INVESTIGATING PHOTOGRAMMETRY AS A METHOD OF DEVELOPING EDUCATIONAL MATERIALS FOR ARCHAEO-TOURISM AND PUBLIC EDUCATION AT XUNANTUNICH, BELIZE

By

Kelly J Baer

A Thesis

Submitted in Partial Fulfillment

of the Requirements for the Degree of

Master of Arts

in Anthropology

Northern Arizona University

May 2024

Approved:

Jaime Awe, Ph.D., Chair

Kayeleigh Sharp, Ph.D.

Alder Keleman-Saxena, Ph.D.

Lisa Hardy, Ph.D.

ABSTRACT

INVESTIGATING PHOTOGRAMMETRY AS A METHOD OF DEVELOPING EDUCATIONAL MATERIALS FOR ARCHAEO-TOURISM AND PUBLIC EDUCATION AT XUNANTUNICH, BELIZE

KELLY J BAER

After decades of archaeological investigation and consolidation, the site of Xunantunich in western Belize has become an epicenter for archaeo-tourism and public education. Several archaeological projects have made strides in the past to make the archaeological park a visitor-friendly tourist destination, complete with a visitor center and interpretive exhibits. At the request of the Succotz and Cayo Tour Guides Associations, and to act as a supplement to past efforts, I explored the use of 3D modeling to create interactive and informational graphics of Maya structures. These graphics and their accompanying guide were subsequently incorporated into a program that utilizes QR Codes for use by the tour guides of local communities. Over the course of this project, I addressed the grey area that exists between archaeological research and recordation, and how the information is refined and made available for the public. A major goal of this project was to determine how archaeologists can improve the dissemination of data and information to the general public, promote public accessibility to archaeological information, and to improve academic transparency. Here, I posit that this method of dissemination works as a cost-effective, efficient, and replicable project that highlights collaboration between local populations and archaeologists. Without these models, graphics, and programs, this information would likely not be available to

those outside of academia, which underscores how public education should be a major goal of archaeological projects.

Acknowledgements

First and foremost, I would like to thank the Belize Valley Archaeological Reconnaissance Project and the Institute of Archaeology in Belize for providing resources in support of this project. I would also like to thank the Cayo and Succotz tour guides associations for initially requesting this project for their training program and for being open to collaborating and discussing the site history with me. I am truly thankful for the friendships I made while at Xunantunich through the BVAR Project and through the local tour guides associations.

I am also grateful for my committee, Drs. Jaime Awe, Alder Keleman-Saxena, Kayeleigh Sharp, and Lisa Hardy. I would not have made it to the end of this process without each of you. I want to extend my gratitude to the entire Anthropology Department at NAU, staff and faculty both, for their continued support of myself, my cohort, and all anthropology students. I am also grateful for the funding provided by the department through the Ray Madden Research Grant, which allowed me to travel to Belize for six weeks to perform my research.

And finally, I would like to thank my cohort, and my friends and family near and far. Ove the course of this program I have experienced so much life and so much loss. I truly would not be where I am today if it weren't for their constant support and pushing me toward my goals. I will forever be grateful for the people who pushed me to do my best when the times were tough.

Table of Contents

List of Figures

Chapter 1: Introduction

In 1954, crews completed construction on the modern road and hand-cranked ferry that led to the ancient Maya city of Xunantunich. Early explorers travelling from Belize to the Peten region of Guatemala had passed by the buried structures here for nearly a century, but the completed road and ferry made the site more accessible to many researchers and curious archaeologists (LeCount & Yaeger. 2010). This increase in research activity at Xunantunich became the foundation for several archaeological projects and conservation efforts in the region. Archaeologists continue to work at Xunantunich today, building upon this foundation and expanding the archaeological record in the region.

Although Xunantunich has been the focus of several archaeological surveys and active consolidation projects (Awe 2008; Hoggarth et al. 2020; LeCount & Yaeger. 2010), the site itself has great promise as an educational center for the local public and tourists alike. This project aimed to address the gap between anthropology and education by examining the process of creating digital teaching models using terrestrial photogrammetry. I define terrestrial photogrammetry as a series of overlapping photos taken by a ground-stationed camera without the use of drones or other methods of aerial photography. I focused on four main questions to develop a well-rounded framework that would address academic, public, and community needs:

1. Is terrestrial photogrammetry an efficient, cost-effective, and feasible method of recording archaeological sites in the heavily forested jungles of Belize?
2. How can archaeologists record sites and architectural data using traditional methods while simultaneously preparing public-friendly educational tools?

3. How can community collaboration play a role in decolonizing public education within archaeology and elsewhere in academia?
4. If successful, is this method replicable at other sites with different archaeological characteristics?

In Summer 2023, I carried out a single-person study at Xunantunich to examine the feasibility of using terrestrial photogrammetry for purposes of creating digital educational content in this challenging outdoor environment. While operating through the auspices of the Belize Valley Archaeological Reconnaissance (BVAR) project and using their established standards and framework for community collaboration, I developed a guidebook, alongside a series of digital 3D models, designed as training aids for local tour guides and educators.

The Study Area

Belize is a relatively small coastal nation just south of Mexico's Yucatan Peninsula. The country covers around 8,867 square miles and is home to around 441,471 people as of 2022 (International Trade Administration 2022). Belize is home to numerous ancient Maya sites, 14 of which are featured tourist destinations on the official Belize tourism website (Belize Tourism Board 2023). One of these popular sites is the ancient city of Xunantunich.

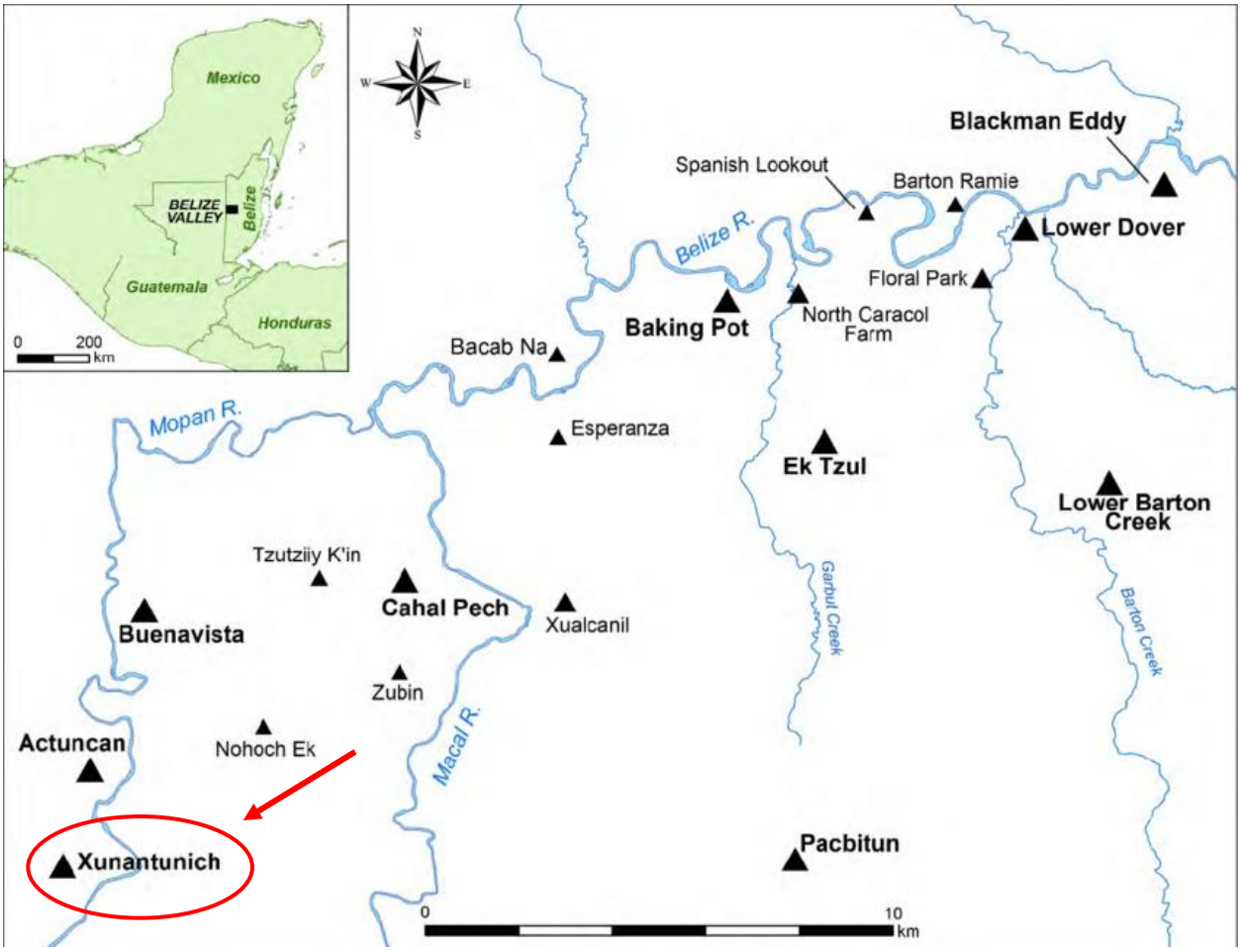


Figure 1 A map of the western Belize River Valley. Adapted from map by Claire Ebert (2018) from Watkins et al. 2018. Adapted by author.

Xunantunich is an archaeological site located in the Belize River Valley sub-region of western Belize (see Figure 1). This region is comprised of tropical rainforests, having a rainy season extending from early summer to early winter, and a dry season occurring the remainder of the year. Western Belize houses numerous major Maya cities and several impressive cave sites, many of which are within a few miles of Xunantunich. These sites also serve as major heritage centers and tourist destinations.

Xunantunich is also located along the Western Highway which is a major tourist route that connects Belize to both Mexico and Guatemala. Within proximity to the site

are the town of San Ignacio, the village of San Jose Succotz, and Benque Viejo del Carmen. The people who live in these villages form tight knit communities, and many work in the tourism industry at different capacities. These communities are major tourist hubs, with San Jose Succotz providing much of the labor force that works at the site and which is home to many of the local tour guides. Just over a mile to the west of Xunantunich's site core is the Belize-Guatemala border, which can be easily seen from the top of the massive El Castillo (A-6) acropolis. Xunantunich was founded between 1200 – 900 BCE during the Pre-classic period. After slow growth during the Preclassic and ensuing Early Classic period (200 – 600 CE), the site reached its apogee around 780 – 890 CE during the Tsak' phase, when it became the regional capital of the lower Mopan River valley (Awe et al. 2020).

Goals of the Project

In recent years, tourism in western Belize, particularly at Xunantunich and other neighboring archaeological sites has increased dramatically, and with it the demand for tour guides and knowledgeable professionals capable of providing accurate information to visitors. It is within this context that this project was initiated and following the request for more detailed information on the site by local community and tour guides associations in the Cayo district. The community requested I create a teaching guide to assist with the tour guide training process and make the course informative, applicable, and accessible to local stakeholders (Awe, personal communication 2023). Taking these needs into consideration, I combined multiple aspects of archaeology, including

excavation data, photogrammetry, 3D modeling, cultural heritage management in the context of public education.

I decided that the most efficient and accessible way to complete this task was to create a series of interactive digital models of the many structures within the site's core, accompanied by a comprehensive guide to the history and architecture of each modeled structure. I used photogrammetry as a fast and effective way to record site structures and used non-metric 3D modeling to create models. I processed these models and short descriptions of each structure to create digital files that are accessible via Quick Response (QR) codes and digital download. This approach makes the information easily available on any mobile device, such as a phone or tablet, and other devices, such as desktop computers. I also intended to demonstrate that archaeologists can simultaneously record data to be analyzed remotely and while at the same time creating educational content for a wide range of educational purposes.

I designed the project to include consistent community collaboration and the involvement of local stakeholders throughout the course of this research. I did this by consulting with local guides about what information they would like to see included with the educational models I developed, and what parts of the site visitors had the most questions about. I placed a heavy focus on developing these files for use in the local area with the goal to help further history and heritage education.

My hope is that this research will also serve to inspire other researchers and educators to take the lessons learned here and apply them to their own research across Mesoamerica. To my knowledge, this is a project that has never been attempted in Belize on this scale. What I plan to create with this project is a working model and

example of practical research dissemination beyond the traditional article and book format. I chose this mode of dissemination because the stakeholders, who are largely non-academics, would likely not have access to academic journals. Additionally, I built this project on a basis of collaboration and accessibility, utilizing and expanding upon open avenues of communication between local communities, tourists, and archaeologists, to support similar projects in the future. In this respect, the project sought to contribute to the Belize Valley Archaeological Reconnaissance (BVAR) Project's continued emphasis on community engagement, heritage education, and rural development in western Belize (Awe 2018, 2020a, b, In Press; Beardall 2021; Chase et al. 2020; Hoggarth et al. 2020)

Chapter 2: Background

This project is rooted in the current academic understanding of Xunantunich and the evolution of archaeological research since the field's inception. Xunantunich has a rich history, from its construction and use by the Maya, to the many research expeditions that have passed through its plazas. Many excavations have taken place here over the past century, with each field season bringing new research questions, strategies, and technology. It is important to first understand the history of excavations and outreach at Xunantunich before delving into this thesis project and its future implications.

Literature review

Although analog methods of recordation such as hand-drawn site maps and sketches of artifacts have remained useful tools in excavation and survey, new digital methods of documenting archaeological sites are becoming more widespread and accessible to researchers (Garstki 2017; Forte 2014, Fortenberry & Leifeste 2020, Quartermaine et al. 2014). Analog recording methods are still widely used today, but cameras, LiDAR scanning, and other digital-based methods are easing the recordation process thanks to their efficiency and accuracy. The popularity of digital recordation is also due to the ability to preserve archaeological data in a way that can be used indefinitely and does not physically decay over time, although it is important to remember that technology is constantly improving and certain technology may become outdated (Forte 2014, Lischer-Katz & Cook 2022, Quartermaine et al. 2014).

Photogrammetry and 3D modeling are becoming loosely standardized, and digital versions of sites, artifacts, and features are becoming more common respectively (Dell'Unto et al. 2017, Magnani et al. 2020, Marín-Buzón et al. 2021). These digital models are used by other researchers, even remotely, to study and answer research questions about sites and objects found all over the world (Bonacchi 2017; Edwards-Ingram 1997, Quatermaine et al. 2014).

A primary goal of archaeologists and local communities and stakeholders is to collect, preserve, and disseminate data to the general public. However, for much of its history, there has existed a significant gap between the field and education (Boellstorff 2016, Brameld & Sullivan 1961, Jameson & Baugher 2007). Archaeologists take time to compile and present archaeological information, but these conclusions usually circulate

through academia rather than reaching the public. Furthermore, while researchers are open to using digital technology, there has yet to be any substantial exploration into applying that same technology for purposes of public education. In today's world, access to smart devices has become more commonplace, opening new avenues for the dissemination of research to translate into a more accessible digital world (Boellstorff 2016, Goldberg & Richards 1995, Lischer-Katz & Cook 2022, Quartermaine et al. 2014). However, accessibility goes beyond having information available to oneself. Accessibility includes having multiple avenues for learning. In this project, I focused on audio, visual, and mechanical learning as a foundation for developing these materials.

Visual education creates interactive experiences that stay with the student or observer for a longer period of time. Dale's (1966) cone of learning (see Figure 2) suggests that interactive learning experiences provide greater educational foundations than verbal teaching like lecture settings (Anderson n.d., Boellstorff 2016, Bruner 1966, Dale 1966, Davis & Summers 2015, Diamond 1989, Goldberg & Richards 1995). Learning methods near the top of the cone like reading and listening show only a 10% retention rate, whereas methods near the bottom of the cone like simulating a real experience or performing a presentation, have a retention rate closer to 90% (Dale 1966, Davis & Summers 2015). Dale's (1966) concept suggests that after two weeks of instruction, using various teaching methods, students and observers can learn more about a subject if they actively participate in the learning process. Digital modeling, with or without a physical visit to a site, provides an interactive learning experience for all

age groups. Digital learning tools allow for a variety of educational experiences which can facilitate audio, visual, and mechanical learning styles.

It is important to note the reality of the digital world when discussing its capacity for education and learning. Digital spaces, such as social media, educational websites, and more notably, virtual reality (VR), offer a variety of experiences for users. The existence of the virtual world blurs the line between the “real” and the “unreal” (Boellstorff 2016). Oftentimes, the digital world is considered “unreal” due to its lack of physicality and factual nature. But this confuses “real” with “material” and “fact” (Boellstorff 2016). On the contrary, some objects and concepts in the “real” world are “unreal” in certain contexts. One popular example of this is folk knowledge. While this knowledge is considered “real” to the communities who believe in it, communities who do not believe in this knowledge consider it “unreal.” The digital world, then, still elicits emotional reactions in the same way that the physical world does, and many similar experiences can be had online. In this case, I focus on the ability to use digital models to utilize the “digital real” for public education (Boellstorff 2016).

When it comes to the social effects of public education, one must recognize that value systems change not only from culture to culture, but also within cultures over time. No single group remains static, let alone monolithic (Brameld & Sullivan 1961, Joyce 2013, Laing 2023, Magnoni et al. 2007, McGill 2018, Ramsey & Everitt 2008, Webster 2000). To create educational content from archaeological data, it is important to note the effects of past relationships between archaeologists and local stakeholders, and how those relationships have changed over time (Edwards-Ingram 1997, Goldberg & Richards 1995, Hardy 2023, Joyce 2013, Magnoni et al. 2007, Webster 2000). The

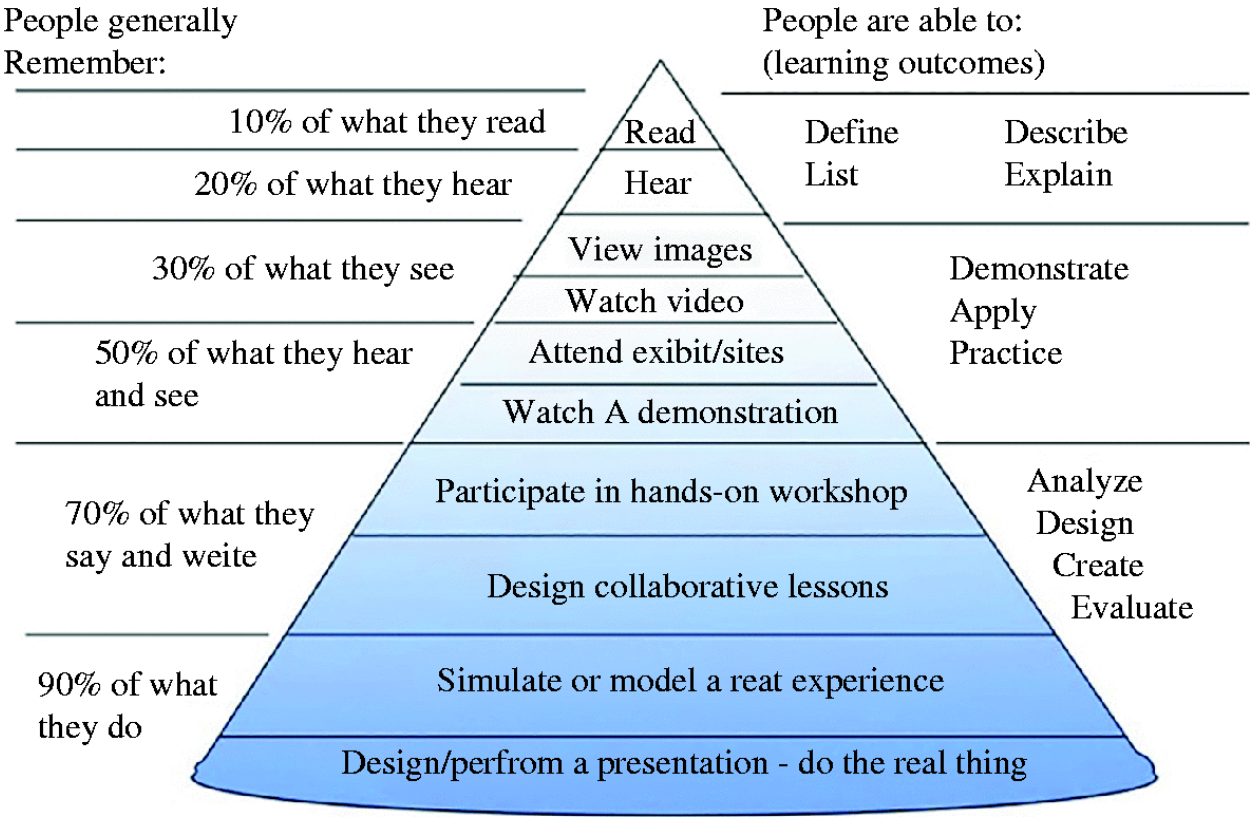


Figure 2 Dale's (1966) Cone of Experience, also known as the Cone of Learning, highlights information retention rates based on how information is taught. From Dale & Summers (2015).

established colonial nature of archaeology places archaeologists in a position of privilege compared local communities. Often, this is mistaken for a reason to withhold information, make it difficult to access, or ignore local perspectives and folk knowledge of sites, artifacts, and cultures. This takes power from local stakeholders and recirculates colonial ideologies in public education systems (Díaz-Andreu 2013, Edwards-Ingram 1997, Freire 1970, Magnoni et al. 2007, McGill 2018).

Archaeology, and by extension, anthropology, have a long history of exoticization of cultures, usually those that are not western (Edwards-Ingram 1997). This leads to the "othering" and objectification of other cultures and groups. The moment that a group of people is seen as an object of interest, the dehumanization process begins (Freire 1970). This process works to reduce their history and culture to a series of customs and

nameless faces who come to represent “the whole” of a group, often depicted as wildly strange and increasingly foreign to the observer, to attempt to create a globalized sense of “us” and “them” (Díaz-Andreu 2013, Edwards-Ingram 1997, Freire 1970). This is tool that has been used not only socially, but also politically in the past to create a sense of control over the oppressed population (Díaz-Andreu 2013, Edwards-Ingram 1997, Freire 1970)

To avoid this pitfall, one must be willing not only to present their conclusions in way that reduces personal biases as much as possible, but also to come to those conclusions based on communal research and collaborative activity (Hardy 2023, McGill 2018, Parks et al. 2006). Community collaboration is one of the most successful strategies for repairing past relationships with communities, and strengthening existing ones (Freire 1970, Hardy 2023, Jameson & Baugher 2007, McGill 2018, Parks et al. 2006). The protection and projection of these stories and local histories creates sense of empathy and connection between groups (Brameld & Sullivan 1961, Hardy 2023). To fully understand and properly depict Indigenous groups and cultures, one must become a willing participant of the cultural area they are studying, as much as it is allowed by the local community through personal communication and a stripping of self-proclaimed academic authority (Freire 1970, Hardy 2023, McGill 2018).

To create a relationship between local communities, visitors, and researchers, many sites have turned to archaeological tourism, or archaeo-tourism. Archaeo-tourism is the development of archaeological sites into tourist-friendly destinations where visitors can learn about the history and corresponding cultures of a site (Díaz-Andreu 2013). The ethics of archaeo-tourism remain a distinct issue among scholars and local

stakeholders alike (Díaz-Andreu 2013, Jameson & Baugher 2007, Magnoni et al. 2007, Webster 2000). Uniquely, Belize has seen an increase not only in tourism, but also in the revenue earned by local and indigenous groups compared to its other Latin American counterparts (Awe, personal communication, 2024, Díaz-Andreu 2013). At Xunantunich, local communities provide much of the labor force, including site interpreters, tour guides, and researchers. Local workers are the foundation of collaboration and storytelling at Xunantunich, providing visitors with an educational experience based not only on archaeological research, but also on local perspectives. Visitors develop a more personal relationship with the site's history by interacting with the descendants of the Maya who lived there and the explorers who once passed through the area.

Research and Previous Excavations

While Xunantunich became more widely accessible in the 1950s, research at the site began roughly a century before, when early explorers would stop in the site core to observe exposed stela as they passed through on their way to Guatemala's Peten region (Leventhal et al 2010). In the 1840s, the nearby town of San Ignacio, located a mere six miles to the northeast, served as a popular staging area for expeditions by ecologists and archaeologists alike. Although the towns of Benque Viejo and San Jose Succotz are much closer in proximity, they were rather small villages at the time, and San Ignacio was the last community where sufficient supplies could be found and bought for westward travel.

In the late 1800s, Thomas Gann, a medical doctor, was the first to explore and report on Xunantunich. Gann (1925) later returned to the site in 1924 during which time he conducted limited investigations of some structures Group A of the site core. It was during this time that Gann also first recorded the site of Actuncan, about two kilometers to the north. Research was sporadic at Xunantunich in the decades following Gann's survey of the site, until 1938, when Sir J. Eric S. Thompson began surveying the center and its surrounding area. Thompson was the first to explore and excavate at Group B, uncovering many samples of Maya ceramics. This led Thompson (1942) to create the first ceramic chronology in the region. In that same year, A. H. Anderson was named the first archaeological commissioner of British Honduras, a British Colony that would eventually become the country of Belize.

One year later, World War II broke out in Europe and raged for six long years before coming to an end in September 1945. After the war subsided, archaeological research entered a new era as researchers flooded into the Maya world. After four years of work at Xunantunich, Anderson discovered the now iconic eastern frieze atop the second story of Str. A-6, now colloquially known as "El Castillo." Anderson deemed the frieze to be an incredible find, and eventually reburied it to keep it safe from the elements. In 1950, archaeologist Linton Satterthwaite (1950a, 1950b) re-exposed the eastern frieze to document the size of the intricate carvings and record the symbols it contained.

In a series of excavations spanning from 1952 to 1954, British archaeologist Michael Stewart uncovered Strs. A-2, part of the eastern triadic shrine in the site core, and A-16, the stelae house located at the base of Str. A-2 (Leventhal 2010). In 1957,

Stewart conducted an investigation of Group C, located to the south of El Castillo. Archaeologist Euan MacKie (1961) excavated at the site over a short series of seasons from 1959 to 1960. During this time, MacKie (1961) excavated Str. A-11, which stands at the northernmost point of the palace group in Plaza A-III, and Str. A-15, which stands at the base of the raised city center. More recently, a modern road was built to increase access to the site, and Str. A-15 can be seen just a few meters to the left as one approaches the site core.

Stewart continued working at Xunantunich throughout the 1960s, thoroughly excavating Str. A-5, which is a series of rooms connected to the Eastern side of El Castillo (Leventhal 2010). Stewart also continued work on El Castillo, clearing dirt and debris from the rooms that comprised the first level of the structure. During the 1960s, thanks in part to rising interest in the ongoing research there, Xunantunich was officially opened to the public for tourism. In 1968, Peter Schmidt was named the new archaeological commissioner for Belize (Leventhal 2010). Schmidt (1974) oversaw several excavations in Plazas A-I and A-III, including work on Str. A-1 and the exposure of Stelae 8 and 10. Schmidt was also responsible for organizing efforts to expose several rooms connected to Str. A-6, as well as the reconstruction and conservation of the roof comb.

Joseph Palacio, the archaeological commissioner of Belize from 1971-1976, focused renewed efforts on conserving the eastern frieze of Str. A-6 (Leventhal 2010). The eastern frieze had been badly damaged years prior, in 1961, when Hurricane Hattie ravaged the country. This was not the only natural disaster to gravely affect Belize and, more specifically, Xunantunich. In 1978, archaeological commissioner Elizabeth

Graham noticed cracks in the construction of Str. A-6. Graham found the reconstruction of the roof comb and other parts of the structure were too heavy and dense compared to other sections of Str. A-6 which had not yet been conserved (Leventhal 2010). These sections began to crack and crumble after an earthquake struck the region in 1976. Graham coordinated a conservation project on Str. A-6 to seal and repair the cracks and conserve much of the structure (Leventhal et al.2010).

Graham partnered with archaeologist David Pendergast in 1979 to address looting in Group B, which was seeing higher levels of illegal retrieval of artifacts at that time. This became a salvage operation, with archaeologists excavating and collecting as much data as possible to prevent further loss of information (Pendergast and Graham 1981).

The Xunantunich Archaeological Project and the Xunantunich Settlement Survey

The Xunantunich Archaeological Project (XAP) was established in 1991. The project was conceived by the Ministry of Tourism and the Environment and the Department of Archaeology in Belize to begin developing some of the archaeological sites in Belize for tourism (Leventhal 2010). Under the direction of Richard Leventhal, the XAP lasted six-years. By 1993, new maps of the site had already been developed using a combination of total station survey, and Surfer and GenericCAD software to create detailed depictions, not only of the site core, but also of the surrounding structure groups. From there, Leventhal, with colleague Wendy Ashmore from the University of Pennsylvania, began to focus more on excavation and further investigating the relationship of Xunantunich to its hinterlands.

The Xunantunich Settlement Survey (XSS) was established to achieve the latter goal. The XSS “sought to place Xunantunich withing the context of its hinterlands” (Leventhal 2010), analyzing how the city would have served the surrounding settlements and vice versa. The Belize River Valley became an area of interest for researcher from all fields during the 1990s, so the XSS had access to more detailed and accessible comparative data. More specifically, the project relied heavily on comparative data collected by the Barton Ramie Project, carried out by Gordon Willey (1965) in the 1950s.

Ashmore (2010) and her graduate students surveyed Xunantunich and the surrounding region from 1993-1995. Transects, starting at Xunantunich and ending at the Macal and Mopan Rivers, were marked, and surveyed. Settlements were found along the corridors, including sites like Chaa Creek and Rancho San Lorenzo. The team then excavated these sites, along with Chan Noohol and Dos Chombitos (see LeCount and Yaeger 2010). Concurrently, Jennifer Smith conducted a geomorphological study in the region. Overall, the XSS team concluded that well-drained uplands were able to sustain greater populations than the floodplains near the rivers and determined that Xunantunich’s hinterlands had a unique collection of resources, opportunities, and constraints.

By the mid-1990s, many structures at Xunantunich had remained unconsolidated, and the few structures that had already been conserved were in dire need of repair. Leventhal enlisted the help of the Getty Conservation Institute in 1994 to begin repairs on the western frieze of Str. A-6. A team from the Instituto Nacional de Antropología e Historia in Mexico determined that disparities between the salinity of the

stucco and limestone used in the construction and consolidation were too high, causing the rapid deterioration of the structures. The Getty Conservation Institute, aided by architectural consultant Carlos Rudy Larios Vallalta created a precise fiber glass replica of the western frieze, which was placed over the original to protect it from weathering and erosion. The large eastern frieze, however, did not receive similar attention.

Larios worked alongside Belizean Rubén Penados to conduct some limited stabilization of the first and second stories of Str. A-6 while concentrating more effort on consolidating the north and south faces of Str. A-1 (Leventhal 2010). With the knowledge that salt content of building materials could affect the life of the reconstruction, Larios and Penados reopened the ancient limestone quarries that were used by the Maya to build the original structures. Larios and Penados used limestone from these quarries and local soils and clays were mixed into lime mortar (Leventhal 2010). This continues to be the method used for consolidation at Xunantunich.

Archaeo-Tourism and the Tourism Development Project

Over the past few decades, Belize has become a popular vacation and tourism destination. Tourism is the largest of the tertiary economic sectors in the nation, which also includes other services such as communication, transport, and financial services. In fact, tourism accounted for 41.3% of GDP in 2017, and directly provided 21,000 jobs, contributing 13.4% of total employment (Belize Chamber 2024a). Indirectly, tourism accounted for 37.3% of total employment (59,000 jobs) in 2017. This is due in part to the development of infrastructure at archaeological parks, which are points of high interest for tourists visiting the country and provide an avenue through which

contemporary Maya communities can share their history and culture (Belize Chamber 2024c). This is known as archaeo-tourism.

During the XAP project, the Xunantunich archaeological park underwent construction to help further develop the infrastructure and transform it into a popular destination for tourists and locals alike. Architect Angela Hiltz designed a visitor's park area, complete with a new visitor's center, concessions, picnic areas, and storage facilities. The visitor's center focused on the political history of Xunantunich and the surrounding regions. A shelter was erected near Plaza A-II to house three carved stelae from the site core and Stela 1 from Actuncan (Leventhal 2010). In 1992, Xunantunich had around 8,000 foreign visitors and 8,000 Belizean national visitors per year. As of 2008, it was estimated that around 46,000 people visited Xunantunich each year (Belize Chamber 2024a, Leventhal 2010).

Between 2000 and 2004, the Belize Government launched an ambitious, country-wide, conservation program under the name of The Tourism Development Project (TDP). Directed and coordinated by Belizean archaeologists Drs. Jaime Awe and Allan Moore, the TDP was funded by the Belize Government and the Inter-American Development Bank. Xunantunich was among seven sites that were selected for further excavations and conservation by the TDP, with work supervised by Awe, Juan Louis Bonor, and Carolyn Audet (Leventhal 2010). The purpose of the TDP was to continue excavating and consolidating monumental architecture in the site core, and to improve tourist facilities at the park. In additions to the latter, the TDP also paved the access road to the center, constructed new restrooms, a large parking lot, gift shops, and administrative facilities within the park during the four-year long TDP. Strs A-4, A-6,

A-14, A-15, A-32, and Ballcourt 1 were excavated and conserved, and TDP archaeologists also partnered with University of Texas San Antonio archaeologist Jason Yaeger to excavate Str. A-11 in Plaza A-III (Leventhal 2010). Besides their work on several of the large buildings at the site, TDP archaeologists also made several significant discoveries such as Panel 2 and a Samal-Phase (600 – 670 CE) crypt in Str. A-4 (Audet 2006; Awe 2008). Inscriptions on Panel 2 are significant for they identify the original emblem glyph of the site as likely being ka-ta-wi-tzi (Helmke et al. 2010). The Str. A-4 crypt, which contained the remains of an elite male individual, represents the first royal burial reported for the site (Audet 2006; Awe 2008).

The Xunantunich Archaeology and Conservation (XAC) Project

In 2015, Jaime Awe of Northern Arizona University launched the Xunantunich Archaeology and Conservation (XAC) Project as a collaborative effort between his Belize Valley Archaeological Reconnaissance Project and the Belize Institute of Archaeology. Prior to the launch of the XACP, and during Awe's last year as Director of Belize's Institute of Archaeology, he had designed a display and produced graphical information for a new visitors' center at the site. The purpose of the XACP was to continue excavating and conserving the monumental architecture in the site core, and to further enhance the tourism potential of Xunantunich.

Since its inception in 2015, the ongoing XAC Project has conducted excavations and conservation on Strs. A-2, A-3, A-4, A-6, A-7, A-9, A-10, A-11, A-13, A-20, on Ballcourt 2, and in Group B. Results of this work have been significant, highlighted by the discovery of a royal tomb and the inscribed Panels 3 and 4 in Str. A-9, by the

recovery of numerous caches in Ballcourt 2 and other structures in the site core, by the Preclassic architecture buried within Str. A-7, and the more recent discovery of several stelae and altars near Str. A-1. Other important finds include ancient graffiti on the floors and rooms of several buildings, plus a sweat bath and evidence for post-abandonment rituals in Group B.

Xunantunich and Public Education

For many years, the Maya have remained a popular topic in K-12 history classes around the world. But in 1994, students in the United States were offered a unique opportunity to learn about the Maya in real time with archaeologists at Xunantunich through the JASON Project (Leventhal 2010; JASON Project 2023). JASON is a non-profit, online learning program, founded by Dr. Robert. D. Ballard in 1989 to provide fun learning experiences through science, technology, engineering, art, and math (STEAM). The Project works alongside donors and organizations such as National Geographic, the Smithsonian Institute, and many more. The “Belize 1994” leg of the project explored the natural ecology and archaeological history of Belize, specifically at Xunantunich (JASON Project 2023). Participants shared information and progress with students in the United States, called “argonauts,” via the program’s website and satellite uplink. Leventhal (2010), along with a team of archaeologists and graduate students, participated in the program to provide content and archaeological expertise for JASON (JASON Project, 2023).

Similarly, in 1995, a team of cyclists, led by brothers Dan and Steve Buettner, embarked on “MayaQuest,” an interactive expedition through the world of the Maya led

by students in classrooms across the United States (Hefte 1995; Leventhal 2010). The project spanned 12 weeks with cyclists visiting 15 archaeological sites across Mesoamerica, including Xunantunich. MayaQuest used a combination of state-of-the-art technologies for the time, including laptop computers and satellite modems, which connected the cyclist team to schools via Classroom PRODIGY, an online curriculum and learning service (Hefte 1995). Students were able to follow along and make decisions for the team, from what sites to visit and which experts to consult, to what to pack and what traditional or local foods to prepare. CNN Newsroom broadcasted nightly updates on the team's location and progress (Hefte 1995). Additionally, MayaQuest had a hotline that students could call that provided information about the project and updates. All of this was combined with a curriculum guide for educators which contained lesson plans revolving around Mesoamerican culture and history (Hefte 1995).

Not only has Xunantunich been the focal point of educational programs in the US, but it also served as the epicenter for local education programs. In the early to mid-1990s, Leventhal held a series of educational workshops for the Cayo Tour Guides Association to train new tour guides at the site (Leventhal 2010). This practice continues today with the ongoing work of the XAC Project which conducts training for tour guides in the region every summer so that it can impart new information about the site (Awe, personal communication, 2024). Additionally, people from nearby towns and villages have found seasonal employment at or around Xunantunich. Thanks to the archaeological projects, laborers can earn income by participating in excavations and management of the natural resources in the archaeological park. Some locals have established shops and stalls near the ferry that crosses the river to sell hand-crafted

items to site visitors, not to mention the local businesses, which thrive due to the many visitors brought to the area by archaeo-tourism.

Chapter 3: Methods

As this project is highly processual in nature, great emphasis was put on objectivity, rather than subjectivity and inferred conclusions. The schedule to complete the research was divided into three separate phases, each dedicated to a different stage of research and creating the deliverables. A project of this magnitude and method has never been attempted at Xunantunich and is a working example of practical research dissemination beyond the traditional article and book format, which few non-academics would be able to access. This is, however, a growing tradition, and this research serves to inspire other researchers and educators to take these lessons and apply them to their own research across Mesoamerica.

Theory informing methods

Educational centers, such as schools, are a place of both objective learning and places where one's own culture is taught. It is possible that colonial ideals can be recirculated into an existing curriculum if the foundation of that curriculum was developed by colonialist thinkers (Freire 1993). The goal, then, is to develop a method by which one can create educational material with input and collaboration from within the surrounding community (Freire 1993). It is paramount to remember inclusion and decolonization within this context (Cook 2018; Edwards-Ingram 1997; Garstki 2017; Grima 2017). Higher education and academia have existed as inherently colonial

forums, especially in anthropology and archaeology (Cook 2018). Applied archaeologists have a responsibility to the public to refrain from bias as much as possible and use language that promotes diversity, inclusion, and recognition of past and present peoples (Brighton 2011; Colwell-Chanthaphonh 2009; Edwards-Ingram 1997). This responsibility also includes the democratization of the archaeological process to ensure that all communities involved are served to the best of the researcher's capabilities (Fisher et al 2021). Democratization includes consistent collaboration throughout a project by focusing on what information can and cannot be shared with the greater public and ensuring that past and present cultures are accurately represented (Colwell-Chanthaphonh 2009, Fisher et al. 2021). This is an integral part of decolonization within the discipline.

Xunantunich was developed as part of the tourism industry in Belize, meaning that it also serves as an educational center for tourists and local visitors alike. I chose to focus on developing teaching tools using a basis of collaboration and accessibility, which will also open avenues of communications between local communities, tourists, and archaeologists, to support similar projects in the future. I define accessibility based on the Universal Design for Learning Guidelines (UDL Guidelines 2018). These models and the accompanying training guide aim to provide:

1. A mode of learning through which the observer can self-regulate their experience and learn at their own pace (UDL Guidelines 2018).
2. Collaborative and community-based learning (UDL Guidelines 2018).
3. A mechanical learning experience to supplement the current audio and visual-based training used by the tour guides associations (UDL Guidelines 2018).

4. Free resources to be used and kept by individuals training at Xunantunich that allow more time for personal study without needing to visit the site outside of training time (UDL Guidelines 2018).

Not only did I consult with local guides about what information they would like to see contained in the files I was creating, but I also focused heavily on developing these files for use in local schools to help further history and heritage education. In this respect, the project contributes to the Belize Valley Archaeological Reconnaissance (BVAR) Project's continued emphasis on community engagement, heritage education, and rural development in western Belize (Awe 2018, 2020a, b, In Press; Beardall 2021; Chase et al. 2020; Hoggarth et al. 2020).

Technology and Equipment

In this study, I was able to complete each task using relatively simple and affordable tools. The needed technology consisted of a digital camera, computing tablet, and an external hard drive. Photos were easily sorted using the files application on the tablet and stored on the hard drive, and professional modeling software was downloadable to the tablet.

I selected the Canon Rebel SL3 digital single-lens reflex (DSLR) camera for capturing photos. The Rebel SL3 comes equipped with an inner mirror, adjustable digital view screen, and numerous other features which make it ideal for use in the field. Aside from the camera body, I also used a detachable 18-50mm lens with a UV protective coating to help filter sunlight. While the Canon Rebel SL3 is considered an

amateur camera, it can take photos and videos with up to 4K resolution. I also purchased a Dell Latitude 7212 rugged tablet to sort photos and complete the process of creating and refining the digital models. The Latitude has an Intel® Core™ i5-7300 CPU and uses the Windows 10 standard operation. It is constructed with a tough outer shell to protect it from drops and impacts, making it near-standard for use in the field.

The modeling program I used was Agisoft Metashape v2.1.0. This is a user-friendly program that uses photogrammetric triangulation to create three-dimensional objects from a series of photographs. This function works in two different ways. The function that I have used here works by estimating the location, angle, and distance of the camera from the target object to create a point cloud. The application allows the user to edit the point cloud, or move forward by creating a 3D “mesh,” or blank textured surface in the shape of the target object. This mesh can also be edited before developing the texture, which is derived from combining, or “stitching” the images together to create a high-resolution image. The program then drapes this combined image over the mesh to create the complete model.

Phase I: Field Work

Phase I of this project was carried out at the site of Xunantunich in Belize for six weeks between June 1st and July 31st. The goal of this phase was to capture photographic images of significant structures within the site core. For purposes of this project, I define the term “significant structures” as structures that have been excavated, are conserved or in the process of being conserved, and are major points of interest on visitor tours. Knowing there were only a few weeks to capture my photos, I spent the

first week ranking structures from high priority to lower priority based on three guiding criteria: public interest, archaeological significance, and ease of access for taking photos. I began by joining a tour of the site and consulting with members of the local Tour Guide Association to determine which structures had the highest volume of frequently asked questions from visitors. I shadowed multiple tours of the site before conferring with BVAR directors to decide which structures had the greatest archaeological significance. Structures with established significance had priority over newer excavations given that they were more exposed and had been previously investigated.

The final step in the ranking process consisted of a self-guided observation to categorize each structure based on its accessibility and surroundings. Accessibility, in this sense, means my own ability to climb, summit, and safely navigate each structure. Terrestrial photogrammetry requires the photographer to have access to most parts of a structure, including all sides and the upper levels of construction. Although many of the structures at Xunantunich have been stabilized through restoration and conservation, some structures remain slightly unstable with no clear path or stairway to the top. This self-guided observation aimed to determine which structures were fully, partially, and nearly non-accessible. Structures with operational staircases were deemed fully accessible. Those with no staircase but that had undergone conservation and were easily climbable were categorized as partially accessible. And those structures that were mostly overgrown or unstable were considered nearly non-accessible.

Structures' natural and architectural surroundings were also evaluated for incorporation by the project, including the encompassing density of plant life and other

structures that may cast shadows. Analyzing this factor helped to avoid over-exposure and high-contrast shadows from uneven sunlight. By evaluating shadows on the structures at different times during the day, I avoided the need to edit and correct the contrast and brightness in each image. This also ensured the models were developed consistently and did not show any discoloration from nearby structures and plants.

I proceeded with taking photos of each structure after ranking them. Overall, the method was designed to be cost and time efficient and require little previous experience or training to perform tasks. No measurements were taken to determine where the camera should be positioned in relation to the structure, and all photos were taken from approximately five feet above ground level without the use of special rigs or drones to take photos from other heights. I positioned myself approximately 15 meters from the base of each structure and took photos in succession, beginning from and “origin point” on the base to the summit, turning slightly toward the rest of the structure, and photographing again from the summit to the base. I continued moving in a zig-zag pattern from left to right until the entire view of the structure had been photographed from one point, creating a “view set” (see Figure 3). After each view set was complete, I adjusted position by moving in six-meter increments parallel to the base of the structure process for each side of the structure, and then again at the vertical halfway point, as well as from the summit looking down each side.

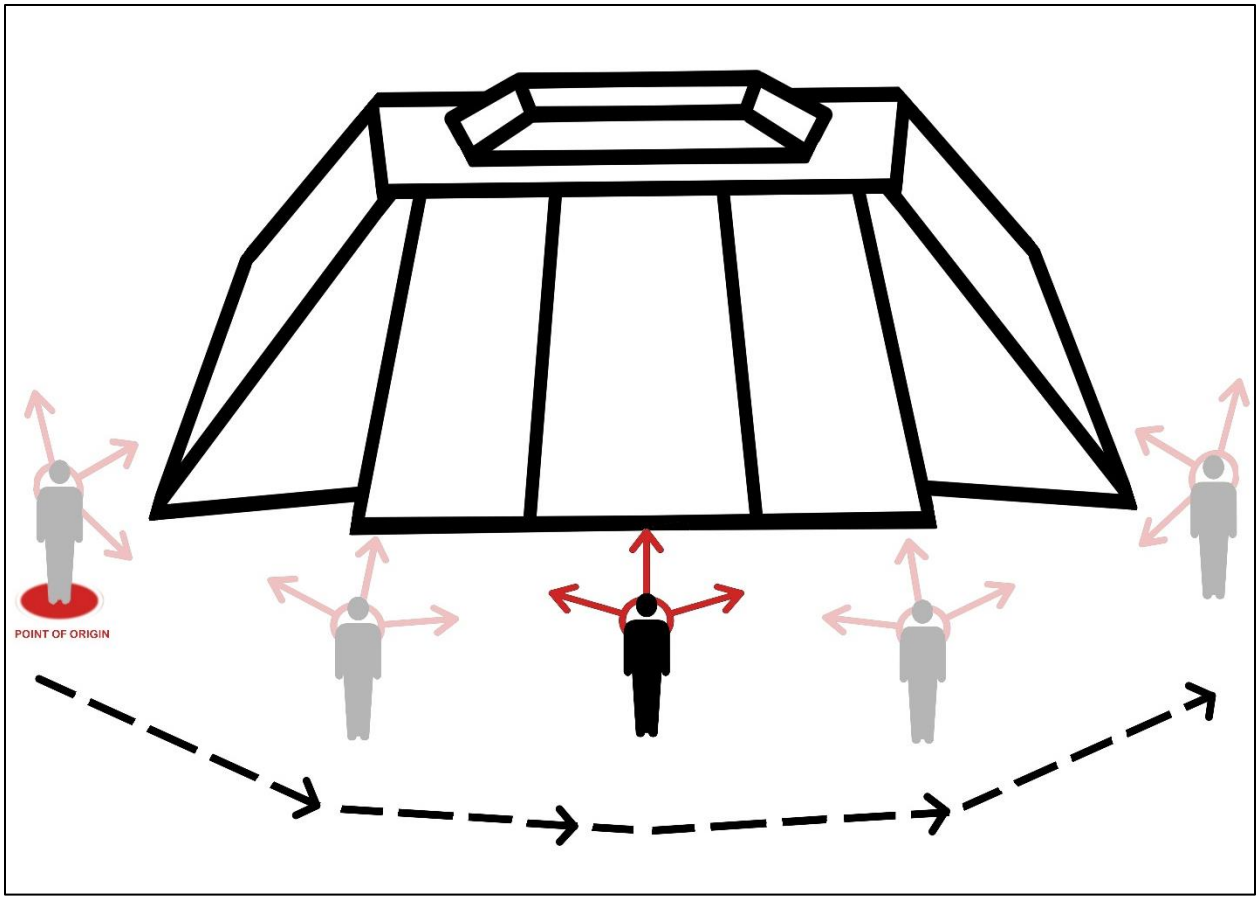


Figure 3 Visual representation of photogrammetric method. The photographer moves around the structure taking photos from the top of the structure to the bottom from a variety of angles, thereby creating a "view set." Figure by author.

Phase II: Refining models

The purpose of Phase II was to create and refine digital 3D models of each structure. Raw models were generated as view sets were completed concurrently with Phase I. These test models were intended to determine whether certain structures or parts of structures needed to be rephotographed. The process was carried out using Agisoft Metashape Pro software. This software is designed to be mostly self-regulating, meaning that it can perform a series of selected tasks without interference from the user until completion. Metashape algorithms can recognize stable objects in a series of images and create clouds of matching points generated from each image. It then produces a mesh, or rough 3D outline, based on measurements it estimates from the

photos and the existing point cloud. Once the mesh it complete, it is possible to add color and texture from the images used to render the point cloud and mesh. View sets were uploaded to the Agisoft Metashape program to render, often overnight or during off-site hours when other tasks took precedence.

Once the models were complete, I judged them based on visual accuracy. Visual accuracy depends on the appearance of holes, lack of texture in areas, and overall shape of the model once it is complete. A model with 85% or higher visual accuracy is considered successful, while partial models and models with 70-84% visual accuracy are considered partially successful and models with 69% or lower visual accuracy are considered unsuccessful. Visual accuracy is determined by a series of non-metric photo comparisons where completed models are visually compared to photos taken of the corresponding structure. Models which fell into the partially successful or unsuccessful categories were selected for photo retakes and then rendered again. Successful models moved on to the editing stage of this phase.

In Agisoft Metashape, users can highlight and clip sections of the workable model after it has finished rendering. In this case, I removed extra foliage and any sections of the models that were warped or out-of-shape, leaving only the desired shapes and structures behind. After cleaning and refining the models, they must be decimated to be accessible on mobile devices. Decimation, also known as “down sampling,” is a process that resamples the points in a digital model and reduces the amount of data within them. This procedure combines pixels together, makes the files smaller and more friendly to devices with less processing power such as cellphones and tablets. Each model was saved as an object (OBJ) file and then transferred individually to Sketchfab.

Sketchfab is an online model publishing community which allows users to post, download, and obtain model data like specifications and measurements for personal use. I uploaded my models on private mode, so they were only viewable by myself or a person with the link to view them. The models were closed to the public and made accessible to members of the tour guides association to ensure they were used for their intended purpose and to protect any identifiable information within the models that may put the structures at risk. Although the intention is to make easily accessible content for learners, these models have been developed as part of a pilot project, and therefore should only be available to the communities and groups who have asked for them specifically. I used Sketchfab functions to facilitate the addition of text boxes and interactive components to the OBJ files as well. This is what permits tourists and students to interact with the models, turning them to see the structures from different angles. I used this feature to create points of interest, or POI's, which are interactive features denoted by a number symbol. When tapped or clicked, each point produces the structure's "blurb." Each structure has a minimum of three POIs that viewers can interact with.

Phase III: Developing the training guide

Phase III emphasized creating the non-virtual teaching material. Data was gathered from a series of publications and reports from past excavations at Xunantunich. These reports included the 1992-1997 Xunantunich Archaeological Project seasonal reports and the 2010 – 2022 BVAR project seasonal reports, as well as a number of unpublished theses and dissertations from the project's history. This

data included facts about a structure's architecture, how it relates to Maya history, and information about its archaeological significance. This was then compiled into informational "blurbs," which were organized to accompany each respective model. A "blurb" is a short fact or description of part of a structure or its history. These blurbs were divided into two groups, with much of the information overlapping between the two categories. First, the "model blurbs," which accompany the digital teaching models as interactive points within the digital experience. And second, the "guide blurbs," which are in-depth descriptions included in the non-virtual tour guide training material.

Chapter 4: Results

The purpose of this study was to develop and analyze a method of creating interactive material for public education. To create accessible materials and an accessible method of development, I recorded not only the success and failures of this project, but also my own experiences. Furthermore, the study looked to define a cost-effective way of creating educational materials, and judging whether the project could be completed using a relatively low-budget and affordable equipment. These results bar the need for travel and room and board expenses, focusing solely on the price of materials.

Modeling Results

I photographed 17 separate structures and carved features in the site core (see Figures 4 and 5) averaging two to three structures per day of field work and captured

7,196 photos in total. Some structures and their associated surroundings were modeled more than once, so a total of 22 models were rendered with varying degrees of success. For purposes of this study, I define successful models as models that had a high visual accuracy. There were ten successful models, four partially successful models, and eight failed models. Overall, the models had a 45% success rate, an 8% partial success rate, and a 36% failure rate.

Str. A-1 was the most photographed structure with 1,918 images in total over two rendered models. The first model, A-1a consisted of 491 photos, whereas the second model, A-1b consisted of 1,427 photos. Both models were unsuccessful. Str. A-2 produced one model from 305 photos but was unsuccessful. Str. A-3 produced one successful model from 416 photos, and Str. A-4 produced one partially successful model from 416 photos. On the western side of Plaza A-I, Str. A-7 produced two models from a total of 569 photos. Model A-7a, which was a model of the entire structure, consisted of 473 photos but was unsuccessful. Model A-7b, which was a model of the front, east-facing flank of A-7, consisted of 96 photos and was partially successful. Str. A-9 and its surrounding monuments produced the most models, with 639 photos generating five models. The models of Panels 3 and 4 were successful, and the model of Stela 4, which lays in front of the main stair of Str. A-9 was partially successful. The model of the entirety of Str. A-9 failed, but the model of the front of the structure was partially successful.

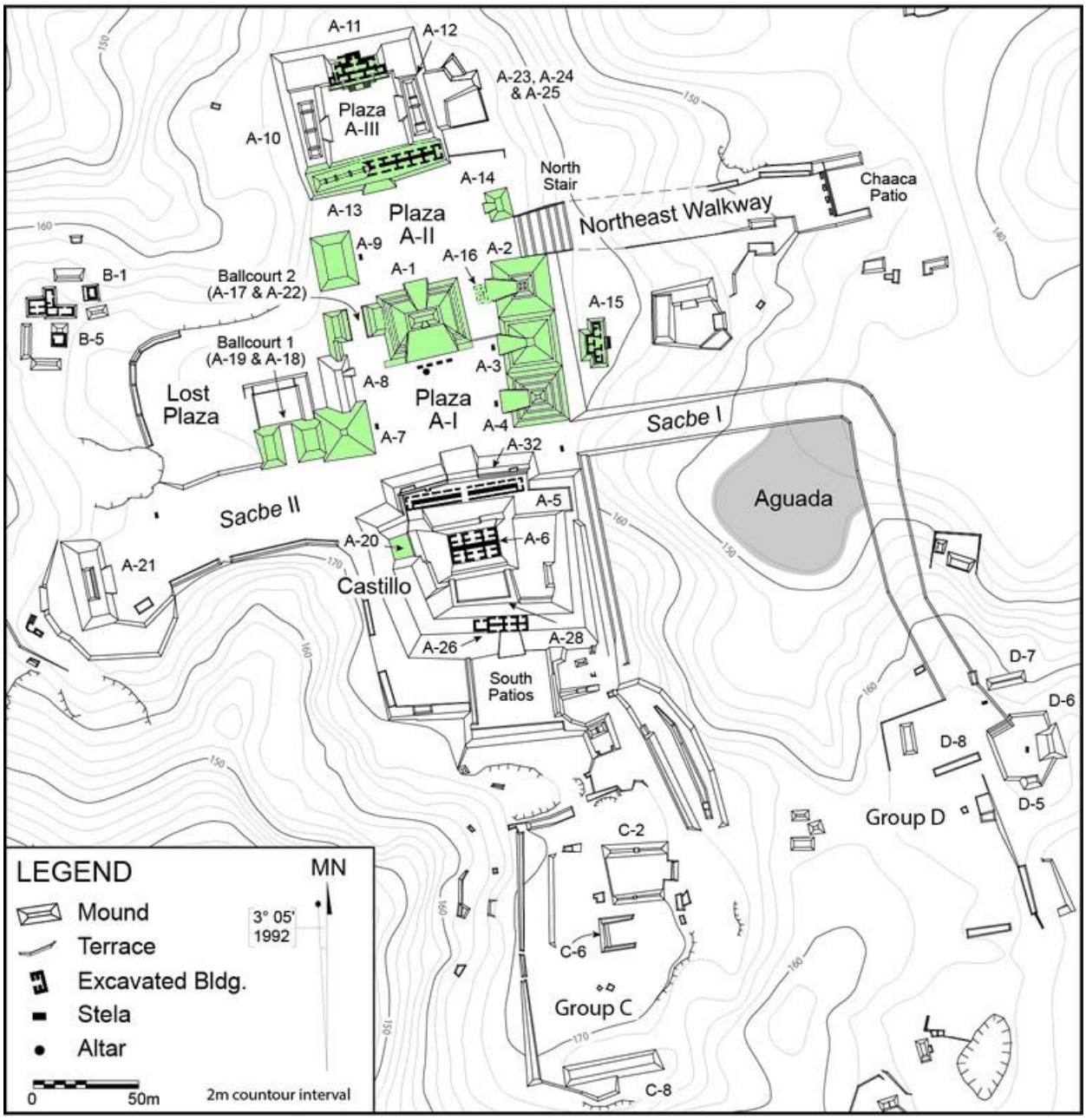


Figure 4 Map of structures with project-inclusive structures highlighted in green. Adapted from map by Lisa LeCount from LeCount & Yaeger (2010). Adapted by author.

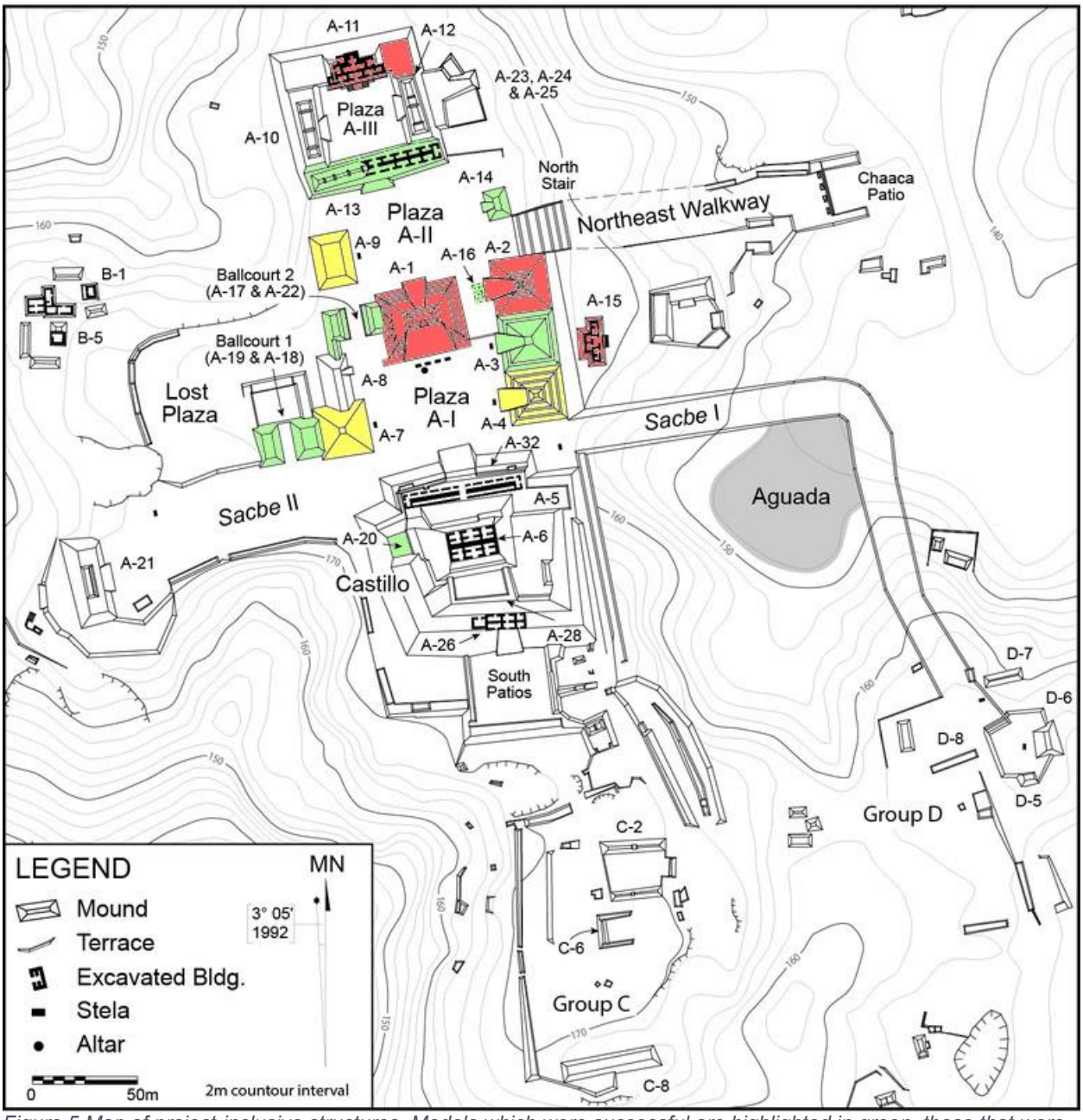


Figure 5 Map of project-inclusive structures. Models which were successful are highlighted in green, those that were unsuccessful are in red, and mixed successes are in yellow. Adapted from map by Lisa LeCount from LeCount & Yaeger (2010). Adapted by author.

Str. A-11 generated one model from 690 photos but was unsuccessful. Str. A-13 was modeled in two separate pieces, the North façade and South façade, from 826 photos. Model A-13a, the South façade of the structure, consisted of 489 photos and model A-13b, showing the North façade consisted of 337 photos. Both models were successful, though combining the models to represent the entire structure as one piece was unsuccessful. Str. A-14 generated one successful model from 283 photos. Str. A-15 produced one unsuccessful model from 243 photos and Str. A-16 produced one successful model from 279 photos. Str. A-20 produced two models from a total of 295 photos. Model A-20a consisted of 125 photos and was unsuccessful. Model A-20b consisted of 170 photos and was successful. Ballcourt 1 (BC-1) produced one successful model from 184 photos. The least photographed structures were those comprising Ballcourt 2 (BC-2). Using only 137 photos I was able to produce a successful model of this ballcourt.

Cost of Equipment

The cost of equipment and software used for this project totaled around $1,960. The Canon Rebel SL3 DSLR camera kit, which includes the 18-55mm lens attachment, cost around $750. The Dell Latitude 7212 rugged tablet cost $850 refurbished. A new tablet usually costs around $1,200. Both items had to be shipped, each with a fee of around 10% of the cost of the item added for protection and carrier insurance. The Agisoft Metashape Standard Edition software cost $179 for one year for a node-locked license. The professional version of this software, not used here, costs just short of

$4,000, but includes a few additional features that are not necessary for use in the method applied in this project.

Time Commitment and Physical Requirements

The first phase of this project required the entirety of the original six-week time commitment I had estimated for being in the field. I attended four separate site tours, including one-on-one tours and group tours. These tours, coupled with the time it took to properly rank structures by priority used one week of the allotted time in the field. Conversations and collaborative efforts with local guides could not be completed in a single day due to circumstances beyond my control, and therefore had to be completed over several days, using one of the six weeks. In total, the preliminary preparations for Phase I totaled two of the six weeks.

As for the initial modeling completed during Phase I, the time commitment varied by day and structures rendered. I photographed structures for nine days during this six-week period for six hours per day. Time dedicated to photography tallied around 54 hours. Around one hour was spent each night sorting and creating backup copies of the photos from that day and days prior. Models averaged around 327 photos each and were rendered during off-hours. It took three to five hours on average to complete each model with some models, such as Str. A-1, taking as long as eight hours to complete.

During the second phase of the project, around 30 hours was dedicated to editing and exporting the successful models. This also included the model decimation process and selecting sets of images to represent structures that did not produce a

successful model for inclusion in the digital teaching material. Another 150 hours was dedicated to researching and writing the non-virtual structure guide.

Physical requirements for conducting the field component of this project are minimal to moderate and mostly isolated within the field work phase. The photographer must have the ability to climb, stand, bend, and walk for several hours at a time. Most images were taken from the ground level around structure perimeters. However, some photos had to be taken from elevated positions and even the summits of structures. The ability to climb up steep stairs or slopes multiple times per day, as well as a basic knowledge of climbing without specialized gear were required. Some structures involved more strenuous activity than others. Str. A-2, for example, has no accessible stair, meaning that the structure must be scaled carefully to capture images from the summit.

The second and third phases of this project require little physical ability aside from being able to sit for long periods of time when editing models and writing report summaries for structures.

Chapter 5: Xunantunich: A Guide through the Ancient City

Xunantunich was a major sociopolitical center during its occupation, and this is reflected in its monumental architecture and general layout of the site. Excavations within site core Group A have produced unique finds that help us to better understand the role that Xunantunich played locally in the upper Belize River Valley, and regionally in the eastern Maya lowlands. From local diagnostic ceramics to evidence for foreign influences throughout the site, Xunantunich provides intriguing data and clues for

addressing archaeological research questions, while also presenting new perspectives about the city's occupation and decline.

Description of the Site Core

The site core at Xunantunich is aligned on a North-South axis and divided into three main plazas (see Figure 6). Plaza A-I is the most southward plaza, with Plaza A-II being most central, and Plaza-AIII located to the north. Several sacbeob lead to the core and connect it with outlying structures groups. For example, Sacbe I connects Plaza A-I to the Group D to the southeast, while Sacbe II connects Plaza A-I to Str. A-21 to the west. A modern walkway connects the lower visitor's center and parking area to the north stair, which leads into Plaza A-II.

Plazas A-I and A-II are bisected by Str. A-1, which is located at the center of the core. Plaza A-I is bordered by Str. A-1 to the north, Str. A-7 to the west, Str. A-4 to the east, and the infamous El Castillo (Str. A-6) to the south. Adjacent to Str. A-1 is Str. A-3, which rests on the eastern edge of the core between Plazas A-I and A-II. To the west of Str. A-1 is Str. A-8, which connects Strs. A-7 and A-9 and establishes a barrier between the main plazas and the Ballcourt 1 area to the west (Strs. A-19 and A-18).

Plaza A-II is bordered by Str. A-1 to the south, Strs. A-2 and A-14 to the east, Str. A-13 to the north, and Str. A-9 to the west. At the base of the main stair of Str. A-2 is Str. A-16 which is a stela house. On the western side of Str. A-1, Ballcourt 2 opens into Plaza A-II, aligned north-south with the rest of the site (Str. A-17 and A-22). Str. A-13 is a long structure which acts as a divider between Plaza A-II and Plaza A-III.

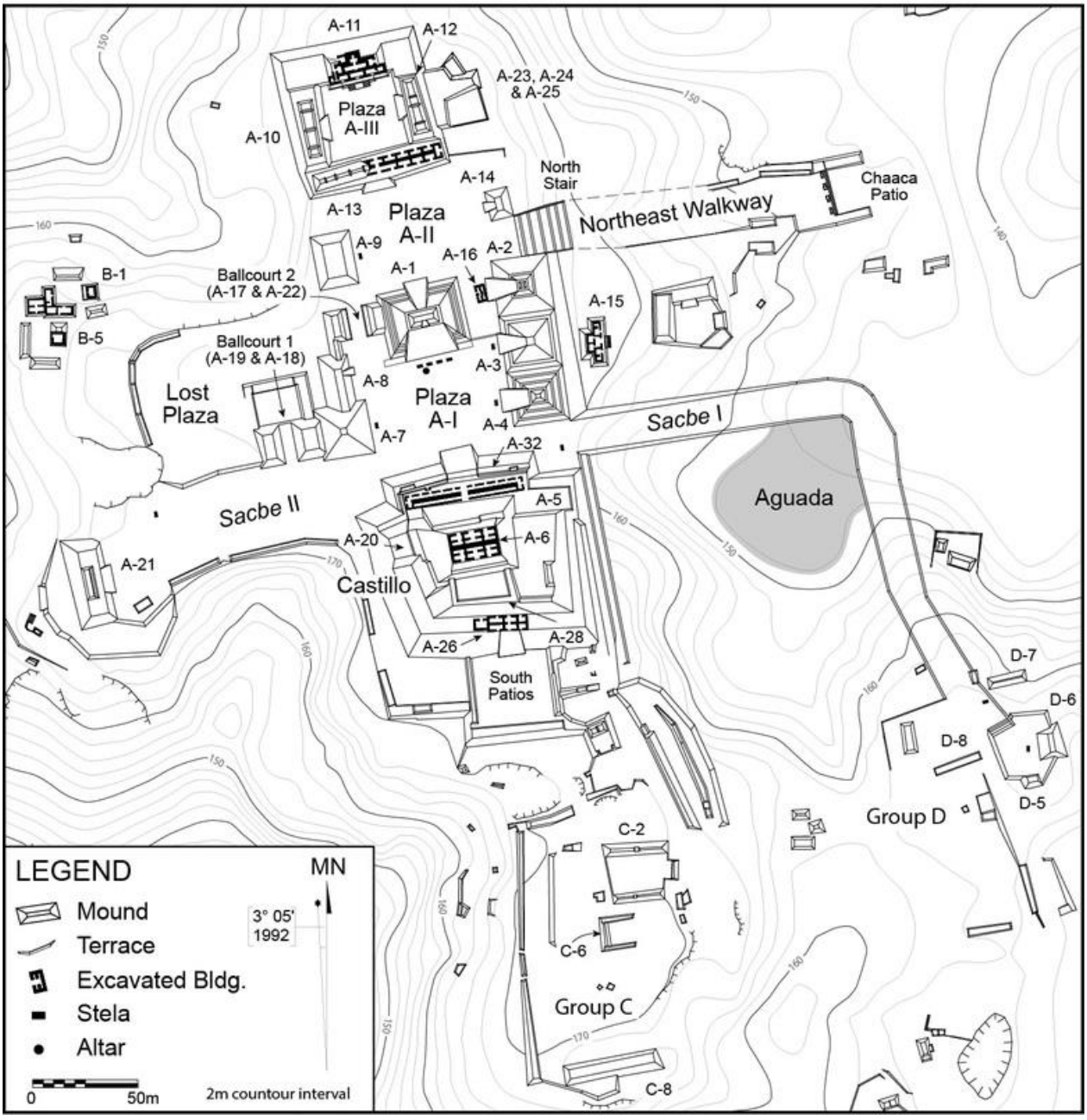


Figure 6 Map of the Xunantunich site core by Lisa LeCount from LeCount & Yaeger (2010).

Plaza A-III, otherwise known as the palace complex, is located at the northernmost extreme of the site core. The plaza consists of Str. A-13 to the south, Str. A-12 to the east, Str. A-11 to the north, and Str. A-10 to the west. To the east of Str. A-12 are Strs. A-23, A-24, and A-25. Due to its closed-in nature, Plaza A-III is significantly smaller than Plazas A-I and A-II.

Located to the northwest, and separated from the main site core is Group B, a relatively small collection of residences. Included among these structures is a sweat bath. The group follows the alignment of the rest of the site core and is home to two major structures. The first, Str. B-1, is located to the northeast of the main group. The second, Str. B-5, is part of the southern portion of the group. In spite of its separation from the site core, Group B remains a popular point of interest for tourists and visitors to Xunantunich.

The Eastern Triadic Shrine

The Eastern Triadic Shrine at Xunantunich is represented by Structure A-2, A-3, and A-4. These structures lie on the eastern side of Plaza A-I and were built in the Late Classic period (Awe et al. 2017; Jamison & Wolff 1994; Lewis 1996; Santasilia & Tilden 2016). An eastern triadic shrine is a configuration of three adjoining temples aligned north to south and located on the east side of major epicentral courtyards (Awe 2019; Awe et al. 2017). Variations of this arrangement of structures can be found throughout the Maya world. During the Preclassic period, these triadic assemblages served astronomical purposes that were associated with recording the passages of the solstices and equinoxes. Later, during the Classic Period, they were converted to

shrines and used as mausoleums or burial places for the ruling elite (Awe et al. 2017). Awe (2019) also recently posited that eastern triadic shrines may have been converted to funerary temples because, architecturally, they represent the three-hearthstone place that is described in the *Popol Vuh*, or the Maya creation myth. As such, the perception is that rulers interred within these temples would, like the sun, resurrect from these easterly locations.

Structure A-2 which borders Plaza A-II, is the northernmost temple of Xunantunich's Eastern Triadic assemblage. Sometime during the end of the Late Classic Period (800-900 CE), Structure A-16 was constructed directly in front (west) of Str. A-2, almost blocking access to the stairway of Str. A-2 (Etheridge 1996). This small structure is believed to be a stela house. Stelae, which are carved stone monuments, were often erected in front of important structures and, in some cases, had shelter houses built around them to highlight the importance of the stela or to protect them from the elements. Evidence shows that the main stairs on the western façade of Str. A-2 were cut to make room for Str. A-16. While Str. A-16 is not technically part of the eastern triadic, its proximity and relation to Str. A-2 make it a relevant addition to the eastern triadic portion of this guide.

Structure A-3 is the central structure in the Eastern Triadic Shrine at Xunantunich and is 16 meters tall and 24 meters wide (Santasilia & Tilden 2016). This structure is also a few meters to the east of Str. A-1. A low, 45-centimeter wall, called Motmot wall, extends from the southeastern corner of Str. A-1 to the southwestern edge of Str. A-3. Its placement suggests that it was constructed sometime after the addition of Str. A1, and likely during the disintegration or decline of the ancient city. Its construction would

have served to cut access into Plaza A1, thereby further separating Plazas A-I and A-II. Around the same time, several other peri-abandonment platforms were constructed in front of the Triadic group, the Castillo (Str. A6), and Str. A1.

Excavations by the XAC Project in 2015 discovered a cache (Cache A3-1) of nine chert eccentrics and nine obsidian eccentrics behind the first basal step of Str. A-3 (Santasilia & Tilden 2016). Zachary Hruby (Personal communication to Santasilia, 2015) concluded that the cache is indicative of interment during the Late Classic period (Santasilia & Tilden 2016) and that the eccentrics ranged between ceremonial and utilitarian shapes. A second cache was also discovered within the fill of Structure A-3, just east of the location of Cache A3-1. This second cache contained two large jade beads, an obsidian bloodletter and a clam shell. The presence and exotic nature of some of these items suggests social and economic inequality, and add to the ideological significance of Str. A-3 and the Eastern Triadic Shrine (Santasilia & Tilden 2016).

Structure A-4 is the southernmost structure of the Eastern Triadic assemblage, and the closest in relation to the Castillo. It was first excavated by Jaime Awe as part of the Tourism Development Project in 2002 (Audet 2006; Awe 2008; Tilden et al 2017). Str. A-4 is known to have had at least two major phases of construction (Awe 2008; Jamison 2010; Tilden et al. 2017). Within the Str. A-4-2nd substructure, TDP archaeologists excavated a burial crypt (Audet 2006; Santasilia & Tilden 2016) containing the remains of an adult male accompanied by two partial polychrome vessels, seven eccentrics, three obsidian blades, an obsidian core, and two jade beads. The individual in the crypt had been placed in typical Belize Valley burial pattern with head to the south and in an extended position. At the summit of the structure, directly on

the surface of the floor, was a Terminal Classic cache. This cache contained the skeletal remains of two individuals in addition to the skulls of three other individuals (Audet 2006; Santasilia & Tilden 2016).

Plaza A-I

Structure A-1 is in the center of the main core of the site, in a location that bisects and separates Plaza A-I from Plaza A-II. Being one of the most prominent architectural features at Xunantunich, many early excavations took place in and around this structure. At the turn of the 1900s, for example, Thomas Gann (1925:71) noted that villagers from San Jose Succotz would often stop by an altar on the southern base of the structure to say a few prayers and leave offerings. Many years later, Belize Archaeological Commissioner Peter Schmidt (1974) partially excavated the northern stairway of A1, and he also placed units beneath Stelae 8 and 10, and below a plain altar at the base of the temple. In 1992, the Xunantunich Archaeological Project (XAP) began the first full comprehensive investigation of Str. A-1. The north and south faces of the structure were exposed along with a summit platform (Jamison 1992). Excavations into the platform uncovered a simple burial of an adult in extended position and head to the south. Except for a few potsherds, no artifacts were found with the burial. XAP archaeologists noted that Structure A1 was constructed in a single construction phase with possibly two later minor modifications.

Researchers (Zeleznik 1993) also found that the fill used inside the structure was divided into “bins” or construction pens which were separated by stone walls. Curiously, these bins were different sizes and depths and there was little uniformity. Each bin was

filled with a different material, suggesting that different groups or families may have been assisting in the construction of Str. A-1 and were therefore excavating their own materials from the surrounding area to use as building fill (Zeleznik 1993).

Much of Str. A-1 was eroded or collapsed before the initiation of the XAP project, and it is thought that some of the material from Str. A-1 was removed and reused by the Maya for later constructions during the decline of the city. The XAP excavations also revealed that Str. A-1 was constructed during the Late Classic Period around 700 CE. It was further determined that Str. A-1 was not original to the site core but was a much later addition. Originally, Plazas A-I and A-II were a single, large plaza, but Str. A-1 was later built in a place that essentially divided the large plaza in half thereby creating Plazas A-I and A-II (Jamison 1992; Zeleznik 1993). There have been many theories as to why Str. A-1 was built, but the most likely conclusion is that the structure served as a barrier between the more private, elite-centered northern plaza (A-II) and the public southern plaza (A-I). The period of its construction suggests that this may have been a show of control, creating a more limited space where the public could gather for ceremonies and events (Jamison 1992; Zeleznik 1993).

This theory is further supported by evidence of the aforementioned low-lying Motmot wall that runs between Plazas A-I and A-II from the southeast corner of Str. A-1 to the base of Str. A-3 in the Eastern Triadic Shrine. The southern vertical face of the Motmot wall appears to have been well constructed and possibly even finished, whereas the northern face of the wall was not, meaning that it may have been free-standing and possibly built into the ground. The slight elevation difference between Plaza A-I and Plaza A-II, with the latter being higher than the former, suggests that this

wall would have also served as architecture to demarcate the boundary between the public plaza and the private plaza. In other words, this series of constructions were meant to make it clear to the public that anything beyond the wall to the north was off-limits if one was not an elite.

Increased excavation activity at the structure caused it to become increasingly unstable, and the consolidation efforts began during the 1993 field season. Although a plan had not yet been developed to consolidate the architectures at Xunantunich, the instability of Str. A-1 prompted research into local building materials like those used by the Maya during the original construction of the city. During the 1993 field season, consolidation teams managed to repair and conserve some portions of the second terrace retaining wall and the second terrace level, as well as portions of the third terrace retaining wall. This was in addition to the other consolidation project which mainly focused on the badly deteriorated northern face of Str. A-1. A more detailed plan, including a system of materials and a labor force to complete the task were developed during the 1993 and 1994 field seasons. This plan was finalized just in time, as a near-completed excavation trench collapsed during work in 1994 after intersecting with another excavation unit located at the southern stairs. Excavations were halted at Str. A-1 after this event, and consolidation of the exterior of the structure became a priority.

Several carved stela and altars were uncovered in association with Str. A-1 over the course of its excavation history. Stela 1 (849 CE) was discovered at part of a row od four stelae and three altars at the southern base of Str. A-1 (Helmke et al. 2010). The monument was first reported in 1891 (Helmke et al. 2010), and therefore was badly eroded, almost beyond recognition (Gann 1925, Helmke et al. 2010, Maler 1908, Morely

1937-1938). Excavations around the stela produced a dedicatory cache of chert eccentric lithics (Gann 1925, Helmke et al. 2010, Morley 1937-1938).

Stela 8 (820 CE) was found as part of the main monument group (Graham 1978, Helmke et al. 2010). The stela depicts a royal figure facing to the left. They are surrounded by feathers and dressed in royal battle attire including a headdress and a "back rack," which is fastened across their chest with a cloth strap (Helmke et al. 2010). Archaeologists (Grube & Schele 1995, Helmke et al. 2010) theorize that the eroded glyphs on the stela describe an event related to an important period ending, or rituals associated with the ending of a temporal cycle.

Further analysis of the figure on Stela 8 suggest that this person is from the nearby polity of Naranjo, which is believed to have ruled over Xunantunich for much of the city's occupation. Although the name of the figure is eroded, many of the visible glyphs bear similarity to those associated with the name of the last known ruler of the Naranjo dynasty, Waxaklajuun Ub'ah K'awil (Helmke et al. 2010, Martin & Grube 2008). The monument also bears the same date as the last monument in Naranjo, which refers to similar events taking place there only 13 kilometers away (Helmke et al. 2010, Martin & Grube 2008).

Stela 9 was discovered in the same cluster of monuments as Stela 8 was poorly preserved (Helmke et al. 2010). The iconography of Stela 9 is highly similar to Stela 8 as well, suggesting that it may have been made by the same sculptor and may represent the same ruling figure. Unfortunately, due to the sever erosion of the stela surface, not much else can be concluded about Stela 9 or the event it describes (Helmke et al. 2010).

Altar 1 (849 CE) was uncovered near Stela 1 in 1905 (Maler 1908) but had been significantly eroded over time (Helmke et al. 2010). Unfortunately, Thomas Gann (1925, Graham 1978, Morley 1937-1938) “trimmed” the altar to make shipping it to the British Museum easier. In the process of doing so, Gann cut off the entirety of the remaining text (Graham 1978, Helmke et al. 2010). In 1994, XAP archaeologists re-discovered some fragments that broke off before Gann’s discovery while excavating at the base of Str. A-1 (Helmke et al. 2010). Combined research into previous descriptions and sketches of the altar, combined with the discovery of these fragments, reveal the original design on the altar. The altar depicts a crouching skeletal figure known only as God A (Helmke et al. 2010, Miller & Taube 1993, Schellhas 1897, 1904, Taube 1992). The glyphs on the altar describe the exhumation of an individual who had been presumably buried within Str. A-1 (Helmke et al. 2010).

Structure A-6, referred to here by its more colloquial name “Castillo” is located at the southernmost edge of the site core. This monumental pyramid is the largest structure at Xunantunich and the second tallest in Belize, rising 40 meters (130 feet) above the plazas below (Awe 2008). In its present form, the architecture exposed on the Castillo is represented by two construction phases or episodes: A-6-2nd, the lower, wider foundation of the structure, and A-6-1st, the upper, more ornate construction. Research on Castillo began in the 1950s (Department of Archaeology 1970, 1991; Leventhal et al. 1992; Mackie 1961, 1985; Miller 1996; Robin 1994; Sanchez 1993; Satterthwaite 1950, 1951) focused primarily on A-6-1st and its construction. More recently, four other projects have investigated this massive structure, the XAP, the TDP, the XACP, and the Mopan Valley Preclassic Project.

Some preliminary investigations of the Castillo were initiated by the XAP project in 1992, but thorough excavations did not begin until 1993. In that year, the western frieze was uncovered on the western flank of A-6-1st, like the eastern frieze discovered decades before by A. H. Anderson in 1949. The western frieze contained several motifs found throughout the Maya world at sites like Piedras Negras, Caracol, Palenque, and Quirigua. Images like the “skyband,” which is considered a symbol of accession, appear here, denoting that the poorly preserved carvings may have once represented a ruler (Fields 2004, Miller 1996). Although there is evidence of a ruler being carved into the frieze, it seems to have been purposefully defaced.

The western frieze was in poor condition when it was uncovered and showed evidence of cracks from centuries of hurricanes and earthquakes in the region, which were also present on other parts of Castillo. Preliminary sketches were made of the frieze’s intricate design which appeared to have references to auto-sacrifice, ancestors, and the underworld (its eastern counterpart appeared to contain references to morning and the movement of celestial bodies like the sun, moon, and Venus) and the frieze was reburied during the 1993 field season (LeCount & Yaeger 2010, Miller 1995). Rather than rebury the frieze in soil, archaeologists consulted with conservation experts and decided to use a lime mixture to patch and repair cracks in the façade, and a wall was erected in front of the frieze which was filled in behind with limestone *sascab*. During the 1994 field season, both the western and eastern friezes were re-excavated and rehabilitated (LeCount & Yaeger 2010, Leventhal 2010). Then, in 1996, XAP project directors decided to construct a fiber glass replica of the western frieze and to mount

this replica on top of the original frieze. This replica is now what's visible to visitors at the site.

Five years later, between 2001 and 2002, the Tourism Development Project renewed conservation efforts on Str. A6. Besides excavating and conserving the central or northern stairway of the Castillo, the TDP also excavated and conserved Str. A32 (see below) as well as the eastern frieze. Like the case with the western frieze, the TDP produced a fiber glass replica of the east frieze, reburied the original, then mounted the replica over it.

A study by iconographer Virginia Fields (2004) suggests that the two friezes decorating Str. A-6-2nd both focus on creation and celestial themes, and they place rulers at the center of these events. The east frieze, for example, has an upper and lower register. The upper register depicts part of a serpent-headed throne that is flanked by two sky bearers. Directly below the seated figure, in the lower register, is a long-lipped deity with a cross-band over his forehead that identifies him with Chak Xib Chak, a rain deity. Flanking the central mask on the lower register are two other masks that depict Pax gods that are associated with the world tree (Fields 2004).

The western frieze, like its counterpart to the east, is also decorated with ideological imagery on two registers. At the north end of the upper register of the western frieze there is a partly preserved figure of a seated individual flanked by two sky bearers. The sky bearer to the right appears to hold a long cord. To the south of this sky bearer is a shell depicted in cross section. Beyond this point, only the lower sections of three columns remain preserved. The preserved section of the lower register depicts three main figures. Directly below the seated figure on the upper register is a mask with

a K'awil headdress, T-shaped teeth, axe eyes, and barbels that emanate from its mouth. Interestingly, some of the features of this mask associate it with the sun deity, and with the world tree. To the right of this mask is depicted the profile head of a deity with an axe eye and flame coming out of its forehead. The latter feature is generally associated with K'awil, a patron of rulers. According to Fields (1974:186), "rulers who wear the smoking axe of K'awil primarily do so after death." The third, and central mask on the lower register appears to have crossed eyes, tau tooth, and barbels coming out the sides of its mouth, features that are generally associated with sun gods.

In addition to the now iconic friezes atop the Castillo, archaeologists also discovered Panel 2 (Helmke et al. 2010). Panel 2, which was likely carved between 780 and 820 CE, was discovered in 2003 by the Tourism Development Project. The panel contains a description of dynastic activity at Xunantunich, and the glyphs on its surface are very well preserved (Helmke et al. 2010). The panel also refers to Monpan, a cave site located about 90 kilometers south of Xunantunich (Helmke et al. 2006, Helmke et al. 2010). Due to etymological variables and the evolution of language and writing, the panel may also refer to the much closer Mopan River, which runs at the base of the hill where the city was built (Helmke et al. 2010). After analyzing the text, archaeologists concluded that the panel describes some kind of event that happened near Xunantunich (Helmke et al. 2006, Helmke et al. 2010).

Structure A-7 is located on the western edge of Plaza A-I just northwest of the Castillo. The first excavations on Str. A-7 were carried out by Thomas Gann (1925) in the 1920. Gann's early investigations uncovered a relatively sizable cache that included fragments of human remains, over 200 flint cores, 35 bifaces with five eccentrics, and a

number of other natural and worked materials indicating some kind of elite activity. Gann even proposed that Str. A-7 must be the burial place of the royal jeweler given the amount of material within the cache that could be worked into personal adornments such as shells and white stone beads (Gann 1925; Tilden et al. 2017).

After a very long hiatus, excavations of Str. A-7 were renewed in 2016 by the Northern Arizona University XAC Project under the direction of Jaime Awe. The main goals of the XAC Project investigations were to locate “Gann’s wall,” a wall of “squared stones” (Gann 1925) that Gann found while excavating the structure, to determine the sequence of architectural modifications on the mound, and to prepare the structure for tourism-related conservation purposes. During the 2016 season (Tilden et al. 2017), XACP archaeologists discovered what appeared to be a central staircase located on the east face of Str. A-7. Several of the facing stones of this stairway were missing and apparently removed, a common practice during the Terminal Classic period (Tilden et al. 2017). While normal construction at Xunantunich consists of construction pens filled with a variety of materials, such as those use in Str. A-1 and the Castillo (Miller 1996, Tilden et al 2017). Str. A-7 did not utilize this method of construction. Instead, archaeologists discovered that most of the fill was mortar with cut or rough stones placed intentionally within the mortar (Tilden et al. 2017).

Excavations by the NAU project continue to investigate Str. A-7 and have uncovered four total constructions phases within the structure. The earliest construction phase of A-7, designated as A-7-1st dates to the Middle to Late Preclassic period (Watkins et al. 2019). The last phase of Str. A-7-4th is represented by the outer or final phase of construction that is visible from Plaza A-I. Str. A-7-3rd was given to the phase

of construction beneath A-7-4th, and A-7-2nd below that. During excavation, a number of rooms were located inside Str. A-7-3rd. Room 1 appears to have been intentionally closed off, and Room 2 was constructed sometime after its closure (Watkins et al. 2019).

Several notable cultural remains were found in Str. A-7 during the 2017 and 2018 seasons, including modeled stucco fragments with preserved red pigment, with one fragment having preserved blue pigment as well (Watkins et al. 2019), graffiti incised on the walls of a room in Str. A7-3rd, and three artifact caches. The first cache found in Str. A-7-4th included six eccentric flints that were discovered in a deep unit at the summit of the structure. The XACP unit was placed in the same area that Gann had excavated in the early 1920s, and where he had uncovered the aforementioned cache. The cache found by the XAC Project, however, is likely from an area deeper than where Gann had excavated. The second cache, discovered below the stairway of Str. A-7-3rd, consisted of four complete laurel leaf bifacial knives stacked on top of one another and oriented north-south (Watkins et al 2019:260). The third cache, deposited during the Late Preclassic period, consisted of two halves of two different ceramic bowls. One of the partial cache vessels pertains to the ceramic-type Sierra Red and the other to Savana Orange.

Str. A-20 is a small elite shrine which stands on the westernmost edge of Castillo's upper west plaza (Robin 1994; Neff 1995). The structure was originally built in the Terminal Classis period and oriented north-south, but the entrance of the structure was modified, and the structure became east-west oriented (Zanotto 2016). Excavation in 1994 revealed that the structure had undergone four main phases of modification,

with each modification aiming to improve the aesthetic appearance and symmetry of the original structure (Neff 1995; Zanotto et al 2016). Most interesting is the presence of cylindrical pillars built into the structure. Pillars like these are not common in the Belize Valley region, and their appearance suggests an interesting link and interaction between the Maya at Xunantunich and elsewhere in Mesoamerica. Structures similar in form to Str. A-20, for example, are typical of buildings with portico entrances that are commonly found at Puuc sites in Yucatan (Awe et al. 2023). The presence of such a building at Xunantunich thus suggests Yucatecan influence at Xunantunich during the Terminal Classic period (Awe et al. 2023; Zanotto et al. 2016).

Carved into the floor of Str. A-20 are a pecked cross and a *patolli* board (Awe et al. 2023), which is an enigmatic feature at Maya sites. Very little is understood about the functions of *patolli* boards, but researchers agree that they are incredibly similar to the Aztec game boards of the same name (Yaeger 2010). The presence of this board demarcates this space as highly restricted and only available in elite-centered ritual spaces (Walden & Voorhies 2016; Zanotto et al 2016). It is hypothesized that the game may be used for a combination of divination and wagering (Walden & Voorhies 2017). Still other researchers believe that the boards are representative of the Maya vision of the cosmos (Watkins et al. 2019). Ultimately, it appears that Str. A-20 was ritually buried and then repurposed post-occupation (Neff 1995; Zanotto et al. 2016).

Structure A-32 is a long, range-type, double vaulted building that is located on the central north face of the Castillo. The building was completely excavated by the TDP in 2021 and then conserved. Structure A-32 has 13 doorways facing Plaza A-I. The number 13 is significant for it represents the number of levels in the Maya heavens. Awe

(2008) previously noted that these 13 doorway buildings are typical of audiencias in western Belize, and that other examples have been found at Cahal Pech and Caracol. As the name implies, audiencias were likely used by elite rulers to meet and greet affluent visitors to their court. Awe (2008) also noted that these audiencias are generally constructed at locations that separate public from private space. The location of Str. A-32, midway up to the palaces at the summit of the Castillo, reflects this perspective and provides further evidence for the suggested function of these building.

Plaza A-II

Plaza A-II is bordered by Structure A-9 to the west, Str. A-14 to the east, Structure A-1 to the south, and Structure A13 to the north. It is likely that the plaza was originally connected to Plaza A-I in antiquity before the construction of Motmot wall and Str. A-1.

Structure A-9 is a small temple pyramid located on the western edge of Plaza A-II. The structure is about 10 meters tall and 25 meters wide and was constructed in the Late Classic period between 600 and 900 CE. At the eastern base of the structure is a large, broken, and uncarved stela (Stela 4) lying on the plaza floor. The first investigations of Str. A-9 were conducted by Thomas Gann (1925) in the early 1920s. At this time, Gann performed a minimally invasive excavation at the summit of Str. A-9 and located an intrusive burial of a female individual near to the surface. A second phase of investigation followed in the 1990s when XAP archaeologists excavated a narrow trench on the southern flank of the structure. The XAP excavation exposed two architectural terraces rising from the base of the mound.

The XAC Project launched the third phase of excavations in Str. A-9 during their 2016 field season. The XACP investigations included a long axial trench that extended from the eastern base of the structure to its summit where Gann had previously excavated in the 1920s, a horizontal excavation along the entire eastern base of the mound, and the clearing of the humic layer from off the eastern face of the structure. Another excavation was placed at the base (Slocum 2018), and the latter excavation revealed a cache (Cache A-9-1) containing of 28 eccentric lithics (Awe et al. 2019; Slocum 2018; Sullivan 2017). A second cache, Cache A-9-2, was found at the base and centerline of the axial stairway. Cache A-9-2 included 9 obsidian eccentrics, several marine and freshwater shells, fragments of jadeite, pyrite, and hematite (Awe et al. 2019; Slocum 2018).

During an excavation of the axial trench, archaeologists discovered an area of the temple that appeared to be slumped inward. Upon further investigation, this depression was found to cover the collapsed center capstones for a vaulted tomb inside the structure. The tomb had filled with collapsed material over time, but once this material was removed, archaeologists found human remains, along with associated grave goods and faunal remains (Slocum 2018). Evidence shows that the tomb was not an intrusive burial, or a burial added to a structure after its completion. Instead, it appears as though the tomb was built contemporarily with Str. A-9, making this the most likely purpose for construction of the small temple. Although the burial was originally assumed to be male due to the robusticity of the pelvic and femur remains, subsequent DNA analysis revealed that the individual interred inside the tomb was a female between 30 and 39 years old (Awe et al. 2019).

The horizontal excavations along the eastern base of Str. A-9 uncovered two large and inscribed limestone panels. Panel 3 was discovered in a unit placed to the east side of Str. A-9 just to the south of the axial stairway. Believing that another panel may be present to the north of the axial stairs, Slocum (2018) opened an excavation unit at the point where they predicted a panel may be located. Panel 4 was discovered in a northward extension of this original unit on the plaza floor at the base of the first terrace. When it was exposed, the panel was broken into two pieces. Archaeologists (Helmke & Awe 2016a, 2016b; Simon Martin 2017; Slocum 2018) concluded that these panels were part of a hieroglyphic stairway erected during the reign of K'an II (618-658 CE), king of Caracol, who commissioned the stairway to be built in 642 CE in commemoration of his defeat of Naranjo in 631 CE. In 680 CE, Naranjo returned the proverbial favor by defeating Caracol, and the stairway was dismantled and transported to Naranjo as a trophy (Helmke and Awe 2016a, 2016b; Awe et al. 2019; Slocum 2018). Awe et al. (2020) concluded that the association of these panels with the mausoleum of the individual interred in Str. A-9 likely indicates that the individual was somehow connected to, and possibly participated in, the defeat of Caracol by Naranjo (Awe et al. 2019; 2020). The monuments, therefore, were likely gifted to the Xunantunich ruler for their alliance and contribution to Naranjo's successful war against Caracol.

Str. A-14 is located on the eastern edge of Plaza A-II, almost directly across from Str. A-9. The structure is a wide, low-lying pyramid near the main entrance to Plaza A-II. Str. A-14 appears very plain and insubstantial compared to other structures at Xunantunich. Its contrasting appearance has led to much speculation about its original purpose and researcher have questioned why it looks so plain in the context of the site.

It is even alleged that Gann used dynamite to excavate the upper part of the structure, effectively destroying any construction above the two lower terraces that we see today (Audet 2006). Fortunately, there is very little evidence to support this allegation.

Structure A-14 was excavated and conserved by the TDP in 2002. In an excavation placed at the western base of the structure's central stairway, the TDP archaeologists uncovered two caches. Cache 1 contained 9, finely chipped, chert eccentrics. Cache 2 contained eight eccentrics and one jadeite bead. The eccentrics in both caches were represented by various forms, including effigies of scorpions and centipedes (Awe, personal communication 2024).

Plaza A-III

Plaza A-III is the northernmost courtyard in Xunantunich's site core. This plaza, which is enclosed by Structures A-10, A-11, A-12, and A-13, is also more elevated that Plazas A-II and A-III, a feature commonly associated with elite residences Previously, some archaeologists had suggested that Plaza A-III, and particularly Str. A-11 was the main dwelling for the ruling family (Harrison 1996; MacKie 1985; Yaeger 2010). They argued that before the construction of Plaza A-III, members of the ruling class lived in or near the Castillo acropolis (Yaeger 2010). Later, Str. A-11 appears to have served as a new palace to replace the ever-crowding Castillo complex (Yaeger 1997), and it is likely that this shift in residence indicates a replacement or discontinuity of the ruling class who were replaced by a foreign ruler from the site of Naranjo to the west (Harrison 2003; Harrison & Andrews 2004; Yaeger 2010).

They add that the construction of the entire complex at the northernmost plateau of Xunantunich, and the placement of Str. A-11 at the northernmost point in the plaza, places the ruling class in a symbolic position of celestial connection and ancestral divinity (Ashmore 1991; Yaeger 2010). North was analogically linked to the heavens, which existed above the earthly plane, whereas the south was linked with the underworld (Ashmore 1991). Although the original elite residence at Castillo on the southern edge of the site offered similar cosmological implications, repositioning to the northern edge of the city may have acted as symbolic move of accession and ascension of the ruling class to be closer to the gods.

They further posit that the discovery of poorly preserved fragments of a frieze at Str. A-11 (MacKie 1985) seemed to imitate the design and function of the contemporary frieze located at Castillo. What imagery could be deciphered appeared to include divine ancestors occupying thrones and places of honor, another symbolic way to justify the elite status and power of the current rulers (Fields 2004; Yaeger 2010).

More recently, Awe and his colleagues (2020) have countered this perspective, noting that the principal residence for the ruling family was always the palaces at the summit of the Castillo. These palaces are considerably more elevated and private than those in Plaza-AIII and the sheer monumentality of the Castillo adds to the physical manifestation of power by the elite who resided in those lofty residences (Awe 2008). This pattern has been noted at other sites in western Belize, particularly at Caracol and Cahal Pech. Another compelling piece of evidence noted by Awe et al. (2020) is that strontium isotope analysis of all skeletal remains in elite burials at the site show no evidence of foreigners taking over rulership of the site. All skeletal remains of elite

individuals recovered at Xunantunich so far are those of locals. Lastly, Awe and his colleagues noted that it is inconceivable that the sites ruler would have eschewed living in Plaza A-III from where they would have to look up at those who remained living at the summit of the Castillo. This flies in the face of how power structures operate and is particularly not a pattern evident in ancient Maya society.

Previous investigations by British archaeologists Euan MacKie (1985) discovered *patolli* boards carved into the floors of Rooms 2 and 3 in Str. A-11, as well as an additional board in Room 5. In the lower construction, another three partial boards were discovered. As mentioned previously, the use of these board in Maya civilization is unknown, but most *patolli* boards are found in private, elite, ritual contexts. Investigations by Jason Yaeger in Room 9 of Structure A-11 also recorded several examples of graffiti including a series of anthropomorphic figures. Some archaeologists (Haviland and Haviland 1995; Yaeger 2010) have concluded that these may be records of visions achieved during rituals and trances in this room. This suggests that while the upper construction of Str. A-11 was entirely private for those who resided there, the lower construction may have been used for private or semiprivate spiritual experiences and rituals performed by elites. Yaeger worked on Str. A-11 in 1997 also recovered three conjoining fragments of Panel 1 on the front terrace of the building beneath a layer of architectural collapse (Helmke et al. 2010, Yaeger 1997). Helmke et al. (2010) note that panel fragment was decorated with an inscription that includes a “flaming ajaw” logogram and is contemporary with the Hast’ Chaak phase (660-780 CE), which is estimated to be the phase when Str. A-11 was constructed (Yaeger 1997). Unfortunately, the rest of the panel has never been recovered at the site.

Str. A-13 stands at the southern edge of Plaza A-III and faces the more public Plaza A-II to the south. In the 1980s, the government of Belize performed a clearing operation to expose upper rooms on the east side of the structure. However, the exposure project was a little too successful, and the exposed eastern rooms of Str. A-13 were left to the elements, causing severe deterioration, and eroding of the stone (Harrison 1996). Later, inexperienced consolidation teams used an irreversible cement mixture to partially reconstruct the exposed features of Str. A-13, leading to what may conclusively be inaccurate reconstructions of the structure. Excavations in 1996 (Harrison 1996) concluded that the structure may have had three major phases of construction. Initial stages of construction likely included the basal platforms upon which the final structure was built.

In 2001, archaeologists with the Tourism Development Project excavated the lower eastern terrace of Str. A-13, as well as the stairway leading up from Plaza A-II to Plaza A-II. In the process of excavation, they noted that many of the facing stones of the building's lower and south-facing terraces had been removed in antiquity. Along the base of the terrace, they also uncovered two simple caches, one to the east of the stairway, and the other to the west of the stairway (Awe et al. 2020b:113). The western cache (Cache A-13-1) included a small, unslipped bowl that was placed upside down next to the stairside outset. The eastern cache (Cache A-13-2) included a single biface placed in line with the lowermost row of cut stones of the terrace. A third cache (Cache A-13-3) containing large fragments of several ceramic vessels was found beneath the surface of the bench of the room just west of the entrance to Plaza A-III.

More recent excavations by the NAU Project (Watkins et al. 2018; 2019; 2023) particularly on the western half of Str. A-13, found that almost all the rooms in this building are exactly alike, with 30 cm high, c-shaped benches and a 12 cm high step leading into each room. The main outlier of these rooms is Room 17, located east of the Plaza A-II entryway, which has a slightly different morphology. While still maintaining the 30 cm c-shaped bench inside, the entrance was, at one point, blocked off, restricting access to the room. Higher concentrations of ceramic in this room suggest that it was blocked prior to end of the site's occupation.

Investigations by the NAU project recorded graffiti in most of the rooms in Str. A-13, particularly in Rooms 11, 12, and 13. The most common type of graffiti were *patolli* boards. In total, there were ten *patolli* board motifs discovered in Str. A-13 with varying degrees of completion and preservation (Watkins et al 2018; 2019; 2023). The highest density of *patolli* boards was found in Room 11, as was the largest *patolli* board documented at Xunantunich to date. Researchers concluded that the *patolli* boards may have been used to practice the game, or to play it formally (Watkins et al. 2019) and that the spaces in Str. A-13 would have allowed their use for this purpose.

Special Structures

Str. A-15 is a small structure located outside of the site's central core. Very little is known about this structure, and its position in relation to the rest of Group A calls into questions its true purpose and association with the city. Euan W. MacKie (1961, 1985) who excavated the structure in 1959, suggests that Str. A-15 was a dwelling of some kind, likely having two phases of occupation. The first phase, hypothesized to be an

elite occupation due to its proximity to Group A and its architectural complexity, was supposedly ended abruptly after the vaulted ceiling collapsed (MacKie 1961). MacKie believed that the second occupation was of a group of “regular class” inhabitants of nearby villages who reoccupied the building sometime after it had fallen into disuse.

In contrast to MacKie, other archaeologists have argued that a so-called throne in Str. A-15 suggests that the building was constructed for the ruler of Xunantunich (Yaeger 2010). Although not an immediately ideal location, it is surmised that access to the site along sacbeob would offer travelers a view into Str. A-15, and therefore a presentation of power from the king. Furthermore, ruling elites would be able to watch the coming and goings of visitors and residents at Group A from this structure (Yaeger 2010). More recently, Awe and colleagues (2020a) have questioned the latter interpretation noting that the so called “thrones” are nothing more than a style of benches that are common at sites during the Late Classic Period. Some sites, like Cahal Pech downriver, also have several of these “throne-like” benches in multiple buildings. Furthermore, the lack of association between Str. A-15 and a plaza or place where people could wait to engage with the current ruler makes this location for the throne even more odd and impractical.

Ballcourt 1 is located to the west of Str. A-7 with its eastern building (Str. A-18) connected to the western side of A-7 (Feely 2019; Jamison 1996; Tilden et al. 2017). The ballcourt is composed of Strs. A-18 and A-19 and was most likely constructed at the end of the Classic period (Feely 2019). Previous excavations at Ballcourt 1 were performed by the Tourism Development Project, using horizontal excavations to expose Strs. A-18 and A-19 in preparation for their conservation. During excavation, fragments

of two ballcourt rings were discovered on the flanks of the two buildings. The use of Ballcourt rings, which were tenoned into the side of ballcourt buildings, is a feature that is diagnostic of the Puuc region of Yucatan and atypical in the central Maya lowlands (Awe et al. 2023). Like Str. A-20, Ballcourt 1 thus reflects a clear sign of Yucatec influence at Xunantunich during the Terminal Classic period (Awe et al. 2023; Zanotto & Awe 2017). In 2001, and in 2018, several excavations were placed along the center of the playing alley to search for possible ballcourt markers and caches. The excavations revealed none of these features, a pattern inconsistent with ballcourts in western Belize. Conservation efforts at Ballcourt 1 were completed in 2001 (Awe 2023; Feely 2019).

Ballcourt 2 is located to the west of Str. A-1 and was erected around 700 CE (Feely 2019). This ballcourt complex consists of Strs. A-17 and A-22. Originally, it is hypothesized that the free-standing Ballcourt 2 acted as a hierarchical divider between the elite ruling class and commoners at Xunantunich based on its just-off-central location in the site core (Feely 2019)**.** After the construction of Str. A-1, which was partly built over the east side of Str. A-22, the ballcourt became a symbolic and literal "passage" between Plaza A-I and Plaza A-II (Jamison 1996; Feely 2019).

There have been two phases of excavations at Ballcourt 2 in the past. The first investigation was conducted by XAP archaeologists in the 1990s (Jamison & Wolf 1994). The XAP excavations uncovered the interred remains of a sub-adult interred in a flexed position (Feely 2019; Ramirez et al. 2023). The second phase of excavations were conducted in 2018 and 2022 by the XAC Project under the auspices of NAU (Feely 2019; Ramirez et al. 2023). The 2018 excavations along the center of the playing alley discovered four caches. Apart from Cache BC2-1, all the caches contained large

numbers of eccentrics (Feely 2019). Cache BC2-1 had several eccentrics encircling two large ceramic vessels placed in lip-to-lip fashion. Inside the vessels were three stingray spines and several more eccentrics.

In 2023, archaeologists from the XACP reopened the previous 2018 excavation to further investigate a low Preclassic wall that had been recorded during the earlier investigation. Along the wall, practically at the center of the playing alley, the 2023 excavation discovered a cache (Cache BC2-5) containing of 54 eccentrics (18 obsidian, 33 chert, 3 granite/limestone). Interestingly, the cache was unearthed just below where the 1990s XAP archaeologists had discovered the remains of the juvenile (Ramirez et al. 2023). The eccentrics were placed in a circle around an exhausted obsidian core, and a layer of jute shells were discovered underneath the cache (see Figure 7).

Group B

Group B is a group of residences located to the northwest of the site core and main plazas. It lies approximately 150 meters west of Str. A-1 (Etheridge 1995, Sullivan et al. 2017). The masonry construction of Group B suggests that the occupants were most likely affluent, perhaps even family members of advisors to the ruling family. Furthermore, Thompson (1942) also found little evidence of occupation at Group B before the establishment of the palace group in Plaza A-III, suggesting that theses

Figure 7 Plan view of the eccentrics from cache BC2-5. Image by Ebert from Ramirez et al. (2023).

residences may have been constructed around the same time (Etheridge 1995, LeCount & Yaeger 2010).

Group B, while small in comparison to the monumental site core, is one of the most important sections of Xunantunich archaeologically. Thompson (1942) excavated units in Str. B-1, as well as six rooms in Str. B-3. This led to the discovery of a diverse collection of an estimated 30,000-35,000 ceramic sherds (Sullivan et al. 2017). Of these sherds, 3,979 were diagnostic, and were instrumental in the completion of Thompson's ceramic sequence for Xunantunich (Etheridge 1995, LeCount & Yaeger 2010, Sullivan

et al. 2017, Thompson 1942). Even today, archaeologists uncover hundreds of ceramic sherds at Group B during each field season.

Str. B-1 turned out to be a small ancestral shrine which contained a burial that was capped with flat stones made form slate (Thompson 1942). The structure appeared to have undergone at least four separate construction events, with the terminal structure resulting in a small, vaulted room atop a small platform (Sullivan et al. 2017, Thompson 1942). Thompson also uncovered other artifacts including limestone axes, fragments of *metates*, obsidian flakes along with one exhausted obsidian blade-for eccentric, perforated shells, and seven speleothems, or cave rocks like stalactites and stalagmites. These speleothems would have needed to be transported from a cave, and likely represent the underworld in the Maya cosmology (Sullivan et al. 2017).

Decades later, initial XAP excavations began after Pendergast and Graham (1981) discovered that the outlying group had been extensively looted. The salvage project (Pendergast & Graham 1981) revealed that Str. B-5 had been occupied from 700 CE to around 950-1050 CE. Around 200,000 ceramic sherds were recovered alongside censors and polychrome vessels (Sullivan et al. 2017). Most notably, an intrusive burial was found in the terminal construction of Str. B-5. According to the surrounding stratigraphy, the remains were most likely interred after the initial occupation of the site (Pendergast & Graham 1981, Sullivan et al. 2017). Also surprising was the presence of two musical instruments that were uncovered in Group B ((Keller 2010). The first instrument was a whistle, which was uncovered in association with a burial by Pendergast and Graham (1981), and the second was a drum located in a dedicatory deposit (Keller 2010, Thompson 1942).

Later, in 1995, archaeologists discovered midden filled with ceramic sherds located between Strs. B-1 and B-2. At the bottom of the midden, archaeologists discovered two complete vessels, indicating that this may have been a ritual deposit (Etheridge 1995). Excavations in 1995 revealed the bed rock beneath this deposit had been carved into two basins, oriented east to west, which were open to the north (Etheridge 1995).

Excavations turned to the main courtyard, Courtyard 1, during the BVAR 2016 field season (Sullivan et al. 2017). Another burial, Burial 4, was discovered in Str. B-1, the small eastern shrine, just below the terminal layer of the structure's platform (Sullivan et al. 2017). The burial was comingled, meaning that multiple individuals were interred together. Preliminary reports suggest that there may have been three individuals in total (Sullivan et al. 2017).

Chapter 6: Discussion

The purpose of this research was to analyze the process through which archaeologists create educational materials for the public, and the role that technology can play in providing these materials in the modern world. Throughout the course of this project, several factors were considered, including the use of community collaboration alongside scientific research, as well as the effectiveness and efficiency of technology in the field. Additionally, this project aimed to provide a resources for the local communities surrounding Xunantunich as a show of the strong relationship between archaeologists and stakeholders that is possible when the community becomes a priority.

The project saw a number of successes, as well as some shortcomings. The greatest shortcoming of this project lies within its second phase. I focused mainly on photographing structures in such a way that requires no in-depth training or special equipment to prepare for. In essence, I relied heavily on the software's ability to estimate camera locations and the distance of the photographer from the structure.

The models were mostly successful using this method, but some models were not, specifically, Str. A-1 and El Castillo. But both models arrived short of my determined standard for different reasons. Str. A-1 was mostly covered in grass on all sides, and almost entirely covered on the top. Agisoft Metashape found it difficult to determine how far the camera was from the structure. In addition, the grass made one part of the structure look too similar to other parts of the structure, making it difficult for the software to stich images together in the right order to create the proper shape and texture. As a result, the model for Str. A-1 was warped to the point that it was unrecognizable when compared to the actual structure.

Many models, including those for Strs. A-2, A-7, and A-9, also suffered from severe overlap from surrounding greenery, leading to warped appearances and holes. Str. A-2 in particular did not have any accessible stairs and had to be climbed. Vegetation around the structure was very heavy, and a large tree stood at its base in the plaza. The shade and vegetation made the sides unrecognizable to the software, and only part of the roof comb, which was mostly exposed to sunlight and surrounded by little vegetation, was accurately modeled with the program. Although only part of the structure could be modeled successfully, the level of detail within the existing model was incredibly high.

Originally, I had planned to model the entirety of Str. A-7 but found it unfeasible because of its modern appearance and installments, and ongoing excavations. The first model of Str. A-7 failed due to vegetation. Much like Str. A-1, Str. A-7 is primarily covered with grass, as well as leaves, brush, and trees. Because of the foliage, the structure lies in the shade for most of the day, with the eastern face receiving direct sunlight in mid-morning. Direct sunlight causes deep shadows which confuse the program, as Metashape uses shadows to determine the shape and distance of objects. An excavation unit was also opened in the southern face of Str. A-7 near the time that I began photographing the structure to create a second test model. For this reason, only the eastern face could be modeled.

Modeling the eastern face was possible, but the center of Str. A-7 has a modern, metal roof installed on its eastern face, angling downward toward Plaza A-I. Beneath the roof are previous phases of construction which were exposed during earlier excavations. These features are protected from erosion and weathering by the modern room while allowing visitors to view them and learn more about previous uses of the structure. While the roof is an important installment for conservation, it made it incredibly challenging to capture and model the front of the structure. The stark contrast between the natural sunlight and dark, unlit underside of the roof, made it difficult for Metashape to determine the depth and shape of the features in relation to the rest of the structure.

I encountered similar issues with Str. A-9, which was also covered with a variety of plant life and surrounded by trees. In fact, Str. A-9 did not receive much sunlight during the day at all, as its eastern face was entirely shaded by the surrounding trees.

The speckling of the sunlight caused very little issue, however, and the main challenge was the inclusion of the tomb at the top of the steps. Like the exposed features of Str. A-7, the lighting allowed for little discernment when the photos were entered into the program. Confusion in the software caused by this contrast resulted in warping and holes throughout the model.

The plan to model the Castillo failed in its infancy due to time constraints and the Castillo's large, complex exterior. The Castillo is the tallest structure at Xunantunich and was too large for the capabilities of my equipment. Not only this, but terrestrial photogrammetry requires that the photographer be capable of climbing, summiting, and navigating the exterior of the subject. I did summit the Castillo twelve different times, but the beautifully intricate and monumental construction of the structure made it difficult to photograph it in its entirety. Even if I had succeeded in this goal, detail of the structure would have been lost during the decimation process, just as it was with the other, more successful models. Between having limited time, and the fact that little detail would be conserved in the modeling process, it simply was not practical to attempt to model the Castillo alongside the other structures in the short window of time I had available.

These shortcomings warrant further analysis so changes can be made to the overall methods used throughout this process. Limitations, however, do not define the accomplishments of this project, as I feel it was highly successful as a pilot example of participating in community collaboration and digitally modeling monumental architecture at a well-known site in such a short period of time. The results of this project suggest that there is great promise in developing this method further and applying it at other sites. I consider the successes of this project to be a testament to the stability of this

method and its possible usability across many contexts. Any shortcoming of this research can be seen as a steppingstone or pivotal point which future researchers can use to build upon. A project of this novelty and magnitude cannot be perfected on the first try. As with any methodology, there is always room for improvement.

Relation to research questions

1. **Is terrestrial photogrammetry an efficient, cost-effective, and feasible method of recording archaeological sites?**

During the field work phase, I initially had concerns regarding the usability of this method in contexts with monumental architecture. Photogrammetry was originally developed for use with smaller objects in more controlled environments such as laboratories, but I had little to no environmental control while in the field. And while small objects can be rotated by hand, these structures were stationary and monumental in size, meaning that I had to move around them and maintain a 50-70% overlap between each successive photo. I managed to do so only by sight and without the need of special settings or programs, which were not equipped on the camera.

I was able to complete the field work phase, as well as a portion of the modeling phase, of this project with little difficulty in a matter of six weeks. I photographed an average of two to three structures per day for a total of nine days throughout that six-week period. This means that it would be feasible to model a site like Xunantunich using this method in less than two weeks if one is solely dedicated to the task. If the time

dedicated to this task is interrupted by other responsibilities, the process would likely take longer, but could still be completed within a six-week time span.

The cost of equipment for this project was expected to be around $2,000 in total. The actual cost of equipment and software was below this limit, although only slightly. It is clear that the selection of Agisoft Metashape was advantageous and well worth the subscription cost given its success in creating the initial and final models. Both the camera and the software were ultimately user-friendly, so there was no need to include training costs in the total budget. However, this may not be true for all users. I have nearly ten years of photography experience, five of which have been in semi-professional contexts. I view this as a technological bias wherein I am capable of learning new technology very easily and with little to no training. For other archaeologists attempting to use this method, I would recommend the tutorials available on the Agisoft website first, followed by a paid training course if there is a further need to familiarize oneself with the application.

2. Can archaeologists record sites and architectural data using traditional methods while simultaneously preparing public-friendly educational tools?

Since the Agisoft Metashape software is self-regulating, models can be rendered during off-hours, or when other tasks at the site need to take precedence. In fact, around 84% of the models created for this project were complete or nearly complete by the end of the field work phase. The only tasks left to complete in the rendering process was “cleaning” the models, or cropping out unnecessary backgrounds and foliage, and decimating them to a usable file size, which can also be done during the field season or

saved for post-field analysis. In this way, using terrestrial photogrammetry can act as a supplement to other ongoing research and excavations without requiring a person or team to be dedicated to modeling alone. I would argue that archaeologists would need very few additional resources to carry out a similar project alongside pre-established research.

This method also leaves relatively abundant time during the field season for photo retakes and allowing rendering to take place while the next structure is being photographed or photos are being prepared for rendering. However, it is important to note that the rendering process does take some time, usually a few hours depending on the number of photos and size of the structure. This can extend the amount of time needed to process the images and create usable models, but as previously mentioned, this does allow researchers the opportunity to multitask and potentially reach more research goals in less time.

There was a large amount of planning and research that went into developing the models as educational tools. Within this framework, the intended deliverable was a series of interactive, digital 3D models, accompanied by a short but comprehensive training guide detailing the history of excavations and interpretations of each structure within their historic context. Attention to detail and an ability to summarize advanced technical reports to make available information accessible to non-academics is paramount in this phase. Many hours were dedicated to this step of the project, including not only report summaries and research into previous excavations of each structure, but also aligning the tools' content to normalized educational theory and teaching standards. This stage would have to be completed either before the field

season begins or after. Though most preliminary research was carried out before the field season began, I reserved summarizing reports for after the field season given the importance of pre-season preparations and to make way for what I expected to be a steep, technological learning curve for myself.

3. **How can community collaboration play a role in decolonizing public education within archaeology and elsewhere in academia?**

Colonialism has long stained the intended purposes of archaeology. Though the field means to investigate and learn about past peoples, biases from one's own culture tend to cloud interpretation and limit the dissemination of information and conclusions. This in turn leads to sensationalized depictions of archaeology and the exoticization of cultural groups with an "us" and "them" mindset. To limit my own biases, I chose to actively pursue a collaborative framework in addition to summarizing technical reports. Although these reports are presumably not free from bias, the technical application of evidence to interpret a site and reach a conclusion is purely a part of the scientific method. If one cannot be present for major excavations, as is often the case, to use the information available in an unopinionated manner is perhaps the closest one can be to becoming "unbiased."

Decolonization is an invitation to include a more holistic understanding of history, individuality, and social connectivity in archaeology. This invites conversations about Indigenous and local knowledge of sites and histories which can be paired with research and scientific interpretation to create well-rounded, informative media. As mentioned previously, this project was requested by the local community around

Xunantunich, as well as by the tour guides involved with the site. Because of their request for training material, I made a point to collaborate with these groups throughout the entirety of the project. This was made easy thanks to the Belize Valley Archaeological Reconnaissance (BVAR) Project, which has a long-standing framework of community collaboration and provides seasonal employment to local laborers, as well as annual site training visits. The senior director of the BVAR Project, Jaime Awe, is also Belizean and his close relationship to community members and organizations, as well as with the Belize Institute of Archaeology facilitated interaction with all these stakeholders. Working with this project therefore allowed me the opportunity to meet with local guides in-person during their visits to Xunantunich and made it possible to discuss their needs and wants for the training material I developed.

On a more personal note, I recognize that my access to Xunantunich is a privilege, and I am working with history and material that does not belong to me or my cultural ancestors. Maya cities across Mesoamerica, and specifically at Xunantunich, are sacred spaces, and with respect to Indigenous and descendant communities, I did what I felt was within my power to elevate those voices rather than my own. Though it should go without saying, I would suggest that using technical, non-partisan language while developing educational material is a best practice.

4. If successful, is this method replicable at other sites with different archaeological characteristics?

Based on these results, I believe that this method could be replicated at a number of sites throughout Mesoamerica. However, the research suggests that this modeling

method may or may not be limited to singular, free-standing structures. Xunantunich offered a unique opportunity as few structures are built to be physically connected to one another. Models could be made of most individual structures without the interference or inclusion of other structures, but others became warped due to foliage and lighting contrast. Although this is not an inherently positive or negative quality of the models created here, there is a possibility that it could serve as a limitation in the future. I believe there is great potential in applying this method at a site, such as nearby Cahal Pech, where structures are clustered closer together and, in many cases, built to connect with one another. Terrestrial photogrammetry lends itself well to modeling objects that stand on their own with few or no surrounding objects, such as the monumental architecture at Xunantunich. However, given that some of the larger, stand-alone architecture was more difficult to capture and model in detail, it may prove more difficult to model interconnected spaces such as Cahal Pech.

Additional Successes

The technology I used exceeded my expectations of performance. In general, the climate in Belize during the rainy season is very hot and humid, which normally would have a negative impact on technology. For example, a colleague visited the site an attempted to use PolyCam, another well-known modeling software, to model Str. A-1 on a standard tablet. Unfortunately, due to the heat and humidity, the tablet quickly overheated, and its battery drained within just an hour. It was unusable for the rest of the day since there are few locations at Xunantunich to recharge the battery. While working in the field, I noticed no functional abnormalities in any of my equipment,

meaning that the camera and tablet I selected worked in extreme temperatures and weather without requiring cooling periods or a constant source of power. This suggests that careful examination of equipment specifications can lead to long-term investments and cost reduction for projects choosing to use this method.

Suggestions for the Future

This project resulted in many successes, and showed that Agisoft Metashape could create detailed and accurate models of structures ranging from relatively plain structures like Str. A-14, to very complex structures like Str. A-13. The height and size of the Castillo were the main factors that made it an impractical subject for the scope of this research, but focusing solely on this structure could yield a detailed model that is just as successful as others created for this site. As for the other failed models, I would suggest the use of photogrammetric targets or tiles. I hypothesize that targets would assist the program in discerning different features and points within the photos taken, making the final models more accurate in shape and texture. Whether target points would improve the accuracy of model developed from high-contrast photos due to harsh sunlight remains to be seen, but they would almost certainly be beneficial for grass and foliage-covered surfaces.

Chapter 7: Conclusions

This research sought to contribute to the relationship between public education and archaeology and address a long-standing and unnecessary gap between the two

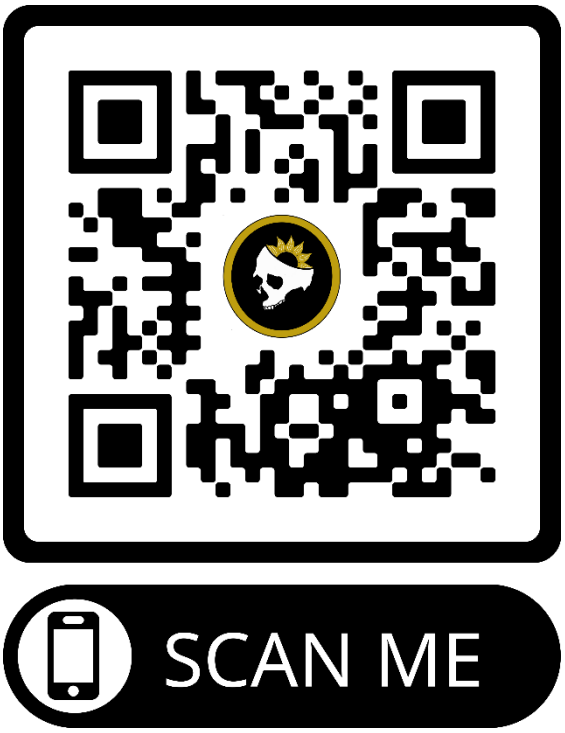
disciplines. While the method used here serves as a starting point for future research and application, the entire project serves as call for the inclusion of public outreach and education projects as an integral and necessary component of archaeological investigation.

Building upon the public engagement framework established by the Belize Valley Archaeological Reconnaissance Project (Hoggarth et al. 2020), this project has developed yet another avenue for community involvement. Since its inception in 1988, the BVAR Project has aimed to create an inclusive environment, where the needs of the community and of cultural heritage management take precedence alongside archaeological investigation (Hoggarth et al. 2020). The completion of this thesis, then, stands as a testament to this long-standing relationship between the local community and archaeologists, and to the BVAR Project's dedication to its participants and stakeholders.

The focus of this research was limited to one site in Mesoamerica but has broader implications across the region and even globally. The application of this method has the potential to further contribute to current standards for site recordation in archaeology, and I predict that this project precedes countless educational possibilities in the realm of fair, accessible materials. In essence, my research represents a foundational approach to an efficient and effective marrying of public education and archaeology. The results and further interpretation of this thesis indicate that this method of recording and translating data for the public is not only possible with cost-effective materials and equipment but equally effective at archaeological sites in Mesoamerica as in other parts of the world.

CODE: STRUCTURE A-3

CODE: STRUCTURE A-4



CODE: STRUCTURE A-7

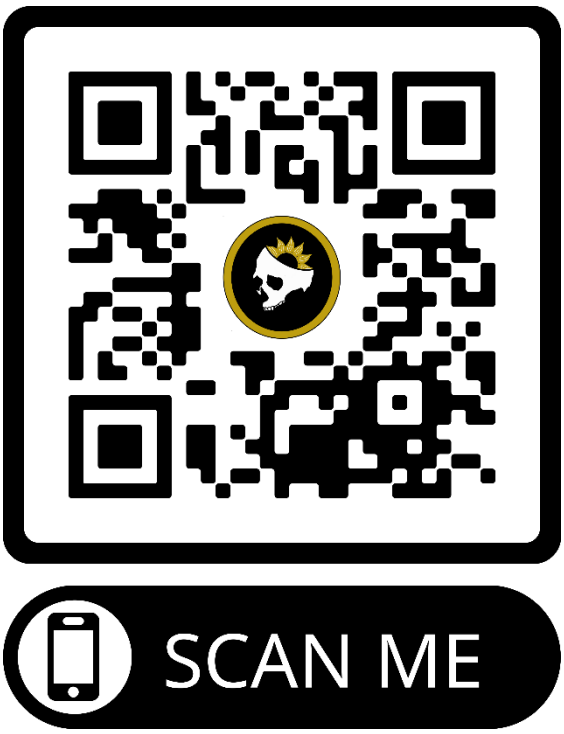
CODE: STRUCTURE A-9

CODE: STR. A-13 (NORTH FAÇADE)

CODE: STR. A-13 (SOUTH FAÇADE)

CODE: STRUCTURE A-14

CODE: STRUCTURE A-16



CODE: STRUCTURE A-20

CODE: BALLCOURT 2

CODE: PANEL 3 (STR. A-9)

CODE: PANEL 4 (STR. A-9)

REFERENCES

Anderson, Heidi Milia

n.d.

Dale's Cone of Experience. *Successful Teaching Excellence Perspectives for Pharmacy Educators*.

Awe, Jaime J

2008

Architectural Manifestations of Power and Prestige: Examples from Classic Period Monumental Architecture at Cahal Pech, Xunantunich, and Caracol, Belize. *Research Reports in Belizean Archaeology* 5:159–174.

2017

The Discovery and Political Significance of the A9 Tomb and Hieroglyphic Panels 3 and 4 at Xunantunich, Belize. *Third Shanghai Archaeology Forum: Awarded Projects*:106–121.

2020a

Conservacíon de Monumentos Arqeologicos y el Desarollo del Arqueo-Turismo en Belice. *Arqueología Mexicana* 165(Special issue on Maya Archaeology in Belize):66–71.

2020b

Cultural Resource Management in Belize. In *Cultural Resources Management: A Collaborative Primer for Archaeologists*, edited by Thomas F King, pp. 117–125. Berghahn Books, New York, NY.

In Press

Maya Archaeology in the National Consciousness of Belize. In *Oxford Handbook on Maya Archaeology*, edited by Thomas G Garrison, Jeffery B Glover, and Brent K S Woodfill.

Awe, Jaime J, Christophe Helmke, James J. Aimers, Claire E Ebert, Julie A Hoggarth, and W. James Stemp

2020

Applying Regional, Contextual, Ethnohistoric, and Ethnographic Approaches for Understanding the Significance of Peri-Abandonment Deposits in Western Belize. *Ancient Mesoamerica* 31:109–126.

Awe, Jaime J, Christophe Helmke, Julie A Hoggarth, and Claire E Ebert

2023

Changing Sphere of Interaction in Terminal Classic Western Belize. *Research Reports in Belizean Archaeology* 18:219–242.

Awe, Jaime J, Christopher Helmke, Diane Lynn Slocum, and Douglas Tilden

2019

Let’s Talk of Graves, Eccentrics, and Epitaphs: The Socio-Political Implication of Recent Discoveries on Structure A9 at Xunantunich, Belize. *Research Reports in Belizean Archaeology* 16:57–74.

2020

Ally, Client or Outpost? Evaluating the Relationship between Xunantunich and Naranjo in the Late Classic Period. *Ancient Mesoamerica* 31(3):494–506.

Awe, Jaime J, Julie A Hoggarth, and James J. Aimers

2017

Of Apples and Oranges: The Case of E-groups and Eastern Triadic Architectural Assemblages in the Belize River Valley. In *Early Maya E-Groups, Solar Calendars, and the Role of Astronomy in the Rise of Lowland Maya Urbanism*, edited by David A. Freidel, Arlen F

Chase, Anne Dowd, and Jerry F. Murdock, pp. 412–449. University Press of Florida, Gainesville, FL.

Awe, Jaime J, and Shawn G. Morton

2023

All in all, it's Not Just Another Brick in the Wall: Examining the Diverse Function of Wall Architecture in Western Belize. In *Construction of Maya Space: Causeways, Walls, and Open Areas from Ancient to Modern Times*, edited by Thomas Guderjan and Jennifer Mathews, pp. 187–206. University of Arizona Press, Tucson, AZ.

Beardall, Antonio

2021

Public Archaeology and Cultural Heritage Management in Belize: Successes and Shortcomings. Unpublished M.A., Northern Arizona University, United States -- Arizona.

Belize Chamber

Services. *Belize Chamber of Commerce and Industry*. https://www.belize.org/trade-investment-zone/sectors/services/, accessed January 3, 2024.

Belize Tourism Board

Archaeology Archives. *Travel Belize*. https://www.travelbelize.org/activities/archaeology/, accessed January 3, 2024.

Boellstorff, Tom

2016

For Whom the Ontology Turns: Theorizing the Digital Real. *Current Anthropology* 57(4):387–407.

Bonacchi, Chiara

2017

Digital media in public archaeology. In *Key Concepts in Public Archaeology*, edited by Gabriel Moshenska, pp. 60–72. UCL Press.

Brameld, Theodore, and Edward B. Sullivan

1961

Anthropology and Education. *Review of Educational Research* 31(1):70–79. DOI:10.2307/1169020.

Bruner, Jerome S.

Toward a Theory of Instruction. Harvard University Press1966, Cambridge, MA.

Chase, Arlen F, Diane Z Chase, John Morris, Jaime J Awe, and Adrian S Z Chase

2020

Archaeology and Heritage Management in the Maya Area: History and Practice at Caracol, Belize. *Heritage* 3(Maya Anthropological Archaeology):436--456. DOI:10.3390/heritage3020026.

Dale, Edgar

1969

Audio-Visual Methods in Teaching. 3rd ed. Holt, Rinehart &Winston, New York.

Davis, Beverly, and Michele Summers

2015

Applying Dale's Cone of Experience to increase learning and retention: A study of student learning in a foundational leadership course. In *QScience Proceedings*, 2015: pp. 6. Hamad bin Khalifa University Press, Hamad bin Khalifa University.

Diamond, Robert M.

1989

Designing and Improving Courses and Curricula in Higher Education. Jossey-Bass, San Francisco, CA.

Díaz-Andreu, Margarita

2013

Ethics and Archaeological Tourism in Latin America. *International Journal of Historical Archaeology* 17(2):225–244.

Ebert, Claire E, Julie A Hoggarth, and Jaime J Awe

Home. *BVAR*. https://www.bvar.org, accessed January 2, 2024.

Edwards-Ingram, Ywone

1997

Toward “True Acts of Inclusion”: The “Here” and the “Out There” Concepts in Public Archaeology. *Historical Archaeology* 31(3):27–35.

Etheridge, Bevin

1995

Excavations at Group B, Structures A-2, A-3, A-4, and the Stela House (A-16). *Xunantunich Archaeological Project 1995 Field Season Report*:71–82.

Feely, Cassandra

2019

Game On: Investigations of Ballcourts 1 and 2 at Xunantunich, Belize. Unpublished Master’s Thesis, Department of Anthropology, Northern Arizona University, Flagstaff, Arizona.

Forte, Maurizio

2014

3D Archaeology: New Perspectives and Challenges—The Example of Çatalhöyük. *Journal of Eastern Mediterranean Archaeology & Heritage Studies* 2(1):1–29. DOI:10.5325/jeasmedarcherstu.2.1.0001.

Fortenberry, Brent R., and Amalia Leifeste

2020

Querying the Products of Two Recording Techniques: Analog and Digital. *APT Bulletin: The Journal of Preservation Technology* 51(2/3):47–56.

Gann, Thomas W. F.

1925

Mystery Cities: Exploration and Adventure in Lubaatun. Charles Scribner's Sons, New York, NY.

Garstki, Kevin

2017

Virtual Representation: The Production of 3D Digital Artifacts. *Journal of Archaeological Method and Theory* 24(3):726–750.

Goldberg, Bruce, and John Richards

1995

Leveraging Technology for Reform: Changing Schools and Communities into Learning Organizations. *Educational Technology* 35(5):5–16.

Graham, Ian

1978

Naranjo, Chunhuitz, and Xunantunich. In *Corpus of Maya Hieroglyphic Inscriptions*, 2: Harvard University, Cambridge: Peabody Museum of Archaeology and Ethnology.

Grube, Nikolai, and Linda Schele

1995

The Last Two Hundred Years of Classic Maya History: Transmission, Termination, Transformation. In *Notebook for the XIXth Maya Hieroglyphic Workshop*, edited by Linda Schele, pp. 87–211. University of Texas Press, Austin, TX.

Hardy, Lisa J.

2023

Community Engagement Through Collaborative Writing: Storytelling Together. Routledge, New York, NY.

Harrison, Ellie

1996

The Ruler's Residential Plaza at Xunantunich. *Xunantunich Archaeological Project 1996 Field Season Report*:71–89.

Hefte, Rachel

1995

MayaQuest: A Student Directed Expedition. *Social Studies and the Young Leaner* 7(3):4–7, 16.

Helmke, Christophe, Jaime J Awe, and Nikolai Grube

2010

The Carved Monuments and Inscriptions of Xunantunich. In *Classic Maya Provincial Politics: Xunantunich and Its Hinterlands*, pp. 97–121. University of Arizona Press, Tucson, AZ.

Helmke, Christophe, Nikolai Grube, and Jaime J Awe

2006

A Comprehensive Review of the Carved Monuments and Hieroglyphic Inscriptions of Xunantunich, Belize. Edited by Christophe Helmke and Jaime J Awe. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2005 Field Season*:143–186.

Hoggarth, Julie A, Jaime J Awe, Claire E Ebert, Rafael A Guerra, Antonio Beardall, Tia B Watkins, and John P Walden

2020

Thirty-Two Years of Integrating Archaeology and Heritage Management in Belize: A Brief History of the Belize Valley Archaeological Reconnaissance (BVAR) Project's Engagement with the Public. *Heritage* 3(3):699–732. DOI: https://doi.org/10.3390/heritage3030040.

Hoggarth, Julie A, Jaime J Awe, Claire E Ebert, Rafael A Guerra, Antonio Beardall, Tia Watkins, and John P Walden

2020

Thirty-Two Years of Integrating Archaeology and Heritage Management in Belize: A Brief History of the Belize Valley Archaeological Reconnaissance (BVAR) Project's Research and Public Archaeology Outreach Programs Engagement with the Public. *Heritage* 3(Maya Anthropological Archaeology):699–732. DOI:10.3390/heritage3030040.

International Trade Administration

Belize - Market Overview. https://www.trade.gov/country-commercial-guides/belize-market-overview, accessed January 3, 2024.

Jameson, Jr., John H., and Sherene Baugher

2007

Public Interpretation, Outreach, and Partnering: And Introduction. In *Past Meets Present: Archaeologists Partnering with Museum Curators, Teachers, and Community Groups*, pp. 3–17. Springer Science & Business Media, New York, N.Y., U.S.A.

Jamison, Thomas

1992

The Excavation of Structures A-1 and A-4. *Xunantunich Archaeological Project 1992 Field Season Report*:22–31.

Jamison, Thomas R.

1996

Excavations on the West Side of Plazas A-I and A-II. Edited by Richard M Leventhal and Wendy Ashmore. *Xunantunich Archaeological Project 1996 Field Season Report*:59–70.

Jamison, Thomas R., and Gregory A. Wolff

1994

Excavations In and Around Plaza A-I and Plaza A-II. *Xunantunich Archaeological Project 1994 Field Season*:25–47.

JASON Project

2024

JASON Project. *JASON Learning*. https://jason.org/, accessed January 2, 2024.

Joyce, Rosemary A.

2013

Confessions of an Archaeological Tour Guide. *International Journal of Historical Archaeology* 17(2):296–314.

Keller, Angela H.

2010

The Social Construction of Roads at Xunantunich, from Design to Abandonment. In *Classic Maya Provincial Politics: Xunantunich and Its Hinterlands*, edited by Lisa Jeanne LeCount and Jason Yaeger, pp. 184–208. The University of Arizona Press, Tucson, AZ.

Laing, Deanni

2023

How Archaeology Has Unveiled a Booming Tourism Opportunity for the Maya Culture. *Travel Belize*. https://www.travelbelize.org/how-archaeology-has-unveiled-a-booming-tourism-opportunity-for-the-maya-culture/, accessed January 3, 2024.

LeCount, Lisa

Xunantunich Archaeological Project. *Lisa LeCount*. https://llecount.people.ua.edu/xunantunich-archaeological-project.html, accessed March 10, 2024.

LeCount, Lisa Jeanne

Xunantunich Archaeological Project. *Lisa LeCount*. https://llecount.people.ua.edu/xunantunich-archaeological-project.html, accessed January 2, 2024.

LeCount, Lisa Jeanne, and Jason Yaeger (editors)

2010

The Xunantunich Archaeological Project, 1991-1997. In *Classic Maya Provincial Politics: Xunantunich and its Hinterlands*. 2nd ed. The University of Arizona Press.

Leventhal, Richard M

2010

Changing Places: The Castillo and the Structure of Power at Xunantunich. In *Classic Maya Provincial Politics*, pp. 79–96. University of Arizona Press, Tucson, AZ.

Lewis, Brandon

1995

Excavations of Structures A-3 and A-4. *Xunantunich Archaeological Project 1995 Field Season Report*:61–70.

Lischer-Katz, Zack, and Matt Cook

2022

Virtual Reality and the Academic Library of the Future. *Transactions of the American Philosophical Society* 110(3):185–210.

MacKie, Euan W

1961

New Light on the End of Classic Maya Culture at Benque Viejo, British Honduras. *American Antiquity* 27(2):216–224. DOI: https://doi.org/10.2307/277836.

Magnoni, Aline, Traci Ardren, and Scott Hutson

2007

Tourism in the Mundo Maya: Inventions and (Mis)Representations of Maya Identities and Heritage. *Archaeologies* 3(3):353–383. DOI:10.1007/s11759-007-9042-8.

Maler, Teobert

1908

Exploration in the Department of Peten, Guatemala, and Adjacent Region: Topoxte, Yaxha, Benque Viejo, Naranjo. *Memoirs of the Peabody Museum of American Archaeology and Ethnology* 4(2).

Martin, Simon, and Nikolai Grube

2008

Chronicle of the Maya Kings and Queens: Deciphering the Dynasties of the Ancient Maya. 2nd ed. Thames and Hudson, London.

McGill, Alicia Ebbitt

2018

Examining the Pedagogy of Community-Based Heritage Work through an International Public History Field Experience. *The Public Historian* 40(1):54–83.

Miller, Julia C

1995

Tunneling Excavations in El Castillo. *Xunantunich Archaeological Project 1995 Field Season Report*:26–37.

1996

The 1996 Tunneling Excavations in El Castillo. *Xunantunich Archaeological Project 1996 Field Season Report*:28–39.

Miller, Mary E., and Karl A. Taube

1993

An Illustrated Dictionary of the Gods and Symbols of Ancient Mexico and the Maya. Thames and Hudson, London.

Morely, Sylvanus G.

1937

The Inscription of the Peten. Carnegie Institution of Washington Publications, Washington, DC.

Parks, Shoshaunna, Patricia A. McAnany, and Satoru Murata

2006

The Conservation of Maya Cultural Heritage: Searching for Solutions in a Troubled Region. *Journal of Field Archaeology* 31(4):425–432.

Pendergast, David M., and Elizabeth Graham

1981

Fighting a Looting Battle: Xunantunich, Belize. *Archaeology* 34(4):12–19.

Quartermaine, Jamie, Brandon R. Olson, and Ann E. Killebrew

2014

Image-Based Modeling Approaches to 2D and 3D Digital Drafting in Archaeology at Tel Akko and Qasrin: Two Case Studies. *Journal of Eastern Mediterranean Archaeology & Heritage Studies* 2(2):110–127. DOI:10.5325/jeasmedarcherstu.2.2.0110.

Ramirez, Estevan, Jessica Ratcliffe, Robert Gescheider, Douglas Tilden, and Jaime J Awe

2023

The Origins of Socio-Political Complexity in Western Belize: Investigating Preclassic Occupation in the Site Core of Xunantunich. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2022 Field Season* 26:149–199.

Ramsey, Doug, and John Everitt

2008

If you dig it, they will come!: Archaeology heritage sites and tourism development in Belize, Central America. *Tourism Management* 29(5):909–916. DOI:10.1016/j.tourman.2007.11.002.

Santasilia, Catharina, and Douglas Tilden

2016

2015 Excavations of the Eastern Triadic Shrine at Xunantunich, Belize. *The Belize Valley Archaeological Reconnaissance Project A Report of the 2015 Field Season* 21:118–138.

Satterthwaite, Linton R

1950a

Plastic Art on a Maya Palace. *Archaeology* 3(4):215–222.

1950b

Reconnaissance in British Honduras. *University Museum Bulletin* 16(1):21–37.

Schellhas, Paul

1897

Die Göttergestalten der Mayahadschriften: Ein Mythologisches Kulturbild aus dem Alten Amerika. Verlag von Richard Bertling, Dresden.

1904

Representations of Deities of the Maya Manuscripts. *Papers of the Peabody Museum of American Archaeology and Ethnology*.

Schmidt, Peter

1974

A New Map and Some Notes on Terminal Classic and Postclassic Activities at Xunantunich, Belize. Mexico City, Mexico.

Slocum, Diane Lynn

2018

Contextualizing Xunantunich in the Late Classis Upper Belize Valley Through Investigations of Structure A9. Unpublished M.A., Northern Arizona University.

Sullivan, Kelsey, Hannah H. Zanotto, Victoria S. R. Izzo, Chrissina C. Burke, and Jaime J Awe
2017
Revisiting Group B: Preliminary Results from the 2016 Excavation of Group B, Xunantunich. Edited by Claire E Ebert, Chrissina C. Burke, Jaime J Awe, and Julie A Hoggarth. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2016 Field Season, e* 22:379–406.

Sully, Dean
2020
Conservation Theory and Practice: Materials, Values, and People in Heritage Conservation. In *Museum Practice*. John Wiley & Sons.

Taube, Karl A.
1992
The Major Gods of Ancient Yucatan. Dumbarton Oaks, Washington, DC.

Thompson, J. Eric S.
1942
Late Ceramic Horizons at Benque Viejo, British Honduras. Carnegie Institution of Washington Publications, Washington, DC.

Tilden, Douglas, Diane Lynn Slocum, Jaime J Awe, and Kelsey Sullivan
2017
Investigation of Structure A9 at Xunantunich, Belize. Edited by Claire E Ebert, Chrissina C. Burke, Jaime J Awe, and Julie A Hoggarth. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2016 Field Season* 22:316–345.

United States Department of the Historian

Belize - Countries - Office of the Historian. https://history.state.gov/countries/belize, accessed October 30, 2023.

Watkins, Tia, Jaime J Awe, Christophe Helmke, and Rosamund Fitzmaurice

2018

Classic Maya Palaces and Their Roles Within The Greater Ceremonial Center: Results From The 2017 Field Season Xunantunich, Belize. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2017 Field Season*.

Watkins, Tia B, Claire E Ebert, Gabriela Saldaña, Jorge Can, and Jaime J Awe

2020

Continues Investigation of Graffiti at Plaza A-III: The 2019 Excavations at Structure A13. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2019 Field Season* 25:125–136.

Watkins, Tia B, Estevan Ramirez, Gabriela Saldaña, Rosamund Fitzmaurice, Brett Meyer, Jorge Can, and Jaime J Awe

2023

Investigations of the Northern Palace Compound at Xunantunich, Belize: Structures A10 and A13. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2022 Field Season* 26:127–148.

Watkins, Tia B, Douglas Tilden, and Jaime J Awe

2019

Architecture and Activity at eh Ceremonial Center of Xunantunich: Results from the 2018 Field Season. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2018 Field Season* 24:249–270.

Webster, David

2000

The Not So Peaceful Civilization: A Review of Maya War. *Journal of World Prehistory* 14(1):65–119.

Willey, Gordon R.

1965

Chapter VIII. Artifacts. In *Prehistoric Maya Settlements in the Belize Valley*, edited by Gordon R. Willey, William R. Bullard, John B. Glass, and James C. Gifford, pp. 391–522. Papers for the Peabody Museum of Archaeology and Ethnology. Cambridge University Press, Harvard University.

Yaeger, Jason

1997

The 1997 Excavation of Plaza A-III and Miscellaneous Excavation and Structural Clearing in Group A. *Xunantunich Archaeological Project 1996*:24–55.

2010

Shifting Political Dynamics as Seen from the Xunantunich Palace. In *Classic Maya Provincial Politics: Xunantunich and Its Hinterlands*, edited by Lisa Jeanne LeCount and Jason Yaeger, pp. 145–160. University of Arizona Press, Tucson, AZ.

Zanotto, Hannah H., and Jaime J Awe

2017

Xunantunich Archaeological and Conservation Project: A Progress Report of the Second (2016) Season of Excavations. Edited by Claire E Ebert, Chrissina C. Burke, Jaime J

Awe, and Julie A Hoggarth. *The Belize Valley Archaeological Reconnaissance Project: A Report of the 2016 Field Season*:289–292.

Zeleznik, Scott

1993

The 1993 Excavation and Consolidation of Structure A-1. *Xunantunich Archaeological Project 1993 Field Season Report*:30–55.