence of a very large burned nuchal, one very large left first pleural gnawed on the ventral surface, one very large right
epiplastron gnawed on the ventral surface, and three fused pleural and neural fragments (two of which are browned). A smaller, juvenile individual of river turtle is identified by one right first pleural, one browned left second-or-fourth pleural fragment, one browned right third-or-fifth pleural fragment, and one burned third-fifth-or-seventh pleural fragment. Additional skeletal elements attributed to the river turtle include three neurals (one is burned), 17 peripheral fragments (one is burned), 25 pleural fragments (nine are browned and four are charred), 14 plastron fragments (four are burned), 15 hyo/hypoplastron fragments (two are browned and one specimen is covered by carnivore gnawing), 14 plastron fragments (three are browned), 21 browned carapace/plastron fragment, and 340 unburned carapace/plastron fragments. One of the neural fragments is polished on the dorsal surface and may have been part of an artifact such as a bowl or ornamental object (Figure 5).



Figure 5. Striation marks (visible on the lower right corner) likely caused by polishing on the dorsal surface of a neural fragment (LA2789-11) of a Central American river turtle.

In LA2789, the scorpion mud turtle is identified by one left fourth pleural with carnivore gnawing on both ventral and dorsal surfaces. Mud turtle specimens, which may belong to the scorpion mud turtle individual or other mud turtle species, are also represented by one nuchal, one complete left second peripheral, one complete browned left third peripheral, one charred left seventh peripheral, one browned left ninth-or-tenth peripheral fragment, one right complete tenth peripheral, one second-fourth-or-sixth pleural fragment, one right third-or-fifth pleural fragment, one burned and one unburned third-fifth-or-seventh pleural fragments, one charred right hyoplastron with two cutmarks near the bridge on the dorsal surface, one hyo/hypoplastron fragment, and five carapace/plastron fragments (two are charred). The left third peripheral belongs to a juvenile or subadult individual based on the size and bone texture.

One individual of the furrowed wood turtle is represented by one right second-or-fourth pleural fragment and one browned plastron fragment. The giant musk turtle is identified by one charred first peripheral, one browned left fourth peripheral, one left fifth-or-sixth peripheral fragment, one charred right ninth-or-tenth peripheral fragment, and one pleural fragment. One charred left first pleural, one burned left fifth pleural with two fine cutmarks on the dorsal surface (Figure 6), one hyo/hypoplastron fragment, one burned and one unburned pleural fragments, and five carapace/plastron fragments (one is burned) were attributed to the Mesoamerican slider. Unidentified turtle specimens consist of three browned, five charred, and 76 unburned carapace/plastron fragments.



Figure 6. Two sets of cutmarks on the dorsal surface of an almost complete left fifth pleural (specimens LA2789-099, LA2789-100, and LA2789-101) of a Mesoamerican slider.

The lot LA2790 represents the sediments recovered between 20 and 40 cm in the large midden near the lagoon edge. At least three adult individuals of Central American river turtle are represented by three browned first neurals, one complete browned second neural, one complete browned fourth neural, one almost complete fifth neural, one left first peripheral, one right second peripheral, one browned right fourth peripheral, six fourth-to-sixth peripheral fragments (four are browned), one browned right fifth peripheral, one charred left seventh peripheral, one browned left and four burned right eighth peripherals (the left eight peripheral displays hack marks on the distal edge), one browned left and three browned right ninth peripherals (one of the right ninth peripherals has cut mark on the ventral surface, near the rib attachment), five browned and eight unburned ninth-to-eleventh peripheral fragments, one right tenth-or-eleventh peripheral fragment, one browned right first pleurals (a carnivore tooth pit is present on the ventral surface of the unburned first pleural), one unsided first pleural fragment, five

browned second-fourth-or-sixth pleural fragments, two browned left fourth pleurals, one browned left fifth pleural, one almost complete right sixth pleural, two browned right seventh pleurals, two browned and one unburned entoplastra (the latter is covered in carnivore gnawing), two left epiplastra (one is burned and the other displays carnivore gnaw marks), two browned right epiplastra (one displays cut marks on the dorsal surface and the other has one tooth pit on the dorsal surface), one epiplastron fragment, two browned left hyoplastra, one hyoplastron fragment, one browned and one unburned right hypoplastra, two browned left xiphiplastra (one has carnivore gnaw marks on the dorsal surface), and two xiphiplastron fragments. An anatomical refit was observed between one fifth neural and one left fifth pleural (Figure 7).



Figure 7. Anatomical refit of a Central American river turtle. *From left to right*: an almost complete left fifth pleural (four fragments from LA2790-039 and LA2790-040) and an almost complete fifth neural (LA2790-057).

Two older adult individuals of river turtle were identified in the assemblage based on the very large size of the bones. These specimens, all of which are burned, include one right ninth peripheral, one left epiplastron, one fused neural and pleural fragment, one first neural fused to a second neural, a right first pleural and a right second pleural (Figure 8), and another specimen that consists of one third neural, one right second pleural, and one right third pleural. The dorsal surface of the latter is polished and faint striations are visible. At least two juvenile individuals are present, represented by one complete third-or-fifth neural fragment, one right eighth peripheral, one browned ninth-tenth-or-eleventh peripheral fragment, one browned right first pleural, one right second-fourth-or-sixth pleural fragment, one browned right third pleural, one unburned left and one charred right third-or-fifth pleural fragments, one browned left seventh pleural, one almost complete entoplastron with gnawing marks on both dorsal and ventral surfaces (Figure 9), one browned left epiplastron, two browned left xiphiplastra, one pleural fragment, and three hyo/hypoplastron fragments (one has a set of three cut marks at the base of the bridge and one is burned). Additional specimens of the river turtle include two charred neural fragments, 55 peripheral fragments (18 are browned

and one is charred), 45 pleural fragments (23 are browned and four are charred), 18 hyo/hypoplastron fragments (one is browned), two browned and three unburned plastron fragments, as well as 56 browned, 36 charred, and 314 unburned carapace/plastron fragments.



Figure 8. Fused first and second neurals and right first and second pleurals from a Central American river turtle. *Left*: ventral view showing the first and second neurals (from left to right) at the top and the first and second pleural bones (from left to right) at the bottom. *Right*: dorsal surface showing that the suture lines have disappeared.

One adult individual of scorpion mud turtle was identified by one browned left second pleural gnawed by a carnivore on both dorsal and ventral surfaces. Additional mud turtle specimens include one nuchal, one left fourth peripheral, one burned right fifth-or-sixth peripheral fragment, one left seventh peripheral, one right tenth peripheral, one browned left first pleural, one browned right third pleural, one left and one charred right epiplastra, one burned

left hyoplastron, one charred right xiphiplastron, and one pleural fragment. One juvenile individual of mud turtle (*Kinosternon* spp.) was identified based on the size and bone texture of a left ninth peripheral. At least one giant musk turtle individual is present in the lot, identified by one burned left third peripheral with hacking marks on the anterior cross-section of the bone, one browned left third pleural, one charred left sixth pleural, one browned left epiplastron with three carnivore tooth pits on the dorsal and ventral surfaces, one peripheral fragment, two pleural fragments (one is burned), and one plastron fragment.



Figure 9. Carnivore gnawing marks on the ventral surface of an almost complete entoplastron (LA2790-15) of a juvenile Central American river turtle.

Two individuals of furrowed wood turtle were identified. A pleural fragment was identified to a juvenile individual based on size and porous bone texture. Identified specimens attributed to an adult individual include one browned right seventh peripheral, one right first pleural, one charred right second-fourth-or-sixth pleural, one browned right eighth pleural, one left hyoplastron, one browned right hypoplastron with two carnivore tooth pits on the ventral surface, and one charred right xiphiplastron. The Mesoamerican slider is represented by a single individual: one left eleventh peripheral, three pleural fragments (one is charred), one charred epiplastron fragment, and three carapace/plastron fragments. Specimens identified as Emydidae/Geoemydidae could belong to either the furrowed wood turtle or the Mesoamerican slider. These include one browned hyo/hypoplastron fragment and five plastron fragments, one of which is browned. Unidentified turtle skeletal elements include one browned and five unburned plastron fragments as well as 13 browned, 9 charred, and 106 unburned carapace/plastron fragments. Three faunal specimens in this lot were very damaged and could only be identified as Tetrapoda.

Taphonomy

This section considers the potential taphonomic factors influencing the composition of the faunal assemblages, in particular recovery methods, fragmentation, surface preservation, and gnawing. This analysis helps assessing the comparability of the faunal assemblages recovered from distinct locations in the Terminal Postclassic-Early Colonial zone of Lamanai. With this in mind, the taphonomic analysis of LA2789 and LA2790 is compared to that of LA2791. LA2791 was analyzed during the 2015 lab season and represents the soil recovered between 40 and 60 cm in the lagoon-side midden (Unit N1.5/W2).

Recovery methods can affect the taxonomic and skeletal composition of faunal assemblages because the use of large sieves (e.g., 1/4 inch mesh screen) generally creates a bias towards the recovery of large bones and taxa (Casteel 1972; Shaffer 1992; Shaffer and Sanchez 1994; Wake 2004). In contrast, the use of finer mesh sieving (e.g., 1/8 and 1/16 inch) facilitates the recovery of smaller bone specimens (Shaffer and Sanchez 1994; Wake 2004). During the 2004 excavations, Wiewall (2009) used 1/8 inch mesh screen. This practice should have resulted in good faunal recovery, as supported by a zooarchaeological recovery test conducted in 2014 at Lamanai (Boileau 2016).

Fragmentation of the faunal assemblages can also affect taxonomic and skeletal identification. The size distribution of faunal specimens for LA2789, LA2790, and LA2791 indicates that the assemblages are very fragmented, with 59.6% of the fragments measuring less than 2 cm and 26.9% measuring 2 to 3 cm (Figure 10). Only 5.8% of the material measures more than 4 cm. The near absence of specimens smaller than 1 cm may be explained by the difficulty of collecting bone fragments of that size (Villa et al. 2004). In addition, despite the use of 1/8 inch mesh screens, the recovery of small faunal specimens may have been hindered by the sticky clay soils in which the faunal remains were recovered. Overall, the three lots appear comparable in terms of fragmentation and therefore, were likely affected by similar taphonomic processes. It should be noted that LA2789 is slightly more fragmented than LA2790 and LA2791. Given that this lot represents the soil found between 0 and 20 cm, its material was likely more prone to trampling than material found in deeper lots. Because of the midden's location near the lagoon, it also is possible that this area may have been subject to flooding during the rainy season. This phenomenon could cause smaller-sized fragments to move upwards and larger ones to move downwards in the sediments, a process caused by aquaturbation. However, this process would have likely resulted in greater differences in size distributions than those observed among the three lots. Therefore, I argue that trampling rather than flooding likely explains the differences in fragment size distribution.

The distribution of fragment size is relatively different when only identified elements are considered (NISP = 277, Figure 11). Unsurprisingly, no fragments smaller than 1 cm were identified. When indeterminate bones are not considered, the proportion of identified specimens measuring 1 to 3 cm significantly declines and that of more than 3 cm increases. In fact, nearly all specimens measuring more than 4 cm were identified to skeletal element. On the whole, the proportion of bones in each size categories appears fairly similar between the three lots, with LA2789 being slightly more fragmented than LA2790 and LA2791.

Overall, 85% of the turtle specimens from LA2789, LA2790, and LA2791 were identified to at least family level (Table 1). Therefore, the high fragmentation level of the assemblages did not significantly impact taxonomic identification because freshwater turtles from the Maya subarea can easily be identified to family or genus based on bone texture. However, identification to skeletal element was often restricted due to the small size of many specimens. Only 12.2% of the specimens were identified to a specific element of the carapace or plastron.



Figure 10. Fragment size distribution for all faunal specimens from LA2789 (n = 644), LA2790 (n = 821), and LA2791 (n = 814) at Lamanai.



Figure 11. Fragment size distribution for identified specimens from LA2789 (n = 75), LA2790 (n = 108), and LA2791 (n = 94) at Lamanai.

The preservation of the cortical surface was recorded for all specimens, with the exception of unidentified carapace/plastron fragments. Overall, the preservation of the turtle remains is moderate to good (Figure 12). Poor organic preservation is common in the Maya subarea and Lamanai is no exception. Exfoliation caused by root and acid etching constitutes the most common damage observed on the bones surfaces. Other natural modifications include cracking, sheeting, and staining. No specimens were identified as having an intact surface. The majority of bones (50.0 to 70.2%) were scored as slightly damaged and less than 10.6% were considered very damaged. The specimens from LA2789 are more damaged than those from LA2790 and LA2791; these results are in line with the fragmentation data. Because they are not buried as deep as the other lots, specimens from LA2789 are more susceptible to natural taphonomic actors (e.g., plants, animals, water, sun, and air). Overall, the good surface preservation likely resulted in the preservation of bony landmarks and bone texture and, therefore, in higher chances of identification to lower taxonomic levels. The high degree of taxonomic identification (84.5% of the assemblages is identified to genus level or lower) supports this observation. Marks left by human and animal agents are also more likely to be visible, if present.



Figure 12. Overall surface state for turtle specimens (excluding carapace/plastron fragments) for LA2789 (NISP = 188), LA2790 (NISP = 292), and LA2791 (NISP = 205).

Carnivore and rodent gnawing may also impact the preservation of animal remains. Rodent gnawing is inexistent in LA2789, LA2790, and LA2791, while carnivore gnawing is marginal, only affecting 0.7% of the assemblages (Table 3). Gnaw marks were observed on specimens of a Central American river turtle, scorpion mud turtle, furrowed wood turtle, and giant musk turtle, and on a variety of carapace and plastron elements (Figure 9). They are more prevalent in LA2789 and LA2790 than LA2791, but even so, are only identified on a small portion of the

specimens. A qualitative assessment of the gnawing marks indicates that gnawing was generally restricted to a few tooth pits and punctures on a limited section of the bone.

Location	Location	Car	nivore	Rodent		
Location	NISP	n	%NISP	n	%NISP	
Feature N25/E50						
LA2789	648	6	0.9			
LA2790	828	9	1.1			
LA2791	814	2	0.2			
Total	2290	17	0.7			

Table 3. Carnivore and rodent gnawing for three Early Colonial lots at Lamanai.

In sum, the bone fragmentation of LA2789, LA2790, and LA2791 is high. This does not appear to have significantly affected taxonomic identification but did impact skeletal element attribution to a certain extent. Bone surfaces are generally well preserved, a state that likely facilitated taxonomic identification as well as identification of natural and human modifications on the faunal remains. Carnivore gnawing is marginal and rodent gnawing, inexistent. The observed patterns are consistent among the three lots, although fragmentation is higher and bone surfaces more damaged in LA2789.

Skeletal Element Distribution

The analysis of skeletal element distribution only considers identified carapace and plastron bones because the identification of cranial and appendicular elements has not yet been completed. However, an inventory of the Lamanai fauna in 2014 indicates that these elements are rare in comparison to the number of identified carapace and plastron bones. Table 4 presents the minimum number of elements (MNE) and the minimum animal units (MAU) for the five species identified in LA2789, LA2790 and LA2791.

MAU is a useful quantification method for turtles because it helps comparing skeletal parts that do not have the same number of elements. It provides an expected frequency for each element by dividing the MNE by the number of times an element is represented in a complete skeleton (Lyman 2008). On average, the carapace and plastron have 49 and nine elements, respectively (but eight plastron bones for *Kinosternon* spp. because they do not have an entoplastron).

Given the difficulty of identifying turtles of the genus *Kinosternon* based on osteological characteristics, all specimens identified to mud turtles were pulled together in this analysis. The number of specimens identified as "hyo/hypoplastron" was divided in half between the hyoplastron and hypoplastron. It is relatively easy to identify specimens to either hyoplastron or hypoplastron but it can be difficult to determine which specific element is represented unless the specimen is complete.

Using MAU values, it appears that carapace elements are more abundant than plastron elements for the giant musk turtle overall, and for the river turtle in LA2789. In other species as well as the river turtle in LA2790 and LA2791, plastron elements were more frequently

identified than carapace elements. The different thickness and shape of the carapace and plastron may explain this difference. The flat and thick plastron elements may be more durable than the curved and thinner carapace elements. It is also possible that the lower number of carapaces result from their removal from this area of the site (formed of lesserstatus households) to another, higher-status area, or from Lamanai altogether to be used as containers, musical instruments, or other functions. However, given that the MNE values for the skeletal distribution are small for most species (with the exception of the river turtle), these results should be interpreted with caution.

Skeletal element	LA2789		LA2790		LA2791		Total	
	MNE	MAU	MNE	MAU	MNE	MAU	MNE	MAU
Central American river turtle								
Carapace	42	0.91	53	1.15	25	0.54	120	2.61
Plastron	6	0.67	18	2.00	14	1.56	38	4.22
Mud turtles (Kinosternon spp.)								
Carapace	10	0.22	10	0.22	6	0.13	26	0.57
Plastron	2	0.25	4	0.50	4	0.50	10	1.25
Mexican giant musk turtle								
Carapace	5	0.11	5	0.11	15	0.33	25	0.54
Plastron			1	0.11	1	0.11	2	0.22
Mesoamerican slider								
Carapace	3	0.07	2	0.04	8	0.17	13	0.28
Plastron	1	0.11	1	0.11	1	0.11	3	0.33
Furrowed wood turtle								
Carapace	1	0.02	5	0.11	5	0.11	11	0.24
Plastron			3	0.33	1	0.11	4	0.44

Table 4. Skeletal distribution of turtle carapace and plastron at Lamanai using MNE andMAU values, by lot numbers.

Human Modifications

Evidence of human modifications of turtle bones is demonstrated by the presence of butchery marks and burning on carapace and plastron elements (Table 5). When all three lots are considered, 47% of turtle bones are burned. The majority of the fragments are browned, indicating that the bones were not subject to intense heat alteration. The browned bones generally exhibit a spotted pattern and are burned on both ventral and dorsal surfaces. Several hypotheses may explain this pattern. The bones may have been smoked or roasted on a spit, a method that exposes the turtle shell to a low-to-medium heat. The shells may also have been curated over cook-stoves, a practice documented in the Petén region of Guatemala (Kitty F. Emery, personal communication, 2016). The spotted burning pattern observed on the bones may result from the uneven detachment of the keratin scutes covering the bones during heating. This remains to be tested.

		Butchery					Burning						
Location	Location	Cut marks		Chop marks		Scrape marks		Browned		Charred		Calcined	
	NIJF		%		%		%		%		%		%
		n	NISP	n	NISP	n	NISP	n	NISP	n	NISP	n	NISP
Feature N25/E50													
LA2789	648	3	0.5					74	11.4	46	7.1	1	0.2
LA2790	828	3	0.4	2	0.2			205	24.8	69	8.3		
LA2791	814	4	0.5					617	75.8	61	7.5		
Total	2290	10	0.4	2	0.1			896	39.1	176	7.7	1	<0.1

Table 5. Human modifications on turtle remains at Lamanai, by lot numbers.

Surprisingly, the difference in the proportions of burned bones among the lots is important. The percentage of charred bones is similar across the lots but not that of browned bones. Only 18.7% and 33.1% of the bones in LA2789 and LA2790 are browned, respectively, compared to a whopping 83.3% for LA2791. It is difficult to explain this difference but it is possible that the use of turtle shells changed over time, leading to the abandonment of a practice that resulted in the browning of the bones.

Butchery marks are infrequent in LA2789, LA2790, and LA2791. They were identified on 0.5% of the assemblage, for a total of ten cut marks and two hack marks. Butchery marks were observed on the Central American river turtle, Mesoamerican slider, giant musk turtle, and small mud turtles.

The cut marks found on pleural fragments (n = 2) are located on both ventral and dorsal surfaces of the carapace (Figure 6). This may represent evidence for scraping meat from the carapace. Additional cut marks (n = 5) were found near the bridge, on the ventral or dorsal surfaces of hyoplastrons and hypoplastrons. These may be associated with the separation of the carapace and plastron to open the turtle shell. The two hack marks were identified on a third and an eighth peripherals—these are the peripherals connecting to the bridge of the hyoplastron and hypoplastron—and are likely associated with the dismemberment of the turtle at the junction of the carapace and plastron. The bridge is one of the thinnest sections of the turtle shell; it appears logical that the Maya would break it open at this location. This would also allow them to keep the carapace fairly intact to use it as drum, rattle, shield, and container (Emery 2010; Pohl 1983; Tozzer and Allen 1910). Finally, one cut mark was found on the dorsal surface of an epiplastron and another on the ventral surface of a ninth peripheral.

In fact, evidence for the transformation of turtle shells into artifacts at Lamanai comes from a fragment of a fused third neural, right second pleural, and right third pleural (LA2790-70, LA2790-71, LA2790-72). The dorsal surface of this fragment was polished and faint striations marks are visible, probably produced while abrading the surface of the carapace. Additional polished specimens were examined during the 2016 lab season: a fused neural and pleural fragment with a polished dorsal surface (LA2782-39); a second-fourth-or-sixth pleural fragment with a polished dorsal surface (LA2791-128); and unidentified carapace/plastron fragments with a polished ventral surface (LA2591-1), a polished dorsal surface (LA2746-12), and both ventral and dorsal polished surfaces (LA2782-12a and LA2782-12b). The fragments were likely part of larger objects given that they all measure less than 5 cm in length. However, the small size of the specimens makes the identification of their function difficult. They may have served decorative, utilitarian, or ritual purposes. As described above, turtle shells are known to have been used as containers and musical instruments.

Discussion of Turtle Remains

The results of the zooarchaeological analysis of LA2789 and LA2790 season indicate that the Lamaneros exploited many species of freshwater turtles likely available in the New River Lagoon and surrounding wetlands. The Central American river turtle dominates the assemblages, followed by small mud turtles, Mexican giant musk turtle, Mesoamerican slider, and furrowed wood turtle. All freshwater turtles prevalent in Belize were identified, with the exception of the narrow-bridged musk turtle (*Claudius angustatus*) and the Central American snapping turtle (*Chelydra rossignonii*). Remains of marine turtles were not identified in the lots analyzed but their presence in Terminal Postclassic-Early Colonial faunal assemblages was noted during an inventory of Lamanai faunal remains in the summer 2014.

The river turtle, mud turtles, furrowed wood turtle, and Mesoamerican slider are represented by a greater number of plastron than carapace elements; the pattern is reverse for the giant musk turtle. The location of butchery marks suggests that the carapace was separated from the plastron at the bridge and that meat was likely scrapped from the carapace. Several specimens show evidence of browning or charring. The largest species were likely captured using nets and traps and smaller ones could have been caught by hand. All but the river turtle aestivate; the Maya may have taken advantage of the onset of the rainy season to acquire turtles.

The results from LA2789 and LA2790 were similar to those of LA2791, a lot analyzed in 2015. All three lots come from the same unit in a large collective midden near the shore of the New River Lagoon. Minor differences in fragmentation and surface preservation were noted, with LA2789 being more fragmented and less well preserved than the two other lots. This may be explained by the fact that LA2789 forms the upper layer of the unit (0–20 cm). It may have been more greatly exposed to the effects of trampling, acid and root etching, moisture, and air than deeper sediments. The difference in burning intensity among the three lots is unexpected. More than 75% of LA2791 is browned, contrary to 11% for LA2789 and 25% for LA2790. It is possible that this results from a change in practice, which led to less turtle shells being burned over time.

The results from the 2016 lab season are comparable to those observed during the 2015 lab season, when 2,332 turtle bones were analyzed. The taxonomic quantification and skeletal part distribution are very similar. Overall, surface preservation is moderate to good but bone fragmentation is relatively high. Carnivore and rodent gnawing are marginal throughout all the assemblages analyzed so far. Human modifications in the form of cut or hack marks are generally few. With the exception of LA2791 (and a few other lots), burning is generally present on less than 25% of the bones.

The discussion presented here is considered preliminary in nature because 33 lots from the 2004 excavations by Wiewall remain to be analyzed. More than 10,000 turtle bones were

recovered from Terminal Postclassic-Early Colonial deposits at Lamanai. This collection, unique by its size in the southern lowlands, represents an unprecedented occasion to examine the importance of turtle exploitation before and after Spanish contact. The quantity of turtle remains recovered at Lamanai suggests exploitation on a scale larger than community level, possibly for trade with other Maya communities (Emery 1999). Turtles were desirable animal goods, favored by the Maya elite (Carr 1985; Emery 2007; Hamblin 1984:63-65; Teeter 2001:133–134; Thornton 2011a) and used as tribute (Pohl 1983:60). The New River Lagoon and its tributaries would have served as perfect locations for the acquisition of large freshwater turtles, which could then be processed at Lamanai. In fact, the identification (so far) of 3,808 turtle remains associated with domestic (i.e., lower-status) contexts rather than elite structures, burials, and caches suggests that turtles were likely prepared at Lamanai and exported rather than imported to the site. Turtle cranial and appendicular elements, nearly absent at the site, could have remained attached to the meat sent to other sites. Support for the trade hypothesis also comes from the position of Lamanai as a trading port during the Postclassic and possibly Colonial periods (Graham 2011; Pendergast 1990). For instance, nonlocal deer were identified in a Postclassic cache, indicating that animals were indeed traded during this time period (Thornton 2011b). Finally, two recent phylogeographic analyses of modern river turtle in Central America by González-Porter and colleagues (2011, 2013) suggest that turtles were likely harvested and translocated by humans in the past. The researchers found high levels of gene flow across long geographic distances (>300 km), which cannot be explained by natural patterns of genetic diversity. It is even possible that the river turtle was husbanded at Lamanai, as suggested by Stanchly and Wiewall (2012). Vogt and colleagues (2011) report that this species is one of the easiest to raise in captivity because it does not need space to bask and can be fed with grasses and leaves.

ANALYSIS OF SHELL ARTIFACTS

A total of 99 shell artifacts recovered from several deposits dating to the Terminal Postclassic-Early Colonial period were analyzed during the 2016 lab season. The artifacts were recovered during three different excavation programs at Lamanai: the 1984–1985 excavations by David Pendergast (Pendergast 1986a, b, c), the 2004 excavations by Darcy Wiewall (Wiewall 2009), and the 2001–2006 excavations by Scott Simmons and colleagues (Simmons 2004, 2005, 2006; Simmons and Howard 2003). Artifact sub-types identified include disk beads, square beads, rectangular beads, tubular beads, barrel beads, spherical beads, perforated gastropods, tinklers, gastropod pendants, rectangular pendants, oval pendants, adornos, zoomorphic cutouts, perforated disks, historic buttons, worked shells, possible tools, and possible shell detritus. A total of 15 different taxa were identified.

Methodology

All shell artifacts were identified to the lowest taxonomic level possible. However, given that most artifacts were heavily worked, it was often not possible to identify them more precisely than class level (e.g., Gastropoda, Bivalvia, Scaphopoda). Many artifacts were also identified as "large gastropods," a term which refers to specimens made from a variety of large shells, such as *Lobatus gigas, Turbinella angulata, Triplofusus giganteus, Cassis flammea,* and *Fasciolaria tulipa*. Taxonomic identifications were based on the size, color, surface characteristics, and morphology of the specimens. Most recent accepted nomenclature was

verified with the World Register of Marine Species (WoRMS) at http://www.marinespecies.org/index.php. Shell parts were identified using the terminology presented by Reitz and Wing (2008:373–374) for the internal and exterior features of spiral gastropods and the dorsal and ventral views of bivalves (Figures 13 and 14). All shell artifacts were photographed in the field with the help of R. Scott Hussey. Photos of grouped artifacts (e.g., several disk shell beads) were taken by the author with a Nikon D3200, using an 18–55 mm VR lens, while individual shell artifacts were photographed by Hussey with a Nikon D5300 using a 40-mm DX macro lens. Broad taxonomic identifications were made in the field. Photos and artifact descriptions were subsequently used to confirm and refine the identifications using reference guides (e.g., Andrews 1969; Morris 1966, 1973; Warmke and Abbott 1975), online photo databases (e.g., Hardy 2017; Natural History Museum Rotterdam 2017; Wieneke et al. 2016), and comparative specimens held in the Environmental Archaeology collections of the Florida Museum of Natural History.



Figure 13. Internal and external features of a spiral gastropod (Reitz and Wing 2008:Figure A2.15).

Shell artifacts were classified according to a typology adapted from Bobbi Hohmann (2002:104–109) and Angeliki Cavazos (2015:95–175). Specimens were classified as worked shell artifacts, shell detritus, or ecofacts. Worked shell artifacts were divided into five types, based on the general shape and possible function of the artifacts, and 17 sub-types, defined by specific cultural modifications. The characteristics of each sub-type are summarized in Table 6. Detritus are fragmented shells that were not intentionally shaped or worked, but most likely result from the shaping of a shell core and were removed by knapping, cutting, or sawing. Ecofacts are unworked shell specimens. The typology used here was designed so as to include common artifact types recognized in the Maya subarea. It is based first and foremost on artifact morphology and, although the name of artifact types such as beads and pendants carry a functional significance, function should not be ascribed to artifacts based solely on their typological identification.



Figure 14. Internal and external features of the left valve of a bivalve (Reitz and Wing 2008:Figure A2.17).

Beads are small worked artifacts with one or more perforations. They are separated into two categories: cut shell beads and whole shell beads. Cut shell beads can take five different forms. Disk shell beads are circular to oval with a central perforation. They are small (<2 cm) and thin, with two relatively flat surfaces. The lateral edges may be perpendicular to the surfaces of the bead or slightly rounded. Two varieties of disk beads are possible: smooth edges or rough edges. The margins of the former are ground and smoothed, giving the bead a very circular outline. The latter variety has an overall discoidal shape, but its edges are uneven and show little grounding. Tubular (or cylindrical) beads are elongated with a length greater than the diameter. The perforation is longitudinal and generally biconical, running through the length of the bead. The cross-section appears circular or sub-circular. Barrel beads are similar to tubular beads but their lateral edges are constricted at the ends. They also tend to be shorter and to have a larger diameter than tubular beads. Square or rectangular beads are relatively flat beads, with one or more perforations. Their length and width tend to be greater than their thickness. The lateral edges and corners are generally smoothed and slightly rounded. They tend to have one or more holes drilled through the faces or longitudinally. Spherical beads look like a sphere with two relatively flat edges. The length of the perforation tends to be smaller than the diameter of the bead. Spherical beads are distinguished from disk beads based on their roundness and larger size.

In contrast to cut shell beads, which are made from portions of shells, whole shell beads are made from complete or nearly complete shells. They are divided into two categories. Whole scaphopods are complete or fragmented tusk (*Dentalium* spp.) shells. The outer surface of the shells may exhibit longitudinal ribbing or may be smooth. The form of these beads is natural, with a length greater than the diameter. Perforated gastropod beads are small marine gastropod shells whose original form was preserved, with the exception of small modifications. The most common modification is a punched or cut perforation in the body

whorl or outer lip to allow for vertical stringing. Shells used to produce this artifact sub-type include the genera *Prunum*, *Nerita*, and *Olivella*.

Pendants are large items of various shapes with one or more perforations for suspension. They may be of five varieties: tinklers, gastropod pendants, bivalve pendants, rectangular pendants, and oval pendants. Tinklers look similar to whole gastropods beads, but the apex or spire has been removed, either through cutting, sawing, or grinding. This gives the shell the appearance of a "bell." Tinklers tend to have a single drilled or longitudinal perforation for vertical suspension near the posterior section of the body whorl, near the outer lip. They are most often made from Olividae shells. In the case of gastropod pendants, the overall shape of the gastropod is preserved, with minor alterations. These pendants are made from gastropods larger than those used in the manufacture of perforated gastropods or tinklers. As a result, gastropod pendants may be of many shapes and sizes. They have one or more perforations, the location of which is highly variable. Bivalve pendants correspond to the perforated valve of marine (e.g., Spondylus) and freshwater (e.g., Nephronaias) bivalves. The perforation is most often located near the hinge or umbo for suspension. Rectangular pendants are flat pieces of cut shell with an overall rectangular, square, or trapezoidal shape and rounded corners. Two or more perforations are generally placed along one of the edges. Oval pendants, sometimes referred to as "horse collars," are large worked shells of elliptical shape with a very large ovoid perforation or hole in the center. In profile, the sides of the artifact flare out, reflecting the natural concave shape of the shell used in its manufacture. Small perforations are often placed on one edge of the object, likely for suspension.

Cutouts are thin artifacts of variable geometrical shape cut in shell. Three sub-types were defined. Adornos are geometric cutouts with no perforation. They are generally flat with a circular or rectangular shape. Zoomorphic cutouts are similar to adornos, but are shaped like animal figures. Modifications on the shell may include drilling, grooving, and incisions. They may or may not have perforations. Perforated disks differ from beads by their large size (>2 cm) and thinness. They generally have one central perforation of varying diameter and may have additional perforations along the margins.

Blanks are shell fragments that have been roughly shaped into a specific form but have not been processed into a finished artifact. Examples include preforms for disk or rectangular beads. These differ from irregular beads in that their edges show signs of flaking or grinding. Finally, miscellaneous worked shells include any other worked shell artifacts that does not fit into the previously described type categories, such as tools, fragments of shell mosaic, composite artifacts, shell detritus, and decorated artifacts of unknown function.

Artifact type	Artifact sub-type	Shape	# of perf.	Location of perf.	Other characteristics
	Disk	circular to oval	1	central	- small (less than 2 cm) - thin
	Tubular	elongated, cylindrical	1	longitudinal	 length greater than width circular cross-section
Cut shell beads	Barrel	cylindrical with constricted ends	1	longitudinal	 length greater than width circular cross-section
	Rectangular	rectangular or square	1+	central or longitudinal	 length and width greater than thickness
	Spherical	sphere with flat edges	1	central	 length smaller than diameter larger than disk beads shape and perforation natural
Whole shell beads	Whole scaphopods	cylindrical	1	central	 possible ribbing on outer surface Dentalium spp.
	Perforated gastropods	small marine gastropod	1+	generally through body whorl or lip	 perforations cut or punched complete <i>Prunum</i>, <i>Olivella</i>, and <i>Nerita</i> shells
	Tinklers	small marine gastropod	1+	generally near outer lip	 apex/spire removed looks like a "bell" Olividae shells
	Gastropod pendant	large marine gastropod	1+	variable	 larger gastropods than tinklers or perforated gastropods minor alterations
Pendants	Bivalve pendant	marine or freshwater bivalve	1+	near hinge or umbo	- little modification to the shell - complete or near complete valve
	Rectangular pendant	rectangular or square	1+	along one of the edges	- flat, thin - rounded corners - large central perforation
	Oval pendant	large oval	1+	central	 - 1+ smaller perforations near edges - "horse collar"
	Adornos	variable geometric form	0	n/a	- thin and flat - no perforation
Cutouts	Zoomorphic cutout	variable	0+	variable	- in the form of an animal - with or without perforation
	Perforated disk	circular	1+	central	 thin and large (>2 cm) additional perforations possible along the edges roughly shaped shell
Blanks		variable	0+	variable	fragment - signs of flaking or grinding

Table 6. Shell artifact typology.

Nominal and metric data were also recorded for the purpose of performing a technological analysis of the shell artifacts. Nominal data include surface condition (recorded as intact, slightly damaged, damaged, or very damaged), shell part (e.g., spire, columella, lip, body whorl, valve), completeness of the specimen in 10% increments, perforation technique (drilling, puncturing, cutting), perforation type (conical, biconical, or longitudinal), and presence of other alterations such as cutting, flaking, abrading, incising, puncturing, and smoothing. The production stage (i.e., finished, unfinished, debitage, or unknown) and artifact completeness were also recorded. The metric data consist of the length (or diameter if circular artifact), width, and thickness in millimeters, and weight of the artifact in grams. The diameter was also recorded for each perforation. The presence and location of natural modifications (e.g., exfoliation, root etching, cracking, staining, and gnawing) and burning (i.e., browned, charred, and calcined) were also noted. All remains were observed with a magnifying glass (10X) under light to facilitate the identification of surface modifications. NISP is the only quantification measure used in this analysis. It was not possible to tally MNE and MNI counts because most artifacts are unidentified shell fragments.

All shell artifact specimens were attributed a Small Find number during excavations, formed of the lot number followed by a dash and a small find number (e.g., LA1560/1). This number was retained for analysis. All taxonomic identifications and taphonomic analyses were reported on a standard zooarchaeological identification form for shell artifacts (see Appendix B). Data was later entered into a spreadsheet in Microsoft Excel. Forms were also scanned as a PDF document.

Taxonomic Identification and Skeletal Part Distribution

Ten genera, ten families, and two classes of shells were identified in the Lamanai shell artifact assemblage, for a total of 99 specimens represented by 15 taxa (Table 7). The bulk of the assemblage is composed of gastropods (64.6%). Olive shells are the most abundant gastropods (9.1%). Seven *Americoliva* spp. (formerly *Oliva*) are represented by one complete shell, three almost complete shells, and three body whorl fragments. Two shells, one almost complete and one body whorl fragment, were attributed to the Olividae family. *Prunum* shells, forming the second most abundant family (Marginellidae), are represented by three specimens (3.0%), all of which are complete.

Several shell families are represented by two specimens, all individually comprising 2.0% of the shell artifact assemblage. *Turbinella angulata*, from the Turbinellidae family, is represented by two body whorl fragments. Muricidae are identified by one complete shell of *Vokesimurex rubidus* (formerly *Murex rubidus*) and one complete Muricidae shell. A large anterior body whorl fragment was identified as *Cassis flammea*, while a fragment of the inner lip could only be attributed to *Cassis* spp. Strombidae are represented by an almost complete body whorl from a young Strombidae specimen (less than 3 years of age) and by an outer lip fragment of a mature *Lobatus gigas* (formely *Strombus gigas*) specimen. The age determination of the former is based on the small size of the shell and absence of lip, while the thickness of the lip and presence of ridges secured the determination of the latter (Keegan 1984; Serrand and Bonnissent 2005).

Several gastropod genera and families are only represented by one specimen. A large body whorl fragment belongs to *Scutellastra mexicana* (formerly *Patella mexicana*), an almost complete shell was identified as *Neritina* spp., and one almost complete shell belongs to a *Bulla* spp. specimen. Seven specimens (7.1%) were identified as large gastropod fragments of the body whorl or lip. One of these is browned. Unidentified gastropod specimens are numerous, accounting for 34.3% of the total assemblage. One specimen likely comes from the columella, two are body whorl fragments, and 32 are unidentified fragments that were extensively modified, a process which hindered precise shell part identification. One of the body whorl fragments is browned and two unidentified gastropod fragments are calcined.

Bivalves form 32.3% of the shell artifact assemblage. The majority of these (28.3%) are valve fragments of *Spondylus* shell, easily identifiable by their texture and distinctive red or pink color. Only one specimen had an identifiable valve part: an umbo. One of the unidentified valve specimens is partially charred. It was not possible to determine whether the shells belong to *Spondylus americanus*, an Atlantic species, or *Spondylus crassisquama* (formerly *S. princeps*) and *Spondylus limbatus* (formerly *S. calcifer*), two Pacific species, because the artifacts are extensively worked and/or fragmented. In fact, species-specific characteristics are often deleted even by common minor alterations made to valves (Cavazos 2015:128). Four valve fragments could only be identified as Bivalvia. Finally, three shell fragments were identified as Mollusca.

Taxon	Vernacular Name	NISP	%NISP
Scutellastra mexicana	Giant Mexican limpet	1	1.0
Neritina spp.	Nerite	1	1.0
Lobatus gigas	Queen conch	1	1.0
Strombidae	True conchs	1	1.0
Cassis flammea	Flame helmet	1	1.0
Cassis spp.	Helmet shell	1	1.0
Vokesimurex rubidus	Rose murex	1	1.0
Murecidae	Murex and rock snails	1	1.0
Prunum spp.	Margin snail	3	3.0
Turbinella angulata	Indian chank	2	2.0
Americoliva spp.	Olive	7	7.1
Olividae	Olive shells	2	2.0
Bulla spp.	Bubble shell	1	1.0
Gastropoda: large	Large gastropods	7	7.1
Gastropoda	Gastropods	34	34.3
Spondylus spp.	Thorny oyster	28	28.3
Bivalvia	Bivalves	4	4.0
Mollusca	Molluscs	3	3.0
Total		99	100.0

Table 7. Taxonomic identification of shell artifacts at Lamanai.

Taphonomy

The preservation of the cortical surface was recorded for all shell artifacts, with the exception of three artifacts (LA2040/5, LA2081/3, and LA2087/2) that could not be located during the 2016 lab season. Overall, the preservation of shell artifacts is very good (Figure 15). The vast majority is well preserved, being labeled as either intact (10.4%) or slightly damaged (82.3%). Less than 7.3% artifacts are damaged or very damaged. These figures are not surprising because the calcium carbonate present in shells acts as an equalizer in soils of high acidity, such as those present in the tropics (Hohmann 2002:46). Exfoliation and root etching are the most common damages observed on the specimens; cracking and sheeting were also identified on four and 13 artifacts, respectively.



Figure 15. Surface state preservation of shell artifacts dating to the Terminal Postclassic-Early Colonial transition at Lamanai (NISP = 96).

Only five artifacts were burned: two are browned, one is charred, and two are calcined. This represents 5.2% of the assemblage. It seems unlikely that shell artifacts were intentionally burned for or during manufacture given that extended contact with fire makes shell more brittle and fragile (Claassen 1998:61). Similarly, bivalve such as oysters (*Ostrea* sp.) can exfoliate completely when burned (Claassen 1998:66), losing their valued iridescent ventral surface. Nonetheless, it is possible that shell artifacts were burned if used as paraphernalia in rituals or ceremonies, if discarded as trash, or if the shell was heated to cook the mollusc before manufacture.

Carnivore and rodent gnawing are absent from the shell artifact assemblage. Artifacts are often curated for long periods of time, making them inaccessible to predators. When deposited in the archaeological record, shells are not particularly attractive to carnivores or rodents because the animal living in the shell has already been removed.

Description of Shell Artifacts

The shell artifact assemblage at Lamanai is relatively large, with a total of 99 artifacts (Table 8). Eighteen artifact sub-types were recognized: 18 disk beads, 5 tubular beads, 1 barrel bead, 3 square beads, 13 rectangular beads, 1 spherical bead, 6 perforated gastropods, 7 tinklers, 3 gastropod pendants, 6 rectangular pendants, 1 oval pendant, 13 adornos, 2 zoomorphic cutouts, 6 perforated disks, 4 historic buttons, 5 worked shells, 3 possible tools, and 3 possible shell detritus. Cut shell beads are by far the most common artifact type, forming 41.4% of the total assemblage. They are followed by cutouts (21.2%), pendants (17.2%), miscellaneous artifacts (10.2%), whole shell beads (6.1%), and historic buttons (4.0%).

Artifact type	Artifact sub-type	NISP	%NISP
	Disk	18	18.2
	Tubular	5	5.1
Cut shall boods	Barrel	1	1.0
Cut shell bedus	Square	3	3.0
	Rectangular	13	13.1
	Spherical	1	1.0
Whole shell beads	Perforated gastropod	6	6.1
	Tinkler	7	7.1
Dondonto	Gastropod pendant	3	3.0
Pendants	Rectangular pendant	6	6.1
	Oval pendant	1	1.0
	Adornos	13	13.1
Cutouts	Zoomorphic cutout	2	2.0
	Perforated disk	6	6.1
Historic buttons		4	4.0
Miccollanoous	Worked shell	5	5.1
wiscellaneous	Tool?	2	2.0
	Shell detritus?	3	3.0
Total		99	100.0

Table 8. Number of identified specimens by artifact types for shell artifacts at Lamanai.

Disk beads represent the most common sub-type of beads, with a total of 18 artifacts (LA827/2, LA856/10, LA858/54, LA883/30, LA1578/16, LA1582/12, LA2105/2, LA2373/4, LA2789/6, LA2789/7, LA2932/3, LA2945/1, LA2950/3, LA2961/1, LA2966/3, LA2966/17, LA2966/33, and LA2973/15). The majority of the disk beads from Lamanai are small, very similar in size and form (Figure 16). They all appear to be finished artifacts, with a conical or biconical central perforation and smooth sides and edges. The average diameter of the beads is 7.7±1.4 mm, for a thickness of 2.9±0.8 mm. LA827/2 is the largest bead, with a diameter of 11.0 mm, while LA2932/3 is the smallest, measuring 5.3 mm in diameter. The diameter of the perforation is also highly standardized, measuring on average 2.7±0.2mm (n = 18). The beads were likely made from large gastropods, such as *Lobatus gigas* and *Turbinella angulata*. Two beads, LA1582/12 and LA2105/2, stand out, as the former is browned and the latter, charred.

Five tubular beads were recovered from the contact period deposits at Lamanai (Figure 17). Four are made from *Spondylus*, displaying shades of orange (LA892/4 and LA1594/1) and pink

(LA885/50 and LA3018/5). The beads are relatively thick, cylindrical in shape, with a conical or biconical longitudinal perforation. LA885/50 and LA892/4 are perfect examples of this definition. Grooves on both ends of LA885/50, near the perforation, suggest that this bead was strung. LA1594/1 and LA3018/5 are much smaller and their cross-section is more oblong than cylindrical. A fifth tubular bead, LA1581/6, has an irregular shape. The cylindrical surface of this bead was flattened to the extent that part of the perforation is exposed, giving the impression that only half of the original bead remains. It is made from an unknown marine shell and has one conical perforation through the cross-section. The surface of all five tubular beads was abraded and smoothed.

One bead, LA892/3, is identified as a barrel bead based on the constricted ends of the artifact (Figure 18). Made from *Spondylus* shell, this elongated bead has one longitudinal biconical perforation. The circumference of the bead is made of four distinct surfaces but the edges between them were rounded, giving a cylindrical shape to the bead. The surface is smooth.

Three square beads were identified (Figure 19), all made from *Spondylus* shell. LA858/56 is small with three perforations. One of the perforations goes from the center of the large surface to one of the short sides. The other perforation also starts in the center of the same large surface and has two endings: one on the parallel large surface and one on the short sides. LA875/6 and LA885/46 are larger and thicker. The former has one longitudinal conical perforation, while the latter has two longitudinal biconical perforations. For both beads, one side of the bead is pink while the other is white. The edges of these three beads were abraded so as to make them rounded.

Thirteen shell artifacts were categorized as rectangular beads (Figure 20). Two rectangular beads, LA858/55 and LA882/12, are similar in manufacture to the square beads described above. LA858/55 is an elongated rectangular bead made from Spondylus with one longitudinal biconical perforation. Also made from Spondylus shell, LA882/12 is wider and has two longitudinal perforations as well as one incomplete perforation. The surfaces of these beads were abraded to make them smooth and their edges were rounded. Ten beads (LA856/9, LA873/3, LA883/20, LA883/21, LA1581/17, LA2761/8, LA2776/1, LA2791/7, LA2966/14, and LA3013/7) present a rather uniform elongated oblong shape, with two biconical perforations placed along the center line, on the largest surface of the artifacts. In the case of LA873/3, LA883/21, and LA2791/7, two small parallel notches were incised on one of the long sides of the artifact. These objects are made out of white gastropod shell. Six beads are complete, while only half of LA883/21, LA2791/7, and LA2966/14 remains—these beads are broken transversely along one of the perforations. The beads cluster into two size groups. LA2761/8, LA2776/1, and LA2966/14 are small beads, measuring less than 15.8 mm. The other beads are larger, with an average length of 23.1±3.4 mm and width of 5.3±1.0 mm. With the exception of LA2966/14, which is very thin, the thickness of all rectangular beads ranges between 3.1 and 6.3 mm. The beads show relative uniformity in manufacture. They were all cut from a white marine shell. The sides were abraded to make them rounder while the surfaces were ground flat, given a sharp edge to the artifact. Two faint incised lines on LA2761/8, combined with the rougher surface of the bead, suggest that this artifact was not finished. Unlike the rectangular beads described above, LA1581/16 is a small, thin rectangular bead with round edges made from Spondylus shell. It has one biconical perforation drilled in the center.

LA2992/5 resembles a tubular bead, but is characterized as a spherical bead because its diameter is larger than its length (Figure 17). Made from *Spondylus*, this bead is thick, with one drilled biconical perforation and a triangular cross-section. Although half of the bead's surface is heavily weathered, it appears like the surface was originally abraded and smoothed, with rounded edges.

Seven perforated gastropods were identified (Figure 21). Most are complete or nearly complete gastropod shells from various taxa with one or more perforations cut or punched through the body whorl. LA866/5 is a whole *Americoliva* shell with a large longitudinal perforation in the body whorl, near the spire. The surface around the perforation was abraded to flatten it. LA866/6 is an almost complete *Bulla* shell with one perforation punched through the body whorl. A section of the posterior body whorl is broken. Both the outer and inner lips were cut and their edge slightly smoothed. Three perforated gastropods were made from *Prunum* shells: LA885/51, LA1582/15, and LA2761/7. These three beads all have a fairly circular punched perforation through the body whorl, near the outer lip. LA2404/2 is a *Neritina* shell with a perforation punched through the body whorl, near the inner lip. Part of the outer lip was cut and removed and the edge of the lip was slightly smoothed.

Seven tinklers, all made with shells from the Olividae family, are also part of the Lamanai artifactual assemblage (Figure 22). LA819/1 is a large Americoliva shell with one perforation near the anterior end of the body whorl. A large groove was made in the shell and a perforation was punched through the thinner wall created by the groove. The spire of this specimen was removed entirely and its edge was smoothed. Part of the body whorl is broken. LA1560/1, LA1598/5, LA2939/2, and LA2960/7¹ are all made from Americoliva shells of similar size. LA1560/1 has one large longitudinal perforation cut into the aperture. The surface around the perforation was abraded flat and then smoothed. The spire was also cut and removed, but one whorl remains. LA2960/7 is very similar, with one whorl remaining after the spire was removed. However, this tinkler displays one conical perforation in the medial section of the body whorl. The edges of the spire were not smoothed. In the cases of LA1598/5 and LA2966/2, the spire was entirely removed and its edge was abraded and smoothed. LA1598/5 has one cut longitudinal perforation, the edges of which were smoothed, in the body whorl, near the outer lip. Part of the outer lip is broken. LA2966/2, made from an Olividae shell, also has the spire cut and removed, the edge of which was smoothed. However, this tinkler does not have a perforation, suggesting that it may not be a finished artifact. Similarly, it is not clear whether LA2939/2 is a finished object. The spire and part of the body whorl of an Americoliva were removed and the posterior edge of the shell appears to have been cut and smoothed. The end of the columella, which extends posteriorly, well past the body whorl, is broken. The remnant of a possible conical perforation is found on the posterior edge of the body whorl and a large groove is also incised on the body whorl, near the outer lip. This tinkler is unlike the other ones found in the Postclassic-Colonial deposits of Lamanai. Finally, LA2970/5 is made from an Olividae shell; it is too fragmented for more precise taxonomic identification. The thin shell tinkler has two conical perforations: one, broken, near the anterior notch and another in the body whorl. The spire of the shell was cut and its edge smoothed.

¹ This specimen was originally labeled as LA2960/2, but it was later changed to LA2960/7.

Three gastropod pendants were identified (Figure 23). LA827/4 is a small, juvenile Strombidae shell with three conical perforations. The spire was removed above the first whorl and a small section of the outer lip was cut away. The edges of the removed parts were abraded and slightly smoothed. A first perforation was drilled at the anterior end of the outer lip, while a second drilled perforation is located at the anterior end of the body whorl, near the outer lip. A third perforation was drilled near the posterior end of the body whorl, in the section left to the aperture. LA2907/6 is a complete *Vokesimurex rubidus*. The only modification to the shell is a small perforation punched through the body whorl, close to the first varice forming the outer lip. Finally, it was not possible to observe LA2087/2 during the 2016 lab season. However, description of the artifact from the Small Finds Record indicates that this gastropod, probably of the Murecidae family, has two small longitudinal perforations on the body whorl, going through the aperture.

Six artifacts were identified as rectangular pendants (Figure 24). All are made from Spondylus shell. LA883/13 is a thin rectangular pink piece with two parallel perforation holes drilled near one of the short edges. LA883/18 is a thin rectangular bright orange artifact with a perforation near one of the corners of the bead. One side of the pendant is broken. LA885/48 is an elongated rectangular pendant, nearly in the shape of a triangle. One side is pink while the other is cream. One biconical perforation is visible near the short edge. A small depression on the edge, near the perforation, suggests the presence of a possible second perforation, in a form reminiscent of the rectangular beads described above. However, the edges of the artifact were clearly worked. It is possible that the original bead broke along the second perforation and was reworked into a bead with a single perforation. However, a faint groove running from the perforation to the depression on the pink side of the artifact suggests that the second "perforation" may have been caused by stringing. LA885/49 is also triangular in shape, with one biconical perforation near one of the corners, opposite the shorter edge. On one side of the bead, a groove near the perforation may have been caused by stringing or friction against another object. The edges were abraded at an angle, forming a sharp rim in the middle of the lateral surfaces of the pendant. LA3005/6 is a thin, flat pendant with two biconical perforations drilled near one of the artifact's edges. A sixth rectangular pendant (LA2040/5) could not be observed during the 2016 lab season. However, the description from the Small Finds Form suggests that LA2040/5 is similar in size and shape to LA3005/6. The form does not specify the taxonomic identification of this shell artifact.

One oval pendant was identified in the assemblage (Figure 25). LA931/4 belongs to an artifact sub-type traditionally referred to as a horse collar (Ekholm 1961; Kidder et al. 1946), because it is shaped as a large band with a large hole (diameter = 75.7 mm) in the center. This artifact is undecorated with the exception of one biconical perforation drilled in the center of the larger section of the band. The artifact is curved and its edges flare out. The edges were smoothed and the surface also appears to have been abraded and smoothed, although it is severely weathered. It is made from the shell of *Scutellastra mexicana*, a species only occurring in the Pacific Ocean. Similar artifacts were recovered at Kaminaljuyu (Kidder et al. 1946:149, Figure 162e, h) and Uaxactun (Kidder 1947:63, Figure 2).Outside the Maya subarea, one specimen was found as part of Offering H in Edificio B, a structure adjacent to the Templo Mayor at Technotitlan, Mexico (Velázquez Castro 2000:214–222, Photo 38). Because the artifact was positioned near the thoracic region of a wolf (*Canis lupus*) skeleton, Velázquez

Castro (2000) suggests that the shell may have been worn as a pectoral by the animal, similar to depictions of the god Huehuecóyotl in the Codex Borbonicus.

Thirteen adornos were identified in the Lamanai assemblage (Figure 26). Two circular adornos (LA827/1 and LA834/32) are made from an unidentified large gastropod. Both surfaces of LA827/1 were abraded and smoothed. Its edge was abraded at an angle, creating a sharp rim along the artifact's circumference. Only one surface of LA834/32 was ground and smoothed, while the other remains uneven. The edge was abraded and smoothed. LA834/30, also a circular adorno, is made from the inner lip of a helmet shell (Cassis spp.). Eight small notches were incised along the circumference of this artifact, in a pattern reminiscent of a flower. The teeth of the inner lip, present on one of the surfaces, were abraded. Nine other adornos are made from thorny oyster (Spondylus spp.). They display various shades of red (LA902/6), orange (LA845/3 and LA1577/7), pink (LA883/19, LA902/7, LA1579/2, LA2911/7, and LA2912/2), and purple (LA885/47). The shape of the Spondylus adornos varies: LA845/3 and LA883/19 are elongated rectangular pieces; LA2911/7 and LA2912/2 are circular; LA902/7 and LA1579/2 are trapezoid-shaped; and LA885/47, LA902/6, and LA1577/7 are roughly square. Most of the Spondylus-made adorno are thin. Their edges were cut and lightly smoothed. Abrasion lines are visible on the surface of several specimens, such as LA1579/2, LA902/6, and LA902/7. The dorsal surface of the latter was abraded to remove the oyster's spines. A thirteenth artifact was designated as an adorno, but differs from the others by its form and decorations. Made from gastropod shell, LA2918/1 is a roughly triangular artifact with rounded edges. This thin, slightly curved shell has two incised lines on the narrower end of the triangle, giving the artifact a somewhat bell shape. Striations near the incisions are clearly visible on the surface. The edges of the shell were abraded and smoothed.

Two artifacts were categorized as zoomorphic cutouts. LA2780/1 is a thin and fairly round marine shell artifact shaped into the head of a bird (Figure 27). In the center of the specimen, an eye is drawn by a very small puncture surrounded by a large incised circle. At the bottom of the circle, two incised lines form a J and reverse J. A long "eyebrow" is depicted as an arch filled with parallel lines. The beak is formed by a curved projection with an incised line in the middle of it separating the upper and lower beak. Finally, a round protuberance with a puncture in the center is placed above the beak, at the junction with the head. This is reminiscent of a similar feature present on the beak of the male great curassow (Crax rubra) (Figure 27). The edges of the cutout were ground and smoothed. The back surface is smooth but not worked. LA2902/5 is a fragment of a large marine gastropod body whorl carved into an animal-like figure akin to a fish (Figure 28). Although the anterior part of the fish is missing, it is possible to make out other animal parts: incised lines near the bottom of the anterior section demarcate the head from the body; a dorsal fin at the top of the artifact is made from the columellar folds of the shell; and another (pectoral or pelvic) fin on the bottom part of the body is created by two grooves. The posterior part of the shell appears to taper to form a tail but this end is also broken. Three small aligned depressions are drilled in the centerline of the artifact, in an anterior-posterior direction. Two complete and one partial incisions are also visible across the body. The surface along the incised lines was lightly punctured, creating a stippling effect. The edges of the artifact were smoothed. Cutouts in the form of a fish made from shell nacre (Pinctada mazatlanica) were recovered as part of an offering to the god Tlatoc in Chamber II (Gallardo Parrodi 2011; Velázquez Castro 2000:64–78, Photo 4) and as part of Offering 41 (Velázquez Castro 2000:78-81, Photo 12) in the Templo Mayor, at Technotitlan. Each pisiform cutout has two perforations, one in the head and one in the tail. It is possible that the three small circular depressions in a line observed on the Lamanai cutout may be unfinished perforations. Conversely, these depressions may have been made for decorative inlays.

Six perforated disks were identified (Figures 29 and 30). LA831/3 may be a pendant or part of a disk. The artifact is a broken fragment of a larger artifact made from a large gastropod shell. One conical perforation was drilled near the corner of the rounded edge. The faces of the artifact were abraded, as indicated by the smoothed ridges visible on one of the surfaces and the small abrasion lines present on the other side. The worked edges of the artifact were abraded and rounded. LA834/31 is a large flat disk with one conical perforation drilled in the center. One face has fine ridges and appears slightly polished, while the other face is smooth with several clustered fine incisions parallel to the edge of the disk. This artifact is made from a large gastropod shell. LA856/11 constitutes a fragment of a larger disk with one circular perforation near the edge of the disk (Figure 30). This edge was abraded to be rounded, while the other edges are broken. A possible second perforation aligns with the first one and would be located in the center of the disk, on one of the broken edges. This artifact is also made from a large gastropod shell. LA2761/9 is made from an unidentified gastropod. This artifact is broken but it appears as it would have formed a circular ring with a large perforation (diameter = more than 17.3 mm) in the center. The perforation was drilled or cut into the shell, while the edges and surfaces were abraded and later smoothed. This artifact could have been part of a pendant, ear ornament, or other decorative artifact. LA2914/3 is a Spondylus disk with two perforations in the center. Part of the disk is broken, near the most central perforation. It appears like the central perforation was drilled first and that a second perforation was added later. The irregular edges of the latter suggest that it was punched, perhaps through a natural depression already present on the disk's surface. The surfaces were ground to make them flat and the edges were rounded. LA2081/3 is a large roughly circular bead with two perforations located at opposite ends of the artifact and with one perforation near the top edge. This edge is broken and only half of the perforation remains. Unfortunately, this artifact could not be observed during the 2016 lab season. Its description is based on the Small Finds Record.

A series of miscellaneous shell artifacts were recovered during the excavations of the Terminal Postclassic-Early Colonial deposits at Lamanai. Several artifacts display clear worked edges, but it is not possible to tell whether the artifacts are in their final form. LA834/33 is a rectangular artifact made from the body whorl of *Turbinella angulata* (Figure 31). Two edges are cut (but not abraded or smoothed) and the two others are broken. One side of the artifact was also worked, as shown by the presence of cut marks and abrasion lines. LA834/34 is an elongated rectangular fragment of gastropod shell (Figure 31). The long edges are cut while the short edges are broken. This specimen was calcined. This artifact may have been part of a larger, composite artifact, or used as an inlay. LA834/35 is a fragment of a right *Spondylus* valve with the umbo (Figure 32). Two grooves were incised through the lateral hinge tooth and an incised line, beginning at the grooves, runs across the valve. The edge of the lateral hinge tooth was cut and the opposite long edge may have been worked. The other edges are broken. LA1593/3 is made from a white marine gastropod (Figure 32). This thick shell fragment is curved and, since the ends are broken, may have been part of a larger circular object, perhaps an ear ornament. The external surface was abraded to produce a depression;

this countersink surface creates two parallel lips to the artifact. The internal surface is smoothed. LA2763/17 may have been part of a tinkler or bead (Figure 32). This artifact is formed of the anterior notch of an *Americoliva* shell. The posterior and lateral edges are broken. However, the outer lip area and opposing side on the shell were ground to create a flat surface, similar to LA866/5 (perforated gastropod) and LA1560/1 (tinkler).

Two artifacts are possible tools. LA809/2 is a fragment likely cut from the body whorl of a large gastropod (Figure 33). This elongated rectangular artifact has cut edges but these do not appear to have been worked further. The surfaces of the shell remained unworked. LA2996/2 is a body whorl fragment with anterior notch of a large gastropod (Figure 34). The posterior edge is broken. The edges of this artifact were abraded and smoothed. Percussion notches are visible on one of the lateral edges, near the anterior notch. For the following three artifacts, it is difficult to determine whether they were tools, shell detritus from manufacture, or artifacts in the process of being manufactured. LA1703/2 is an outer lip fragment from an adult individual of *Lobatus gigas* (Figure 35). It is unclear whether any of the edges were worked. The thickest edge may have been cut while the other long edge was possibly flaked; small "percussion notches" are visible but these may be natural damage to the shell. LA3013/17 is made from the anterior notch, siphonal canal, and anterior portion of the inner lip with teeth of a *Cassis flammea* shell (Figure 33). One edge is cut while the others are broken. It may be a shell detritus. LA3028/3 is a large body whorl fragment from *Turbinella angulata* (Figure 34). One edge appears to be worked.

Four historical buttons (LA2778/1, LA2992/?, LA2993/2, and LA3033/?) made from an unknown mother of pearl shell were identified (Figure 36). All but LA3033/? were recovered from post-accumulation abandonment or surface deposits. LA2778/1 is a small thin circular button with three conical perforations forming a triangle in the center. The surface of the button is very weathered, but a slight depression is visible between the perforations, perhaps caused by stringing. LA2992/? is a rather large button with one perforation in the center. A 2.0 mm-wide rim runs along the circumference on one side of the button, part of which is broken. A metal pin is stuck in the perforation. LA2993/2 is slightly smaller. It has two conical perforations in the center and no rim. An oval-shaped depression connects the perforations to one another and may have been intentionally produced—rather than caused by stringing— so that the string would lay flat on the button. LA3033/? is a very small button with a rim and four perforations clustered in the countersink surface.



Figure 16. Disk beads. *First row, left to right*: LA2373/4, LA2789/6, LA2789/7. *Second row:* LA827/2, LA856/10, LA858/54, LA883/30. *Third row*: LA1578/16, LA1582/12, LA2105/2, LA2945/1. *Fourth row*: LA2932/3, LA2950/3, LA2961/1, LA2966/3. *Last row:* LA2966/17, LA2966/33, LA2973/15.



Figure 17. Five tubular and one spherical beads. *First row, left to right*: LA1581/6, LA1594/1, LA2992/5 (spherical bead), LA3018/5. *Second row*: LA885/50, LA892/4.



Figure 18. Barrel bead (LA892/3).



Figure 19. Square beads. From left to right: LA875/6, LA885/46, LA858/56.



Figure 20. Rectangular beads. *First row, from left to right*: LA856/9, LA873/3, LA883/20, LA882/21, LA882/12, LA858/55. *Second row*: LA1581/16, LA1581/17, LA2966/14, LA3013/7, LA2761/8, LA2776/1, LA2791/7.



Figure 21. Perforated gastropods. *First row, left to right*: LA866/5, LA866/6, LA885/51. *Second row*: LA1582/15, LA2761/7, LA2404/2.



Figure 22. Tinklers made from Olividae shell. *First row, left to right*: LA1560/1, LA1598/5, LA2939/2. *Second row*: LA2960/7, LA2966/2, LA2970/5. *Photo on the right*: LA819/1.



Figure 23. Gastropod pendants. *Left:* LA827/4. *Right*: LA2907/6.



Figure 24. Rectangular pendants. *From left to right*: LA885/49, LA3005/66, LA882/13, LA883/18, LA885/48.



Figure 25. Oval pendant made from *Scutellastra mexicana* (LA931/4).



Figure 26. Adornos. *First row, left to right*: LA2911/7, LA2912/2, LA1577/7, LA1579/2, LA845/3. *Second row*: LA827/1, LA834/30, LA834/32, LA2918/1. *Third row:* LA883/19, LA885/47, LA902/6, LA902/7



Figure 27. *Left*. Zoomorphic cutout in the form of a bird head (LA2780/1). *Right*: Curassow (*Crax rubra*) (photo credit: Frank Thierfelder).



Figure 28. Zoomorphic cutout in the form of a fish (LA2902/5).



Figure 29. Perforated disks. *First row, left to right*: LA2761/9, LA2914/3. *Second row*: LA831/3, LA834/31.



Figure 30. Perforated disk (LA856/11).



Figure 31. Worked shell artifacts. *Left*: LA834/33. *Right:* LA834/34.



Figure 32. *Left*: worked shell artifact (LA834/35). *Center*: worked shell artifact (LA1593/3). *Right*: possible tinkler (LA2763/17).


Figure 33. Left: possible tool (LA809/2). Right: possible shell detritus (LA3013/17).



Figure 34. Left: possible tool (LA2996/2). Right: possible shell detritus (LA3028/3).



Figure 35. Possible tool (LA1703/2).



Figure 36. Historic buttons. From left to right: LA2992/?, LA2993/2, LA3033/?, LA2778/1.

Discussion of Shell Artifacts

Ninety-nine shell artifacts were identified in the Terminal Postclassic-Early Colonial deposits at Lamanai. They were sorted into six artifact types (cut shell beads, whole shell beads, pendants, cutouts, historic buttons, and miscellaneous artifacts) and 17 artifact sub-types (disk beads, tubular beads, barrel beads, square beads, rectangular beads, spherical beads, perforated gastropods, tinklers, gastropod pendants, rectangular pendants, oval pendants, adornos, zoomorphic cutouts, perforated disks, historic buttons, worked shells, and possible tools or shell detritus). Aside a few pieces, most shell artifacts are finished or almost finished products. A technological analysis of these artifacts provides information about their manufacture.

Manufacture of Shell Artifacts

A variety of techniques were involved in the production of shell artifacts: flaking, cutting, sawing, abrading, smoothing, drilling, puncturing, and incising. Flaking, produced by direct or indirect percussion on the shell, is a common method of reducing shell. The near complete absence of shell detritus makes it difficult to assess whether this technique was employed in shell production at Lamanai. Only two specimens (LA1703/2 [shell detritus?] and LA2996/2 [tool?]) display marks similar to percussion notches on one of their edges. Evidence for cutting and/or sawing, used for reducing and shaping shell, is visible on the edges of five artifacts: LA809/2 (tool?), LA834/33 (worked shell artifact), LA2902/5 (zoomorphic cutout), LA3013/17 (worked shell artifact), and LA3028/3 (worked shell artifact). The lips and spires of various artifacts, in particular tinklers and perforated gastropods, were also likely cut or sawed, but smoothing of these edges has deleted evidence of cutting.

Abrasion is the most common shell working technique observed on the Lamanai assemblage (n = 88, 88.9%), either in the form of diagnostic abrasion lines or smoothed, rounded edges and surfaces. Given that marine shell is a very hard material, abrasion was likely performed by rubbing the shell against a hard surface, most likely stone (e.g., river cobbles, sandstone slabs, granite slabs) (Hohmann 2002:140; Velázquez Castro et al. 2011). Abrasion is used to

both shape and smooth artifacts. It is most common on extensively modified artifacts, such as beads and adornos: LA858/55 (rectangular bead), LA885/46 (square bead), LA1579/2 (adorno), LA2781/1 (zoomorphic cutout), LA2918/1 (adorno), LA2966/17 (disk bead), and LA2973/15 (disk bead). This technique was also employed to abrade and smooth the edge of removed parts, such as the cut edge of spires on tinklers. In fact, it is possible that the spire of small and thin Olividae shells used for the manufacture of tinklers was not cut, but simply ground against a stone (Cavazos 2015:110).

Perforations are common on the Lamanai artifacts; a total of 93 perforations were identified on 73 artifacts (73.7% of the total assemblage). Two techniques were employed: drilling and puncturing. Drilled conical (n = 31, 29.8% of identified perforations) and biconical (n = 52, 50.0%) perforations are most common, identified on beads, rectangular pendants, and perforated disks. Holes were possibly made using a lithic microdrill, hafted on a wooden shaft. The drill shaft could simply be rotated through rubbing of the shaft between the palms. More complicated devices, such as the bow drill and pump drill, could also be employed (Hohmann 2002:141–142). Punched (n = 7, 6.7%) and longitudinal (n = 3, 2.9%) perforations were mainly used on tinklers and perforated gastropods, which tend to have thinner walls than the large marine gastropods used in the manufacture of beads and pendants. Puncturing would be accomplished by punching through or scraping the shell with a sharp tool, such as a microdrill. Although punching is faster than drilling, it results in a somewhat irregular hole, the edges of which can continue to break as they wear against the string (Hohmann 2002:140–141).

Incising is the last technique employed in the manufacture of the Lamanai artifacts. It was observed on the most elaborate objects, such as the zoomorphic cutouts in the form of a bird (LA2780/1) and fish (LA2902/5), where incising is used to carve elaborate designs. A set of two small incisions are also present on the lateral edge of three rectangular beads (LA873/3, LA883/21, and LA2791/7). Finally, the technique was used to create a rosette adorno (LA834/30) and bell-shaped adorno (LA2918/1).

It is difficult to reconstruct the primary reduction phase of the shell artifacts recovered at Lamanai, because most artifacts are finished or almost finished. This means that marks on shells made early in the manufacture have been obliterated by techniques employed later in the production of shell objects. Therefore, the information presented here mainly concerns the final stages of the production process. It is hypothesized that blanks or preforms were detached from the shell through cutting, sawing, or flaking. In the case of artifacts made from *Spondylus* shell, a first step was to remove the spines and abrade the dorsal surface of the valve before preforms could be cut from the shell. Artifacts would then be shaped through additional flaking and abrading. It is not clear whether perforations were made before or after this step. A final step would include further abrading and smoothing, and possibly incising. Most artifacts at Lamanai exhibit characteristics of this later process: smooth surface, smoothed and rounded edges, and, in some cases, abrasion lines.

It is possible to determine with some certitude the production sequence of several shell artifact types, based on the characteristics recorded during the technological analysis and using production sequences established at other sites, such as the manufacture of disk beads at Pacbitun (Hohmann 2002:142–146). One of the most common artifacts identified in the assemblage, disk beads, show great uniformity in size, shape, and manufacture. Bead

preforms were likely detached though percussion or cut from the body whorl, shoulders, and columella of a white marine gastropod to obtain a rough shape. A perforation was drilled in the center of the bead, possibly with a lithic microdrill. The sides and surfaces of the beads were ground to produce the desired shaped, as evidenced by the presence of abrasion lines on some specimens. It is possible that the beads were strung together on a stick or durable fiber when abraded, a practice that produces more uniform artifacts (Hohmann 2002:140). The surface of the bead was then smoothed, if needed. A similar process likely applied to tubular, barrel, square, rectangular, and spherical beads: removal of preform from the shell (gastropod or Spondylus), perforation, abrasion and grounding to obtain the desired shape, and additional abrading and smoothing. Aside the disk beads, a set of ten rectangular beads also show signs of manufacture standardization. These oblong beads were all cut from a white marine gastropod and have two perforations in the center line. They show uniformity in shape and size, clustering into two size groups. The sample sizes of other bead sub-types are too small to examine manufacture standardization. Compared to the manufacture of beads, the production of tinklers was simple. The apex of the shell was removed through cutting and grounding and a perforation was cut or punched through the body whorl, generally near the outer lip. A manufacturing sequence can also be established for the four historical buttons. These were likely cut from a shell in a circular shape. The surface was ground to make it flat. Abrasion lines on the sides of the buttons show that they were abraded to produce an even surface. The perforations were drilled so as not to shatter the fragile buttons. In the case of buttons with an outside rim, the rim was likely produced by incising the shell, removing layers of nacre to create a countersunk surface, and grounding or abrading it to make this newly created surface flat.

Overall, the high standardization of many artifact types—in particular beads—in the Lamanai assemblage, the time invested, and the skill required to manufacture shell objects all point to a specialized shell production performed by a small group of artisans and/or few households. However, it is not possible to determine whether the artifacts were produced *in situ* or were imported to Lamanai in their finished form. Most of the artifacts presented in this report are finished or almost finished. The near absence of shell preforms, detritus, unfinished artifacts, and objects broken during production hint at the import of shell objects rather than on-site production. However, the manufacture of certain artifact sub-types, such as tinklers or perforated gastropods, would leave little archaeological evidence because the modifications made to the shell are minimal (e.g., removal of spire and perforation). In addition, the presence of possible tools and worked shells made from the lip and body whorl of large marine gastropods suggests that at least some manufacturing probably took place at Lamanai. Preforms and detritus may eventually be identified in the assemblage given that the zooarchaeological analysis of the faunal material associated with the artifacts has not been completed.

Function of Shell Artifacts

The majority of shell artifacts from Terminal Postclassic-Early Colonial deposits at Lamanai had an ornamental function. Shell beads of the many varieties identified in the assemblage were likely designed to be strung on necklaces, bracelets, anklets, and other ornaments, as observed across the Maya sub-area (e.g., Colha, Buttles 2002; Kaminaljuyu, Kidder et al. 1946; Pacbitun, Hohmann 2002; Uaxactun, Kidder 1947). Rectangular and square beads with two longitudinal perforations (LA858/55, LA882/12, and LA885/46) made from *Spondylus* could

have been used as spacers. Similarly, ten rectangular gastropod beads (LA856/9, LA873/3, LA883/20, LA883/21, LA1581/17, LA2966/14, LA2761/8, LA2776/1, LA2791/7, and LA3013/7) with two biconical perforations placed along the center line could also have been used as spacer. They may have been strung next to one another and/or with other pendant-like artifacts. The presence of two small parallel grooves on one of the long sides of LA873/3, LA883/21, and LA2791/7 suggests that the beads were likely strung so as to display this incised pattern. Small perforated gastropods were also likely used as beads or sequins (i.e., sewn onto clothes) (Buttles 2002:186–187).

By definition, pendants are suspended objects, strung on necklaces or sewn onto clothes. For instance, tinklers could be strung with other materials, such as jade ornaments on bracelets and collars (Coe 1959:58). However, it is most often suggested (Buttles 2002:190–192; Coe 1959:57–58; Kidder et al. 1946:147–148) that they were arranged so that they would touch each other and produce sound when in movement. This hypothesis is based on the depiction of similar-looking pendants on skirt bottoms, belt edges, and anklets worn by elite individuals on stone monuments (e.g., Stelae 7, 9, 12, and 13 at Piedras Negras, Coe 1959:57-58; Stela A and B at Copan, Kidder et al. 1947:148). Isaza Aizpurúa and McAnany (1999) even suggest that tinklers were an important component of clothing and jewelry worn in ritual dance because they would help creating an acoustic environment. Rectangular pendants were likely used as pendants or clothing ornaments. Faint grooves on LA885/48 and LA885/49 provide evidence for friction caused by thread. At Piedras Negras, Coe (1959:58–59, Figure 4) describes a find of 209 rectangular cut shells of Spondylus in Burial 5, which he interprets, based on their arrangement, as having been sewn onto a piece of clothing. It is possible that the Lamanai rectangular pendants were used in a similar fashion. He even suggests that perforated pendants of difference color and shape could have been used to make design on garments. Large gastropod pendants may have served as pendants or pectorals (Buttles 2002:192–195). Finally, the function of the only oval pendant or "horse collar" in the Lamanai assemblage is unknown. Cavazos (2015:142) suggests that the artifact's name is a misnomer. Based on their size (9–17 cm), oval pendants were most likely not worn around the neck, but used as bracelets. The find from Lamanai supports this hypothesis; LA931/4 was found in Burial N115-7A, on the right forearm of a male individual (Pendergast 1989). However, Ekholm (1961) suggests that horse collars were pendants or pectorals, based on the placement of suspension holes on the object and depictions of elite individuals wearing ornaments in this fashion on monuments at Chichen Itza and in the Codex Vaticanus B.

The function of cutouts is generally less straightforward than for beads and pendants. Several functions were proposed for adornos: mosaic inlays, gaming pieces, blanks for other artifacts such as earplug plates, and clothing ornaments (Buttles 2002:172; Cavazos 2015:156; Kidder et al. 1946:151; Kidder 1947:65). For instance, although the function of the adorno LA2918/1 is not clear, it could have been strung or sewn onto a piece of clothing given the presence of relatively deep incisions on the artifact's surface and the fact that the edges of the incisions appear worn, digging into the sides of the adorno. It is difficult to determine how the other adornos in the assemblage were used beyond a decorative function, because they do not show any traces of use. Similarly, although perforated disks likely served as clothing ornaments and pendants, their large size also suggests use as inlays, mirror backs, and throat plates for earplugs (Buttles 2002:173–175; Cavazos 2015:161). The large size of LA856/11 may suggest use as a mirror back. One may also wonder whether LA2761/9 could have been used

as a ring, since the interior diameter of the artifact is about the size of a finger and the artifact itself is thin and narrow, like a ring. The function of the two zoomorphic cutouts is unknown, but they may have been used as pendants, ear ornaments, children toys, or parts of a larger artifact. The absence of perforations and use wear on both artifacts makes it difficult to pinpoint a function.

Some artifacts also had utilitarian functions. Two shell artifacts are possible tools: LA809/2 and LA2996/2. Their worked and smooth edges as well as relatively smooth exterior surfaces are similar to formal tools found in the Caribbean (e.g., O'Day and Keegan 2001; Serrand 2007). However, the lack of sharp edges casts doubt over their designation as tools, particularly as cutting implements.

Procurement of Shells and Shell Artifacts

The provenance of raw materials used in the manufacture of shell artifacts provides information about use of ecological zones and exchange networks. The majority of the Lamanai shell artifacts are made from marine shells that can be procured from the Gulf of Mexico and Caribbean Sea (Morris 1973). This includes *Spondylus* sp., *Americoliva* sp., *Bulla* sp., *Cassis flammea*, *Neritina* sp., *Prunum* sp., *Turbinella angulata*, *Vokesimurex rubidus*, and Strombidae shells (likely *Strombus pugilis* or *Lobatus gigas*). Several of these shells can be acquired in shallow water (less than 10 m in depth), such as *Bulla*, *Cassis flammea*, *Prunum*, *Turbinella angulata*, *Vokesimurex rubidus*, and Strombidae. *Americoliva* and *Neritina* are intertidal genera. Several species of the latter genus may also be found in fresh and brackish waters. *Spondylus* is the only identified mollusc that lives in moderately deep waters (25–60 m), where it is found attached to rocks and corals. *Scutellastra mexicana* is a Pacific species that all gastropod families could be acquired in habitats easily accessible to coastal populations. The acquisition of *Spondylus*, the only identified bivalve, most likely involved the use of boats and divers.

For reasons exposed above, it is not certain whether the shell artifacts were made on-site or imported. However, it is clear from the presence of marine shells that the Lamaneros were involved in trade with communities located near or on the coast of Belize. Whole shells may have been transported to Lamanai, as evidenced by the presence of worked shell artifacts and possible tools made from large sections of gastropod lips and body whorls. The identification of columella and spines in the zooarchaeological assemblage would reinforce this conclusion. In fact, the import of complete shells has been observed at other Maya sites where shell manufacturing locales were identified (e.g., Cahal Pech, Lee and Awe 1995, Lee 1996; Colha, Buttles 2002; K'axob, Isaza Aizpurúa and McAnany 1999; Mayapán, Masson et al. 2016; Pacbitun, Hohmann 2002, Hohmann and Powis 1996, 1999; Tikal, Moholy-Nagy 1985). In addition, the presence of traded goods is not surprising given Lamanai's ties with sites in the northern lowlands and on the Caribbean coast (Graham and Pendergast 1989; Pendergast 1981, 1986a) and the fact that marine shells and shell artifacts were traded all over the Maya subarea (Andrews 1969; Moholy-Nagy 1985). Lamanai benefited from its position as a port on the New River Lagoon during the Postclassic and perhaps Colonial periods by trading with communities located on the Caribbean coast and islands off the coast of Belize, such as Marco Gonzalez (Graham and Pendergast 1989; Pendergast 1990). It is also

possible that the Lamaneros used the New River as an easy access route to travel themselves to the coast, where they could acquire exotic goods.

The extent of Lamanai's trade network during the Postclassic period can also be appreciated thanks to the finding of an oval pendant made from *Scutellastra mexicana*, a species that can only be acquired from the Pacific Ocean. Lamanai is located hundreds of kilometers from the Pacific Coast. However, this find is not entirely surprising given the presence of copper objects with sources in western Mexico at Lamanai (Cockrell and Simmons 2017; Pendergast 1986a, 1990). Finally, the origin of the four historical buttons is uncertain, as three of them were recovered in post-abandonment accumulation. However, these probably are of European origin, attesting to the contact between the Lamaneros and the Spanish.

ANALYSIS OF BONE ARTIFACTS

A total of 31 bone artifacts from several deposits dating to the Terminal Postclassic-Early Colonial period were analyzed during the 2016 lab season. The artifacts were recovered during three different excavation programs at Lamanai: the 1984–1985 excavations by David Pendergast (Pendergast 1986a, b, c), the 2004 excavations by Darcy Wiewall (Wiewall 2009), and the 2001–2006 excavations by Scott Simmons and colleagues (Simmons 2004, 2005, 2006; Simmons and Howard 2003). The bones of nine different taxa were identified. Artifact types identified include bone beads, tooth pendants, perforated disks, bone tubes, historic buttons, and miscellaneous worked bones.

Methodology

All bone artifacts were identified to the lowest taxonomic level possible. However, taxonomic identification was often constrained to family level because many diagnostic osteological characters were destroyed by bone working. In addition, several artifacts could only be identified as "indeterminate mammal" and were, when possible, attributed to a size class: very large mammal (>100 kg, e.g., tapir, manatee), large mammal (15.1–100 kg, e.g., deer, peccary, jaguar), medium-large mammal (7–15 kg, e.g., dog, monkey, ocelot), medium mammal (2.1–6.9 kg, e.g., paca, armadillo, coati), small-medium mammal (1–2 kg, e.g., rabbit, opossum, agouti), and small mammal (<1 kg, e.g., bats, rats) (Emery and Brown 2012). Most recent accepted nomenclature was verified with the Integrated Taxonomic Information System (ITIS) at http://www.itis.gov. All bone artifacts were photographed in the field with the help of R. Scott Hussey. Specimens were photographed by the author with a Nikon D3200 using an 18–55 mm VR lens or by Scott Hussey with a Nikon D5300 using a 40-mm DX macro lens. Preliminary taxonomic identifications were made in the field; the photos were used to confirm and refine the identifications using comparative specimens held in the Environmental Archaeology collections at the Florida Museum of Natural History.

The typology used to describe bone artifacts was modified from Emery (2008) and Buttles (2002). Bone specimens were separated into three categories: worked bone artifacts, bone debitage, and ecofacts. Worked bones are classified into six types and eight sub-types, many of which are similar to those used for shell artifacts (see Table 6). Bone debitage is the waste resulting from the manufacture of bone artifacts. Ecofacts are unmodified bone specimens. As previously discussed for the shell artifact typology, the types used to describe bone

artifacts are primarily used to sort artifacts into morphological rather than functional categories.

Disk bone beads are small circular objects with a central perforation and two parallel flat surfaces. In comparison, tubular beads have a length greater than their diameter, a relatively circular cross-section, and a longitudinal perforation. Barrel beads are similar to tubular beads, but their ends taper. This likely reflects the natural shape of the bone from which they were made. Bone beads are often made out of vertebrae or segments of long bone shaft. In fact, few modifications to the bone's natural shape are generally necessary to produce the desired final product. For instance, many disk beads are made out of bony fish and shark vertebrae because those skeletal elements are naturally circular. The only modification required is the addition of a central perforation through the vertebra's centrum. Similarly, disk and tubular beads may be made out of long bones, because the marrow cavity acts as a natural "perforation" and the diaphysis of most long bones is naturally circular in crosssection. The long bone only needs to be cut to the desired bead size. Flat disk beads may be cut from relatively flat sections of long bones or from cranial elements and scapulae (Emery 2008). Pendants are artifacts of variable size and shape made out of bone or teeth and displaying one or more perforations. A common pendant sub-type is a mammal and shark tooth with a perforation drilled through the root. Few additional modifications are generally observed for this sub-type. Cutouts are also cut artifacts with a wide range of shapes and sizes. In this category, perforated disks are similar to disk beads since they have a central perforation, but are much larger in size. An additional bone artifact type is the bone tube. Commonly found at Maya sites, bone tubes are relatively long hollow cylinders, generally made from the diaphysis of mammal and bird long bones. Their external surface may be plain or decorated and tends to be polished. The ends of bone tubes are cut and often smoothed. Some may have perforations on the shaft. Finally, miscellaneous artifacts are those that do not fit in the artifact types described above. This includes worked bone and anthropomorphic carving.

The analysis of bone artifacts was similar to that of zooarchaeological specimens. Data recorded for every specimen include taxon, skeletal element, element side, element portion and completeness, length (in mm), width (in mm), and weight (in grams). When possible, the estimated age and sex of the specimen were noted. The presence of surface modifications was documented: surface preservation (scored as intact, slightly damaged, damaged, or very damaged), estimate of preserved surface (in increments of 10%), presence of natural modifications (e.g., exfoliation, sheeting, root etching, staining, cracking, and gnawing), and burning (defined as browned, charred, or calcined). All remains were observed with a magnifying glass (10X) under light to facilitate the identification of surface modifications. For artifacts made out of long bones, the completeness of the circumference (coded as <1/2, >1/2, or complete) and length (coded as <1/4, 1/4-1/2, 1/2-3/4, and >3/4 of the entire length) were recorded following Villa and Mahieu (1991). For broken bones, the type of proximal and distal fractures was assigned to green-bone or dry-bone fractures (Morlan 1980:48-49; Johnson 1985:176-178, 222) and the shape of the fracture was recorded as curved, v-shaped, oblique, transverse, irregular, or ragged (Villa and Mahieu 1991). For each artifact, I recorded the production stage (i.e., finished, unfinished, debitage, or unknown), artifact completeness, and any modification technique, such as drilling, puncturing, abrading, cutting, flaking, incising, and smoothing. For perforations, the type (conical, biconical, or longitudinal), technique (drilling, puncturing, cutting), and size (in millimeters) were also recorded. NISP was used as sole quantification method for the bone artifact analysis. It was not possible to tally MNE and MNI counts because many artifacts could be not identified to element or low taxonomic level (i.e., genus or species).

All bone artifact specimens were attributed a Small Find number during excavations, formed of the lot number followed by a dash and a small find number (e.g., LA1560/1). This number was retained for analysis. All taxonomic identifications and taphonomic analyses were reported on a standard zooarchaeological identification form for bone artifacts (see Appendix C). Data was later entered into a spreadsheet in Microsoft Excel. Forms were also scanned as a PDF document.

Taxonomic Identification and Skeletal Element Distribution

Four genera, seven families, and four classes were identified in the Lamanai bone artifact assemblage, for a total of 31 specimens represented by nine taxa (Table 9). Cartilaginous fishes (Chondrichthyes) account for 19.4% of the artifacts. They are represented by one complete upper tooth of requiem shark (*Carcharhinus* spp.), three complete vertebrae of sawfish (*Pristis* spp.), and two vertebrae of unknown cartilaginous fishes. The tooth from the requiem shark may belong to *C. leucas* (bull shark) or *C. obscurus* (dusk shark), because the teeth from the two species are difficult to distinguish. Similarly, the sawfish vertebrae may belong to *Pristis pristis* (largetooth sawfish) or *Pristis pectinata* (smalltooth sawfish), as these are the only two sawfish species present in Belizean waters. One fin spine with hyperosteotic bone and one vertebra fragment belong to unknown bony fishes (Actinopterygii), which form 6.5% of the NISP. Reptiles are abundant in the bone artifact assemblage (35.5%). They are exclusively represented by 11 specimens of sea turtle (*Caretta caretta*), green turtle (*Chelonia mydas*), and hawksbill turtle (*Eretmochelys imbricata*).

Mammals are also abundant in the bone artifact assemblage (38.7%). They include one upper left canine from a dog (*Canis lupus familiaris*), one first lower left molar from a dog, one lower right canine from a peccary (Tayassuidae), and one manatee (*Trachemus manatus*) rib. The raw material of an additional eight artifacts was identified as mammal bone, but the taxonomic identification could not be more precise given the worked nature of the specimens. These include two long bone fragments and one left femur from large mammals, one long bone fragment from a medium-to-large mammal, one femur fragment from a small-to-medium mammal, and three unidentified mammal fragments.

Taxon	Vernacular Name	NISP	%NISP
Carcharhinus spp.	Requiem shark	1	3.2
Pristis spp.	Sawfish	3	9.7
Chondrichthyes	Cartilaginous fishes	2	6.5
Actinopterygii	Bony fishes	2	6.5
Cheloniidae	Sea turtle	11	35.5
Canis lupus familiaris	Domestic dog	2	6.5
Tayassuidae	Peccary	1	3.2 3.2
Trachemus manatus	West Indian Manatee	1	
Mammalia: large	Large mammal	3	9.7
Mammalia: medium-large	Medium to large mammal	1	3.2
Mammalia: small-medium	Small to medium mammal	1	3.2
Mammalia	Mammal	3	9.7
Total		31	100.0

Table 9. Taxonomic identification of bone artifacts at Lamanai.

Taphonomy of Bone Artifacts

The preservation of the cortical surface was recorded for all bone artifacts, with the exception of one artifact (LA2065/1) that could not be located during the 2016 lab season. Overall, the preservation of bone artifacts is good to moderate (Figure 37). The majority of bone artifacts are well preserved, being labeled as either intact (3.3%) or slightly damaged (56.7%). Nevertheless, 26.7% of artifacts are considered damaged and even 13.3% are described as very damaged. Modifications on bone surfaces produced by artifactual production may have been obscured by this damage. Exfoliation and root etching are the most common damages observed on the specimens; cracking and sheeting were also identified on three and one artifacts, respectively.



Figure 37. Surface state preservation of bone artifacts dating to the Terminal Postclassic-Early Colonial transition at Lamanai (NISP = 30). Carnivore and rodent gnawing can also affect the preservation and identification of bone artifacts. However, no mark of this type was observed on the bone artifacts. It is possible that the absence of gnawing marks results from the use of the bones as material for artifact production. The transformation of bones into artifacts means that bone marrow and grease, which would attract carnivores, have been removed from the bones. If discarded, the bone artifacts most likely have the qualities of dry bone rather than green bone, making them unappealing to carnivores and, possibly, rodents.

Four bone artifacts are burned, representing 13.3% of the bone artifact assemblage. All are browned. The even distribution of the browning on the bone surfaces suggests that the specimens were intentionally burned, most likely during the manufacture process. Bone hardens when heated to a low heat, a process that facilitates its manufacture (d'Errico and Henshilvood 2007:148; Emery 2008).

Description of Bone Artifacts

The bone artifact assemblage at Lamanai is small, with a total of 31 artifacts (Table 10). Eight artifact sub-types were recognized: 7 disk beads, 1 tubular bead, 4 tooth pendants, 12 perforated disks, 4 bone tubes, 1 historic button, 1 incised bone, and 1 anthropomorphic carved bone. Cutouts are by far the most common artifact type, forming 38.7% of the total assemblage. They are followed by cut beads (25.8%), pendants (12.9%) and bone tubes (12.9%), worked bones (6.4%), and historic buttons (3.2%).

Artifact type	Artifact sub-type	NISP	%NISP
Cut bone beads	Disk bone bead	7	22.6
	Tubular bone bead	1	3.2
Pendants	Tooth pendant	4	12.9
Cutouts	Perforated disk	12	38.7
Bone tube		4	12.9
Historic buttons		1	3.2
Worked bone	Incised bone	1	3.2
	Anthropomorphic carving	1	3.2
Total		31	100.0

 Table 10.
 Number of identified specimens by artifact type for bone artifacts at Lamanai.

Bone beads are numerous in the Lamanai artifact assemblage (Figures 38 and 39). LA2574/1 is a small thin disk bead with one perforation drilled in the center (Figure 38). The surface of the bead was abraded and extensively polished. The rim of the bead was abraded at a slight angle, creating a sharp edge running around the circumference of the bead. At least five fairly deep, parallel striations are visible on one of the surfaces. A very small disk bone bead (LA2960/11) was made from mammalian bone (Figure 38). A single conical perforation was drilled in the center of the bead. The surface along the circumference and one of the parallel surfaces of the bead were polished, while the other parallel surface has an uneven texture. A tubular bone bead is made from the femur shaft of a small-medium mammal (LA912/6) (Figure 38). The ends of the bead were cut, abraded, and smoothed, while the bone surface

was extensively polished. The ridges present on the diaphysis were abraded and rounded. The perforation was made by hollowing out the marrow cavity.

Vertebrae were a popular skeletal element for producing disk beads at Lamanai (Figure 39). LA2797/3 is a disk bead made from the whole vertebra of a sawfish (*Pristis* spp.). It has one drilled biconical perforation in the center of the centrum and a natural groove along the circumference of the bead. Three very small disk beads (<1 cm in diameter) were made from fish vertebrae. LA1585/3 is a whole vertebra from a cartilaginous fish (Chondrichthyes) with one conical perforation in the center. The circumference of the bead was abraded and roughly smoothed. LA3030/1 is a complete *Pristis* vertebra with a punched perforation in the center. A natural groove is present on the central section of the circumference, creating an upper and lower rim to the bead. LA1579/4 is an anterior or posterior body fragment of a cartilaginous fish vertebra with a punched perforation in the center. It likely looked similar to LA1585/3 or LA3030/1 before it was broken. Finally, LA2763/18 is identified as a possible fish bead. This artifact is made from the anterior or posterior half of a vertebra centrum. Less than a third of the original circumference of the bead is preserved. One side of the vertebra looks polished, the center of the vertebra appears to have been perforated, and the edges of the perforation were likely abraded and smoothed.

Another artifact type identified at Lamanai is pendants (Figure 40). LA1579/3 consists of a whole upper left canine from a dog (*Canis lupus familiaris*) that was perforated biconically through the root. The lower right canine of a peccary (Tayassuidae) was perforated in a similar fashion (LA1590/12). The size of the tooth suggests that it is from a small individual. A second dog pendant (LA2644/2) is made from a lower left first molar with a biconical perforation drilled through the root. The first cusp and anterior root of the tooth are missing as a result of a recent break. Finally, a complete shark (*Carcharhinus* spp.) upper tooth (LA2953/1) also presents a biconical perforation through the center of the root.

The most common bone artifacts are 11 perforated disks made out of sea turtle (Cheloniidae) shells, commonly referred to as "spindle whorls" (Figure 42). They consist of a large bone disk with a conical perforation in the center—one exception displays a biconical perforation. In general, one of the parallel surfaces is larger than the other, meaning that the lateral surface of the artifact is beveled. Five of the spindle whorls are complete (LA861/4, LA902/8, LA916/32, LA2065/1, and LA2763/16), three are almost complete (LA885/55, LA916/31, and LA2950/6), two are more than half complete (LA883/24 and LA2940/4), and one is more than one-third complete (LA2951/1). The size of the disks is relatively uniform, with a diameter ranging between 22.3 to 28.0 mm (average of 24.9 ± 1.68 mm). Similarly, the diameter of the perforation is fairly constant, with an average of 7.8 ± 0.53 mm. The thickness of the artifacts, ranging from 8.5 to 14.1 mm, suggests that they were manufactured from large turtle individuals. The surfaces of the disks are generally smooth and, in some cases, polished. The edges are also generally rounded. In the case of LA883/24, LA902/8, and LA916/32, one of the parallel surfaces is unworked, with the texture of the sea turtle shell visible. An additional perforated disk (LA916/30) is made from a large sawfish (Pristis spp.) vertebra with a biconical perforation drilled in the center (Figure 41). The natural groove running along the circumference of the vertebra was modified by adding a fine incision running in the center of the groove. This modification altered the natural designs present on the side of the vertebra.

Three bone tubes were identified in the artifact assemblage. LA931/10 is made from a long bone, possibly a femur, from a medium-to-large mammal (Figure 44). The ends were cut and their edges abraded and smoothed. Striation lines are visible on the surface of the bone, perhaps resulting from the process of abrading the bone before it was polished. A red pigment is visible in some of the striations. A second tube (LA2923/1) is a fragment of a carved tube made from a large mammal long bone (Figure 43). One end of the tube was cut and smoothed; the other end is broken. A groove runs along the circumference of the tube, near the cut edge, with a second, finer incision located more distally. The inside of the diaphysis does not appear worked; cancellous bone is visible, suggesting that this specimen comes from a section near the epiphyses. Although the bone surface is significantly weathered, it was likely abraded and smoothed. The third bone tube (LA2974/1) consists of a browned diaphysis fragment from a large mammal long bone (Figure 43). Less than half of the tube's circumference is preserved. A wide groove was incised transversely to the shaft and one of the ends was cut and smoothed, while the other end is broken. An additional artifact may have been part of a bone tube. LA2780/2 is a small fragment of a medium-to-large mammal long bone, with a partial conical perforation drilled in the diaphysis (Figure 43). The bone is broken through the middle of the perforation. The surface is too damaged to tell if it was worked, but it appears to have been polished.

Several miscellaneous artifacts were also present. A small polished button made of bone (LA2572/1) was recovered in a surface deposit (Figure 45). It dates to the contact period (post-1542). The button has four conical perforations drilled in the center (diameter of perforations = 1.8 mm). One surface is countersunk, creating a bulging outer rim. The other surface is slightly curved. The button is broken along two of the perforations and about a third of the artifact is missing. LA2798/3 is an anthropomorphic carved artifact (Figure 46). This manatee (*Trachemus manatus*) rib was carved in the form of a phallus. The glans penis was defined by a transverse groove that runs around the circumference of the rib and ends into a chevron pointing towards the end formed by the glans. The sides of the manatee rib were abraded so as to shave the body of the rib. Abrasion lines are visible on the surface of the artifact, which appears to have been polished. The rib is not complete and both ends of the artifact are broken. LA3015/13 is an almost complete fin spine exhibiting hyperosteosis from an indeterminate fish species (Figure 45). Three parallel fine lines were incised near the base of the spine. The incisions are too pronounced and regular to be considered cut marks.



Figure 38. Bone beads. *Left*: Disk bead (LA2574/1). *Center*: Disk bead (LA2960/11). *Right*: Tubular bead (LA912/6).



Figure 39. Bone beads made from fish vertebra. *Top row, from left to right*: LA1585/3 (cartilaginous fish), LA1579/4 (cartilaginous fish), LA3030/1 (sawfish). *Bottom row, from left to right*: LA2763/18 (bony fish), LA2797/3 (sawfish).



Figure 40. Teeth pendants. From left to right: LA1590/12 (peccary), LA2953/1 (requiem shark), LA2644/2 (dog), LA1579/3 (dog).



Figure 41. Perforated disk made from a sawfish vertebra (LA916/30).



Figure 42. Perforated disks made from sea turtle shells. *Top row, from left to right*: LA861/4, LA883/24, LA885/55. *Second row*: LA902/8, LA916/31, LA916/32. *Third row*: LA2940/4, LA2950/6, LA2951/1. *Last row*: LA2763/16.



Figure 43. Bone tube fragments made from mammal bone. *From left to right*: LA2974/1, LA2780/2, LA2923/1.







Figure 45. *Left*: Historical button made from mammalian bone (LA2572/1). *Right*: incised fish fin spine (LA3015/13).



Figure 46. Manatee rib carved in the form of a phallus (LA2798/3). *Above*: front of the phallus. *Below*: back of the phallus.

Discussion of Bone Artifacts

The bone artifact assemblage at Lamanai is small, with 31 artifacts sorted into eight artifact sub-types: disk bead, tubular bead, pendant, perforated disk, tube, button, incised bone, and anthropomorphic carved bone. Nearly all bone artifacts have been identified as finished or possible finished objects. Insight into their manufacture can be gained from a technological analysis.

Manufacture of Bone Artifacts

A variety of techniques were involved in the production of bone artifacts: cutting, sawing, abrading, smoothing, drilling, puncturing, incising, burning, and polishing. It is difficult to know for certain the techniques involved in the first steps of bone manufacturing, because later steps have erased marks left by the former. Cutting and/or sawing were probably the first techniques used in the reduction of many bone artifacts. Cutting is most apparent on tubular bone beads (LA912/6) and bone tubes (LA931/10, LA2923/1, and LA2974/1). The "groove and snap" production technique was likely used to separate the diaphysis from the epiphyses of long bones. To do so, lithic implements are used to produce a groove all around the bone or a string coated with an abrasive is wrapped around the bone and pulled side-to-side. When the groove is sufficiently deep, the ends are snapped off to detach them from the shaft (Emery 2008).

Abrasion is a common bone working technique observed on the Lamanai assemblage (n = 20, 64.5%). This method would be used to shape and smooth edges and surfaces. It can be identified by smooth, rounded edges, smooth surfaces, and visible abrasion lines. The latter were found on a disk bead (LA2574/1), a bone tube (LA931/10), six turtle perforated disks (LA861/4, LA902/8, LA916/31, LA916/32, LA2951/1, and LA2763/16), and an anthropomorphic carved artifact (LA2798/3). Polishing can be considered the extension of abrasion and smoothing, as it is probably one of the finishing steps of artifact production. Traces of polishing are visible on two disk beads (LA2574/1 and LA2960/11), three turtle perforated disks (LA885/55, LA902/8, and LA916/11), and on the anthropomorphic carved artifact (LA2798/3).

Perforations are relatively common in the bone artifact assemblage: a total of 30 perforations were identified on 27 artifacts (87.1% of the total assemblage). Drilling was the preferred technique employed in artifact production, likely because it provides more control over the size of the perforation and is less likely to break the artifact than puncturing. It was observed on four disk beads (LA1585/3, LA2574/1, LA2797/3, and LA2960/11), all teeth pendants (LA1579/3, LA1590/12, LA2644/2, and LA2953/1), all turtle perforated disks (LA861/4, LA883/24, LA885/55, LA902/8, LA916/31, LA916/32, LA2065/1, LA2763/16, LA2940/4, LA2950/6, and LA2951/1), and one sawfish perforated disk (LA916/30). It resulted in both conical (n = 18, 60.0%) and biconical (n = 7, 23.3%) perforations. In contrast, puncturing was only identified on two disk beads made from cartilaginous fish vertebrae (LA1579/4 and LA3030/1). These perforations were probably made by punching through the center of the vertebra centrum with a sharp tool.

Incising was also used in the manufacture of the Lamanai bone artifacts. It was found on an anthropomorphic carved manatee rib (LA2798/3), two bone tubes (LA2923/1 and LA2974/1), one sawfish perforated disk (LA916/30), and one incised bone (LA3015/13). The designs produced by incising are not particularly elaborate and are limited to large incisions and fine

lines. Burning is also a possible manufacture technique, as heating bone at low temperatures hardens this material and makes it more durable and easier to work (d'Errico and Henshilvood 2007:148; Emery 2008). Two bones are browned, LA2797/3 (disk bead) and LA2974/1 (bone tube), while two are possibly burned: LA2574/1 (disk bead) and LA3030/1 (disk bead).

With this data, it is possible to coarsely reconstruct the manufacture sequence of some artifacts. For the turtle perforated disks, it is posited that a large piece of bone was cut out from a marine turtle shell in a roughly circular shape. The lateral surface of the disk was abraded to form a smooth surface and to give the artifact a cylindrical shape. One or both parallel surfaces of the disk were abraded, smoothed and, in some cases, polished. A perforation was made in the center of the disk, possibly using chert or obsidian drills. The order in which the manufacturing steps were carried out is unclear. Overall, the size and shape of the perforated disks is relatively uniform, suggesting that they might have been produced by a few manufacturing units or communities. In contrast, the manufacture of bone tubes and tooth pendants is simple since few production steps are required. In the case of bone tubes, the epiphyses of long bones were cut and removed to produce a long hollow tube. The ends were abraded to make them smooth and the surface of the bone may also have been abraded to delete bony features such as muscle attachments, crests, and ridges. Finally, decorations may be added through incising. Similar steps would be required to manufacture tubular beads. Finally, the production of tooth pendants would only necessitate, in most cases, drilling through the root. The natural shiny surface of tooth enamel appears to have been a sufficient decoration, at least at Lamanai.

Overall, it is difficult to determine who manufactured the artifacts found at the site. For instance, the production of tooth pendants is so simple that this could be done by about anyone. In contrast, the standardization of the turtle perforated disks and the time required for their manufacture point to production by a few units, perhaps part- or full-time artisans. Sea turtle shells could have been imported from the Caribbean coast to Lamanai for on-site manufacture or the finished objects could have been procured from other sites. At this point, it is not possible to tell which of these possibilities provides the best explanation for the patterns observed at Lamanai, because i) bone debitage and blanks indicative of artifact manufacturing have not yet been identified in the Terminal Postclassic-Early Colonial deposits; and ii) the zooarchaeological analysis of the Lamanai fauna is not completed.

Function of Bone Artifacts

Several of the bone artifacts found at Lamanai likely had an ornamental function. Bone beads could be strung on necklaces, bracelets, and other jewelry items, and sewn onto clothes. The same can be said of the various teeth pendants. Both artifact types are commonly recovered at Maya sites, such as Colha (Buttles 2002:203–212), Mayapán (Masson and Peraza Lope 2014:Figures 6.8 and 6.9), Pacbitun (Healy et al. 2014:101–107), and Uaxactun (Kidder 1947:57, Figure 81). Various functions have also been proposed for bone tubes: beads, whistles, handles, tie-rods, weaving rollers, components of headdresses, or even batons (Baker et al. 2014; Healy et al. 2014:101–103; Kidder 1947:57; Moholy-Nagy 2003:60–61). However, many authors (e.g., Baker et al. 2017; Kidder and Samayoa Chichilla 1959:57; O'Brien 1983:15; Willey 1972:324) have recognized the difficulty of classifying bone tubes into functional categories, particularly when they lack any decoration like the Lamanai bone tube LA931/10. It is possible that this artifact is not finished and is a blank core. However, its

discovery in a burial (Burial N11-5/7) suggests a more ornamental or symbolic function, a hypothesis supported by the presence of red pigment on the bone. Three other bone tubes are decorated—one has a perforation and two are grooved—but their high level of fragmentation makes it difficult to determine their function.

The carved manatee rib may have been used as a decorative or ritual object. Carved manatee ribs have been found at several inland Maya sites. Figurine carvings and canoe miniature models made from manatee bone were recovered at the coastal site of Moho Cay (McKillop 1985) and inland site of Altun Ha (Pendergast 1979:Figures 12a and 46b), while musical rasps were found inland at Ceibal (Willey 1978:169–170) and Colha (Scott 1980:324). McKillop (1985:344) also identified at Moho Cay several sections of manatee rib bones with a circumferential groove, but she likens them to stone fishing weights, far from the phallic form of the incised rib from Lamanai.

Determining the function of the turtle perforated disks is difficult. These artifacts have previously been labeled as spindle whorls, but their form and size also suggest that they could be sewn onto clothes or used as floats on fishing nets. However, no signs of stringing were identified during analysis and use-wear was not apparent. A nearly identical artifact, also labeled as a spindle whorl, was recovered from a turtle burial at the coastal site of Saktunja, in northern Belize (Boteler-Mock 2008:138). A more utilitarian function at Lamanai is possible given that several of the perforated disks were recovered in ballast or midden contexts. Finally, the function of the incised fish fin spine is unknown.

Procurement of Bone and Bone Artifacts

An analysis of the habitats from which animals were exploited provides information about use of ecological zones and possible trade of animal bones and/or bone artifacts. Two of the identified taxa are terrestrial. The peccary is represented by two species in the Maya subarea. The white-lipped peccary (*Tayassu pecari*) prefers closed, mature forests, while the collared peccary (*Pecari tajacu*) lives in primary and secondary forests and likes to raid crops (Emmons 1997; Reid 2009). Other possible animals acquired by the Maya and identified as indeterminate medium and large mammals include the white-tailed deer (*Odocoileus virginianus*) and brocket deer (*Mazama* sp.). These four taxa could all have been found in the close vicinity of Lamanai. Peccary and deer bones and teeth likely were a by-product of acquiring animals for food and constituted a readily available source of raw material. The same can be said of dogs, which are one of the few domesticated species kept by the Maya.

Animals from aquatic habitats were also identified. Two shark species are possible candidates for the tooth pendant: the bull shark (*Cacharhinus leucas*) or dusky shark (*Carcharhinus obscures*). Both are fairly aggressive animals. The bull shark is commonly found along coastal areas and readily enters fresh waters, such as rivers and lakes. In Belize, an individual was caught from the Rio Hondo near San Antonio village, some 70 km inland (Greenfield and Thomerson 1997; Robins and Ray 1986). In contrast, the dusky shark is more of a pelagic species, but it enters shallow waters (Robins and Ray 1986). Therefore, both species may have been acquired in coastal waters, but the bull shark could also be found in the New River. Two species of sawfish, the smalltooth sawfish (*Pristis pectinata*) and largetooth sawfish (*Pristis pristis*), are found in shallow tropical coastal, estuarine, and fresh waters (Robins and Ray 1986). They can travel upstream for considerable distances. For instance, the largetooth

sawfish was spotted in the Belize River and was even found up to 1,340 km inland in the Amazon River system (NOAA 2010; Robins and Ray 1986). Three turtle species nest in Belize and are frequently encountered between the coast and the Belize barrier reef: the loggerhead (*Caretta caretta*), green turtle (*Chelonia mydas*), and hawksbill turtle (*Eretmochelys imbricata*) (Smith et al. 1992). The Antillean manatee (*Trichechus manatus manatus*), a subspecies of the West Indian manatee, visits the coastal waters, cayes, and all river systems of Belize. It has been spotted as far inland as the New River Lagoon (Auil Gomez 2014). From this ecological data, it can be inferred that only sea turtles were definitely acquired from a marine environment. Sharks, sawfishes, and manatees may have been procured from marine, estuarine, or freshwater habitats. They may have been present in the New River, but it is not certain whether they would be regularly found as far inland as the New River Lagoon where Lamanai is located.

Overall, artifacts found at Lamanai were made from animals present in terrestrial, freshwater, estuarine, and marine habitats. Although the Lamaneros likely produced on-site artifacts made from peccary and dog, it is possible that bone as a raw material or finished artifacts were imported from other sites. Thornton (2011b) has shown through strontium isotopic analysis that a few white-tailed deer bones found in a cache were imported from other sites to Lamanai during the Postclassic period. The use of aquatic resources that could be acquired from a variety of habitats also attests to the complexity of the exchange networks in which Lamanai participated. The New River is a convenient trade route as it drains into the Chetumal Bay. The presence of estuarine and marine animals implies that the Lamaneros were involved in medium-to-long distance trade with communities located on the Caribbean coast, more than 75 km from the site, such as Marco Gonzalez (Graham and Pendergast 1989; Pendergast 1990). The Lamaneros also possibly made trips to the coast or downstream on the New River, where they could acquire resources by themselves and/or from other Maya communities.

CONCLUSION

The zooarchaeological analysis conducted during the lab season 2016 allowed for the identification and analysis of 1,476 turtle remains, 99 shell artifacts, and 31 bone artifacts. The main goals of the study of turtle bones was to provide additional data on the exploitation of turtle at Lamanai during the Terminal Postclassic-Early Colonial period and examine the possibility of trade and husbandry of turtles at the site. So far, patterns of taxonomic diversity, bone preservation, and butchery patterns observed last year were supported by this year's analysis. Continued identification of the turtle remains will allow testing of the trade and husbandry hypotheses and confirmation of the observed trends. Additional work includes completing the analysis of the turtle remains from Structures N12-4, N11-28, and N11-29, identifying the turtle remains recovered from Structure N11-18 (the *cacique* house) and adjacent areas, and contextualizing turtle exploitation within the larger zooarchaeological analysis of animal remains from Terminal Postclassic-Early Colonial Lamanai.

The goal of the artifact analysis was to describe the procurement, manufacture, and use of artifacts at Lamanai. Shell artifacts were made exclusively from marine shells from the Caribbean coast, with the exception of one Pacific species. Bone artifacts were made from animals found in terrestrial, freshwater, estuarine, and marine habitats. In both cases, it is

not yet possible to tell whether the bones or shells were brought to Lamanai as raw material or if artifacts were imported as preforms or in a finished form. Continued analysis of the animal remains will help determining whether shell detritus or bone debitage are present in the Lamanai assemblage. If this is the case, it would imply that at least some shell or bone artifact manufacturing took place at the site. Nonetheless, it is certain that Lamanai participated in extensive trading networks during the Postclassic and possibly Colonial periods given the presence of artifacts made from non-local animals (e.g., *Spondylus* shell, olive shells, sea turtles). In the future, the study of artifacts should include a contextual and spatial analysis that would compare the types and abundances of artifacts recovered in different loci (e.g., elite structures, lesser-status structures, and commoner households). This would test whether particular artifact types cluster according to the residents' social status or if artifacts were used across the site. Mapping the presence of bone debitage or shell detritus would also be worthwhile.

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Walking to the site after Hurricane Earl.



Near the rangers' house after Hurricane Earl.



Report on the Theft of Two Jade Artefacts from the Old Museum

Selected Lamanai jades. The stolen objects are the pendant carved with a human face in the upper left and the carved plaque beneath the pendant. The pendant is ca. 5.5 cm (2 1/8 in) X 3.8 cm (1 $\frac{1}{2}$ in) X 2.5 cm (1 in). The plaque with the carved animal (monkey?) is 7.3 cm (2 7/8 in) X 2.3 cm (7/8 in) X 0.7 cm (1/4 in). cm wide .



Cast of jade plaque.

Two jade artefacts were stolen from a Small Finds drawer in the Old Museum sometime between late morning of



Cast of pendant.

Thursday 7th July and noon on Saturday 9th July, when we learned of the theft. Dr. Morris was sent an e-mail, but there was no other way to make contact on the weekend. We had intended to involve the police but decided to wait for direction from the IA. Both objects are



Copy of Louise Belanger's drawing of the pendant in the Lamanai Guidebook.

small, and both are worked. One is a small rectangular plaque (see photo above for dimensions) with shallow carving; it is hard to say what is represented—perhaps a monkey. The pendant (dimensions above) displays a depiction of a ruler's (or elite individual's) face
and headdress in a style that is not uncommon among small jade pendants in the Classic period.

Jaime Awe informed me that he had had a similar situation at Cahal Pech with a bag of obsidian eccentrics. I followed his advice and brought together all who had access to the bodega (staff, workers, students) and stated that if the objects were returned—perhaps to an intermediary who would keep the person's identity anonymous—there would be no repercussions. I also spoke about the importance of the objects to Belize's heritage, and also made clear that jades at Lamanai were relatively rare. The two objects stolen were among the rarest owing to the workmanship; most jade objects from Lamanai are plain. Unfortunately, since the theft was not discovered right away and the objects are small and easy to conceal, it is likely that the plaque and pendant were transported from the site immediately after being stolen. UCL students were checked at exit points—at my request to Dr. Morris—but no objects were found in their possession.

On the following page I have included the flyer made up by Karen Pierce which we posted in the hope of recovering the artefacts.

STOLEN FROM THE LAMANAI SITE MUSEUM BETWEEN JULY 7th and July 9th, 2016.



TWO CARVED GREENSTONE (ALSO REFERRED TO AS JADE) ARTIFACTS.

Approximate size of carved head artifact: 5.5 cm (2 1/8") high x 3.8 cm (1 $\frac{1}{2}$ ") wide x 2.5 cm (1") thick.

Approximate size of carved animal artifact: 2.3 cm (7/8") high x 7.3 cm (2 7/8") wide x 0.7 cm (1/4") thick.

Any information regarding these artifacts should be reported to: Dr. Elizabeth Graham, Lamanai Principal Investigator (<u>e.graham@ucl.ac.uk</u>), or Dr. John Morris, Belize Institute of Archaeology (<u>research@nichbelize.org</u>) Report on the Photographic Documentation of Carved Monuments at Lamanai

Christophe Helmke University of Copenhagen, Denmark

Introduction

On the 6th and 7th of July, 2016, the author of this report conducted photographic documentation of carved monuments found at Lamanai as part of excavations conducted at the site under the direction of Dr. David M. Pendergast (1974–1988) (see Pendergast 1975, 1977, 1981a, 1981b, 1984, 1986). The author serves as epigrapher for the Lamanai Archaeological Project (1998–present), and the documentation was conducted as part of the same project, under the direction of Dr. Elizabeth Graham (2000, 2001, 2004).

The purpose of this documentation effort is to prepare templates that will assist in the drafting of new line drawings of the extant corpus of monuments at the site. These new drawings will form part of an on-going research effort, by the author and Dr. Pendergast to prepare a full-length report on the carved monuments at the site, for publication and dissemination to the academic community, specialists, as well as lay-people alike. This study will provide scholars and interested readers with the context and description of each monument found at the site, as well as line drawings, accompanied by photographs of selected details, and a text providing an up-to-date epigraphic – and where relevant, iconographic – analysis.

The study follows up on the photographic documentation work conducted in 2003, by Stuart Laidlaw, photographer of the Institute of Archaeology of University College London, in England. The present study is also envisioned as building upon the foundation set by the wonderful, three-part study of Stela 9, published in 1988, providing a detailed review of the context, epigraphy and iconography of this important monument (Pendergast 1988; Closs 1988; Reents-Budet 1988). Since these publications the field of epigraphy has steadily progressed and it now deemed a suitable time to prepare new drawings that are more attuned to details of paleography and epigraphy and to provide a more refined and updated analyses, which while somewhat technical given the nature of the subject matter, would also be more approachable text that can be comprehended by tour guides and tourists alike.

Corpus

In preparing the study of the monuments of Lamanai, the author in collaboration with Dr. Pendergast has been preparing a comprehensive inventory of the monuments, to better assist in the process. In so doing we have also been able to update the nomenclature of the monuments to better reflect their nature and also to conform to the norms of the Corpus of Maya Hieroglyphic Inscriptions, the project of the Peabody Museum of Archaeology and Ethnology that is the leading standard for epigraphic research in the Maya area (Graham 1975). Thus, for instance, the carved monument that served as the central riser of the megalithic stair of Str. N10-36, which previously had been designated as Stela 11, has now been re-designated as Panel 1. Similarly, the risers of the hieroglyphic stair that have been found scattered throughout the northern part of Plaza 5, the plaza fronting the High Temple (N10-43) have been re-designated as Steps 1 through 5, since it is now clear that these form part of the same original monument, even though these were displaced by the

ancient Maya in antiquity. Below we list the most updated list of the inventory of monuments documented at Lamanai, with the proviso that these tabulations remain preliminary and are subject to change as this research progresses (Table 1).

Designation	Context	Plain/Carved
Stela 1	Str. N9-56	carved
Stela 2	Str. N10-9	carved
Stela 3	Str. N9-56	plain
Stela 4	Church	plain
Stela 5	N10-11	plain?
Stela 6	N10-63	plain
Stela 7	N10-64	plain
Stela 8	N10-64	plain
Stela 9	N10-27	carved
Stela 10	N10-74	carved?
Altar 1	Plaza P2	carved
Altar 2	N10-38	carved
Ballcourt Marker I	N10-40/41	plain
Panel 1	N10-36	carved
Step 1	Plaza 5	carved
Step 2	Plaza 5	carved
Step 3	Plaza 5	carved
Step 4	Plaza 5	carved
Step 5	Plaza 5	carved

Table 1: Tabulation of the monuments found at Lamanai.

What this tabulation reveals is that the corpus of Lamanai is much larger than is usually appreciated. The size of the corpus is nonetheless clearly proportionate with the size of the site, being the second largest in Belize, after Caracol. For the sake of comparison, Caracol is known to have a corpus comprising 24 carved stelae, 24 carved altars and 5 carved ballcourt markers, in addition to plain monuments, making it the single largest corpus of monuments for any Belizean site.

At present only portions of the hieroglyphic stair originally raised at Lamanai have been found, as parts of five risers, and based on the portions of text preserved and syntactical parameters, I surmise that at least another two or three risers originally constituted the hieroglyphic stair. Assuming that all the risers were aligned to form a single large step at the base of a large monumental stair, we can surmise that the original stair may have graced Str. N10-42, on the western side of the High Temple plaza (Plaza 5), or perhaps even more likely Str. N10-34, on the eastern side of the plaza. Although the risers in question date to the seventh century, based on the associated texts, at Lamanai the practice of using large blocks as stair risers predominates during the Terminal Classic to Early Postclassic transition, and can be observed, in addition to the structures named above bordering the High Temple plaza, as the means to ascend the platform of the Ottawa Group (Plaza N10-3) on the south side (Graham 2004).

Method

The photographic documentation entailed digital photography with a Canon EOS M3, mirrorless camera. All the photography was conducted at night with artificial raking light. The physical photography was conducted by the author of this report with the assistance of Dr. Elizabeth Graham, as well as the Park Rangers, Kevin Díaz and Walter Rodriguez. Compact and portable LED lights of (200 lumen) were held in position close to, but without touching the actual surface of monuments, in order to bright out as many of the carved details as possible, through high contrastive cross-lighting. Due to the low levels of ambient lighting variable exposure times or shutter speeds of 1/8 sec. through 1/40 sec. were employed with high ISO at around 6400. With each shot secured the light was moved in a circular motion to a new position in order to better highlight details that were not readily apparent in the previous shot and a new shot secured. This process is repeated until a minimal selection of six shots have been secured with variable lighting. General shots of the whole monument are secured first, following by large shots of various sections, and finally focusing on smaller details. In the case of glyphic texts for instance, the entirety of the text is shot first, followed by groupings of glyphs and finally on individual glyphs, as necessary. This process is illustrated in the figure that follows (Figure 1).



Figure 1: Three alternate applications of raking light to the hieroglyphic text of Panel 1. Note how each lighting highlights details from the different angles (photographs by Christophe Helmke).

Results

In applying the method outline above, we were able to document Stela 9 as well as Panel 1 and Steps 2 and 3 that are currently on exhibit at the Visitors Centre. In this respect the Rangers were particularly helpful. Stela 1, which is also in the Visitors Centre was not available for photography, however, since it remains boarded up in plywood.

Having completed the documentation at the Visitors Centre, Dr. Graham and the author proceeded to the site, to document some of the monuments that remain on site. These included Stela 2, as well as Altars 1 and 2.

The following day was spent taking measurements of the monuments to help to scale the shots taken during the process of preparing the templates. In addition, photographs were taken of monument fragments stored in the project bodega, in particular the fragment of Altar 1 and the fragmentary Step 5.

What remains for a future season, planned for the summer of 2017, is to double check the drawings produced against the original monuments in the Visitors Centre and on site, as well as to relocate more the glyphic risers of the hieroglyphic stair, as well as Stelae 5, 6, 7 and 8, located to

the west of the Ottawa Group (Plaza N10-3), in an area that remains overgrown and as such is not developed for tourism.

Below a selection of lens-corrected (orthorectified) photographs of the monuments secured during the 2016 field season are provided. All photographs are by Christophe Helmke.



Figure 2: Photograph of Panel 1.



Figure 3: Photograph of Step 2.



Figure 4: Photograph of Step 5.



Figure 5: Photograph of Stela 9.



Figure 6: Detail of Stela 9, showing part of the inscription and the profile of the ruler.

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