# A Tale of Three Middens: Comparing the composition of mollusk taxa at three Middle to Late Ceramic shell midden sites in coastal Pacific Panama (680 CE to 1500 CE)

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Leiden, 15 June 2023, Final Draft

# Acknowledgements

First, I would like to thank Natalia Donner, who inspired in me a fascination with Darién and encouraged me to think like an archaeologist. She was patient with me even when I was clueless. Watching a truly brilliant expert like Natalia do what she does compelled me to stick with my studies even when the going got tough.

To Lucy Gill, an enormous thank you for getting me interested in shells in the first place. Her enthusiasm when I first learned to tell the side of a shell motivated me to learn.

To my supervisor, Dr. Maaike de Waal, my utmost gratitude for being willing to give me feedback on a Panama thesis despite being a Caribbean specialist.

To my parents, I owe them everything. They never gave up believing in me despite my many failures and challenges, and without them I would not be here today.

I would also like to thank my friends, too many to name, who made four years of pandemic and global societal upheaval bearable.

I must thank all my archaeology mentors; from the time I was 14 and did my first field work they saw something in me and were willing to give a young archaeologist a chance. The opportunities and guidance they provided proved fundamental for me down the road.

This thesis is dedicated to the memory of Richard Cooke, a towering figure in the field of Panama archaeology whose work we all build on. I regret that we only had the chance to speak once before he passed, but his achievements and ideas will live on for years to come.

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# 1. Introduction

The archaeological story of Darién province in Panama remains poorly understood. This is due to a variety of factors which have discouraged all but a few researchers from conducting any meaningful study, including the remoteness of the region and lack of roads. Across a small stretch of water from Darién lies the Pearl Islands archipelago. In recent years, some small excavations have been conducted on the islands which have begun to paint a picture of the exploitation of marine resources by indigenous people for thousands of years. On the Darién mainland, however, the scale of survey has been much smaller, and therefore there is less data to work with. The Darién Profundo project has been a recent exception, gathering some of the only archaeological data so far in the region.

Superficially similar in terms of climate and marine species, both Darién and the Pearl Islands have evidence of pre-Columbian occupation including shell mounds. These heaps of primarily mollusk shells frequently also contain ceramics and other animal remains. Mollusks and other marine life have long been a vital food source for communities inhabiting the Pacific coast of Panama, and to this day people in Darién still eat multiple species found in the archaeological record. (Donner et al., 2021, p. 61). By looking at the remains of what pre-Columbian inhabitants ate, in this case shells, we can learn about aspects of how they lived and utilized their environment. This thesis will combine mollusk taxonomic data from shell mounds surveyed by the Darién Profundo project and data from similar mounds in the Pearl Islands from three sites dating to between 680 CE and 1500 CE to attempt to fill in some of the blanks in the archaeological picture of Darién in Pre-columbian times. In the thesis I will seek to answer the following question:

*How does the taxonomic composition of mollusk remains from Late Ceramic shell middens on the mainland compare to that of a Middle Ceramic shell midden in the Pearl Islands, and what does this tell us about the exploitation strategies of the people living in these two areas?*

For the purpose of comparison, the archaeological contexts from which the data will be drawn are from as close in time as possible given the available data that has been published, from the 7$^{th}$ to 16$^{th}$ centuries CE. To support the main research question, it will be necessary to also examine several sub-questions relevant to the topic. These will include:

*Is there a significant difference between the taxonomic makeup of mollusk remains at the mainland shell mounds of Piangual and San Antonio?*
*Do the taxa (molluscan species) on the mainland come from different habitat types from those on the islands?*
*What factors might influence differing mollusk exploitation strategies on the mainland vs on the islands?*

The first section of this thesis will give a brief background on the sites and the region in which they are situated. This information is crucial to understanding the context in which the sites sit. This will be followed by an overview of the prior archaeological study conducted in the research area to make clear the current state of knowledge there. The background section will also explain the concept of a shell mound and explain how these sites are formed to fully understand the data from them.

The second section will be a detailed description of the methodology used to acquire the data set and the practices used to interpret it. The challenges of doing archaeological work in Darién affect the methods used in collection and survey, therefore they affect the data collected. The methodology section will address both the methodology of survey and collection in the field and the way in which the data will be analyzed after the fact.

The third section will contain the data in the form of tables and graphs, supplemented by field drawings made by myself and other members of the field team showing the stratigraphy and layout of the contexts from which the data was retrieved.

The fourth section will be the analysis, or interpretation of the data, in which the research questions will be answered, and the results of the data synthesized.

Finally, in the conclusion the points of the thesis will be summarized and the implications of the results for future research will be discussed.

# 2. Background

Before diving into the methodology, data and discussion of this thesis, I include in this chapter a comprehensive background on the regions, sites and concepts to be discussed. First will be a general introduction to Darién Province and the Pearl Islands, including their geography and history. Next I will give short descriptions of each of the three sites on which the thesis focuses. I will then explain the concept of a shell midden site and provide information about some notable sites of that type in Panama, which will help in understanding my arguments. Finally, I will include a brief overview of the state of archaeological knowledge in the region to inform readers of where that knowledge currently stands.

## 2.1. General Background

This section will provide general background on the geographic and cultural landscape of Darién and the Pearl islands

### 2.1.1. Darién

Darién is the southeasternmost province of Panama, bounded to the north and east by Guna Yala, the *comarca (*government-sanctioned territory) of the Guna indigenous people, which forms a thin strip along the Caribbean coast. To the northwest, it borders Panamá province, to the west the Gulf of Panama and the Pearl Islands, and to the south, Colombia. The small population is concentrated on the Pacific coast, around the bays of San Miguel and Garachiné and along rivers such as the Tuira which wind deep into the heavily forested interior of the province. There are few roads and little infrastructure, especially toward the border with Colombia, where the terrain is lowland jungle. Most transport on the Pacific coast is by water. The people of Darién province are ethnically diverse, consisting of afrodescendant communities along the Pacific coast, indigenous Emberá, Wounaan and Guna people throughout much of the province, and *interioranos,* people of primarily mixed indigenous and European descent, (Donner et al., 2021, p. 3) who traditionally farm the inland areas.

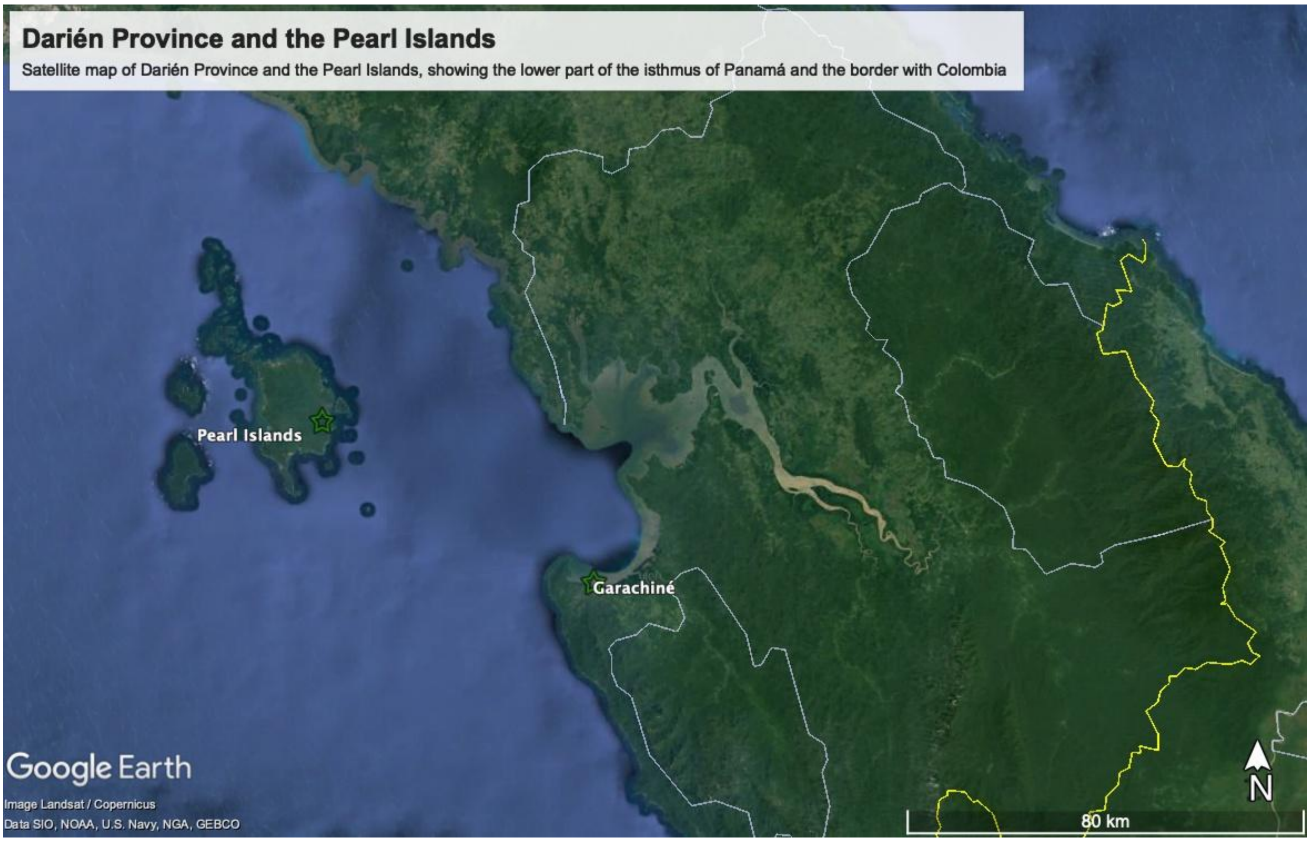



*Figure 1: Map of Darién and the Pearl islands. This satellite map shows the spatial relationship between the Pearl Islands and Garachiné, the location of San Antonio and Piangual on the Darién coast (Google Earth Pro, 2023).*

The sites on which this study will focus, San Antonio and Piangual, are located near the small town of Garachiné, today a majority afrodescendent


*Figure 2: Map of Garachiné area showing San Antonio and Piangual. This satellite image shows the locations of the two mainland sites that are the focus of this thesis in relation to the village of Garachiné (Google Earth Pro, 2023).*

settlement. Garachiné sits on the shore of a bay formed by a hilly peninsula to the west and a forested, low-lying eastern shore. Mudflats are exposed at low tide, especially to the east of Garachiné. Along the southeastern shore of the bay, mangrove swamps extend inland from the shoreline, reaching their broadest extent around the mouth of the Sambú River. The inland area surrounding the town consists mostly of pasture for cattle. Further south are mountains covered by rainforest, which can be seen from Garachiné.

### 2.1.2. The Pearl Islands

The Pearl Islands, just northwest of the Bay of Garachiné, are an archipelago of several large islands and dozens of small islets. They were once connected to the mainland, but were separated by rising sea levels between 10000 and 9000 BP (Martín et al., 2016, p. 379). The islands are formed from basalt, and many are ringed by coral reefs (McNiven, 2003, pp. 33-4). There are mangrove areas on many of the islands, especially the largest, Isla del Rey (McGowan et al., 2010, p. 860). The archipelago derives its name from the once-abundant pearl oyster, *Pinctada mazatlanica.* Most of the current inhabitants are the descendants of Africans brought as slaves to harvest these pearls (McNiven, 2003, pp. 34).

Vasco Núñez de Balboa, a Spanish conquistador, was apparently the first European to visit the islands in 1513. He noted the abundance of oysters and observed the native inhabitants harvesting the shells for meat while discarding the pearls (Galtsoff, 1950, p. 3). By about a century after this first contact, the pearl diving industry had already become extremely valuable, and the first enslaved Africans were shipped to the islands by 1562 (Cooke et al., 2016, p. 737). In the ensuing centuries, the pearl industry continued through booms and busts up to the 20th century (Cipriani et al., 2008, p. 691). According to Galtsoff, who surveyed the remaining oyster population in 1950, over-harvesting had caused the number of *Pinctada mazatlanica* to crash dramatically (Galtsoff, 1950).

## 2.2. Early colonial sources

Because the native peoples of what is today Panamá lacked writing, and more importantly because the geographic distribution and cultures of indigenous peoples changed dramatically in Darién after the Spanish conquest, only limited sources are available. There are several reports by Spanish and other European writers from the very earliest colonial period, which describe aspects of indigenous culture and settlements. These are, however, highly suspect as the writers were biased in their goal to colonize and ultimately subjugate these peoples. Nevertheless, a brief mention of the content of these accounts might hold some useful information for understanding the basic outlines of indigenous life in Darién and the Pearl Islands. Linné quotes early conquistador Balboa as saying he received word of a coastal region with islands (the Pacific coast), describing its pearl resources. Linne also refers to early European sources stating that the chiefs of the Pearl Islands often raided the mainland coast. One source states that the chief, or *cacique* of the islands lived in a palace (Linné, 1929, pp. 63-72). These stories gave rise to the idea that the people of Pearl Islands were somehow dominant over those of the coast, but archaeologists should be naturally suspicious of the accounts of hostile outsiders such as the Spanish. All that can be said definitively is that there were interactions between the people living on the islands and those on the coast of today's Darién. The archaeology bears this out, as will be discussed later. Of Garachiné in particular, little is said until Dampier, in the late 17th century, mentions stopping to trade with the native inhabitants for food (Dampier, 1699, pp. 197-8). This indicates that it was at least inhabited at that time by an indigenous population.

## 2.3. Basic site descriptions

Some short descriptions of the three shell midden sites discussed in this thesis are included in the following section. More detailed analysis will take place later in the text.

### 2.3.1. San Antonio

The Swedish archaeologist Sigvald Linné (1929) first described the site now called San Antonio, describing it as an exceptionally large former indigenous settlement. He noted many pieces of ground stone that had been modified as surfaces for grinding, commonly known as *metates* or *yunques.* Linné also recorded a large amount of ceramic sherds on the surface (p. 157). He either failed to notice or did not include the largest shell mound at the site, now known as San Antonio M (M for mound). This could have been because even today the mound area is covered by vegetation, unlike the upper part of the site which is pastureland.

*Figure 3: Part of the San Antonio pasture area. In this image part of the upper pasture area of San Antonio can be seen, with the mountains south of Garachiné in the background. (photograph Leo Kalajian, 2022)*

Survey conducted by Donner et al. (2021) recorded multiple mounds in the pasture area of the site, containing ceramics and some malacological remains, as well as anecdotal evidence from looters that ceramic vessels containing human remains had been found inside mounds (pp. 27-8). San Antonio includes the pasture area, uphill and south of the modern road, and the shell mounds of San Antonio M north and downhill from the road. The current road is modern but according to local people, it was built on an ancient pathway, which may be related to the site (Natalia Donner, personal communication, July 27, 2022). San Antonio M, being one of the subjects of this study, will be discussed in detail later, but a general description will be given here. The central shell mound, the largest of three, rises 6.5 m from its base in the mangrove swamp and is about 14.3 m from the road (measuring from the roadside to the base of the mound). On the side facing the road there is only a slight perceptible rise in elevation to the summit of the mound, while the other sides of the mound slope steeply downwards to the mangrove swamp. The mound's slopes are covered with shells of various taxa, deposited in layers from the mangrove swamp level up to the mound summit. Some ground stone implements and at least one large metate are evident in the vicinity. Ceramics are plentiful over much of the mound. About 30 m away from the base of the largest mound to the west is another, less prominent shell mound, lying on a raised terrace above the mangrove swamp that extends below all three of the mounds.

### 2.3.2. Piangual

Piangual is a smaller site, located on the outskirts of the town of Garachiné on the east bank of the San Antonio River. The site is about 360 m from the river's mouth where it meets the Pacific Ocean (Google Earth Pro, 2019). A dense layer of mollusk shells covers the surface of the site, which is theorized to be a mixture of pre-Columbian and more modern deposits according to Donner et al. (2021) who recorded that the highest point of the mound was about 1.5 meters tall and that, because of its location in a populated area, it was subject to disturbance (p. 22-3).

*Figure 4: A view of the main shell deposit at Piangual. This image shows some of the disturbance at the site, in the form of modern trash (Donner et al., 2021)*

Further investigation has since revealed that portions of the site were bulldozed by a local official to make way for development that was never realized (Natalia Donner, personal communication, August 2, 2022). Therefore, the upper portion of the site is likely very disturbed, but the 2022 season test excavation revealed some remaining strata in situ. In contrast with the mounds at San Antonio, there is little soil formation at Piangual, perhaps indicating use continuing to a more recent period in the past.

### 2.3.3. Pedro González L-106

L-106 is a shell mound located on a northeast-facing beach on Pedro González, one of the Pearl Islands. The island is on the western side of the archipelago, in the Gulf of Panama (Sáenz-Ulate, 2014, p. 9). It is positioned about equidistant from both Garachiné and Panama City. L-106 is part of the Playa Don Bernardo (PDB) site complex, which includes both ceramic and preceramic contexts and multiple shell mounds. Excavation at L-106 consisted of test pits and coring to determine the extent of the site (Sáenz-Ulate, 2014, p. 70). L-106 belongs to the Middle Ceramic, and has been dated to 680-890 CE (Sáenz-Ulate, 2014, pp. 8, 73-74).

## 2.4. What is a shell mound?

Because this thesis centers entirely on mollusk remains from shell mound contexts, I will define and explain this type of site briefly. The terms “shell mound” and “shell midden” are often used interchangeably. Waselkov (1987) defines a shell midden as “a cultural deposit of which the principal visual constituent is shell” (p. 95). Shell mounds or middens can vary from being deposits of exclusively mollusk remains, to sites where there are large amounts of shell mixed in with soil and other materials such as animal bone, ceramics and even burials. The reasons for deposition of shell mounds can also vary. They are often the remains of food processing but can also be traces of industry (tool or ornament production) and even solid mounds upon which to build structures or settlements (Claassen, 1991, pp. 251-3). Shell sites are difficult to excavate for several reasons. Firstly, biological processes such as tree growth can dramatically affect the shape and structure of a shell mound. Secondly, although shells often last longer than other biological materials, they can be severely corroded by chemical and biological processes (Waselkov, 1987, pp. 148-9). Finally, it is not as easy to distinguish archaeological layers when there is little soil, as is often the case within shell-bearing contexts. We observed two of these phenomena, bioturbation and chemical erosion of shells, at San Antonio M. This will be explained in more detail later.

Many of the significant sites excavated in Panama have had shell components. Several of these are located on the opposite side of the Gulf of Panamá from Darién, on the coast of Parita Bay. Cerro Mangote and Sitio Monagrillo are two large shell midden sites first excavated in the mid-20th century. Cerro Mangote was dated to the Preceramic period, slightly less than 7000 BP (Cooke & Sánchez, 2004a, p. 15). The site contained chipped and ground stone tools and interestingly, burials were found within the shell midden itself (McGimsey, 1956, pp. 156-8). At Sitio Monagrillo, Willey & McGimsey (1954) excavated a very large shell mound that included ceramics and showed a change in taxonomic composition of shells throughout the strata. They theorized that this reflected geological changes in the surrounding environment of the site which caused certain species to thrive and others to diminish (pp. 48-9). The site was dated to between 2400 BCE and 1200 CE (Cooke & Sánchez, 2004a, p. 16).

The last shell site I will mention here is Cerro Juan Díaz, which differs from the previous two as it was associated with a tool and ornament industry.
Based on the artifacts found at the site, it was a workshop making tools and ornaments such as beads from mollusk shells including *Larkinia (Anadara) grandis*, *Pinctada mazatlanica* and *Strombus* species (Mayo & Cooke, 2005, pp. 286, 293). The shell workshop at Cerro Juan Díaz was radiocarbon dated to between 1020 and 1280 CE, with the ceramic chronology indicating slightly earlier dates (Cooke & Sánchez, 2004a, p. 16).

These other notable shell sites emphasize the role that mollusk species exploitation clearly played in pre-Hispanic societies around the Gulf of Panama. These examples also show the usefulness of shell mounds in archaeology, as their creators often used them for secondary purposes such as burial.

## 2.5. History of archaeological research in Darién and the Pearl Islands

In order to understand where more research is needed in an area of study, it is first necessary to be fully aware of the current state of archaeological knowledge and the history of how it was compiled. Therefore in this section I give a short overview of the past research in the areas of Darién and the Pearl islands.

### 2.5.1. Darién

The earliest archaeological study of Darién was not until 1921 when Swedish archaeologist Sigvald Linné conducted a broad but shallow survey of the Pacific and Atlantic coasts of the lower Panamanian isthmus. His study concerned sites in Darién and some parts of adjoining Colombia (Linné, 1929). As previously mentioned, Linné documented San Antonio and several other sites in the vicinity of Garachiné, but did not take note of Piangual (pp. 157-163). Though he did not record the largest San Antonio shell mound, many similar mounds were documented in the Pearl Islands in the same work (p. 87). Linné's work has been a vital source for more recent archaeology in Darién because of the lack of any alternative. Since Linné's publication and until recently there were only a few small mentions of Darién archaeology in reports (Cruxent, 1959), (McGimsey, 1964). McGimsey conducted some small-scale excavation consisting of test-pits in the vicinity of Garachiné, describing one site that is likely Piangual but omitting San Antonio (McGimsey, 1964, pp. 48-9). Modern archaeologists working in Panama have devised a system of three "culture-areas" to understand the isthmus in the time before European contact. *Gran Darién*, including the modern provinces of Darién and Panamá, along with the indigenous *comarca* territories bordering them, *Gran Coclé*, the central third of the country, and *Gran Chiriquí*, the western third and part of what is now Costa Rica (Donner et al., 2021, p. 4). Although variations of theorized cultural classification existed before, Cooke (1976, p. 122) was the first to suggest three regions from east to west. Coclé and Chiriquí were already well studied, but the eastern third remained a supposedly empty, undefined area with only scattered and shallow archaeological knowledge (Cooke, 1998, p. 91). Bray (1984) argued that the area that would become known as *Gran Darién* was distinct from the other regions and theorized that trade relations connected communities along the Pacific coast. Cooke and Sánchez (2004b) emphasize that the boundaries of these areas were not static and did not prevent the movement of people or economic exchange (p. 9). At best, this “three regions” theory should be regarded as only a general outline of the actual archaeological and historical realities of Panama and should be subject to change based on new archaeological findings. Cooke himself was skeptical of relying on cultural areas, criticizing flaws in earlier models based entirely on limited ceramic evidence (Cooke, 1972, pp. 14-18).

### 2.5.2. Pearl Islands

Compared to Darién, the Pearl Islands have been subject to much more archaeological study. Beginning in 2007, projects were financed by the STRI (Smithsonian Tropical Research Institute) based in Panama city with the aim of conducting archaeological research in the islands before the development of tourism infrastructure destroyed pre-Columbian sites (Sáenz Ulate, 2014, p. 2). Small-scale excavations have been carried out on several islands, including in shell midden contexts (Martínez et al., 2009, Pearson et al., 2020, Cooke et al., 2016, Martín et al., 2016), the most studied island being Pedro González, which is the location of the Playa Don Bernardo site complex (Martín et al., 2016, pp. 379-81). The earliest known sites containing ceramics in Panama date to 4500 BP (Cooke & Sánchez, 2004b, p. 8). Radiocarbon dating suggests that PDB was initially occupied during the Preceramic period, with a date range of 6200-5600 cal BP (Cooke et al., 2016, p. 750). After this early occupation, there is a long gap in the archaeological record until the site was re-inhabited between 2340 and 2270 cal BP. These dates are considered Early Ceramic, as similar dates on the mainland came from contexts containing ceramic remains (Martín et al., 2016, p. 384). The occupation at PDB continued through the Middle and into the Late Ceramic with L-106 and up to about 600 BP in other contexts (Martín et al., 2016, pp. 389, 392). The above mentioned papers mostly deal with vertebrate faunal remains and ceramics, although these materials tend to be found in shell midden contexts, known as *botaderos* or *concheros.* Only one publicly-available paper goes into the detail of mollusk remains from these sites (Sáenz-Ulate, 2014). The data comes from a context on Pedro

González, L-106. These data will be used as the comparison to those of the mainland sites. A final thing to note is that despite being the mollusk that gave the Pearl Islands their name, *Pinctada mazatlanica* is almost never found in shell midden contexts either on the Pearl Islands or the mainland (Martín et al., 2016, p. 393). At one of the only major sites where they have been found, Cerro Juan Díaz (see section 2.4) the *P. mazatlanica* shells were used as material for tools and ornaments (Mayo & Cooke, 2005, pp. 286, 293).

# 3. Methodology

Before beginning to interpret any data, it is important to explain how this data was collected and recorded. Two different approaches to data collection can result in differing interpretations. Alternatively, if a methodology is flawed, the conclusions based on data collected and recorded using that methodology are unreliable. For transparency, and to ensure that the conclusions made based on the data are understood, a detailed methodology for this thesis and relevant parts of the field work that went before it is necessary and will be provided in the subsequent chapter.

## 3.1. Solutions to survey challenges in Darién

Conducting archaeology in Darién presents a unique set of problems which any team intending to work there must solve to gather data while maintaining archaeological standards. The tropical forest biome that occupies much of the province is not an ideal environment for delicate instruments such as total stations, and the dense tree cover over many sites (for example, San Antonio M) renders satellite-connected GPS nearly useless (Gill & Donner, 2022). There is, therefore, an element of creativity required for surveying and excavation. The parallel visibility at the San Antonio M site is quite low due to jungle foliage and uneven terrain. In the upper pasture at San Antonio, the problem is instead ground visibility, as thick grasses cover the soil surface completely in some areas (Donner et al., 2019, p. 27). It is easy to see why the few archaeological projects that have taken place in Darién have employed some unorthodox techniques.

## 3.2. Initial site survey techniques in Darién

Survey techniques at San Antonio consisted of a combination of systematic and unsystematic surveys. For the systematic portion, in the upper pasture, team members walked parallel transects 5 meters apart from one end of the pasture to the other. When an archaeological find or feature was encountered, it was recorded by plotting the location in a GPS with a unique name based on the type of find or feature, and a number, for example GS3 for the third ground stone tool found. Each archaeological find or feature was then photographed, and the photo numbers and find or feature names were recorded in a table, along with a brief description. We used unsystematic survey methods for the rest of the San Antonio site. Along the side of the road separating the pasture area from the forested shell mound site, archaeological material was clearly visible, including ceramics, lithics and shells. This material was out of context, disturbed from its original position by the construction of the road and piled up on the side. Though they could not be related to a context, these materials could be used as a reference collection for the site and could be collected without disturbing artifacts still in situ. The collection was unsystematic, with team members simply walking along the roadside and collecting lithic and ceramic, and shell remains. A representative sample of these materials was recorded and stored with other archaeological materials from the project. The above surveys followed the initial site prospection conducted in 2019 (see Donner et al., 2021).

## 3.3. Looting: problems and incidental uses

The looting of archaeological deposits is an endemic problem in Panamá, owing to the poverty of people living in the rural areas where many sites are located and to rumors of gold and other valuables buried there. Local people in Garachiné are aware of the looting that occurs, and some openly participate in it, though there is a diversity of opinions even within the local community over whether it should be permitted. Though as archaeologists we condemn looting in all its forms, in Darién it is a fact that this practice is widely accepted. Instead of trying to prosecute local people for looting, we must use the knowledge of those who engage in looting to protect and document what remains. Local people are, in many cases, the most important sources for site locations. Often the same people who have knowledge of these sites have also taken artifacts from them. Specifically at the San Antonio mound site, two deep looter pits and a scattering of small holes have been dug directly into the largest shell mound. While these have unfortunately removed archaeological material and damaged the site, they provided the Darién Profundo team with the unique opportunity to record the stratigraphy of the mound without committing to a full-scale excavation. Anecdotal evidence from local people also revealed some of the objects looters removed from the mound via the pits, including ceramic vessels containing human remains (Donner et al., 2021, p.28). This kind of hearsay cannot be admitted as archaeological data, but it can give clues to the uses of the site.

## 3.4. Excavation

This section will provide a detailed description of the excavation portion of the methodology, which included profile cleaning and shovel tests.

### 3.4.1. Profile cleaning and layer collection in Darién

The shell data collected from San Antonio M comes from the profile cleaning of two looter pits- H4 and H3. Of the two, H4 is much deeper, reaching 3.5 meters below the surface. Only the north profile was cleaned, in 10 cm increments from the datum point slightly above the ground surface. All soil removed by the cleaning was collected in bags. Each bag represented one 10 cm arbitrary level. The bags were labeled with the stratigraphic unit (archaeological layers visible in the profile) numbers in Roman numeral form, the arbitrary level numbers and their depth below the datum, date of excavation, site name and name of the team member who collected the bag. Team members used trowels to lightly scrape the outer layer of soil away from the pit profile, and continued straight down the profile to keep the surface flat. The irregularities in the looter pit wall were such that at some levels, more soil had to be removed to keep the profile uniform from the top to the bottom.

*Figure 5: Setting up ladder at San Antonio H4. In this image, one of the team members is securing the ladder we used to clean the profile. The south profile of pit H4 is also visible (photograph by Leo Kalajian, 2022).*

When the profile was fully cleaned to the bottom of the pit, the stratigraphic layers and features were measured using a line level and measuring tape, after which the entire profile was drawn at 1:20 scale and photographed along with a scale, north arrow and a whiteboard with contextual information according to accepted archaeological practice. All strata and features were described and the descriptions recorded.

### 3.4.2. Excavation on Pedro González

The L-106 shell mound was excavated in 2009. The initial excavation consisted of a 2x1 m cut, placed directly on the shell deposit. This was excavated in 10 cm arbitrary levels down to the sterile layer, approximately 60 cm below the surface. All sediment was sieved through 4 mm mesh and archaeological materials were separated into faunal, lithic, and ceramic remains. When the initial cut was completely excavated, four 50x50 cm columns were excavated, one from each profile of the pit. Each was excavated by stratigraphic level, and the sediment removed was placed in bags according to the stratigraphic unit. Materials were separated by level in order to determine whether the species composition changed throughout the sequence. When fully excavated, the profiles were drawn at 1:10 scale. All archaeological material was separated by stratigraphic layer and placed in plastic bags with labels indicating the site, person excavating, level and material. The chipped stone was wrapped in paper within the bags to prevent cracking. Each new stratigraphic level of excavation was photographed. Archaeological material was then processed at the Smithsonian Tropical Research Institute (henceforth STRI) laboratory in Panama City (Sáenz Ulate, 2014, pp. 95-101).

## 3.5. Shovel tests at Piangual

A shovel test is perhaps the smallest-scale, least invasive method of excavation known to archaeologists. They are most commonly used in greater numbers for prospection at suspected sites (Krakker et al., 1983, p. 470). At Piangual, however, we used shovel tests to evaluate the extent of damage caused by bulldozing in previous years, and to determine the boundaries of the remaining archaeological deposit. We conducted two shovel tests, one in the center of the shell deposit where the team leaders expected more preservation, and one at the edge of the visible shell area which was likely more disturbed. Each shovel test consisted of a roughly 30 x 30 cm hole, the width of a shovel. The initial cut of the hole was made by a shovel, and then subsequently each 10 cm arbitrary level was removed by troweling. The soil from the shovel test was collected in bags by arbitrary level, the same method as used at San Antonio M. We continued to remove levels until


*Figure 6: Shovel Test at Piangual. This image shows one of the shovel tests conducted at Piangual, in the less disturbed of the two contexts. It shows the very limited soil formation at this site (Photograph by Kai Tjong-Ayong, 2022, used with permission).*

reaching the natural layer. The test at the edge of the shell deposit contained modern refuse and appeared very disturbed, and below a thin layer of shells we reached soil. It was concluded that this area had been completely disturbed by modern activity and we ceased excavating. The shovel test in the center of the site did reveal shell layers apparently *in situ* down to level 4, (30-40 cm below the surface) where the shell layers transitioned to soil with crushed shells decreasing in density with depth. The shovel tests were then photographed with scale and north arrow. They were not drawn because the lack of visible stratigraphy in the shell layer rendered drawing unnecessary (Donner et al., in prep).

## 3.6. Shell data recording methods

To understand the significance of archaeological data, it is important to explain how it was collected and recorded. In the following section I will explain in detail the methodology that was used at each site to collect data on mollusk remains.

### 3.6.1. Darién

All soil collected in bags from San Antonio M was sieved through 3mm mesh. Each bag representing one 10 cm arbitrary level was sieved by itself and all artifacts from that bag were placed in bags also associated with that level, with the relevant contextual information and the category of find: bone, shell, and ceramics. Any finds that did not fit these categories were given their own bag. Shell was not initially separated by taxon. Shell and ceramic bags from each sieved arbitrary level were weighed on a scale and each weight was recorded in grams. Some levels lacked enough of either ceramic or shell to register on our scale, being less than 10 grams. After weighing, shells were washed by hand and re-bagged. Due to time limitations, neither total weights per taxon nor MNI (Minimum Number of Individuals) were determined in the field. The shell taxa present were however recorded and will be discussed in detail in the data section. The mollusk MNI data for Piangual and San Antonio used for this thesis comes from the 2019 season of the Darién Profundo project. In 2019, sample collections of mollusk remains were taken from Piangual and San Antonio. The San Antonio sample came from a looter pit in the upper pasture area of San Antonio (not San Antonio M) (Donner et al., 2021, p. 49). The sample from Piangual was taken from the area of the site the project leaders considered least disturbed (the middle of the shell deposits at the highest point of the site) (Natalia Donner, personal communication, April 23, 2023). The shells in these samples were then sorted by species and counted for MNI (Donner et al., 2021, p. 49).

### 3.6.2 Pedro González

Shell species were identified with the help of an expert and using STRI reference materials. First, shell remains were separated into *Bivalvia* (bivalves), *Gastropoda* (gastropods) and *Polyplacophora* (chitons). For each species, the total weight of the shell recovered was recorded. The researchers also weighed and counted the number of shell fragments with diagnostic features including umbos for bivalves and spires for gastropods. Next the MNI (Minimum Number of Individuals) and NISP (Number of Identified Specimens) were determined (Sáenz Ulate, pp. 101-04). The NISP is calculated by counting the total number of individual faunal remains identified as being from one species. Calculating the MNI is more complicated and involves counting the number of diagnostic features and determining the minimum number of individual animals that could fit within the amount of physical remains present in a sample (Renfrew & Bahn, 2016, p. 294). Finally, the common habitats of each taxon were identified. The weights of the shell remains were used to determine the probable weights of the meat from each taxon and the amount and composition of nutrients each would have provided. (Sáenz Ulate, 2014, pp. 111-12). The meat weight and nutritional composition data will not be used in this study, therefore the process by which they were calculated need not be described in detail.

## 3.7. Date coring for AMS (Accelerator Mass Spectrometry)

For the purposes of this thesis, the dates of the archaeological deposits at San Antonio are relevant because they place the shell mounds in context relative to the already dated sites on the Pearl Islands, including L-106 on Isla Pedro González. We used AMS (Accelerator Mass Spectrometry) to calculate the dates from San Antonio. AMS dating is a form of radiocarbon dating, which works by counting the amount of radiocarbon in a sample. It requires less material than other methods. It is of vital importance that the samples be protected from contamination by placing them in a sealed container (Renfrew & Bahn, 2016, pp.148-49). The procedure for collecting these dates involves removing small samples of soil from the contexts to be dated. We collected these samples using plastic tubes, which were pressed into the profile of pit H4 and then removed, extracting a small core of soil. These core tubes were then sealed, wrapped in aluminum foil and placed in ziploc bags, and kept in refrigeration to prevent any contamination. AMS dating was conducted by the Beta Analytic testing laboratory (Natalia Donner, personal communication, June 10, 2023). Four dating samples were taken from H4, ranging from near the bottom of the pit to the top. The locations of the cores are marked in green circles on the left side of Figure 8

# 4. Results

In the results section, I present all of the relevant data and any information necessary to understand it. The data are divided into three sections, one from each site, and I have presented them in both visual and written form for maximum clarity. For the major mollusk taxa, images are included to highlight the physical characteristics of each species. All numbers used in the context of taxa are the NMI, or Minimum Number of Individuals, in contrast to the NISP, which only counts the number of individual fragments without making an estimate of how many individuals are contained in a data set (Renfrew & Bahn, 2016, p. 294). I found this to be a more sensible way to visualize the data. For example, using the NISP method of counting, one individual shell fractured into many small fragments could lead one to believe that there were more of that species than another shell that was only broken into two pieces.

## 4.1. San Antonio

The following results are the summary of data collected during field work conducted by Donner et al. (2021) during the 2019 season and new data from the 2022 season, to be published as Informe preliminar julio 2022-enero 2023 (Donner et al., in prep.).
These include mollusk shell taxonomic data as well as the total weights of shell recovered by arbitrary level at San Antonio M. These data will be supplemented by observations made in the field during the 2022 season. Also included is a description of the stratigraphy and AMS radiocarbon dating at San Antonio M, as it is relevant to the central questions of this thesis.

### 4.1.1. Taxa

This section will reveal the most numerous shell taxa at the site of San Antonio near Garachiné, Panama, drawing from data collected during the 2019 field work season. The mollusk remains from San Antonio which have been identified by species have an MNI (Minimum Number of Individuals) of 90. These data are from the upper pasture area of San Antonio, collected from the profile of looter pits there (Donner et al., 2021, pp.49-50).

| **Mollusk taxa** | **MNI** |
|---|---|
| *Iliochione subrugosa* | 69 |
| *Crassostrea* sp. | 13 |
| *Leukoma ecuadoriana* | 3 |
| *Crassostrea columbiensis* | 1 |
| *Anadara tuberculosa* | 1 |
| *Larkinia grandis* | 1 |
| *Leukoma asperrima* | 1 |
| *Nerita scabricosta* | 1 |
| Total: | 90 |

*Table 1: Mollusk taxa from San Antonio. This table shows the MNI for each species present in the sample collection from San Antonio taken in 2019 (Data from Donner et al., 2021).*

The taxa *Iliochione subrugosa*, *Crassostrea* sp. (undetermined *Crassostrea* species) and *Leukoma ecuadoriana* were most represented in the sample from San Antonio, with other shell species making up only 5.56% of the total (5 out of 90). All three of these species are bivalves, with gastropods making up only 1.11%, or one individual (*Nerita scabricosta*). The undetermined *Crassostrea* species may be *Crassostrea columbiensis*, also present in the data, or one of the other species of oyster. These were often in very fragmentary condition in contexts at San Antonio and were therefore difficult to identify based on physical characteristics. *Iliochione subrugosa* is by far the most common species in the 2019 mollusk sample. This was also the case at San Antonio M, the focus of the 2022 season. *Anadara grandis* and *Leukoma grata* were also common in the layers at San Antonio M, along with *Crassostrea* taxa that were difficult to identify. Perhaps the most significant species found at San Antonio in terms of archaeology is *Pinctada mazatlanica.* As previously mentioned, this pearl-bearing shell is seldom found at shell midden sites in Pacific Panamá, despite being edible and containing pearls. The thin layers of *P. mazatlanica* found in the lower part of the H4 stratigraphy were in very poor condition, but unmistakable as that species. This is the first instance of *P. mazatlanica* in larger quantities in a shell-mound context in either Darién or the Pearl Islands.

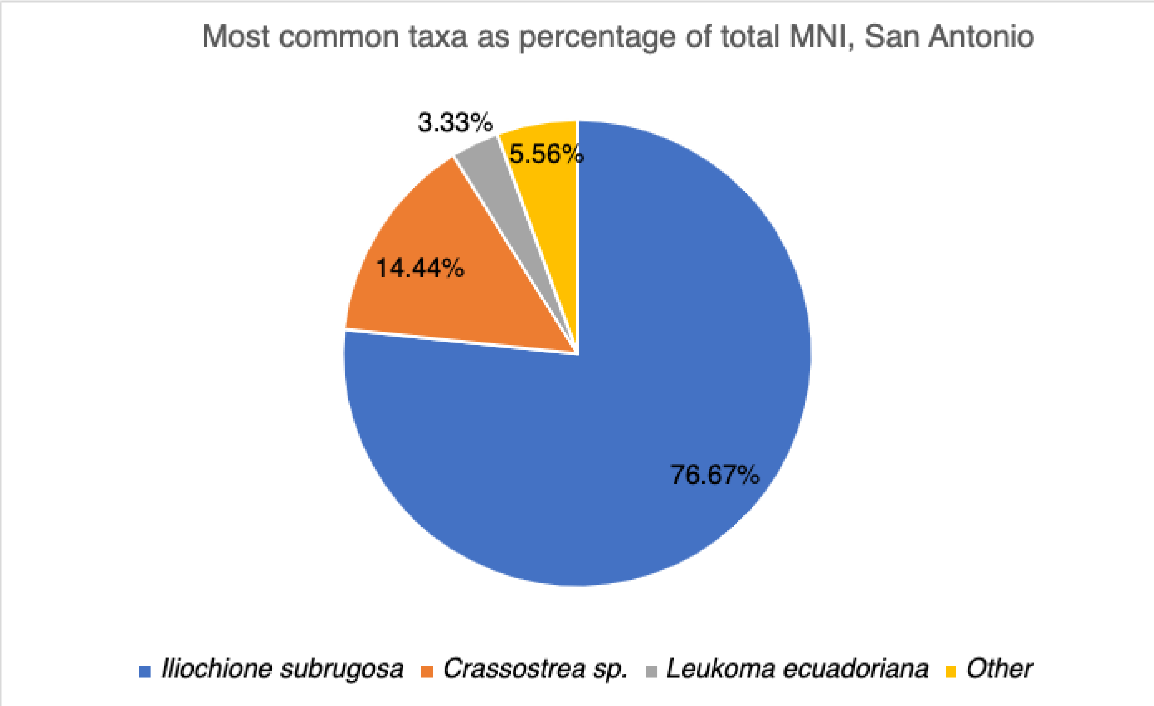



*Figure 7: Pie chart of most represented species, San Antonio. This chart shows the most numerous taxa by MNI out of the 2019 San Antonio sample (Data from Donner et al., 2021).*

### 4.1.2. Stratigraphy

The large mound at San Antonio M contains intriguing stratigraphy that is essential in understanding the site, and being a shell mound it contains vital information that can help answer the central questions of this thesis. By examining the shells that are embedded in the strata of a profile, we can determine without doubt which mollusk taxa were being harvested by the occupants of the site at each stage in its development. With that in mind, this section will provide a brief explanation of the stratigraphy at San Antonio M, and the interpretation of it based on current information. A more comprehensive overview of the San Antonio M stratigraphy will be available in the upcoming field report of Donner et al. (Donner et al., in prep.).

The context with the most complete stratigraphy at San Antonio M is pit H4, a looter pit previously discussed in the Methodology chapter. The upper layers of the profile (I to X, except IX) were loose and filled with shell, often containing more shell than soil. Layer IX was a narrow geological layer with no cultural material, extending alongside the other strata from 64 to 224 cm below datum. This was interpreted as a space where a tree had grown during depositional processes at the site (Donner et al., in prep.). Beginning with Layer XI and continuing to XIX, there were a series of strata that have been interpreted as floors. These contained more ceramics than the other strata, thin horizontal layers of very fragmentary *Pinctada mazatlanica* and two (XI and XV) contained charcoal. These floors were separated by nearly sterile layers of yellowish soil (Donner et al., in prep). The circles visible on the left side of the stratigraphy drawing in Figure 8 show the levels at which AMS dating cores were taken. Although the report with the exact calibrated dates has not yet been published, the project leaders stated that they range from the 12th century CE at the deepest core to the 16th century CE at the shallowest. (Natalia Donner, personal communication, April 23, 2023). These dates match the AMS dates from the upper pasture area of the site, which were between 1127±90 CE and 1206±56 CE (Donner et al., 2021, p. 59). This places the site in the Late Ceramic period, usually considered to be between 700 CE and the Spanish conquest in the 16th century CE (Martín-Rincón, 2006, p. 308; Núñez-Cortés, 2012, p. 44).

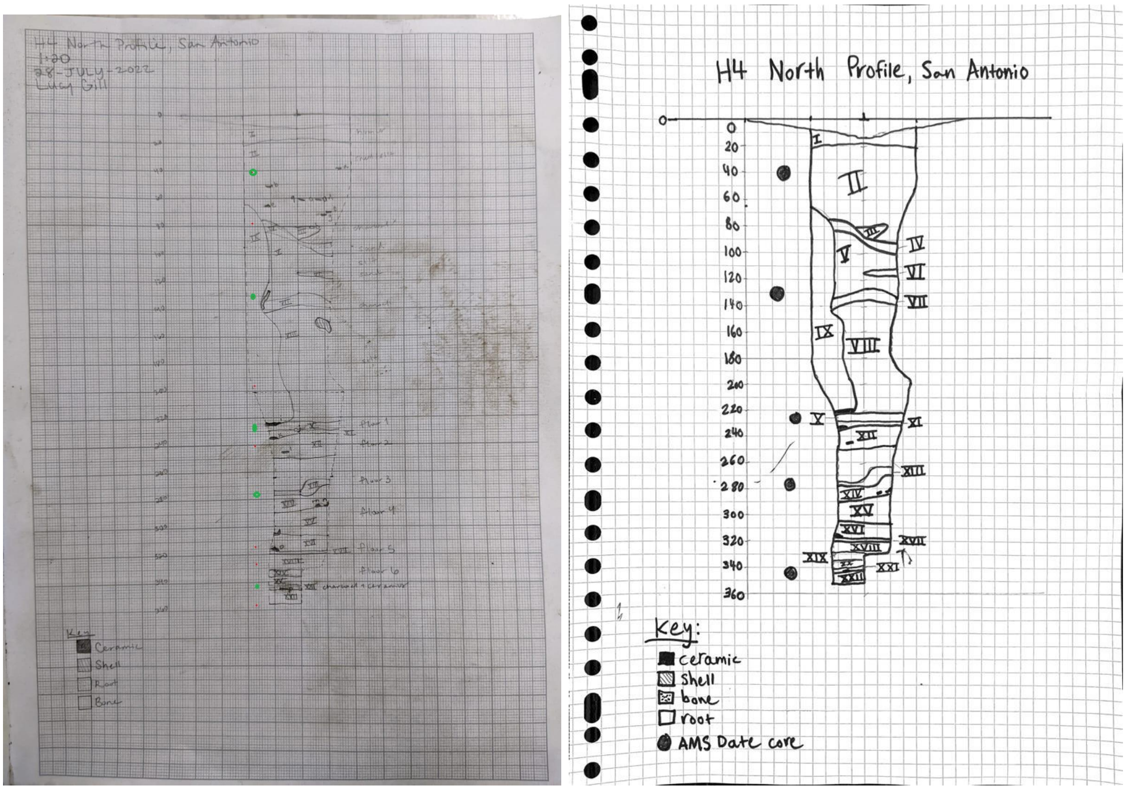



Figure 8: The original SA H4 stratigraphy drawing and a redrawing of it. On the left is the original drawing of the H4 stratigraphy at San Antonio M made in the field. I drew a reproduction of it (not to scale) to serve as a key for this section (Original drawing by Natalia Donner and Lucy Gill, 2022, used with permission).

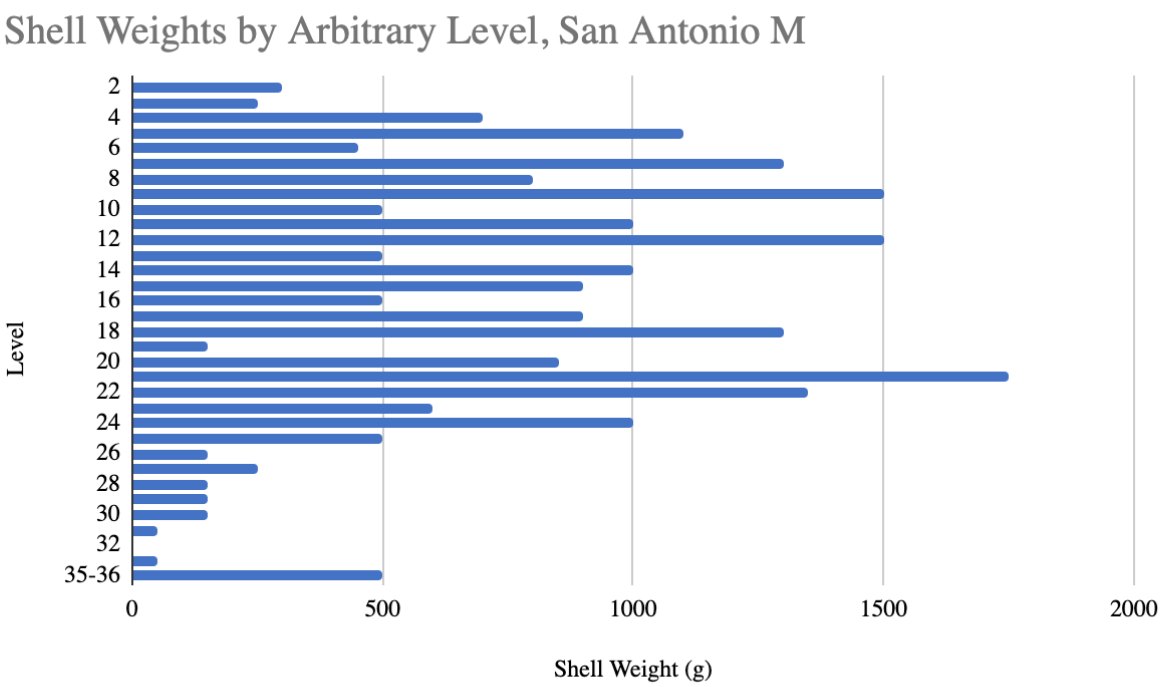



Figure 9: Chart of shell weights by arbitrary level, SA H4. This graph shows the weights of mollusk shell that came from each 10 cm arbitrary level during profile cleaning in pit H4. Clearly visible is the decrease in weight below Level 24 (Field data, shared by Natalia Donner).

To get a better idea of the contents of the shell mound at San Antonio M, I have included a graph of the weights of mollusk remains recovered from the profile cleaning at the site. As previously stated in the methodology section, the weights were recorded by 10 cm arbitrary level. Each bar in the graph represents the weight of mollusk remains from one level. The level with the highest number, 35, represents the weight from the deepest level in the profile. The level with the most mollusk weight was 21, corresponding with strata VIII and IX, 200-210 cm below datum. The weights were highest between levels 4 and 25, with the lowest section of the profile (arbitrary levels 26 to 36, between strata XII and XXII) containing very little mollusk remains. There were fewer remains than could be weighed (<10 g) recovered from level 32 and the data for 34 is missing. Levels 35 and 36 were bagged and weighed together because they contained little material.

## 4.2. Piangual

The mollusk taxonomic data sample from Piangual is a much larger dataset than that of San Antonio. At the same time, given the disturbed nature of the site and possible modern components, it is less reliable than data from archeological contexts that have been correlated with an absolute date, namely the looter pit profile from San Antonio. The mollusk remains that make up the dataset were collected from the surface of the main shell deposit at Piangual (Donner et al., 2021, p. 49).

### 4.2.1. Taxa

The taxonomic composition at Piangual contrasts sharply with San Antonio in several ways. With a total MNI of 366 individuals, there is a much larger sample size. While the proportions of bivalves and gastropods remain roughly the same, with 358 bivalves and 8 gastropods, (97.81% and 2.19% respectively) the assemblage is not dominated by a single species, and is slightly more diverse.

| **Mollusk taxa** | **MNI** |
|---|---|
| *Leukoma grata* | 187 |
| *Iliochione subrugosa* | 134 |

| | |
|---|---|
| *Crassostrea sp.* | 26 |
| *Anadara tuberculosa* | 7 |
| *Crassostrea columbiensis* | 3 |
| *Nerita scabricosta* | 3 |
| *Siphonaria gigas* | 2 |
| *Titanostrombus galeatus* | 1 |
| *Larkinia grandis* | 1 |
| *Granolaria salmo* | 1 |
| *Cerithideopsis californica* | 1 |
| Total | 366 |

*Table 2: Mollusk taxa MNI from Piangual 2019 sample. In this table is the list of mollusk species present in the 2019 sample collection from Piangual, showing the amount of individuals according to the MNI method (Data from Donner et al., 2021).*

At 36.61% *Iliochione subrugosa*, the most represented species at San Antonio, is second to *Leukoma grata* (51.1%) at Piangual. Again, the genus *Crassostrea* is present, mostly of undeterminable species. *Anadara tuberculosa*, locally known as ‘Piangua’, is only a small percentage (1.91%) of the sample from 2019. This is, however, the shell for which the site is named, and they are common in some areas of it. Donner et al. (2021) theorized that these areas were the more recent parts of the shell mound, from the modern period (p. 52).

These data fit with our field observations from the 2022 season, except that *Anadara tuberculosa* was more common than the 2019 sample would suggest.

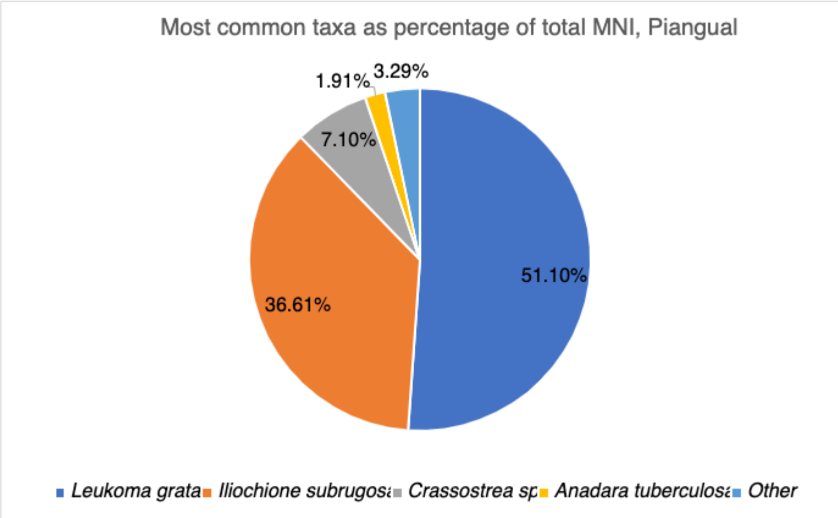



*Figure 10: Pie chart of most represented taxa, Piangual. This chart shows the most numerous taxa by MNI out of the 2019 Piangual sample, corresponding with the data in table x (Data from Donner et al., 2021).*

## 4.3. Taxa habitats, Piangual and San Antonio

To answer the research questions and understand why comparing the makeup of mollusk taxa at three different sites matters, knowing what habitat each species prefers is essential. Below is an explanation of the habitats of each of the major taxa at San Antonio and Piangual and other relevant information about them. Also included is the pearl oyster *Pinctada mazatlanica*, because it was present at San Antonio and is significant to the archaeology of the region.

| **Taxon** | **Habitat/Details** |
|---|---|
| *Iliochione subrugosa* | This species is often found in mud flats or lagoons, and is common around Garachiné and the Pearl Islands (Olsson, 1961, p. 298).<br>*Iliochione subrugosa* also inhabits the outer part of mangroves (Cruz & Jiménez, 1994, p. 83, in Sáenz Ulate, 2014, Appendix 7).<br>This shell is locally known as ‘almeja’ in Darién, and they are commonly |

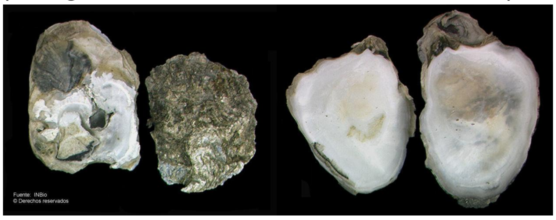
| | |
|---|---|
| <br>*Figure 11:* Iliochione subrugosa *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=708781&pic=67110)* | harvested and consumed to this day in Garachiné. |
| *Crassostrea sp.*<br>(Image is *Crassostrea columbiensis*)<br><br>*Figure 12:* Crassostrea columbiensis *image. A photograph of this species (EOL, https://eol.org/pages/46467118).* | These *Crassostrea* species may be *columbiensis*, *corteziensis* or another *Crassostrea*. *Columbiensis* is found among mangrove roots along the Pacific coast (Olsson, 1961, p. 172). The shells of *Crassostrea* were very fragmentary at San Antonio M and were difficult to identify beyond genus. Some of them may be *Ostrea chilensis*. Galtsoff (1950) described beds of this species in the mudflats of Garachiné Bay (pp. 45-6). |
| *Leukoma ecuadoriana* | Muddy areas in brackish water (Olsson, 1961, p. 312). Likely also found in mangrove areas, like *Leukoma grata* |

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Figure 13: Leukoma ecuadoriana image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=507748&pic=138113).</td>
<td></td>
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<tr>
<td>Leukoma grata


Figure 14: Leukoma grata image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=507750&pic=67232).</td>
<td>This species sometimes inhabits rock or gravel areas that are visible at low tide (Olsson, 1961, p. 306). Sáenz Ulate (2014) reports that they are also found in mangrove areas (pp. 23, 141). We observed that Leukoma grata are found in the mangrove swamp at Garachiné. The local people call this shell ‘concha blanca’ (white shell) and they are still consumed.</td>
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<tr>
<td>Anadara tuberculosa</td>
<td>This species is known to be a primarily mangrove-dwelling mollusk. It is found in muddy areas around mangrove roots (Olsson, 1961, p. 88). In Darién this shell is known as ‘concha negra’ (black</td>
</tr>
</table>

| | |
|---|---|
| <br><br>*Figure 15:* Anadara tuberculosa *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=504313&pic=50816).* | shell) and often consumed by local people in Garachiné. |
| *Pinctada mazatlanica*<br><br><br>*Figure 16:* Pinctada mazatlanica *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=464493&pic=68378).* | The pearl oyster of the eponymous islands. This species can be found living in rocky habitats below the intertidal zone, typically to a depth of around 22 meters (Cipriani et al., 2008a, p. 691). |

*Table 3: Piangual and San Antonio species with images. In this table, the major taxa from San Antonio and Piangual are paired with an image of them and relevant habitat information (various sources, see figures and text within table for source).*

Out of the mollusk remains collected from San Antonio and Piangual during the 2019 field season, almost all were mangrove-dwelling species. At Piangual, 99.45% of the shells were from mangrove species. Only one individual (*Granolaria salmo*) generally inhabits non-mangrove areas, preferring the intertidal zone (Snyder et al., 2012, p. 60). One individual, (*Strombus galeatus*) I consider probable mangrove. Cipriani et al. (2008b) mention that this species can live near mangroves, but also in deeper marine environments down to 30 m depth (p. 889).

All mollusk remains collected from San Antonio were from mangrove species, based on the habitats I personally observed in Garachiné and those recorded in reference materials I used (Olsson, 1962), (Sáenz Ulate, 2014, p. 135). *Pinctada mazatlanica* is not included in this habitat analysis because it was not present in the 2019 sample, but details on this species habitat can be found in the above table.

## 4.4. Pedro González L-106

The following results are a summary of the malacological data collected from L-106, the Middle Ceramic context at Playa Don Bernardo on Pedro González island. These are the data to which the Darién Profundo data from 2019 and 2022 will be compared. Sáenz Ulate (2014) used malacological analysis techniques on mollusk remains from two *capas* (Spanish for stratum, archaeological layer) from a 50x50 cm column excavated out of the eastern profile of the 2x1 cm pit at L-106 (pp. 96-7, 99). Capa 1, the uppermost layer, was situated between 12 and 37 cm depth. Capa 4, the deepest layer, lay between 50 and 75 cm depth. Mollusk remains from these two strata were chosen for analysis (Sáenz Ulate, pp. 118-120).

### 4.4.1. Taxa

The mollusk remains collected from Capas 1 and 2 had a total MNI of 1948 (Sáenz Ulate, 2014, p. 121). This is a much larger sample size than that of Piangual and San Antonio combined (an MNI of 456). There are also more taxa represented in the sample. I will divide this section into two subsections, each with the taxonomic composition results from one of the strata.

*Capa 1*

The bivalve taxa from Capa 1 had an NMI of 350. The most common taxa were, in order: *Megapitaria aurantiaca*, with 30.8%, *Leukoma metodon*, with 27.85%, *Leukoma* sp., with 18.99%, and *Saccostrea palmula*, at 14.77%. The remainder of the taxa constituted 7.64%.

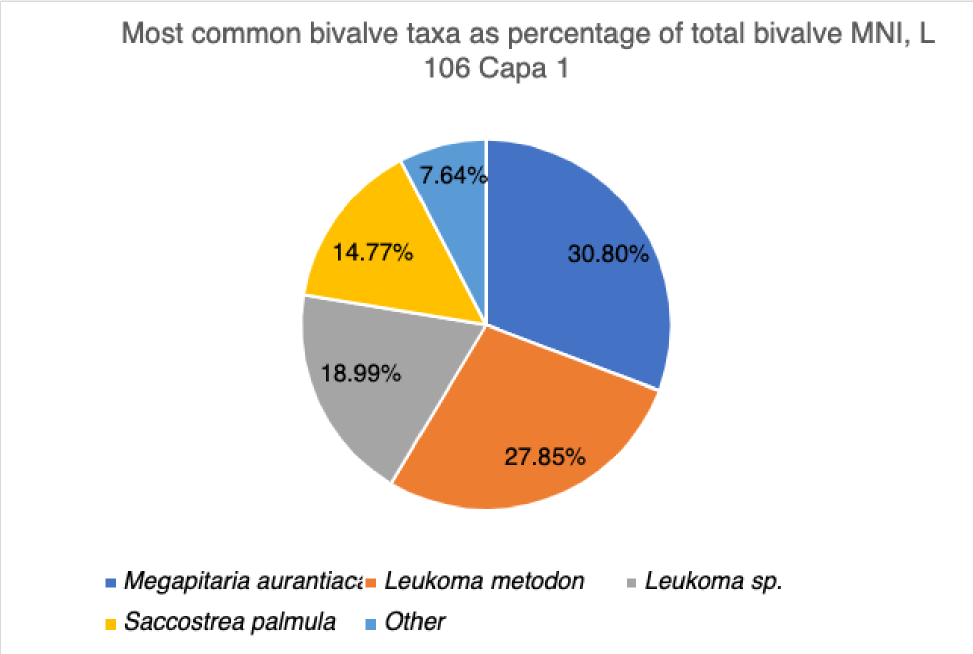



*Figure 17: Pie chart of most common bivalve taxa at L-106 Capa 1 by MNI. This chart shows each major species as a percentage of total bivalve MNI from Capa 1 at L-106 (Data from Sáenz Ulate, 2014).*

The gastropod taxa from Capa 1 had an MNI of 1074. The taxa with highest NMI were *Strombus granulatus*, at 33.4%, *Strombus* sp. with 57.3%, and *Hexaplex radix*, with 2.6%. The remainder constituted 6.7%.

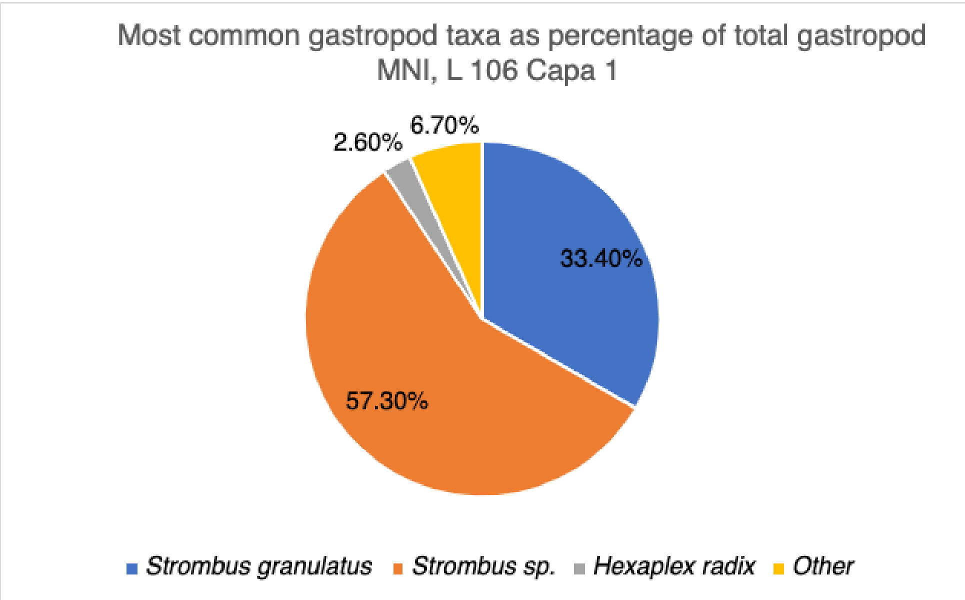



*Figure 18: Pie chart of most common gastropod taxa at L-106 Capa 1 by MNI. This chart shows each major species as a percentage of total gastropod MNI from Capa 1 at L-106 (Data from Sáenz Ulate, 2014).*

*Capa 4*

The bivalves from Capa 4 had an NMI of 286. The most represented species were as follows: *Saccostrea palmula*, with 66.55%, *Leukoma* sp. with 18.66%, and *Megapitaria aurantiaca* with 4.58%. The remaining taxa made up 10.21%.

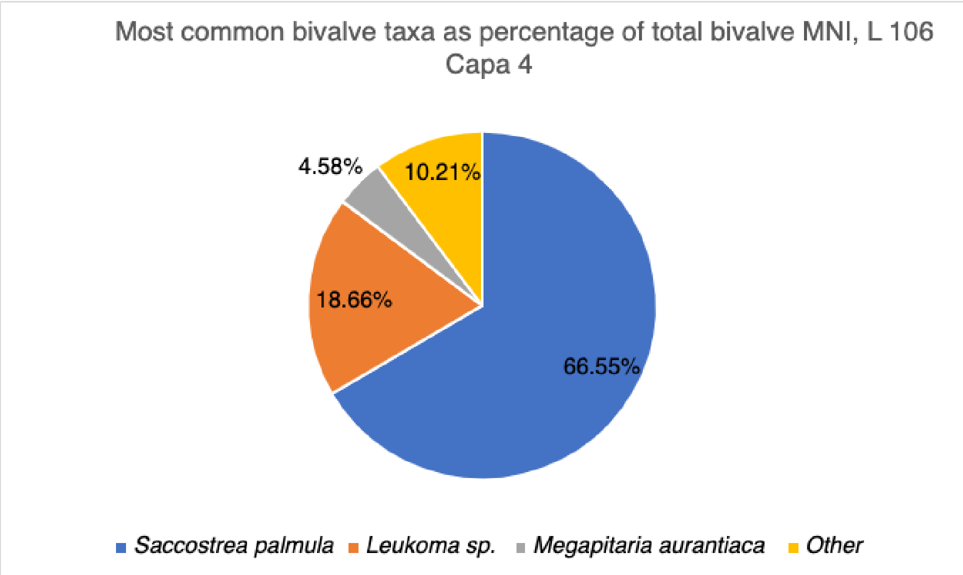



*Figure 19: Pie chart of most common bivalve taxa at L-106 Capa 4 by MNI. This chart shows each major species as a percentage of total bivalve MNI from Capa 4 at L-106 (Data from Sáenz Ulate, 2014).*

The Capa 4 gastropods had an NMI of 350. The most represented species were *Strombus* sp. with 42.45%, *Opeatostoma pseudodon* at 27.64%, *Strombus granulatus* at 14.81%, and *Thais melones* with 6.55%. The remainder was 8.55% (Sáenz Ulate, 2014, pp. 122, 125-7).

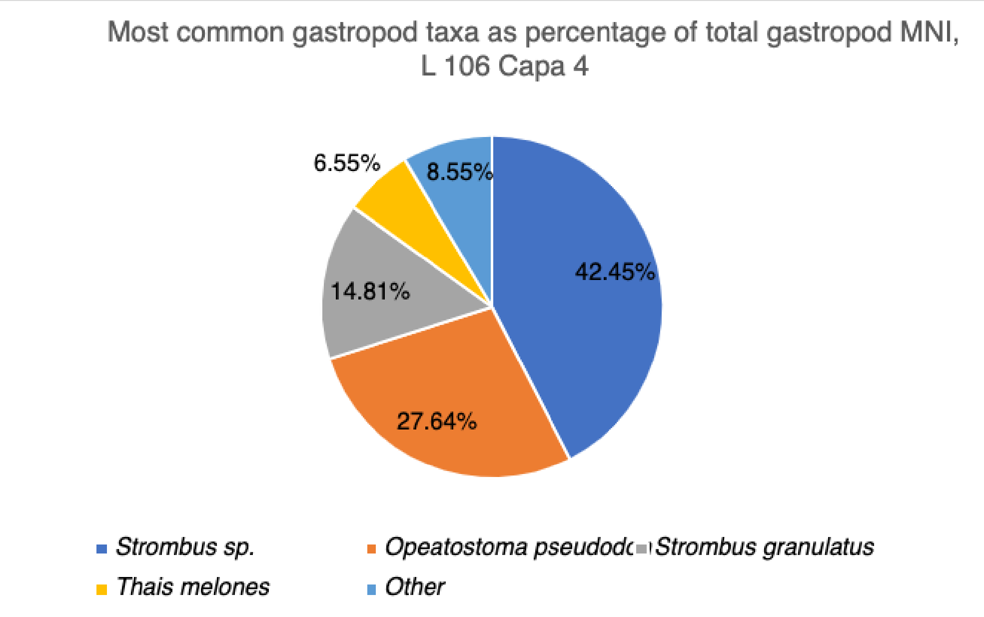


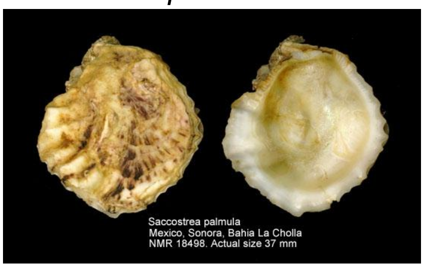

*Figure 20: Pie chart of most common gastropod taxa at L-106 Capa 4 by MNI. This chart shows each major species as a percentage of total gastropod MNI from Capa 4 at L-106 (Data from Sáenz Ulate, 2014).*

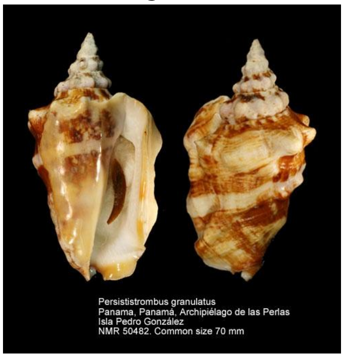
None of the major taxa from L-106 overlap with the ones from San Antonio or Piangual. Only one individual of *Anadara tuberculosa* and one fragment of *Pinctada mazatlanica* were recovered. *Leukoma grata* does not appear in the data either, but some of its sister taxa (*L. metodon and L. asperrima*) are represented (Sáenz Ulate, 2014, p. 183, Appendix 1).

### 4.4.2. Taxa habitats, Pedro González L-106

Below is a table showing the habitats of major taxa from Pedro González L-106 and any other important information about each species.

| **Taxon** | **Habitat** |
|---|---|
| *Megapitaria aurantiaca* | This species lives in coastal areas in the low tide zone, and can be found at depths up to 10 m (Lopez & Urcuyo, 2008, as cited in Sáenz Ulate, 2014). |

| | |
|---|---|
| <br><br>*Figure 21:* Megapitaria aurantiaca *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=714775&pic=70924).* | |
| *Leukoma metodon*<br><br><br>*Figure 22:* Leukoma metodon *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=507749&pic=67234).* | This species prefers soft surfaces on sandy beaches (Sáenz Ulate, 2014, Appendix 7). |
| *Saccostrea palmula*<br><br> | Olsson (1961) recorded this species living on rocks in areas with wave action, and considered them too small to be a worthwhile food source (p. 173). *S. palmula* can also be found in mangroves (Keen, 1971, as cited in |

| | |
|---|---|
| *Figure 23:* Saccostrea palmula *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=506729&pic=68618).* | Sáenz Ulate, 2014). |
| *Strombus granulatus*<br><br><br>*Figure 24:* Strombus granulatus *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=565475&pic=63373).* | This conch species, regionally known as 'cambute', lives in rocky or sandy areas at shallow depth (Arroyo-Mora, 1998, p. 37). Sáenz Ulate (2014) considered this species as possibly living in mangroves, and thought that the undetermined *Strombus* remains at L-106 were likely *S. granulatus* (p. 127, Appendix 7). |
| *Hexaplex radix*<br><br><br>*Figure 25:* Hexaplex radix *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=406198&pic=67071).* | According to Martín-Rincón & Rodríguez (2006) this species lives in rocky environments (p. 93). Alternatively, it may live in mangroves (Cruz & Jiménez, 1994, as cited in Sáenz Ulate, 2014). |
| *Opeatostoma pseudodon* | This species inhabits rocky or coral habitats (Sáenz Ulate, 2014, Appendix 7). |

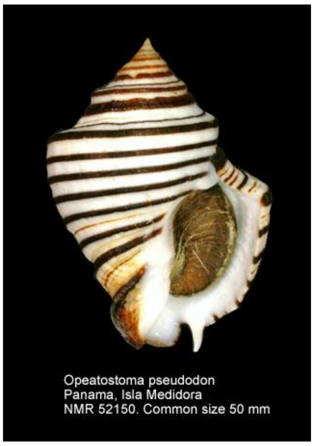
<table>
<tr><td>


*Figure 26:* Opeatostoma pseudodon *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=489078&pic=68216).*</td><td></td></tr>
<tr><td>Thais melones


*Figure 27:* Thais melones *image. A photograph of this species (Molluscabase, https://www.molluscabase.org/aphia.php?p=image&tid=714223&pic=75921).*</td><td>This species was found to live in the intertidal zone on stony substrates (Willis & Cortés, 2001, pp. 27-9).</td></tr>
</table>

*Table 4: Pedro González L-106 species with images. In this table, the major taxa from Pedro González L-106 are paired with an image of them and relevant habitat information (various sources, see figures and text within table for source).*

Sáenz Ulate identified the habitats of each mollusk species in the L-106 dataset and categorized them as either mangrove, possible mangrove, associated with mangrove, or non-mangrove. For Capa 1 mollusks, 15.17% were mangrove, 74.46% were probable mangrove, and 7.85% were associated with mangrove. Non-mangrove species were only 2.52%. For Capa 4 mollusks, 42.97% were mangrove, 31.95% were possible mangrove, 6.95% were associated with mangrove, and 18.13% were non-mangrove (Sáenz Ulate, 2014, 135-39). This data again contrasts with the mollusk data from San Antonio and Piangual, where almost all remains were from taxa that definitely inhabit mangrove areas.

# 5. Discussion

The fundamental goal of this thesis is to compare the taxonomic composition of mollusk remains from shell middens at three sites in coastal Panama, and based on the differences between them, seek to draw small conclusions about how people living in the area during the Middle and Late Ceramic periods collected food resources. The aims of this study may seem small, but in a region so neglected by archaeology, even specialized malacological research can be a benefit to future investigation. The extensive data in the previous chapter provides plenty of fuel for a discussion about the archaeology of these three sites. In broad strokes, San Antonio M, Piangual and L-106 seem similar, three shell middens in coastal areas all located within the same geographic region. When one takes a closer look, however, the mollusk shells they contain are different in almost every way.

## 5.1. Comparing taxa

The most striking difference in the mollusk taxa represented at the sites is between the mainland and Pedro González. The taxa from San Antonio and Piangual are almost entirely bivalves (from the class Bivalvia), with only 9 out of a total MNI of 456 being gastropods (Class Gastropoda)(Donner et al., 2021, p. 50). Just across the water at Pedro González, gastropods in Capa 1 and 4 combined made up 1424 out of a total NMI of 1948, or 73.1% (Sáenz Ulate, 2014, p. 121-22). The large amount of gastropods can be explained by the predominance of *Strombus* sp., the most numerous genus, making up an MNI of 1176, or 60.37% of the total (Sáenz Ulate, 2014, Appendix 3). The prevalence of *Strombus* suggests that these shells were very abundant during the period when the L-106 shell midden was being deposited.

Another aspect to note in the difference in taxa between the mainland and the island is that none of the major taxa at L-106 overlap with those at either San Antonio or Piangual (see Figures 10, 17-20). This suggests either very different subsistence strategies, sharp local differences in the mollusk species living in a given habitat type, or both of these. *Leukoma grata*, the most numerous species at Piangual, is not represented at all in the data from L-106, although other species in the genus *Leukoma* are (Sáenz Ulate, 2014, p. 125). Also absent at L-106 was

*Crassostrea*, and only one fragment of *Pinctada mazatlanica* and *Anadara tuberculosa* were recorded (Sáenz Ulate, 2014, p. 183). Likewise, none of the major taxa from L-106 are found at either of the mainland sites. This could be interpreted as a function of extreme local differences in available mollusk species, but the lack of species diversity at the mainland sites may be related to the difference in date. The total number of species, bivalve and gastropod, was 28 at L-106, but only 13 at the mainland sites (Sáenz Ulate, 2014, p. 185), (Donner et al., 2021, p. 50). At first glance this would appear to be because the sample size for the mainland sites was much smaller than that of L-106, but field observations of mollusks from the 2022 season proved mostly consistent with the species included in the 2019 sample collection (Donner et al., in prep.). Piangual and San Antonio, being Late Ceramic sites, (Piangual may be modern, see section 2.3.2) may have less taxonomic variety than the Middle Ceramic L-106 because of the gradual local disappearance of species due to overexploitation. This phenomenon has been observed by local people in Garachiné, who say that some species are no longer found in the area (Natalia Donner and Lucy Gill, personal communication, July 27, 2022).

As important as the taxonomic makeup, if not more so, are the habitats that these mollusks were harvested from. Before discussing the differences in habitat between the sites, I will give a brief description of the habitats that can be found near the sites. This will help put the data into context.

The Bay of Garachiné has large areas of mangrove swamp along its southern shore, especially to the east of Garachiné, where the San Antonio River meets the ocean. As previously mentioned, both San Antonio and Piangual are situated next to this mangrove, and San Antonio M is partly inside the swamp area. Along the shore of the bay, next to the mangroves, mud flats are visible when the tide recedes. Based on conversations with local people, it is known that these areas are home to mollusk species and are still places where the locals go to harvest these shells (Natalia Donner, personal communication, July 27, 2022).

Pedro González Island has its own distinct set of mollusk habitats. Sáenz Ulate (2014) describes mangroves on the island, which are short and in the form of bushes, containing few mollusks in the root networks (p. 19). Despite this apparent lack of mangrove habitat, there are large areas of mangrove on the nearby island of Isla Del Rey (McGowan et al., 2010, p. 860). A 2008 survey showed that Pedro González had living coral reefs, with the most coral located on the north shore of the island. The same survey noted the abundance of rocky areas below the tideline (Guzman et al., 2008, pp. 49, 52). Mair et al. (2009) found that areas with shell and sand tended to be associated with coral reefs, indicating that mollusks were living there (pp. 378, 382).


*Figure 28: Map of mangrove areas and sites on Pedro González island. This map shows the current mangrove areas on Pedro González and the locations of several sites including L-106 (Sáenz Ulate, 2014).*

Given these habitat types, the taxa habitat assessments in sections 4.4. and 4.5.2. seem correct. San Antonio and Piangual, located in a mangrove-dense area, have mostly mangrove-dwelling taxa in their shell middens. L-106 has a mixture of mangrove, coral, and rock habitats. It also has mangrove and non-mangrove taxa, and some species that could live in multiple different habitats (Sáenz Ulate, 2014, pp. 135-39). *Opeatostoma pseudodon*, a gastropod which made up 27.64% of the Capa 4 gastropod total MNI, is known to live on coral or rocks (Sáenz Ulate, 2014, Appendix 7). Several other taxa present at L-106 also can be found in rocky environments (Sáenz Ulate, 2014, Appendix 7). These species living on rocks or coral could explain the non-mangrove portion of the L-106 taxa.

With the above information, we can attempt to answer two of the sub-questions that guided the research in this thesis:

*Do the taxa (molluscan species) on the mainland come from different habitat types from those on the islands?*

and

*What factors might influence differing mollusk exploitation strategies on the mainland vs on the islands?*

It cannot be said that the shell sites on the island and the mainland were contemporary, but without comprehensive data from a Late Ceramic shell midden on Pedro González, L-106 is the closest in time period available. With that in mind, the first question can be answered easily. There is a clear difference between the composition of mollusk species on the mainland and that of those on the island, with few species overlapping between the two. As for the question of exploitation strategies, it is highly likely based on the evidence I have presented that the communities living on Pedro González and the Bay of Garachiné chose which mollusks to harvest based on the simple fact of which species lived in the habitats closest to them. Those living near mangroves and mudflats collected mollusks from mangroves and mudflats, and those living on an island with a more varied set of habitats took their mollusk meals from those varied habitats.

To the question of how San Antonio and Piangual compare, and why *Pinctada mazatlanica* is present at a shell mound in Garachiné but not on the islands around which it lives, the next section will give some answers.

## 5.2. Comparing sites: San Antonio and Piangual

Piangual and San Antonio M have all of their major mollusk taxa in common and are both composed of almost entirely mangrove species, but differ greatly in other ways. Piangual shows much less soil formation than San Antonio M, being composed of loose shells on the surface and a thick layer of tightly packed shells with almost no soil below (see section 3.5). The large shell mound at San Antonio M, while packed with mollusk remains, does have soil formation, with more soil than shell in some strata (see section 4.2.2.). San Antonio has been dated using AMS, an absolute method (Donner et al., 2021, p. 58). If San Antonio M has soil formation and has been proven to be a pre-modern context, this would circumstantially indicate that Piangual, a site in the same area theoretically under the same environmental conditions, is much more modern. This harmonizes with what Donner et al. (2021) theorized about the site (p. 23). Without a date from Piangual, however, this cannot be absolutely verified.

Another way in which Piangual differs from San Antonio M is in the nature of the two sites. No evidence of structural elements have been found at Piangual, and it appears to be simply a midden for refuse of mollusks harvested for food (Donner et al., 2021, p. 23). San Antonio M seems to be an archaeologically more complex site. The stratigraphy of pit H4 discussed previously poses some interesting questions. Why is there a series of floors separated by nearly sterile layers in the lower portion of the profile? Why does the stratigraphy change to more of a refuse-midden type of deposition above 220 cm below datum?

When thinking of shell mounds, it is often assumed that these are purely piles of food remains. A closer look reveals that they can also be used for other purposes. Waselkov (1987) mentions that shell sites are sometimes abandoned and then reoccupied and used for another purpose such as sites for building (p. 148). Claessen (1991) described instances where the primary purpose for the construction of a shell mound was as a solid foundation for building (p. 253). There are also examples of shell mounds being used for purposes other than refuse dumping in Panama. At Sitio Monagrillo, shell mound He-5 contained layers of burning and fire pits in some strata (Willey & McGimsey, 1954). As previously mentioned in section 2.4, human burials were found within the Preceramic period shell midden site of Cerro Mangote (McGimsey, 1956, pp. 156-58). It is not unusual, then, that San Antonio might have two different types of occupation: one as a refuse midden for mollusk remains and another relating to the floor levels in the stratigraphy. It cannot be known what these floors represent based on the current available data. We know from the graph of shell weights by arbitrary level (see figure 9, section 4.1.2.) that there are far fewer mollusk remains below stratum XII than above. It may be that the nearly sterile yellowish layers between the floors are simply very decomposed shells, as Waselkov (1987) states that at sites experiencing large amounts of rain, mollusk remains can be either very decomposed or not visible at all (p. 149). Darién Province experiences a very heavy rainy season, which we experienced during the 2022 field work. However, this theory does not explain why the thin horizons of *Pinctada* *mazatlanica* have survived if all other shells have decomposed. The presence of *Pinctada* may indicate that San Antonio M was originally a tool or ornament workshop using that species as a raw material, similar to Cerro Juan Díaz (Cooke & Mayo, 2005). As previously mentioned, *Pinctada* has not been found in any significant amount in other shell middens in Darién and the Pearl Islands (Martín et al., 2016, p. 393). It is possible that at some time in the past this species was harvested for food locally, as it is an edible species (Cooke et al. 2007, p. 55, as cited in Sáenz Ulate, 2014, p. 183). Considering the lack of archaeological investigation that has been conducted in Darién, the presence of *P. mazatlanica* could also be common in unknown and un-excavated sites. More field work is needed before this question can be approached properly. Taken all together, San Antonio M presents an intriguing archaeological conundrum and merits more study.

# 6. Conclusion

In the Introduction, I posed the question: *How does the taxonomic composition of mollusk remains from Late Ceramic shell middens on the mainland compare to that of a Middle Ceramic shell midden in the Pearl Islands, and what does this tell us about the exploitation strategies of the people living in these two areas?*

To answer this primary research question, the taxonomic composition of the mollusk remains from the sites on the mainland differs greatly from that of the shells collected at L-106 on Pedro González. The L-106 data are more diverse in both taxa and habitat than the mainland data, and they do not share many taxa. The habitats of the mollusks from the island and the mainland also indicate different practices of exploitation by the communities of people who deposited them in the middens, chiefly that these people gathered mollusks from habitats near to where they ultimately disposed of the shells, which was likely near to where they lived. This conclusion seems simple, but I find it important to know that even in a small area such as the eastern Gulf of Panama, local differences in mollusk habitat and taxa are substantial. In the introduction, I stated that it is possible to learn about the ancient people and the way they lived from examining the remnants of their food. I believe that the data I brought together and the conclusions drawn based on them support this idea at the small scale. While no groundbreaking discoveries were made in the course of this thesis, I have succeeded in filling in one small corner of the mostly blank archaeological canvas that is Darién. It is these small conclusions based on evidence that eventually add up to the 'big picture' of archaeology in a given area of study. Barring further investigation by future archaeologists who collect data totally contradicting my findings, we now know something about people living in two nearby areas within several centuries of each other. We know that they collected large amounts of certain species of mollusk and smaller amounts of others, that most of the mollusks they extracted food from and then deposited in a midden were likely from nearby habitats, meaning they did not choose to range far for their food. Finally we know that in two areas that are very similar to each other from a casual observer's perspective, very different food species were collected. For all this information is worth, it leaves an archaeologist wanting more. Luckily, the data from these sites is not only of a molluscan nature, but includes ceramics, lithics and other sub-areas of study. Most of these have not yet been studied in depth. At San Antonio alone, more excavation and survey is needed to help fill in more of the picture of the settlement that once existed there. The stratigraphy at San Antonio M could certainly provide more opportunity for research. Why was *Pinctada mazatlanica* found there and almost nowhere else, despite the volume of excavation that has recently occurred in the Pearl Islands? This question could be the basis for another thesis in the future, provided more data are forthcoming.

Reflecting on the methodology that this thesis employed, there are a number of aspects of it that could be improved. The research question may have been better served by a broader dataset, taking in more than three sites and casting a wider net in terms of area, since more data from Darién scarcely exists at present. More data would have made me feel more comfortable making generalizations. In a data set as small as the one in this thesis, I could easily be noticing patterns that would not be present in a larger sample size. The data in a study this small could be simply a fluke, skewed and biased by how they were collected. If I could write this thesis again, I would try to get direct access to some more of the data from the Pearl Islands excavations, which I had to read secondary sources to find. Many of these are inaccessible because they were never published on the internet, were never digitized, or are behind a paywall. With more time I could reach out to the people and institutions that collected the data and ask for access. With more resources, I would conduct more in-depth analysis of the mollusk remains at these sites and compare them to similar sites that have been thoroughly excavated and studied. This analysis might include studying how modern people living in the area of research collect mollusks for food and using experimental archaeology techniques to model which species are more worthwhile to harvest in terms of the energy expended to find and collect them.

I conclude this thesis with the thought that in a region where the archaeological knowledge is close to zero, even such small objects as shells can help add up to a big step forward in our understanding of a place and its past.

# Abstract

Darién Province is an area which has until very recently received little attention from archaeology, mostly due to its remote geography and lack of infrastructure. The nearby Pearl Islands, by contrast, have recently seen a significant amount of research and field work including excavations. The Late Ceramic Period sites of San Antonio and Piangual (12th to 16th centuries CE) on the Darién mainland and the Middle Ceramic L-106 (7th to 10th centuries CE) on Pedro González island in the Pearl Islands are midden sites composed mainly of mollusk shells. The exploitation of these species appears to have been central to the foodways of the people who inhabited these areas before the Spanish colonial period. This thesis aims to change the perception of Darién as a place without an archaeological past and increase our understanding of the area by comparing the two sites on the mainland with the one on the island, focusing on the composition of mollusk species present at these sites. To achieve that goal, I use new data collected in 2019 and 2022 from the mainland and data from earlier excavations on Pedro González island. To compare these sites, I discuss the taxonomic composition of the mollusk species from each site and compare them in terms of the relative frequency of each species, typical habitats of the mollusk species represented, and in the case of the mainland sites their structure as midden contexts. Based on the results, I conclude that the species found in the island context barely overlap with those from the mainland, meaning few species are present at all three sites. For the habitat portion of the comparison I find that the habitats of the majority of mollusk taxa in each midden correspond with habitats near the sites. I also argue that Piangual is a predominantly modern, refuse midden context while the midden at San Antonio is a more complex site, containing at least two different types of occupation and one species of mollusk (*Pinctada mazatlanica*) that is rarely found in shell middens in the region. Finally, I acknowledge that more research and field work is needed before these results can be fully confirmed and understood.

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