The Queen of the Archipelago: Indigenous food extraction techniques from Queen Conch shells at Spaanse Water, Curaçao, c. 2800 BCE - 150 CE

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Photographs of archaeological materials taken by the author within this thesis are used with permission from NAAM.

Contents

1. Introduction

The island of Curaçao, located on the southern border of the Caribbean region, provides a multitude of questions to be answered through archaeological research. In spite of its wide body of research going back to the turn of the 20th century, there are still many gaps in our knowledge of human activity on the island prior to the arrival of Europeans. While there is a general understanding of many of the key points and developments between the arrival of the earliest humans on the island and the arrival of the Spanish colonists, a deeper knowledge of specific aspects of the local Indigenous culture, as well as the connection thereof with regional neighbors, has yet to be attained.

One such avenue of research is archaeomalacology, or the archaeological study of molluscan remains. While it has only relatively recently managed to set itself apart from the overarching studies of zooarchaeology and lithic analysis, it has already proven itself worthy as its own field, providing perspectives that led to many new discoveries in recent years (Allen, 2017; Bar-Yosef Mayer, 2005; Keegan et al., 2018; Serrand, 2008; Serrand & Bonnissent, 2018; Thomas, 2015a; 2015b). Moreover, particularly in contexts like the Caribbean where shell has often filled a central role in the societies of ancient peoples, there are still many questions just waiting to be answered with the help of shell analysis. This is especially true for Curaçao, where there remain plenty of completely unresearched shell samples in storage, some of them dating back to excavations that took place as early as the 1960s.

One particular mollusc that formed an important role within Caribbean Ceramic cultures is the Queen Conch (*Aliger gigas*, but until recently known as *Lobatus gigas*, or *Strombus gigas* before that) (Antczak, 1999; Antczak & Antczak, 2005; Dijkhoff & Linville, 2004; Haviser, 1987; 1991; Serrand, 1999). Not only does it form a rich source of nutrition that is still frequently consumed in a variety of Caribbean contexts today, but its sizeable shell has also been shown to have been fashioned into a variety of tools (Dijkhoff & Linville, 2004). Various methods of food extraction and the traces they leave in archaeological context have also been documented through experimental archaeology as well as ethnoarchaeology (Antczak, 1999; Antczak & Antczak, 2005; Lammers-Keijsers, 2007).

Between 2007 and 2009, archaeological excavations were conducted at Spaanse Water, Curaçao, with National Archaeological Anthropological Memory Management (NAAM), the archaeological authority on the island, filling an advisory role (Hoogland et al*.,* 2015)[1]. At Spaanse Water, the researchers investigated two sites that had already been known previously and found an additional site that was partially disturbed by modern construction[2]. During the excavations, they found a wide variety of artifacts ranging in dates from the Archaic to the early Colonial period, indicating "special activity camps," or in other words numerous short-term occupations of the site over long periods of time (rather than long-term occupation). The excavation confirmed earlier suspicions that the site had been visited continuously from the Late Archaic up to the Late Ceramic (Hoogland et al., 2015, p. 81). The characteristics of the site also reinforce the fundamental interrelatedness Archaic Age occupation on the island has with Bonaire and Aruba, as well as the Venezuelan offshore islands, although the true extent of this cultural overlap is left up to future research (Hoogland & Hofman, 2015, p. 194)

It is no surprise that shell forms the most ubiquitous material found at the site. Although particularly interesting is the sheer number of *Aliger gigas* individuals found at C-039, as well as a small number of them at the other two sites. These have been cataloged and stored within the depot at NAAM. While a few preliminary observations on food-extraction have been noted in the excavation report (Hoogland et al., 2015, p. 48) there has been no further research done on the specimens. My aim is to contribute to these observations, within the limited scope of research a bachelor thesis can provide.

In this thesis, I will analyze a selection of *Aliger gigas* found at the sites of Spaanse Water, focusing on the methods of food extraction used to break, perforate, and burn the shell of the Queen Conch to get to the animal within for extraction. In turn, I will compare these to the methods observed elsewhere, particularly by Antczak (1999) on the islands off the coast of Venezuela. To summarize, I aim to answer the following research question:

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[1] Project number 0040SWAT in the NAAM Archaeological Project Register

[2] These sites are designated respectively as C-0039 ('Spaanse Water'), C-0038 ('Seru Boca'), and C-0215 (unnamed) in the NAAM Heritage Register

What techniques of food extraction can be extrapolated from the *Aliger gigas* remains found at the sites of Spaanse Water, Curaçao?

This I divide into several sub-questions:

- Which processing traces are indicative of food extraction, as shown by prior research (ethnoarchaeology, experimental archaeology)?
- What processing traces can be indicative of which food extraction method?
- What traces can be found in the *Aliger gigas* specimens observed? Which techniques do these imply?

1.1 *Methodology*

The selection of *Aliger gigas* specimens I will analyze come from a variety of sources. The majority comes from site C-039 (trenches 2, 3, 4, 7, 8, 12 and 14), dated to both the Archaic and early Ceramic periods, with a few also from site C-215, dated to the early Archaic period. The individuals are selected from a variety of contexts at the site to sketch as wide an image of the processing of the shells as possible.

Working off of prior research, earlier surmised methods of food extraction from *Aliger gigas* shells are summarized, as well as the traces (or lack thereof) that are left on the shell. From this, a make-shift typology will be established in order to set a framework for my research. This typology is then applied to the findings from the Spaanse Water excavations, as all the discernable traces on each shell are observed, documented, and finally linked to a possible extraction technique.

Observations will be recorded in a database to be kept by NAAM. As the institution does not have a database template ready for specialistic information such as the results of my study, I will also build one from the ground up. In turn, my database can hopefully be used to inform future specialist research – particularly in the realm of zooarchaeological research – in Curaçao.

1.2 *Scientific and Societal Relevance*

On Curaçao, plenty of work remains to be done in the research of shell and the roles it played in the pre-Columbian era. Shell assemblages from a variety of sites are still left unresearched, in spite of the information it might give us about the subsistence and culture of the Amerindian population. Certainly, malacological research of any kind, quantitative *or* qualitative, is bound to give us new insights on Indigenous society.

Food extraction from shellfish and the traces it might leave behind are often overlooked or glossed over in material analysis of shell remains in favor of tool and ornament manufacture. I argue it is a step in the *chaîne opératoire*[3] of shell that deserves more attention. As such, the establishment of a framework to better understand conches as a source of food is an effort that could bring valuable insight to the field of archaeomalacology in the Caribbean.

1.3 *Thesis Outline*

This thesis is structured as follows: In chapter two, I summarize the background of Caribbean prehistory as a whole, followed by an outline on the island of Curaçao, as well as an outline of the Spaanse Water sites, the research done there in the past, as well as fieldwork that was carried out between 2007-2009. In chapter three, I explain the selection of the sample set, the methodology behind my observations of the material, as well as the ins and outs of the database I constructed. In chapter four, I lay out the results of my research. In chapter five, I report my conclusions, discuss the questions raised by my research, and highlight possible avenues of future research.

While it has been receiving an increasing amount of criticism and scrutiny in recent years (Antczak & Hofman, 2019; Bérard, 2019; Keegan, 2010), this thesis will largely maintain the use of Irving Rouse's 'modal approach' of complexes and series in the pre-Columbian Caribbean.

[3] I.E., the full chain of anthropogenic processes an artifact undergoes through its lifecycle, including production, use, and disposal.

2. **Background**

2.1 *Caribbean context*

The Caribbean was one of the last regions on Earth to be populated by humans. Geographically, it is made up of the Greater Antilles of Cuba, Hispaniola, Jamaica and Puerto Rico in the northwest, and the Lesser Antilles in the south and east. Zooming in on the latter, you can find the ABC-islands – including the island of Curaçao – bordering western Venezuela.

Analysis of migratory connections between the American mainland and the islands of the Caribbean in the early pre-Columbian period can already be made possible through comparisons between the respective regional material cultures. From this, two distinct aceramic 'Ages' with their own technological complexes were discerned, correlating to complexes on the American mainland: a 'Lithic Age,' c. 4500 BCE – 2000 BCE, alternatively named *Casimiroid*, formed by a distinct presence of flaked stone tools, typified by small, mobile groups relying on big game hunting, and an 'Archaic Age,' c. 5700 BCE – 200 BCE, alternatively named *Ortoiroid*, characterized by ground stone tools and a focus on marine subsistence (Antczak & Hofman, 2019). This would also largely be supported by the genetic evidence (Nägele et al., 2020). Sites typologically linked to the former age have thus far only exclusively been found in the Greater Antilles. This, combined with a comparable material culture to those found in Belize and Colombia, would suggest this earliest population arrived in the Caribbean by crossing over from Central America (Keegan & Hofman, 2017, p. 25; Wilson, 2007, p. 33). The Lithic Age seems to circumvent Curaçao, although some materials found at the oldest sites on the island are said to be more closely associated with Lithic Age assemblies (Haviser, 1987, p. 45).

The Archaic Age finds its beginnings instead on the island of Trinidad, having the oldest known sites in the region (Banwari Trace, but also St. John) (Pagán-Jiménez et al., 2015) – and by extension the oldest known evidence of human activity in the entire Caribbean. This group of peoples finds the starting point of its migration in South America, and likely reached Trinidad long before the Lithic peoples made the cross to the Greater Antilles, back when the island still had a land connection to South America. However, further dispersal of Archaic Age peoples through the Caribbean sketches a much more complex picture. While it might be simplest to say that Amerindians continued their path northward from Trinidad, island-hopping through the Lesser Antilles and eventually reaching the Greater Antilles, material evidence as well as modeling data suggests otherwise. Instead, a leap from South America in this period to the large islands of the Greater Antilles alongside a number of smaller islands in the Northern Lesser Antilles as well as a few located very close to the South American mainland (including Curaçao), followed by a largely southward dispersal across the rest of the Lesser Antilles is the most likely route the Amerindians took (Fernandes et al., 2020; Haviser, 2001; Keegan & Hofman, 2017, p. 38; Napolitano et al., 2019). To add, it is also important to note that the technological assemblages of the Lithic and the Archaic are not entirely separate. Moreover, technological toolkits became increasingly diverse as time went on and regional adaptations took hold.

The marine environment of the Caribbean was highly utilized by the Amerindians in this period, and continued to be throughout the pre-Columbian period. It is because of this that, in spite of the clear value held by the larger islands of the Greater Antilles with its bountiful terrestrial resources, the smaller islands of the Caribbean including Curaçao were likewise highly valuable for their varieties of fish, molluscs, lizards, and even amphibians and sea mammals (Keegan et al., 2008). However, these small islands also posed the risk of overexploitation and resource depletion far more than the larger islands (Fitzpatrick et al., 2008).

Of course, many questions still remain regarding this early history of the Caribbean. Most importantly, the routes, methods, and motives of these early Amerindians are still up to debate – although the most accepted theory is that the Amerindians used dugout canoes to make the crossings between the mainland and the islands throughout the precolonial period (Keegan & Hofman, 2017, p. 27). Moreover, it is still unclear what happened to the supplanted population as they were supplanted by subsequent waves. From recent genetic data, it is concluded that migration throughout the islands during the Archaic Age occurred in three distinct waves, coming from Central and South America, and each largely supplanting the previous wave's population (Nägele et al., 2020).

What follows this early period is the Ceramic period, c. 500 BCE – 1500 CE, when the marine-oriented foraging lifestyles of the Caribbean peoples was largely supplanted by a more sedentary agricultural lifestyle. Of course, as the name implies this is also the period of time that pottery becomes ubiquitous in the archaeological record. However, this black-and-white distinction does not sketch a full picture. After all, some traces of pottery – as well as evidence for proto-agricultural activity – have been found at sites that appear from the outset to have a fully archaic technological complex (Rodrígues Ramos et al., 2008). In fact, more recent work has pushed to reassess this distinction between Archaic and Ceramic, as evidence is mounting to show a reality far more complex than a model of one technological complex fully supplanting another due to its perceived superiority – a reality where so-called Archaic complexes persisted long after the arrival of Ceramic technology, and vice versa where ceramics appeared far earlier than the "Ceramic Era" was slated to begin (Antczak & Hofman, 2019).

Regardless, this does not take away from what we know for sure: in the first millennium BCE, waves of peoples speaking Arawakan languages and taking with them Ceramic technological complexes migrated from the South American mainland and gradually found themselves spread across the entire Caribbean, eclipsing older cultures entirely. While previously, a 'stepping-stone' pattern of colonization gradually moving North along the Lesser Antilles had been supposed, the archaeological evidence seems to indicate otherwise. After all, the earliest dated Ceramic sites (c. 800-200 BCE) appear on Puerto Rico and the Lesser Antilles directly adjacent, not those islands closest to the mainland. While this could be the result of bias in the archaeological record, this seems unlikely in the face of the tremendous amount of surveying done recently in the Lesser Antilles (Keegan & Hofman, 2017, p. 59). Then again, recent genetic evidence supports the contrary, showing an affinity between the mainland and the closest Antillean islands that dissipates as it goes North, suggesting still that a stepping-stone trajectory was perhaps likely (Fernandes et al., 2020). The full truth in this matter may only be uncovered with further research.

While the first peoples who moved into the Antilles at this time were generally 'Arawakan' (described as having 'Saladoid' traditions) with broad cultural and technological similarities between them, the diversity of the ceramic styles across the islands during this time sketches an image of numerous autonomous communities contributing towards the migration. Because of this, a clear singular point of origin cannot be determined through the cultural record alone (Keegan & Hofman, 2017, p. 61). However, opposite to this, there appears to be a clear cut-off point for this early migration. On the island of Hispaniola and beyond, there is a distinct lack of Saladoid culture sites, implying that colonization of the Greater Antilles and beyond was, at first, westwardly limited to Puerto Rico (Keegan & Hofman, 2017, p. 63).

The social organization and by extension the colonization patterns were radically different in Ceramic Arawak communities. Rather than a 'free-flow movement' of individual foragers dynamically adapting to the islands typical of the Lithic and Archaic ages, Arawak colonization was typified by the transposition and reproduction of the originating societies of the colonists, through the movement of entire households and communities (Heckenberger, 2013). Clearly, there was a greater reliance on sedentary lifestyles and agricultural subsistence strategies, both resulting in greater risks for colonization. Replicating the (thus far successful) originating community as well as maintaining strong ties with it would have been vital for the survival of any new colony.

While Saladoid complex assemblages were never truly homogenous from the start (see for example the phenomenon of the *Huecoid* style emerging in Puerto Rico contemporaneously to Saladoid migrations; Wilson, 2007, p. 76), the diversity in styles and toolkits only increased as time went on. With continuing interaction between the already diverse communities across the Caribbean and the mainland (both in the form of cultural and demographic exchanges), as well as regional adaptations taking hold, local traditions would become separated enough from Saladoid styles to warrant their own, post-Saladoid denominations. These are for example the *Ostionoid, Chicoid,* and *Meillacoid* series in the Greater Antilles, and *Troumassoid* and *Suazoid* series in the Lesser Antilles (Keegan & Hofman, 2017) – although these were originally described as 'subseries' to the Saladoid tradition rather than standing separately from it. What is important to note is that the genetic data does not line up with these typologies, suggesting the development thereof was likely the result of cultural, not demographic exchange (Fernandes et al., 2020).

All these developments would lead to the tapestry of cultures and peoples found by Europeans as they arrived near the turn of the 16th century CE, of which only traces can be seen today. The entry of European colonists into the Caribbean was catastrophic for the

Indigenous population. Between the introduction of foreign diseases and the enlisting into forced labor, on top of open conflicts and warfare, the Amerindians overwhelmingly died off (Wilson, 2007, p. 158). However, persistence of Indigenous cultural traditions is still visible in all of the islands of the Caribbean (Hofman et al., 2020).

Overall, the pre-Columbian period of the Caribbean is said to be a constant see-saw between the diversity of regionally adapted cultures, and the homogeneity of overarching influences. Network analysis of pre-Columbian Caribbean cultures indicates as much, as the interconnectivity between the islands functioning as nodes in a network experienced distinct ebbs and flows throughout the pre-Contact period, sometimes having widespread connections reaching across the entire region, while at others being very limited to direct locality (Hofman et al., 2010; Mol, 2014).

2.2 *Curaçao: Geography*

Located near the westernmost tip of the Lesser Antilles, bordering the continent of South America, are the ABC-islands of Aruba, Bonaire, and – largest among them – Curaçao. These islands find their origins in volcanic activity as a result of collisions between the Caribbean and South American continents during the Upper Cretaceous and Early Tertiary periods, creating volcanic rocks that now form the geologic core of the islands. Built upon this are limestone terraces, formed in large part by fossilized coral and algae left behind by fluctuating sea-levels combined with a rising tectonic shift of the islands. On Curaçao, these terraces formed primarily along the coast, with some on the inner parts of the island (*fig. 2*). Wave action and groundwater runoff created numerous cave networks within this karstic landscape. The island today sports numerous inland bays, mangroves, hypersaline lakes (*saliñas*), salt pans, as well as a rich coral reef environment just off the coast (Schmutz et al., 2017). Its landscape is highly variable, ranging from modestly hilled valleys and sandflats to hulking mountains (the tallest of which, the *Sint Christoffelberg*, rises to 372 meters, measuring the tallest point on any of the ABC-islands).

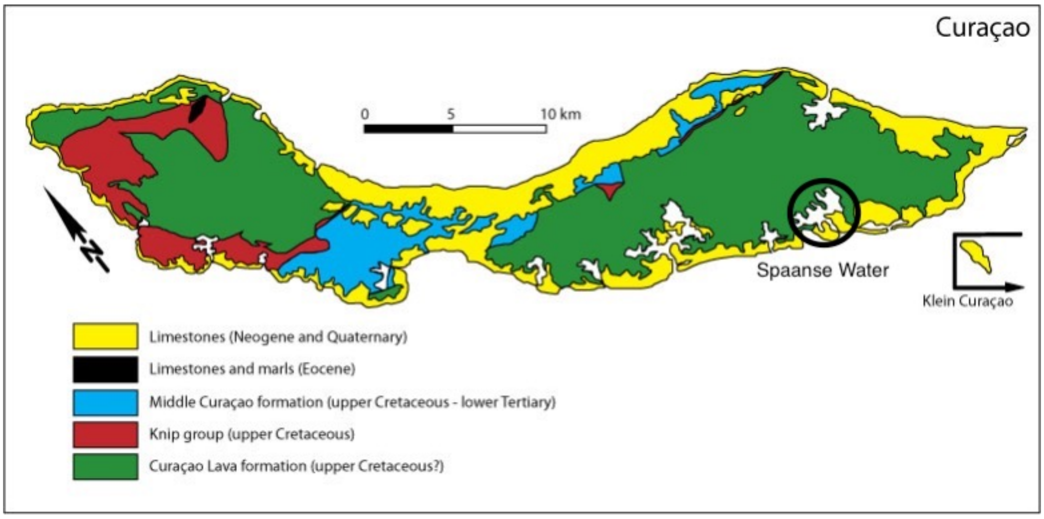

Figure 1 - Geological map of Curaçao highlighting the limestone formations

(adapted from biodivexplorer.dcbd.nl)

2.3 *Curaçao: Pre-Columbian history*

The ABC-islands may find their closest archaeological link with the Venezuelan mainland throughout the pre-Columbian period, coming as no surprise due to its geographical proximity. Among them, Curaçao holds the earliest confirmed human activity, dated to c. 2700 BCE at the site of Rooi Rincon (alternative radiocarbon dates from Spaanse Water are placed around the same time, c. 2650 BCE) (Napolitano et al., 2019; Dunning et al., 2018). The Archaic age on the island sees a concentration of human activity in the site's area, likely because of its access to fresh water. This earliest occupation sees some similarities with Lithic Age activity elsewhere ('crude plano-convex tools'), but it can still be said that Curaçao remained largely uninhabited by Lithic Age peoples, as the lion's share of materials left are instead of distinctly Archaic complexes, albeit with a possible 'continuation' of Lithic Age tools within the Archaic toolkit (Haviser, 1987, p. 44; 1991, p. 39; 2001).

In terms of Archaic migrations, two complex groups appear to dominate the period on Curaçao: Firstly, the Manicuaroid/Cubagua complexes originating from the islands of Margarita and Cubagua, on the eastern coast, and secondly the El Heneal/El Jobo complexes finding its origins on the Venezuelan northern coast. Archaic assemblages from Curaçao share the greatest similarities with the former, although there are significant influences to be gathered from the latter (Haviser, 2001). This is seemingly counterintuitive, as the cultural area of the El Heneal/El Jobo complexes is far more proximal to the island of Curaçao than the islands of Margarita and Cubagua. Haviser (2001), observing similarities between ABC-island and Cuban Archaic assemblages, posits that El Heneal peoples stopped only for a relatively short period of time on the island of Curaçao (completely forgoing the other ABC-islands), using it as a stepping-stone of sorts towards Cuba. While some individuals belonging to this migration possibly remained on the island, these were then assimilated into Manicuaroid populations, arriving a few centuries later in a period of widespread population movements by Manicuaroid peoples along the Venezuelan coast. As suggested by the radiocarbon dating on Aruba and Bonaire, it is then likely that these Manicuaroid peoples only later settled on the other ABC-islands (see fig. 3).

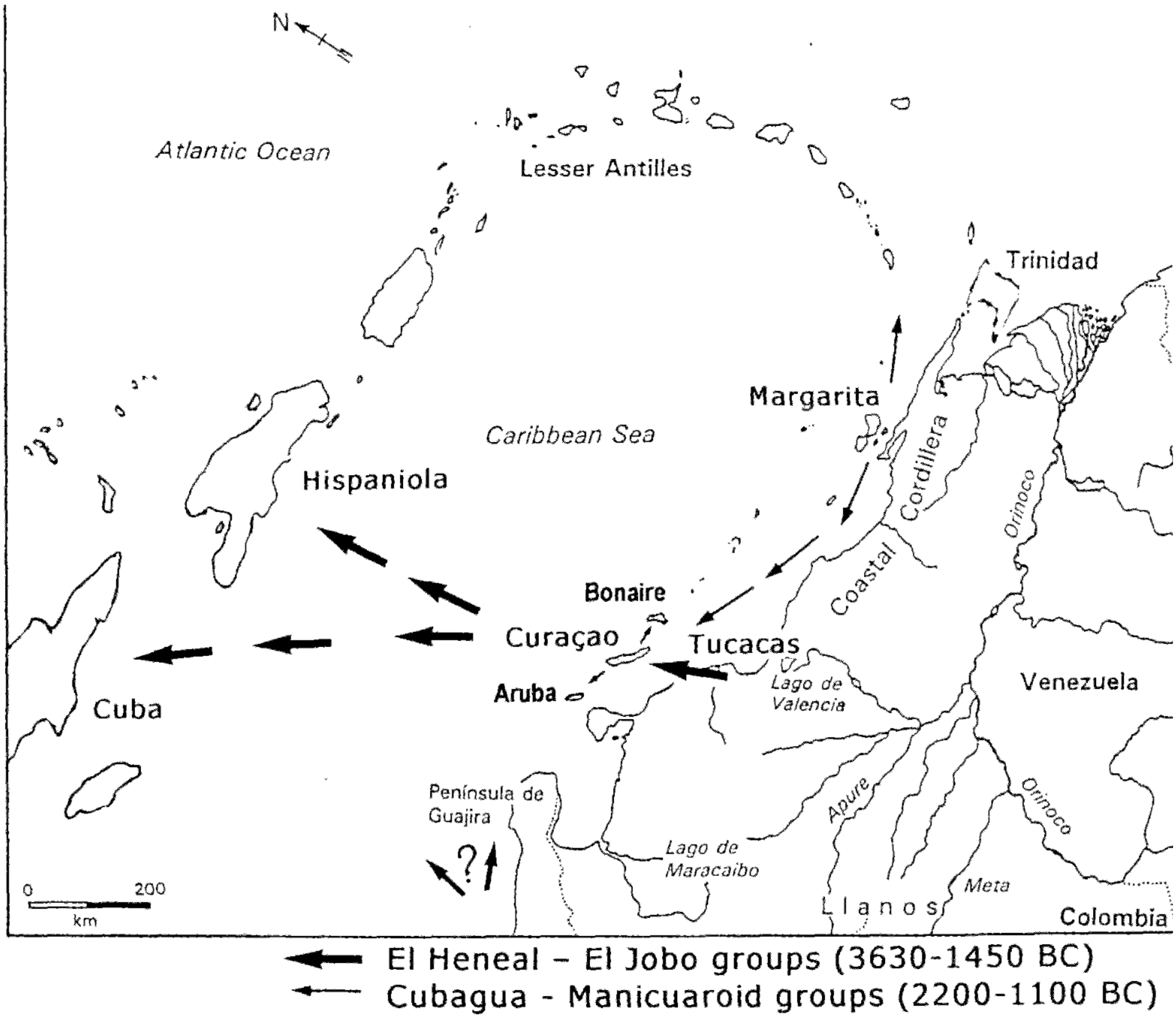

Figure 2 - Suggested Archaic Age movements in the Southern Caribbean

(Haviser, 2001, p. 121)

Just like elsewhere in the Caribbean, these Archaic Age groups are typified by a reliance on hunting and gathering for survival, particularly focusing on the marine environment. As a result, sites of this period in time have, without fault, an abundance of middens built up from the remains of fish, shellfish, and marine mammals (Haviser & Hofman, 2015, p. 42; Hoogland et al., 2015). Beyond ground-stone tools, there also appears to be a heavy reliance on tools made from shell (Haviser, 1987; Dijkhoff & Linville, 2004).

After a period of long-term occupation by these Manicuaroid groups, it appears from the archaeological record that there was a period of lessened activity on the island. Between c. 1000 BCE – 1 CE, our knowledge of human occupation on the island is incredibly limited, and as such it is possible that this hiatus in the archaeological record is instead the result of a lack of data (which is also thought to be the case for Aruba; see Kelly & Hofman, 2019, p. 59). Moreover, the exact nature of the transition between Archaic and Ceramic is still largely unknown (Haviser & Hofman, 2015, p. 43). As with elsewhere in the Caribbean, it might be worthwhile to interpret the transition between Archaic and Ceramic on Curaçao as a complex, dynamic set of adaptations and interdependencies, rather than a simple supplanting of one complex by another (Antczak & Hofman, 2019).

At around 500 CE, the first Ceramic Amerindians came to inhabit the island of Curaçao. As the name implies, this is the time when widespread production and usage of pottery is introduced. More specifically, ceramics belonging to the Dabajuroid series, originating from the northern coast of Venezuela – much like the El Heneal series that came before it – as well as the northeastern coast of Columbia. Haviser (1987, p. 50) points out that the Dabajuroid series as it is known on Curaçao does exhibit characteristics that set it apart from its mainland counterparts (as well as examples found on Aruba). Certain aspects appear to show influence from cultures farther to the east. He theorizes that the explicit Dabajuroid influences indicate a migration of peoples from the mainland, whereas the other influences may have been the result of cultural exchange. Unsurprisingly, genetic evidence supports a strong link with the Arawakan colonizers entering the Lesser Antilles to the east in the same period or later (Fernandes et al., 2020). Linguistic, archaeological and ethnohistorical evidence strongly support Haviser's hypothesis, finding a link between the Dabajuroid culture on Curaçao and macro-Dabajuroid migrations in Venezuela and Colombia (Oliver, 1989). Genetic evidence further exploring this Ceramic Age connection with the South American mainland, however, is as yet minimal.

The Ceramic Age also introduced the widespread utilization of agriculture on Curaçao, including maize and manioc, though evidence shows horticulture to be a part of the economy going back into the Archaic (Haviser, 1987; Dunning et al., 2018). In any case, subsistence continued to lean heavily on exploitation of the marine environment, as fishing as well as the gathering of shellfish continued to be an important part of the Indigenous economy. Society also grew more complex, as the socio-cultural structure evolved into that which would be described by the incoming colonists as *Caquetío*, having a stratified social structure by the incoming colonists. Why this stratification occurred can only be speculated on, though the coastal environment and relative wealth of resources and lack of competition could have been influential (Oliver, 1989, p. 494).

In the Colonial period, the island and its inhabitants were transformed drastically. As Curaçao was seen as having little in terms of valuable resources (at least compared to the more bountiful Greater Antilles), its inhabitants were deported to be used as forced labor, leaving the island largely uninhabited the first century or so after contact with Europeans. While there is some cultural continuity between the prehistoric and modern periods (and significant Amerindian influences on contemporary culture are often overlooked) (Hofman et al., 2018), this is in many ways superseded by African and European influences. In the end, the island's culture today is a complex tapestry, with an equally complex heritage.

2.4 *Curaçao: Pre-Columbian archaeological research*

The earliest archaeological research focusing on pre-Columbian Curaçao dates back to the late 19th century, when a pastor by the name of A. J. van Koolwijk performed the first archaeological surveys on the island, particularly at Knip (C-001), Ascension (C-068), and San Juan (C-008). Throughout the near century-and-a-half of archaeological surveying since, a large number of prehistoric sites were found on the island by a variety of researchers. Koolwijk was followed by J.P.B. de Josselin de Jong in the 1920s, excavating the site of San Juan and building on the earlier surveys. Research began ramping up when, in the late '40s and throughout the '50s, when surveys focusing on Indigenous petroglyphs and rock drawings were carried out across the island by A.D. Ringma, and later P. Wagenaar Hummelinck. Throughout the 1960s and 1970s, archaeological surveying and research on the island increased further, as numerous professional and amateur archaeologists were set on documenting as much of the island's prehistory as possible. It is in this period that the site of Rooi Rincon (C-015) was excavated by H.R. van Heekeren and C.J. Du Ry, and later dated by J.M. Cruxent as the earliest known occupation on the island (and among the earliest dated signs of Archaic activity across the Caribbean) (see also Napolitano et al., 2019).

Perhaps the most prolific and infuential researcher of archaeology on Curaçao is Jay Haviser. His 1987 PhD thesis on the island's cultural geography forms a comprehensive study of Amerindian activity on the island. In spite of some of its contents turning out to be inaccurate, it is still often cited today as the main authority on Curaçao's prehistory. Haviser also carried out numerous excavations on the island from the 1980s onward, as well as numerous radiocarbon datings.

In 1966, the Netherlands Antilles founded the Archeologisch Anthropologisch Instituut van de Nederlandse Antillen (AAINA) on Curaçao, which became the archaeological authority in the Netherlands Antilles. Today, the National Archaeological Anthropological Memory Management (NAAM), an NGO and successor of AAINA, continues to survey the island and perform archaeological research at present, heading several ongoing excavations and research projects, while also being one of the main authorities of cultural resource management on the island.

2.5 *The sites of Spaanse Water*

The *Spaanse Water* (lit. 'Spanish Water') is an inland bay located on the east side of the island (see fig. 3). Its value in terms of archaeological potential was already noted by Haviser (1987), as the area's rich mangroves and veritable rock shelters would have been attractive for Indigenous Archaic and Ceramic Age inhabitants to settle what he called an "intensive resource extraction" site. This, he concluded from comparisons to sites with a comparable cultural geography (Haviser, 1987).

The Archaeological site of Spaanse Water (C-039), located on the eastern shores of the lagoon directly adjacent to the prominent Tafelberg, was originally discovered in 1968 through the survey work done by Juliana and Brenneker. Research on the site, however, only truly began when Haviser carried out a test pit excavation in 1992. While a notably rich presence of shell middens dated to the Archaic Age was ascertained, little more information on the site could be made up from this preliminary excavation (Haviser, 2001). The adjacent site of Ceru Boca (C-038), likewise first recorded by Juliana and Brenneker in 1968, was thought to have been an ephemeral resource extraction site by Haviser (1987). However, the site did not receive as much attention as Spaanse Water.

In the late 2000s, construction plans were drafted for a golf course on the Santa Barbara estate, which also encompassed the Spaanse Water site. By direction of Santa Barbara, N.V, researchers from Leiden University began investigating the site in order to determine its context as well as the possible dangers that the construction plans could hold, starting with preliminary desk research and field surveys in 2007. Through this, numerous shell deposits were found along the banks of the lagoon, and the value of further excavations at the site was confirmed.

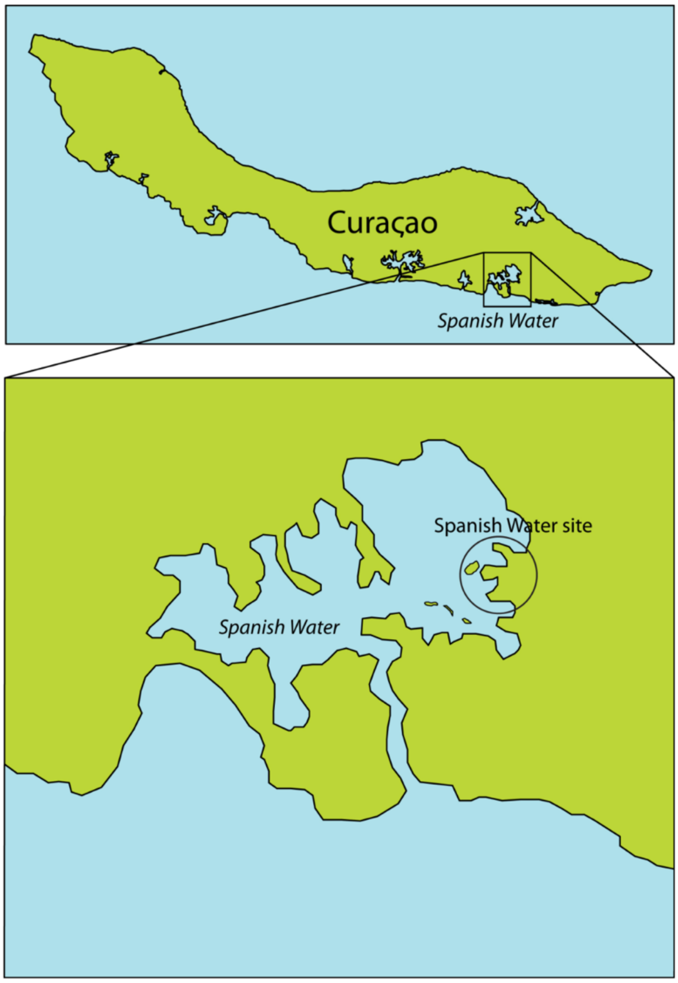

Figure 3 - Location of the Spaanse Water site

(Hoogland & Hofman, 2011, p. 632)

The definitive excavation, carried out by students and faculty from Leiden, began in the summer of 2008. Through sheer coincidence, two other sites in the locality of Spaanse Water were ascertained: a shell midden some distance south of the site, disturbed by modern construction (C-215), and a rock shelter from the nearby site of Ceru Boca (see fig.

4). The former was excavated alongside the Spaanse Water site, and the latter was revisited in 2009 for a preliminary survey.

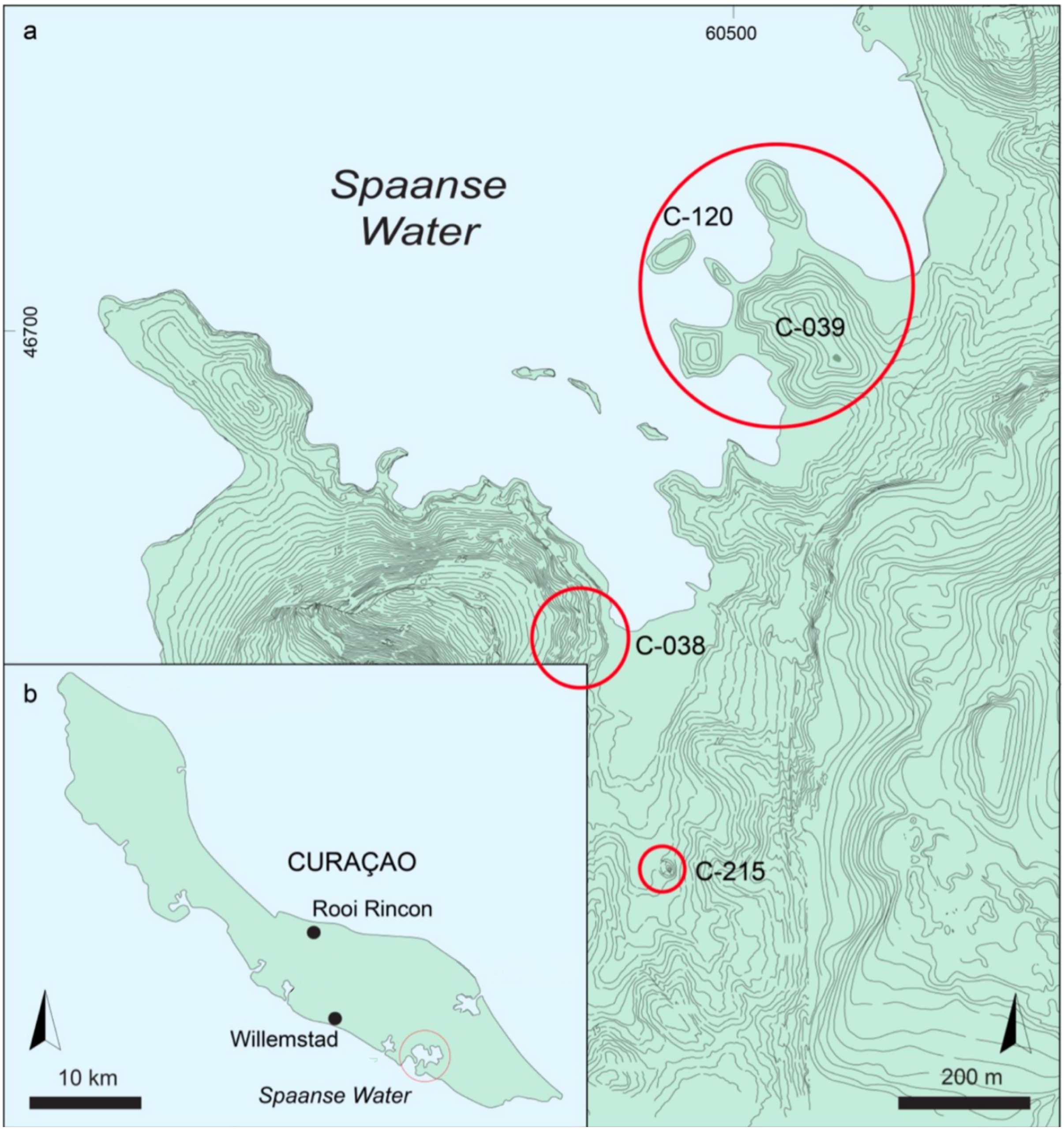

Figure 4 - Overview of the Spaanse Water site

(adapted from Hoogland et al., 2015, p. 2)

The excavation, its finds and its conclusions are summarized in a 2015 report. Overall, the site was determined to be of mostly early Ceramic Age, with some activity going back to the late Archaic – a period of time that previously formed a hiatus in the archaeological record. Haviser's hypothesis of an intensive resource extraction site, focused on the marine environment (i.e., fish and shellfish hunting, gathering, and processing) appears highly likely (Hoogland et al., 2015, p. 80). Certainly, the sheer number of shells found in the 17 shell deposits point to this. Among the shells found, *Aliger gigas* appears to be highly preferential, seeing an increase in exploitation from the Archaic to the Ceramic period occupation. The shallow seagrass-covered environment that is formed by the Spaanse Water lagoon was likely a habitat for *Aliger gigas*, although the report points out that no live specimens were observed during the excavation, possibly indicating that the lagoon only supports a small population today (Hoogland *et al*., 2015, p. 48). Beyond this, plenty of other (primarily marine) faunal remains were found, including fish, sea mammals, crabs, and reptilians.

Further, traces of ceramics were found that indicate a far more gradual transition from the aceramic to the ceramic period, starting far earlier than previously supposed (Hoogland et al., 2015, p. 81; Hofman & Antczak, 2019).

2.6 *Molluscs in the Caribbean*

The importance of molluscan remains in Caribbean archaeology cannot be overstated. At a plurality of archaeological sites to be found in the region, it makes up the majority of the assemblage's material. Bivalves, gastropods, and oysters are frequently shown to take a near-central role in the economies of the pre-Columbian Caribbean, be it as a source of food (Antczak, 1999; Antczak & Antczak, 2005; Serrand, 2008; Serrand & Bonnissent, 2005, 2018), or as a source of material for tools (Ciofalo et al., 2020; Dijkhoff & Linville, 2004; Jones & Keegan, 2001; Lammers-Keijsers, 2007), and ornaments (Falci et al., 2020, p. 185; Linville, 2005). Caribbean economies evidently relied on the marine environment (and particularly the mollusks that live therein) for subsistence throughout the pre-Columbian period.

3. The Queen Conch

3.1 *Significance in the Caribbean*

Queen Conch, or *Aliger gigas* (though previously known as *Strombus gigas* and *Lobatus gigas*) is a species of marine gastropods that is found across the Caribbean, generally preferring environments that are bountiful in seagrass on which it feeds, alongside algae and sand. Its nutritional value, coming from its sheer size as quite the large shellfish – with six individuals being able to give a whole kilogram of meat – has led Antczak (1999) to coin the term 'fruit of paradise,' in turn inspiring the title of this thesis. This makes it a valuable target of exploitation, both by its natural predators (Antczak, 1999, p. 148), as well as by humans, being found commonly in shell middens across Caribbean archaeological sites, and often forming a majority of the deposited shell material (Antczak & Antczak, 2005; Rousseau et al., 2017; Serrand & Bonnissent, 2005).

The shell of *Aliger gigas* is quite sturdy, and has been shown to be fashioned into a variety of tools (Dijkhoff & Linville, 2004; Jones O'Day & Keegan, 2001; Serrand, 1999; Serrand & Bonnissent, 2005; also replicated in experimentation, e.g. Keegan, 1984), ranging from celts to gouges and handpicks. Likewise, it has also frequently been formed into ornaments (Antczak, 1999, p. 176; Linville, 2005; Lammers-Keijsers, 2007), primarily into perforated beads or discs, but also into more elaborate forms of pendants such as effigies (Haviser, 1987).

Perhaps the ubiquity of *Aliger gigas* is especially true for the ABC-islands. On Curaçao and Bonaire, the shellfish appears to have been a preferred source of nutrition, particularly (though not exclusively) in the Ceramic period (Haviser, 1987, 1991; Hoogland et al., 2015). On the exploitation of *Aliger gigas* on the island of Aruba in the Ceramic period, Linville (2005, p. 184) states: "[T]he species *Strombus gigas* truly does reign supreme as the medium of choice for the production of shell objects." The geographically and culturally linked Los Roques archipelago in modern-day Venezuela held numerous highly productive *Aliger* fisheries going into the late Ceramic period (Antczak, 1999; Antczak & Antczak, 2005).

The Queen Conch remains a valuable subject of research in the Caribbean, and particularly on the ABC-islands. Its ubiquity in archaeological sites found in the region, particularly those dated to the Ceramic period, points to a significant reliance on it in Amerindian economies.

Today, Queen Conch forms the second-largest fishery industry of the Caribbean, and is a staple food in many Caribbean cuisines, and even hold cultural significance in several Caribbean cultures. Today, Conches are obtained via 'conch diving', as fishermen use snorkel gear to retrieve the animal from the seafloor in shallow waters (whether similar or different techniques were used by the pre-contact Indigenous is certainly an interesting debate). The animal's shell is discarded and thrown onto piles by the fishermen, not unlike the shell middens from the archaeological record (a good example of this would be Lac Cai, Bonaire). The downside of this significance of the Queen Conch in Caribbean culture and tourism is that it is sadly at almost constant risk of overexploitation, and has led to the total collapse of fisheries in several regions (most notably in Florida and Bermuda). As such, Conch fishing is often under strict regulations restricting the activity to certain areas, periods, or making it illegal entirely.

3.2 *Anatomy*

In examining and describing *Aliger gigas* shells, it is important to understand its anatomy, as well as the nomenclature used in describing gastropod shells. A short description thereof will be given as such (see fig. 7).

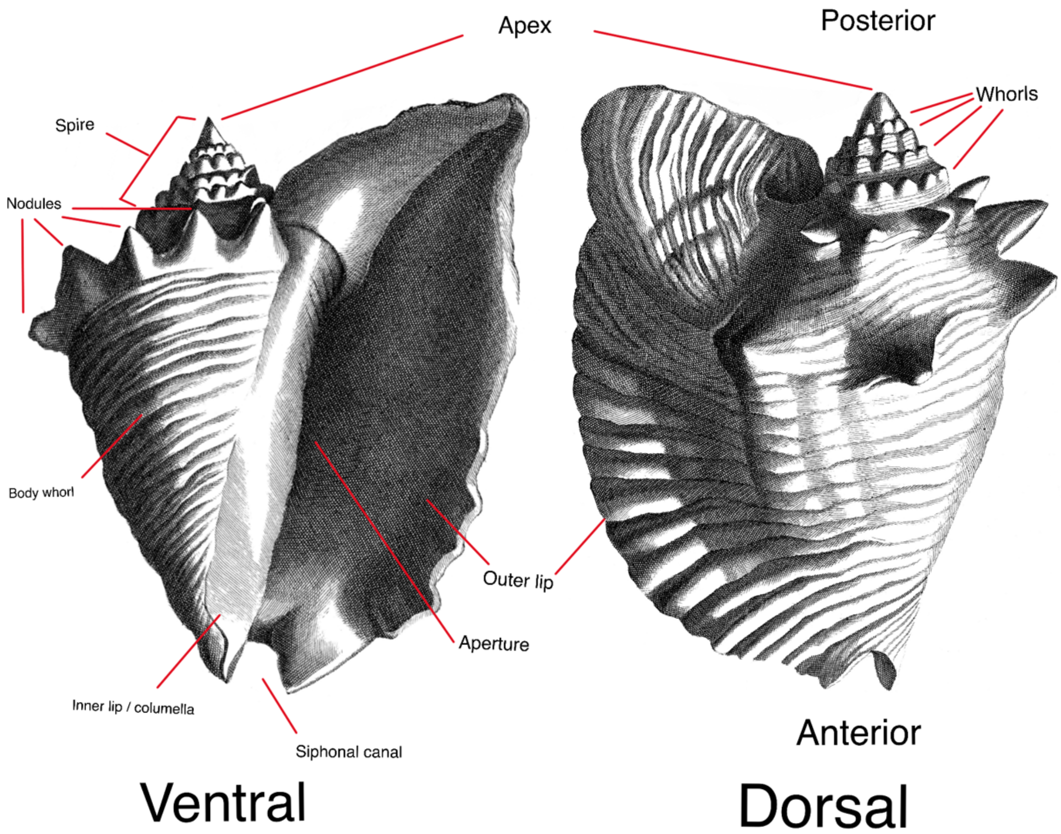

Figure 5 - Annotated illustration of Aliger gigas shell

(adapted from Wikimedia.com)

Working down from the top, or posterior part of the mature shell, there are a number of 'whorls' that make up the 'spire', culminating in a pointed 'apex' at the posterior end. Unique (though not exclusive) to *Aliger* shells is the presence of pointed 'nodules' protruding from the whorls. Going down, the most posterior of these whorls that makes up the majority of the corpus of the shell is known as the 'body whorl,' which opens into the 'aperture' of the shell, and culminates in a flaring 'outer lip,' and 'inner lip' (or 'columella'). Going towards the anterior end of the shell, the body whorl culminates in the 'siphonal canal.' The shell is described as having two 'sides'; the side on which the opening of the aperture is located, described as 'ventral,' and the other side described as 'dorsal.' Juvenile shells have a slightly different morphology, primarily indicated by the lack of a (flaring) outer lip (see fig. 8).

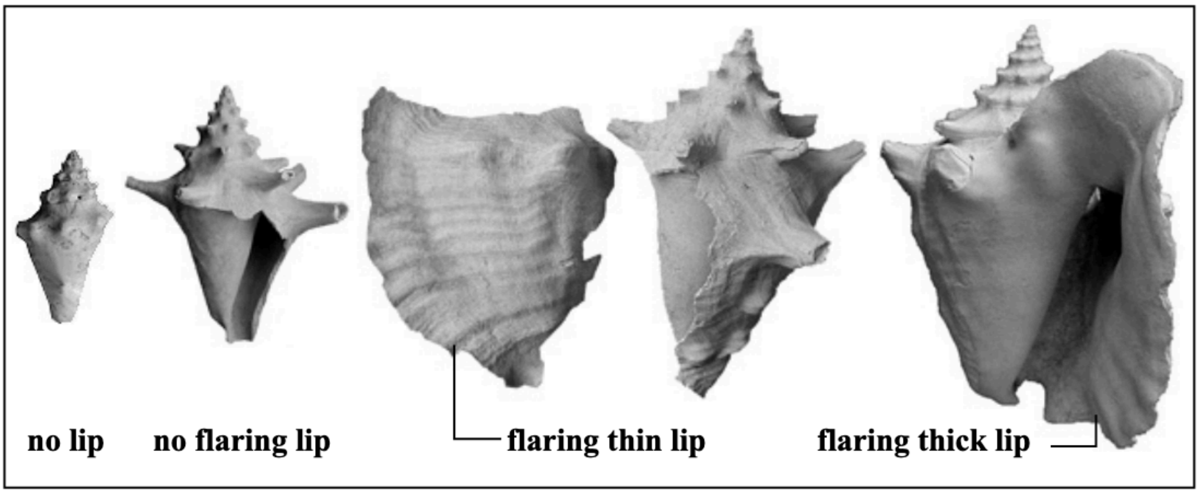

Figure 6 - Growth stages of Aliger gigas

(Serrand & Bonnissent, 2005, p. 33)

4. Methodology

4.1 *An introduction to archaeomalacology*

Molluscan shell is as ubiquitous a material in archaeological sites as it is useful as a tool to archaeologists in working towards a variety of goals. Among these, the ability to date sites and artifacts through both relative and absolute means. The former, through seasonality study and oxygen isotope analysis. The latter, through radiocarbon isotope dating, although some errors can arise from decay analysis, not only due to the marine environment impacting carbon isotope decay (Douka et al., 2010), but also due to the possibility that humans could have used old shell, creating a discrepancy between the dating of human activity and the material (Rick et al., 2005). However, the role of shell within archaeological research does not end with it being used as a dating method. Just as useful is the possibility it gives to grant a greater understanding of the societies we study.

Archaeomalacology, or the study of molluscans, their shells, and the role they had within historic societies can be said to be subdivided into three goals of study: the reconstruction of paleoenvironments, the reconstruction of paleo-diets, and the understanding of shell material as it was used to create tools as well as ornaments (Allen & Payne, 2017). The former two of these usually require a more quantitative approach, as entire assemblages are analyzed to graph the change in numbers of individuals over time, whereas the latter instead often emphasizes a qualitative approach to seek a greater understanding of shell tools and ornaments through functional/morphological analysis, experimental archaeology, as well as ethnoarchaeology – although, to say the former is exclusively quantitative and the latter is exclusively qualitative would be inaccurate.

4.2 *Sample set*

As the goal of this research is to determine what techniques may have been used on the shells, the best way to achieve this is to cast as wide a net as possible. To do this, the sample set was selected based on the available information from the project report, as well as the results from zooarchaeological data (particularly the MNI estimates from the given finds, which were assembled in a spreadsheet by Dennis Nieweg and others). It is important to note however that this data is strictly quantitative. As such, it would be a gamble to know if any given selection of finds would even have shells with an accurate variety of processing traces to be found, or even being in a state fit for typo-morphological analysis (further discussed in section 4.3). While a simple solution would be to 'brute-force' the research and examine the entire assemblage, this was not possible within the purview of my BA thesis (after all, this would mean retrieving, examining, and cataloguing well over a thousand individuals).

To work around this, I simply maintained the goal to cast as wide a net as possible and focused instead on the location of the finds to create a sample set from as wide an array of contexts as possible. To start off, the various trenches that hold shell deposition features from site C-039 (2, 3, 4, 5, 6, 7, 8, 12, and 14), as well as the corresponding numbered shell deposits as described in the report were examined, and from this the ones with significant amounts of *Aliger gigas* were noted. Next, the context of the shell deposition features found within the trenches – as described in the report – was examined, and a selection was made to have a diverse pool. For instance, some of the features have a coastal context whereas others are more inland. Some are located near signs of a fire pit ('haardsporen'), whereas others are located close to potential postholes. The range of dates from each trench was also taken into account and made to be as wide as possible (although, this remains overwhelmingly in the early Ceramic period, as that was when most *Aliger gigas* were exploited). From this selection, a number of features were deemed significant (see table 1, and figures 5 and 6). However, information on the features is at times limited, and sometimes confusing as the data on the excel sheet appears to differ from the 2015 report. I decided to rely primarily on the excel sheet, and only refer to the report should further information be needed – primarily because the latter only touches on the excavated shells in summary, whereas the former is a comprehensive dataset. Beyond this, the finds at site C-215 were also taken into consideration. This, in spite of having a far smaller MNI of *Aliger gigas*, as the site has a far earlier dating than C-039 and also a relatively remote location. The Ceru Boca site (C-038) was left out of the research as the MNI of *Aliger gigas* appears from the report not to be very significant.

Table 1 - List of features selected for the sample set, with their respective shell depositions and contexts

Feature no.	Shell deposition	Contextual description
S02-01 / S02-05	No. 9	Located on the south side of the main excavation area. Shell deposition #9 forms among the largest by area. Trench 2 (find no. 301) was dated to c. 207-55 BCE (Early Ceramic). MNI=131
S03-01	No. 11	Small shell deposition located on the south side of main excavation area. Trench 3 (find no. 300) was dated to c. 415-257 BCE (Early Ceramic). MNI=237
S04-01	No. 16	Little context of this trench can be made up. Significant because of picture in excavation report showing *Aliger gigas* specimens with clear burn marks (Hoogland *et al*., 2015, p. 49), and descriptions of shells with lips missing (p. 48). Trench 4 (find no. 139) was dated to c. 1153-955 BCE (Archaic). MNI=48
S07-02 / S07-03	No. 10	Shell depositions very close to traces of a fire pit (S07-01), as well as a posthole (S07-04). Trench 7 (find no. 333) was dated to c. 15-157 CE (Early Ceramic). MNI=93
S08-03	No. 14	Located near traces of a fire pit, although the dating of charcoal indicates it is from the Colonial period. Marine shell from trench 8 (find no. 176) was dated to c. 423-565 CE (Early Ceramic). MNI=34
S12-01	No. 2	Located far from the rest of the excavation, on the southern peninsula. Trench 12 (find no. 297) was dated to c. 501-359 BCE (Archaic). MNI=87
C-215	-	The site C-215 is a small shell midden located far to the south of C-039, disturbed by modern construction. The site (find nos. 6, 9, and 10) was dated to c. 2822-2492 BCE (Early Archaic). MNI=19

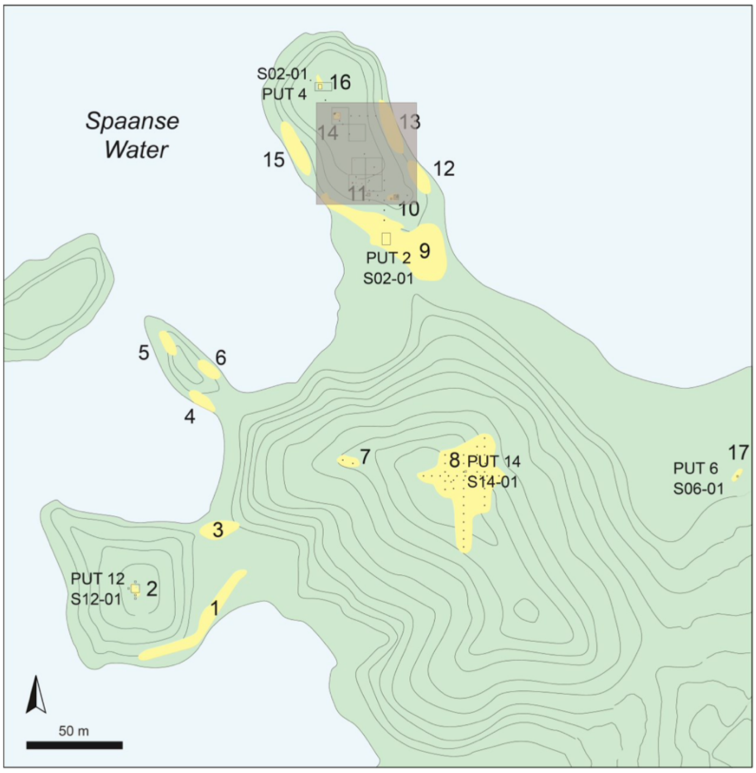

Figure 7 - Overview of site C-039's trenches

(Hoogland et al., 2015, p. 34)

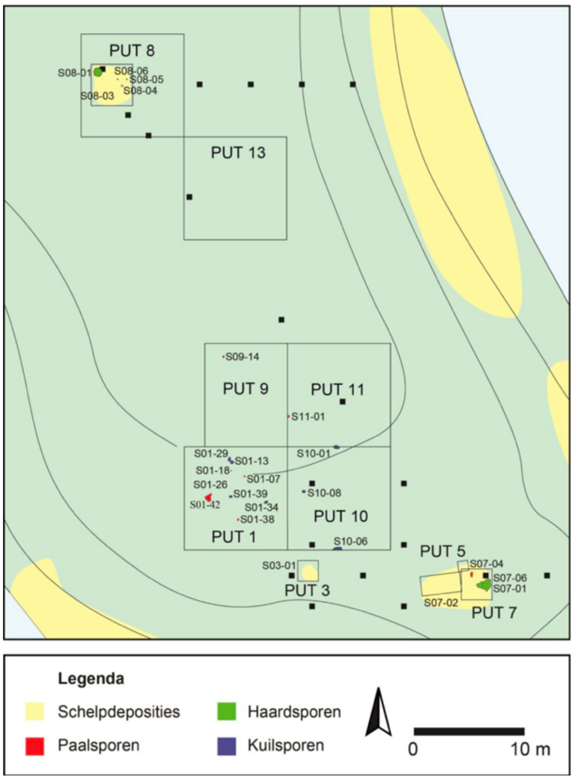

Figure 8 - Trenches of the northern excavation area

(Hoogland et al., 2015, p. 35)

Next, the zoological and malacological data was consulted to determine which finds from these features had significant MNIs of *Aliger gigas*. It is important to note that I applied a clear bias towards finds with high MNIs, with the goal in mind to be able to efficiently retrieve as many individuals from the depot as possible. It would certainly not be very efficient to spend time retrieving finds that primarily hold specimens other than *Aliger gigas*, and only be able to examine one or two individuals for the effort. From this, a 'wish-list' of prioritized finds for each of the features was assembled (see table 2). This list was then consulted to select the samples retrieved from the depot. The bold entries shown indicate finds that ended up being examined.

However, the final sample set does not line up with this list, primarily due to the nature of retrieving these finds from the depot. The method of storing in the depot meant that significant time and effort would have to be spent to reach some of the finds, as they are stacked on top and often in front of each other. This, combined with the lack of manpower available to do this (only consisting of myself and drs. Claudia Kraan transporting the finds) meant that judgement calls had to be made on-site to determine which finds to transport. As such, a clear bias emerges towards those finds more easily accessible in the depot, skewing the sample set. Still, I believe the sample set is wide enough to warrant examination, although it certainly is narrower than I would have preferred. Likewise, some finds that fall outside the "wish-list" were found to have significant amounts of *Aliger gigas* at the depot and were likewise taken for examination (see the 'additional finds analyzed' row in table 2). In total, shells in 19 different find numbers from 8 different features were retrieved from the depot. From these, a further narrowing down of the individuals examined was done in order to keep the focus on as wide a selection of finds as possible, rather than skewing it towards those finds with the highest MNI. In the end, the full sample size of the examined *Aliger gigas* specimen included 168 individuals.

Table 2 - 'Wish-list' of finds holding significant numbers of Aliger gigas individuals

Feature	**Finds**
S02-01/S02-05	- No. 85; 68-07-40, layer 1; MNI=49 - No. 96; 68-07-12, layer 1; MNI=19 - No. 97; 68-07-13, layer 1; MNI=10 - **No. 101; 68-07-23, layer 1; MNI=16** - **No. 285; info missing** - No. 286; 68-07-02, layer 2; MNI=11 - **No. 304; 68-07-23, layer 2; MNI=6** - **No. 385; 68-07-23, layer 1; MNI=17**
S03-01	- No. 112; 58-99-28, layer 1; MNI=8 - **No. 251; 58-99-17, layer 1; MNI=47** - **No. 264; info missing**
S07-02/S07-03	- No. 148; 68-09-96, layer 1; MNI=7 - No. 228; 68-09-76, layer 1; MNI=11 - **No. 356; 68-09-85, layer 1; MNI=45** - **No. 357; 68-09-76, layer 1; MNI=11**
S08-03	- No. 167; 59-74-16, layer 2; MNI=7 - **No. 214; 59-74-36, layer 1; MNI=8** - No. 223; 59-74-35, layer ?; MNI=5 - No. 231; 59-74-35, layer 1; MNI=5
S12-01	- No. 273; 46-56-22, layer 1; MNI=5 - **No. 291; 46-56-04, layer 1; MNI=1** - No. 326; 46-56-31, layer ?; MNI=8 - No. 328; 46-56-04, layer 1; MNI=8 - **No. 329; 46-56-13, layer 1; MNI=17** - **No. 362; 46-56-40, layer ?; MNI=???** - No. 365; 46-56-40, layer 1; MNI=9 - No. 374; 46-56-04, layer 1; MNI=24 - **No. 381; 46-56-04, layer 2; MNI=4** - **No. 384; 46-56-13, layer 2; MNI=1** - No. 414; 46-56-22, layer 1; MNI=6
C-215	- **No. 2; 36-68-45; MNI=13** - No. 4; 36-68-44; MNI=3
Additional finds analyzed	S01: - **No. 45; 59-80-95, layer 1; MNI=4** S05: - **No. 124; 58-09-27, layer 2; MNI=7** Unknown: - **No. ???; MNI=2**

4.3 *Towards a typology for food extraction techniques*

Admittedly, a true typology for food extraction techniques on *Aliger gigas* (or any other gastropod for that matter) has not yet been developed as of the writing of this thesis. Often, typo-morphological analysis is focused on the construction and utility of tools and ornaments, with food extraction techniques - coming as an earlier step in the *chaîne opératoire* - not receiving the same focus (this is, in part, due to the processes both ante- and post-deposition making inarguable conclusions about Indigenous food processing difficult, as well as ongoing debates arising from the difficulties distinguishing shells that are deposited as food waste, and shells that are deposited as tools). As such, I must establish a make-shift typology based on observations made in the research by Antczak (1999; Antczak & Antczak, 2005), Lammers-Keijsers (2007), Linville (Dijkhoff & Linville, 2004; Linville, 2005), and Serrand (1999; 2008; Serrand & Bonnissent, 2005, 2018). From these, a number of techniques of processing the animal could be determined:

Breaking/Breaching: The shell is broken open as a whole to get to the animal within, and either pull it out through the opening made, or 'push' it out through the aperture. This is done using a percussive tool, which could be a hammer made of stone, shell, or coral, or an anvil against which the shell is struck, leaving a large exterior breach with an ellipsoid shape, usually measuring between 30-90 millimetres across (see figure).

Perforating: The breaching of the shell using a bore tool, made of stone, shell, or coral (but also through the use of unmodified shell, see Antczak, 1999, p. 143). This is usually done in a specific spot on the shell to be able to cut into the muscle that connects the snail to its shell with a sharpened tool, to efficiently disconnect it and extract it. Usually, this leaves behind a semi-circular hole in the exterior of the shell (generally on or near the spire), measuring some 10-20 millimetres across. *Aliger* shells that would be used to create these perforations via a strike with the apex would also likely have traces of use-wear. Alternatively, modern, assumedly non-Indigenous techniques might produce a linear perforation in line with the usage of machetes, or other metallic cutting tools.

Figure 9 - Example of a 'break' or 'breach' from Spaanse Water

(Jasper Went)

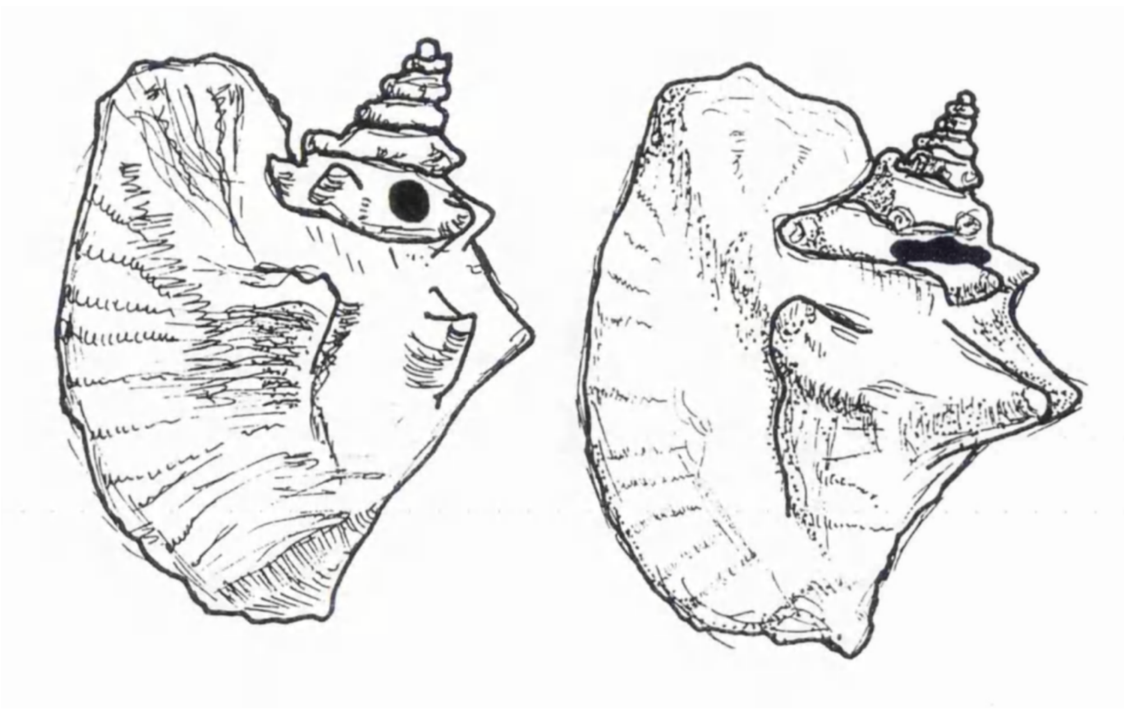

Figure 10 – Illustrations showing perforations in the shell's spire. Left: circular, 'indigenous'-style perforation. Right: Linear, 'modern'-style perforation.

(Antczak, 1999, p. 403)

Burning: The direct contact of shell with open fire, that then allows easy extraction of the meat. This is often done in combination with breaking or perforating. This usually leaves behind grey or black discoloration on the shell's exterior, covering large portions generally limited to one side (Hoogland *et al.*, 2015, p. 48; see also fig. 11).

Heating: The shell being heated for easy extraction of the meat. In this case, the shell does not come into direct contact with fire, and thus burn markings are minimal or absent entirely. Is generally only inferred or hypothesized (Antczak, 1999, p. 144).

Figure 11 - Four individuals from trench 4 of the excavation showing clear signs of burning (Hoogland et al., 2015, p. 49)

Drying: Leaving the shell out for extended periods of time after salting so that the meat starts to dry and decompose, allowing for easy removal. This leaves behind no markings. Alternatively, ethnographic evidence shows the technique of leaving specimens in saliñas to kill the animal, after which it is washed by leaving it in the intertidal zone. These techniques would have been preferable to Amerindians as it leaves a fully intact shell, for consequent processing into a variety of tools (Antczak, 1999, p. 144).

Removing: Antczak (1999, p. 143) mentions that occasionally, it is possible to remove certain older animals from their shell by simply pulling it out. This leaves behind no trace.

As three of these techniques (Heating, Drying, and Removing) leave little to no trace on the shell in archaeological context - at least not on macroscopic scale - these could only be hypothesized from unaltered shells and the context of their finding. In any case, a number of types of traces can be found on shells:

"Break" or "Breach" (BRK): A large (30-90mm), usually irregular breach on the exterior of the shell, indicative of the shell being broken open.

"Perforation" (PRF): A smaller (10-20mm), more circular breach on the exterior of the shell (usually on the spire), indicative of a perforating technique.

"Burn" (BRN): Clear black or grey discoloration on the surface of the shell, expected on the dorsal side, indicative of the shell being in (near-)direct contact with fire.

"No Trace" (NON): The absence of any processing marks left on the shell. Could be indicative of heating or drying.

"Removal" (REM): The striking off of any part of the shell (e.g., the outer lip, the apex, or the lower part of the body whorl/siphonal canal), for further modification most likely into tools or ornaments.

These would be the simple, though distinct types of traces to describe on a shell. The location of the trace would need to be described in anatomical terms, primarily 'posterior' or 'anterior,' and 'ventral' or 'distal.' The size of the trace would also be measured.

In addition to this, the length, weight, and estimated age (juvenile, adult, old) are also determined.

An important point to consider is that, occasionally, natural weathering could leave traces on the shell that might be strikingly similar to any number of the above-mentioned traces, especially if the found specimen was located at or near the surface of the deposition. For instance, trampling might leave traces similar to breaking, and bore sponges might leave similar (though distinct) traces to perforating. To account for this, the general state of the shell must also be examined. Heavy weathering signs include a porous outer shell (due to boring sponges, see Hoogland et al., 2015, p. 48), chemical discolorations (i.e., bleaching), as well as general disrepair of the shell, such as breaches or major parts of the shell being missing in their entirety (see also fig. 13). To err on the safe side, shells that are deemed far too heavily weathered to be able to be examined would be described as such (WTH), *in lieu* of a process trace type.

Finally, there is the aspect of dating the finds. It is assumed that the dating of any individual shell is equal to the 14C dating obtained from its originating feature, or at least trench.

Figure 12 - A shell from Spaanse Water showing heavy weathering, particularly by boring sponge activity (Jasper Went)

4.4 *Database set-up*

The observations for any given shell as described above are documented in a database assembled in MS Access (2016). The database fundamentally has three 'levels' of showing information: Feature-level, artifact-level, and trace-level. To put it simply, for each processing trace observed there is an artifact to which it belongs, which in turn belongs to a find.

Trace-level:

Each processing trace to be found on any shell receives its own entry. Each entry starts off with a unique identifier, made up of the project number (0040SWAT), followed by the find number (000-999), then followed by a sub-number (1-99) given to each artifact, and finally a letter (A-Z) indicating which trace on the artifact the entry refers to. So, as an example, the third trace found on artefact number 4 from find number 356 would have the identifier "0040SWAT356-4C." The sub-number from the artifact the trace is found on is also added in its own entry, to be able to add a relationship linking the traces to their respective artifacts in the artifact-level view.

Next, the trace type is added, consisting of a three-lettered abbreviation to be picked from a list ('BRK': Break, 'PRF': Perforation, 'BRN': Burn, 'NON': No traces observed, and 'WTH': Too weathered to determine trace type). Up next, the location of the trace is described, in two separate binary locus entries, being "Posterior" or "anterior," and "Ventral" or "Dorsal." The shape of the trace is determined (circular, ellipsoid, linear, or erratic), as well as its size (the longest diameter it has, in millimetres). Finally, notes are added for a more specific description of the trace, and pictures are attached in case they are present.

Artifact-level:

Each artifact is likewise given a unique identifier, similar to that given to the shell's traces, minus the letter at the end. Each artifact is also physically tagged with a card showing this identifier as it is kept separated from the rest of the find after examination.

The feature from which the artifact comes also has its own entry, in order to add a relationship linking each artifact to their respective find in the find-level view. Following this, the length (in millimetres) and estimated age (juvenile, adult, or old), is noted. The completeness and state of weathering the shell is in is also described, via a numerical rating between 1 (being mostly complete/barely weathered) and 3 (missing the majority of the shell/being weathered to the point of falling apart). In case the shell is missing a certain part or parts, this is also given in its own entry (being "spire," "body whorl," "(siphonal) canal," and/or "outer lip"). Finally, notes more elaborately describing the shell are added likewise to its traces, and photos are attached in case they are present.

Find-level:

Finally, there is the find-level view, showing which find each artifact was retrieved from. The feature from which the find originates, as well as the dating of the feature (or rather the trench in which the feature can be found) is added in its own textual entry, including the absolute dating range as well as the period this corresponds to (Archaic or Ceramic). Next, some notes are added to each feature should they be needed.

The results of my research – summarized in the next chapter – are documented and saved as such in the database, to be kept by NAAM. The database could also feasibly be used as a template for future research in archaeomalacology or zooarchaeology. For now, though, its use is limited to this thesis.

5. Results

The following is a short summary of the results, based on the information compiled in the database.

5.1 *Characteristics of the sample set*

The majority of the sample set appears to be made up of shells belonging to adult individuals (see table 3). This is likely the result of biases in selection. A full inventory of the morphological age of the *Aliger* shells found at Spaanse Water, however, means that this could not be decisively concluded.

Table 3 - Sample characteristics divided by age

Estimated shell age	# of individuals	Average Length
Juvenile	43	10,0 cm
Adult	115	19,6 cm
Old	10	19,3 cm
All	168	17,2 cm

Most of the individuals were missing one or more parts whole of the shell (see table 4). While most of these appear to be the result of deliberate removal (see 3.3), a number of these could also be the result of post-depositional processes. That said, most individuals were in a good, largely unweathered state, undoubtedly the result of selection bias. For shells that show little to no signs of weathering, the likelihood is exceptionally small that any removed parts are the result of non-anthropogenic processes, considering the strength of the shell. The overwhelming majority of specimens (156 total) are from trenches dated to the Ceramic period (c. 501 BCE – 565 CE), with 12 individuals originating from trenches dated to the Archaic period (before 2500 BCE).

Table 4 - Number of individuals per state of completeness and weathering

Completeness	**# of individuals**	**Weathered state**	**# of individuals**
Complete	38	Good	118
Missing parts	78	Somewhat Weathered	36
Missing majority	52	Heavily Weathered	14

5.2 *Food extraction traces observed*

Only a relatively small number of specimens observed appear to have clear indications of being broken open (36 individuals). Most often, the breaks are singular breaches in the surface of the shell, although occasionally these also appear to come in pairs (6 individuals). The breaches generally have an ellipsoid shape, although their size varies heavily, between 15 and 115 millimetres, averaging at about 50 millimetres. The breaches overwhelmingly are located on the posterior side of the shell (38 counts), although not exclusively (4 counts on anterior side). The breaches appear to be somewhat evenly split between the dorsal and ventral sides, slightly veering towards the ventral side (Dorsal: 18 counts, Ventral: 24 counts). The variability in the shape and size of breaches indicate a variety of tools and techniques likely being used. However, as distinctive hammer-like tool artifacts made of stone, shell, coral, or other material were not retrieved from the Spaanse Water excavation (Hoogland et al., 2015, p. 42 & p. 56), any conclusions made about the tools used are entirely hypothetical. Logic follows that larger breaches could only have been made with larger tools and/or with greater force, and that the opposite is true for smaller breaches. Likewise, it is very possible that other *Aliger* shells were used to break open other shells (Antczak, 1999, p. 142), although no clear signs of any of the shells in the sample set being used as such were found.

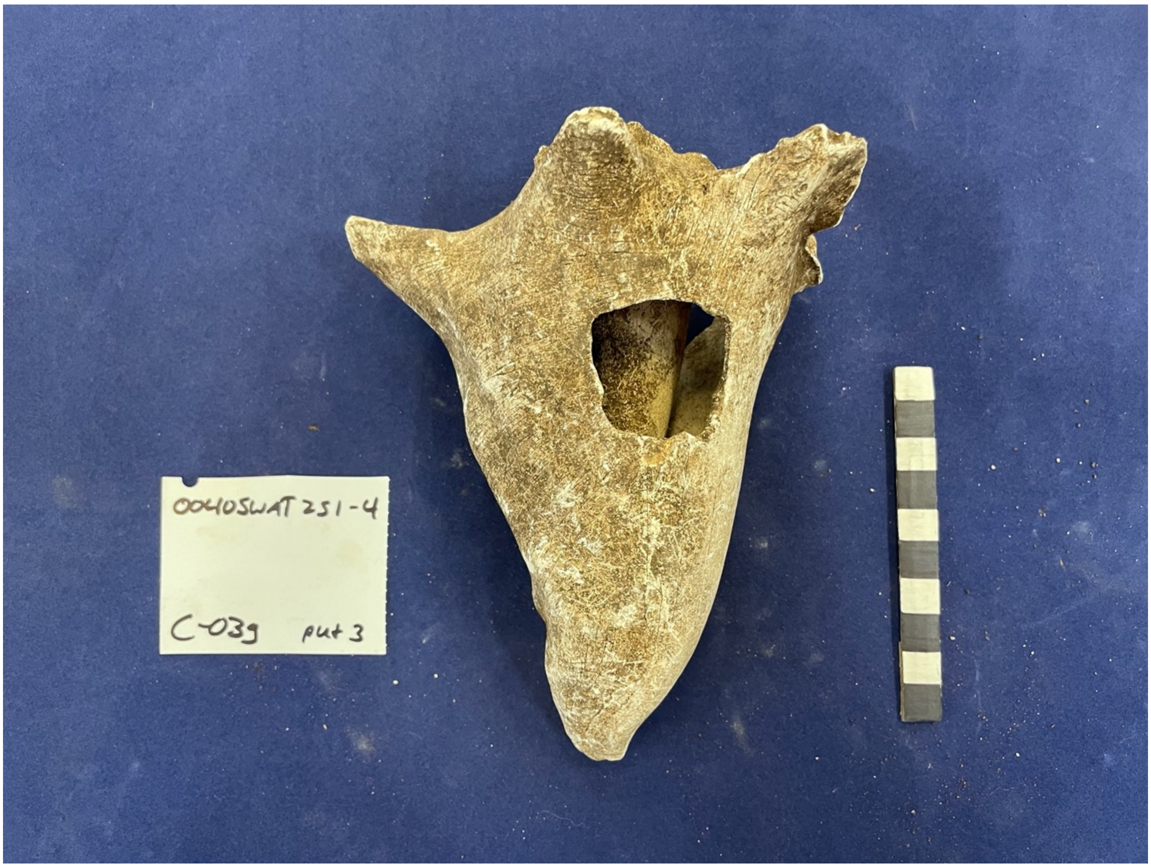

Figure 13 - Juvenile shell showing a square-like breach on the dorsal side of the body whorl (Jasper Went)

Perforations, of the kind observed by Antczak (1999) are rarer still, only being present on 9 individuals. One individual shows a pair of perforations (also described by Antczak, 1999). The perforations varied between 5 and 15 millimetres. Overall, these perforations were placed on or near the spire, with only one appearing on the body whorl. Generally, they were on the dorsal side of the shell, with only 2 of them being present on the ventral side. The tools that could have been used to make these marks, be it lithic, shell, coral, or otherwise, were likewise not recovered in the excavation. A small number of shells had both a break and a perforation (5 individuals), which would possibly indicate the scenario as sketched in the experiments by Antczak (1999, p. 143), where certain sub-adult individuals retreat into the shell after the muscle is successfully cut through the perforation, to the point where the body whorl requires breaching to be able to pull the animal out of its shell.

Unfortunately, the sample set did not contain individuals with clear signs of burning. These are however present in the shell assemblage of the Spaanse Water site, as shown in the report (Hoogland et al., 2015, p. 49, see also fig. 12), also showing large breaches on the ventral side of the shell.

The overwhelming majority of individuals appear to have no clear traces of food extraction, which would highly likely point to techniques other than breaking, perforating, or burning in direct contact with fire being used, such as drying, heating, or simply removing the animal. However, with no method of discerning these techniques these can only be hypothesized. While there is a possibility that some number of individuals that show no signs may have simply been discarded prior to food extraction or other processing of the shell, this would be highly unlikely. After all, there is no discernible reason the Amerindians would go through the effort to kill the animal, only to discard both it as well as its shell.

Spatially, as well as temporally, no clear correlation emerges between the techniques used and the period or location of the find. This comes as no surprise, as the sample size is simply too small to expect a correlation of any kind to form. However, the concentration of significantly weathered individuals in trench 12 is interesting and might be related to the location of the trench being somewhat removed from the others (see figure 5).

Table 5 - Number of individuals found with which traces, divided by trench – BRK = Break, PRF = Perforation, REM = Removal of one or more parts of the shell, NON = No clear signs, WTH = Too weathered to observe other traces

Trench	Dating	#BRK	#PRF	#REM	#NON	#WTH	#Individuals
1	Archaic	-	1	6	-	-	6
2	Ceramic	10	1	28	10	8	50
3	Ceramic	6	2	14	-	1	21
5	Unknown	-	-	3	-	-	3
7	Ceramic	7	1	31	1	3	35
8	Ceramic	1	-	4	-	-	4
12	Ceramic	8	3	19	4	26	38
C-215	Archaic	-	-	6	-	-	6
Unknown	Unknown	4	2	1	-	-	5
Totals		36	10	112	15	38	168

5.3 *Other traces observed*

The overwhelming majority of specimens observed had indications towards the removal of parts of the shell. For instance, numerous adult shells have had the outer lip removed (see fig.). Elsewhere, it is shown that (part of) the outer lip is often removed from *Aliger* shells to fashion into celts or adzes (Dijkhoff & Linville, 2004, p. 74; Lammers-Keijsers, 2007, p. 83; Serrand, 2008, p. 23 – though it is important to note that the excavation report does not mention a presence of distinct celts on the site, nor are any of the individuals in my sample set indicative of a celt, 'pre-form' or otherwise) or to instead use the resulting lipless shell as other tools (e.g., a '*strombus pick*' or 'sturdy perforator', Dijkhoff & Linville, 2004, p. 68 & 70). In other individuals, the anterior part of the shell (i.e., the siphonal canal and part of the body whorl/columella) is removed, likely to fashion into a "*strombus point*" (Dijkhoff & Linville, 2004, p. 89; see figs. 16 and 17).

However, the individuals analysed do not show clear use-wear signs on the macro-scale. Unless techniques were developed to be able to see micro-wear traces on shell in spite of the chemical weathering common in Caribbean contexts, the tool-usage of unaltered shells can only be hypothesized through experimental archaeology, or perhaps observed through ethnoarchaeology.

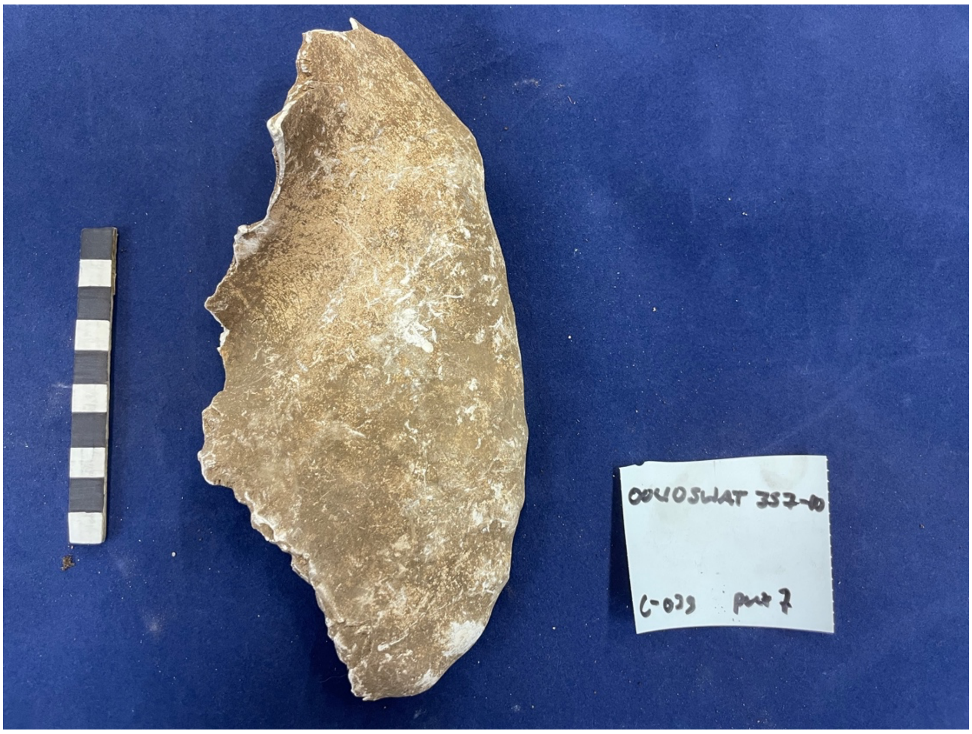

Figure 14 - Example of a removed lip

(Jasper Went)

Figure 15 - Example of a removed columella

(Jasper Went)

Figure 16 - Example of a juvenile shell with a broken-off canal

(Jasper Went)

6. Discussion

In the context of Curaçao, the results shine light on the Amerindians that inhabited the area of Spaanse Water. Moreover, it forms an important step towards understanding food processing of molluscs, something which has as yet only been touched upon in passing in archaeological research on the island.

In the context of prior research in the Caribbean, as well as archaeomalacology, my results are at the very least a small step into the largely unexplored yet integral part of Indigenous culture comprising food extraction in the context of material processing. Until present, research into the processing of *Aliger* shell in the Caribbean has overwhelmingly focused on the analysis of secondary processing (i.e., the manufacture of tools and ornaments) above primary processing, with some exception (e.g., Antczak, 1999).

Perhaps the usefulness of this thesis does not come with the answers it can or cannot give, but instead in the questions it raises. The variation in techniques observed even in such a small sample of the total assemblage is peculiar, and raises the question of *how*: how did Ceramic exploiters of *Aliger gigas* gain knowledge of these techniques to extract the animal for consumption (or otherwise)? Are these the result of tradition, being passed down through the generations? What would have influenced these traditions? The most obvious answer to this would be the Los Roques archipelago with its colossal fisheries with a particular focus on *Aliger gigas* (Antczak, 1999; Antczak & Antczak, 2005), or perhaps elsewhere along the northern coast of South America (Oliver, 1989). After all, a high degree of cultural connectivity between the ABC-islands and coastal Venezuela in the Ceramic Age seemed to be present (Haviser 1987, 1991, 2001; Hoogland et al., 2015, p. 81; Oliver, 1989). This connectivity would no doubt have brought with it the exchange of peoples, or ideas, that would have brought the techniques from the mainland to the islands – or, though more unlikely, from the islands to the mainland.

Likewise, how would these traditions change over time, and why? While the results are too limited to make conclusions about differences in shell processing between the Archaic and Ceramic ages, the possibility of this transition also having influence on the food processing techniques being used is quite interesting. Were this the case, it would then be likely that the transition from the techniques of the Archaic and those of the Ceramic likely were not simply supplanted, but instead changed over a longer period of time through complex processes of cultural and demographic exchange (see also Antczak & Hofman, 2019).

The *chaîne opératoire* of *Aliger gigas* shells taken holistically (i.e., giving equal grounds to primary *and* secondary processing) is also one that deserves more attention, as it could likewise pose valuable questions. For instance, how far ahead were Amerindian exploiters of *Aliger gigas* planning, and how would this have manifested in the selection of techniques used? It may seem obvious, were the Amerindians planning to fashion the shells into tools or ornaments after the animal was extracted, that techniques leaving no damage on the shell would be preferred. And yet, the opposite could also be true: perhaps tool- or ornament-manufacturers simply stumbled upon shells useful for their goals in the piles of food waste that formed, and as such this would have no impact on the selection of food extraction techniques.

While it would be easy to assume a perspective of pure utility, and presume the techniques chosen are the result of agents simply choosing the path of least effort (and the techniques spread as such because of their superiority in terms of efficiency), this would be, in my eyes, a hasty conclusion. After all, the construction of elaborate ornaments taking place on some of the exact same shell specimens point to the opposite being true. Moreover, it seems that 'path of least resistance' models are far more frequently disproven through archaeological research than they are vindicated, in a variety of contexts.

Is it not useful to view these specimens just as much as objects of cultural significance beyond just being the by-products of food processing? While a symbolic meaning behind the techniques of breaking the shell open might be far-fetched (though not impossible), at the very least the significance of tradition manifesting itself in those techniques would, in my eyes, make these objects of food waste just as culturally significant as the tools or ornaments made thereof. In turn, the traditions that could be observed might be just as useful in analysing connections of the Caribbean region as the ceramic-focused 'modal approach' developed by Irving Rouse (as touched upon in chapter 1 - Background), though perhaps this is wishful thinking. That said, lining up the ceramic-focused typology of Rouse with a hypothetical typology of shell processing techniques, both primary and secondary, would almost certainly have interesting results.

In the end, there are certainly more questions waiting to be asked, and more waiting to be answered through functional/morphological analysis of shell remains, even beyond *Aliger gigas*. And perhaps, with further development of material analysis techniques both on macro- and micro-scales, the techniques we use today for morphological analysis might turn into just as much of a mystery for us in the future as the techniques for extracting *Aliger gigas* from its shell seems to us now. Humour notwithstanding, the ever-important and ever-magnificent Queen Conch shall not run out of its usefulness in archaeological research any time soon.

7. Conclusions

Evidently, the sample set of *Aliger gigas* remains from Spaanse Water appears to show a clear inclination towards food extraction techniques that leave no trace on the shell. These techniques could be drying, heating, or simply pulling the animal out of its shell. This is followed by the technique of breaching the shell and removing the animal via said breach. Finally, the technique of perforating a specific area in the spire and cutting the muscle that attaches the animal to its shell before removing it is only present in a relatively small number of individuals. While other *Aliger* shells could have been used as tools in these processes, the lack of shells with clear signs towards this, as well as the lack of shell tools to be noted from the excavation, this cannot be decisively concluded. That said, this absence of shell tools could also be explained by the purpose of the site being 'intensive resource extraction' as indicated by Haviser (1987).

Admittedly, the limited scope of the sample prohibits any quantitative conclusions of significance being made about the sample set. The selection biases present makes the sample inherently unrepresentative of the site's shell assemblage as a whole. Likewise, the limited scope granted by the typology I invented for the site, as well as my own inexperience in analysing shell remains, in turn limits the answers that this study can grant.

If nothing else, the first steps towards forming a typology of extraction techniques from *Aliger gigas* shells are at the very least a step in the right direction for archaeological research. Moreover, the establishing of a database focused on specialistic research such as this for NAAM will undoubtedly prove useful as a template for future research.

7.1 *Future Research*

The most obvious avenue of research to build off of my thesis would be to continue the survey and examination of *Aliger gigas* shells from the Spaanse Water site, and expand the typology used to be more encompassing while also being more rigid and useful. With enough time (and manpower), a study matching that of Antczak's (1999) on the Los Roques archipelago could be completed. Of course, similar studies could then also be conducted focusing on *Aliger gigas* at other sites on Curaçao as well as Aruba and Bonaire.

Next, studies with a similar focus on other mollusc species, such as *Melongena melongena* or *Cittarium pica* – both likewise being ubiquitously present in the shell assemblages of prehistoric archaeological sites in the Caribbean – would also likely provide useful results in reconstructing the maritime-oriented economies of the pre-Columbian Caribbean.

Perhaps, with a full inventory of shell remains as well as the techniques used on them to extract the animals for consumption from a plurality of marine-oriented sites in the Caribbean would reveal patterns of connectivity as shown through the spread of shell processing traditions.

Abstract

Molluscan shell remains are among the most widespread materials to be found at pre-Columbian archaeological sites in the Caribbean. Particularly that of the Queen Conch (*Aliger gigas*, previously known as *Strombus gigas* or *Lobatus gigas*), which became a significant resource for Amerindians throughout the region during the Archaic and formed a central part of many coastal Caribbean economies during the Ceramic. Not only as a source of food, providing plenty of meat, but also for its shell which provided as a handy source material for tools and ornaments.

The extraction of meat from the shell of *Aliger gigas* comes in a variety of techniques, from breaking open the shell, to perforating a part of the shell's spire to cut the animal loose, to burning the shell, but also to simply let the animal out to dry or decompose. The prevalence of some of these techniques over others is an interesting topic in archaeomalacology that is often overshadowed by tool and ornament manufacture. Perhaps most relevant is the research done by Antczak in the Los Roques archipelago, Venezuela.

The ABC-islands, and particularly Curaçao, were particularly reliant on Queen Conch, as a food source as well as a source material for tools. In this thesis, the author examines a sample of *Aliger gigas* individuals taken from the excavations performed by Leiden University at Spaanse Water, Curaçao, to try and understand which food extraction techniques are still visible in the shell assemblage. Shells are analysed on macro-scale, and visible traces of alteration are recorded using a make-shift typology based on prior research and stored in a database.

Results show a clear inclination towards food extraction that leave no mark on the shell (i.e., drying, heating, or decomposing), followed by other techniques such as breaking and perforating. Quantitative conclusions are hard to make, as the sample set is a rather small part of the total *Aliger gigas* assemblage of Spaanse Water. In any case, the high level of variability in extraction techniques raises questions that might require future research to look at food extraction as a cultural process, not unlike tool and ornament manufacture.

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