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CHAPTER 1

1

Setting the Scene

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1.1 Introduction

Intangible dimensions of foodways such as culinary practices leave lasting impressions on memories and help form elements of group identities. Through starch recovery and analysis, archaeologists can reconstruct some of these culinary practices and view a picture of them through a window of time. There is a great view when you stand on the shoulders of giants. This dissertation was partially designed to enrich our understanding of Indigenous Caribbean Peoples' starchy food histories. This endeavor serves to add to what was known conceptually and methodologically from previous microbotanical analyses (Barton and Torrence 2015; Berman and Pearsall 2008; Pagán-Jiménez 2007a; Perry 2005; Piperno 2009). 1

Analysing cultural material remains that came from contexts prior to the advent of European invasions in the Greater Caribbean was ideal because one of several research objectives of the ERC- synergy NEXUS1492 project[1] has been to determine the "immediate and lasting effects of the colonial encounters on Indigenous Caribbean cultures and societies and what were the intercultural dynamics that took place during the colonisation processes" (Hofman et al. 2012). Reconstructions of late precolonial (800-1500 CE) Caribbean foodways have been pushed beyond relying on ethnohistorical texts and ethnographic analogies, to include direct evidence from isotopic dietary analyses, microbotanical remains, and zooarchaeological studies (Giovas et al. 2012; Laffoon et al. 2016; Mickleburgh et al. 2019; Pagán-Jiménez and Oliver 2008; Pestle and Laffoon 2018). Stable isotope evidence (from human remains) have reflected individual diets and large-scale changes of dietary regimens, although this innovative approach cannot provide evidence for similarities or variations in the selection of specific botanical food items and entangled culinary practices (Laffoon et al. 2016). It has been demonstrated that when utilizing starch recovery and analysis there is the possibility to accurately make taxonomic identifications of plant remains and infer the culinary practices which modified plants (Beck and Torrence 2006; Pagán-Jiménez et al. 2015; Pearsall et al. 2004; Perry 2005; Piperno 2006a).

Microbotanical research on samples of artifacts from the insular Caribbean region has exposed a diversity of plants prepared on griddles (food preparation platters) during the Late Ceramic

[1] The NEXUS1492 project was funded by the European Research Council under the European Union's Seventh Framework Programme (FP7/2007–2013)/ERC-NEXUS1492 grant agreement n° 319209. The project was led by Profs. Corinne Hofman, Gareth Davies, and Ulrik Brandes from Leiden University, Free University of Amsterdam, and University of Konstanz.

Age (800-1500 CE), which included maize (*Zea mays* L.), sweet potato (*Ipomoea batatas* L.), beans (*Phaseolus* spp.), and coontie/guáyiga (*Zamia* spp.), among others (see Table 1.1). From a microbotanical viewpoint in the northern Caribbean[2], the understanding of botanical foodways is rather enigmatic, with notable exceptions from Cuba (Chinique de Armas et al. 2015; González Herrera 2016; Mickleburgh and Pagán-Jiménez 2012; Rodríguez Suárez and Pagán-Jiménez 2008) the central Bahamas (Berman and Pearsall 2000; Berman and Pearsall 2008), and Dominican Republic (Pagán-Jiménez in Ulloa Hung 2014 115, 138). In contrast, archaeobotanical studies of foodways in central Nicaragua have been absent. Thus, a focus of this dissertation is on ascertaining culinary practices in the Greater Caribbean from areas with few or no previous microbotanical studies. The Greater Caribbean (pan-Caribbean) region has been envisioned geographically as the seascape and continental areas proximally surrounding and including the insular Caribbean islands, and culturally speaking this includes the Bahama archipelago and the Central Americas, or at least the coastal regions of the surrounding continents (Berman 2011a; Hofman et al. 2010; Rodríguez Ramos 2010; Rodríguez Ramos 2011).

[2] For the purpose of this dissertation, the definition of the northern Caribbean was areas of the insular Caribbean and Bahama archipelago north of the 19th parallel north latitude because this includes four of the case study sites and excludes areas that have previously been critically investigated by starch analyses (see Pagán-Jiménez, et al., 2005; Pagán-Jiménez, 2007; Pagán-Jiménez and Oliver, 2008; Pagán-Jiménez, 2008).

Table 1.1
Clay griddles analyzed for starch content and their identified taxa from insular Caribbean archaeological contexts.

Location	No. Griddles analyzed	Identified Taxa	Reference
Cuba	5	*Zamia pumila* L., *Phaseolus vulgaris* L., Fabaceae, *Zea mays* L., *Ipomoea batatas* L., *Maranta arundinacea* L., cf. *Xanthosoma* sp.	(Rodríguez Suárez and Pagán-Jiménez 2008)
Puerto Rico	1	*Canna indica* L.	(Pagán-Jiménez 2007b)
Puerto Rico	1	*Zamia amblyphyllidia* D.W.Stev, cf. *Zea mays* L., Fabaceae, *Ipomoea batatas* L.	(Pagán-Jiménez 2008)
Puerto Rico	3	cf. *Zamia* sp., *Xanthosoma sagittifolium* L. Schott., cf. *Phaseolus vulgaris* L., *Zamia pumila* L., *Maranta* cf. *arundinacea* L., *Zea mays* L., cf. *Bixa orellana* L., Fabaceae	(Pagán-Jiménez 2011a)
Puerto Rico	1	*Zamia pumila* L., cf. *Zamia pumila* L., cf. *Phaseolus vulgaris* L., *Zea mays* L., Fabaceae	(Pagán-Jiménez 2011b)
Dominican Republic	6	*Ipomoea batatas* L., cf. *Ipomoea batatas* L., *Zamia* sp., cf. *Zamia* sp., *Zea mays* L., cf. *Zea mays* L., Fabaceae	(Pagán-Jiménez in Ulloa Hung 2014:115,138)

To assess microbotanical remains and interpret culinary practices there is a focus on three types of artifacts—bivalve shells, clay griddles, and microliths. Traditionally, archaeologists working in the Caribbean have associated clay griddle and microlith artifacts with manioc processing (Berman and Pearsall 2008; DeBoer 1975; Dufour 1985; Hofman and Hoogland 2015a; Keegan 1992:18; Keegan 1997:59; Keegan and Hofman 2017:222; Loven 1935:359; Perry 2002b; Perry 2004; Perry 2005; Rouse 1992:12; Sauer 1966:241). Based on early European written sources and the abundance of these types of artifacts it was assumed that manioc was a dietary staple for precolonial Indigenous Caribbean Peoples (Allaire 1999; Castillo 1906; Fernández de Oviedo 1851 [1535]; Fernández de Oviedo 1959 [1526]; Keegan and Carlson 2008:4; Las Casas 1909; Newsom and Wing 2004:3; Rouse 1992:12; Sauer 1966; Sauer 1981; Sturtevant 1961; Sturtevant 1969; Wilson 2007). Extrapolations of the chronicles applied to the archaeological record from centuries before are problematic due to the magnitude of devastation and thus cultural changes (i.e. which plants were cultivated, managed, and processed) due to European invasions, systematic colonization, and enslavements (Cortés 1908 [1519]; Curet 2006; Deagan 2004; Denevan 1992; Figueredo 2015; Jennings 1975; Keegan 1996; Montenegro and Stephens 2006; Pagán-Jiménez 2009; Wilson 1993). Paleoethnobotany is a key route to reconstructing the archaeobotanical record without relying on European written sources.

1.2 What is paleoethnobotany?

Paleoethnobotany known otherwise as archaeobotany, in the first half of the 19th century, archaeobotany began by investigating exceptionally preserved macrobotanical remains from arid and waterlogged contexts (Heer 1866; Kunth 1826). Archaeological microbotanical analyses began in the 20th century with remains recovered from uniquely well-preserved contexts (Netolitzky 1900; Schellenberg 1908). This early research cast doubts on the applications of paleoethnobotany in tropical regions, which are notorious for limited organic preservation (Dickau 2010; Pearsall 2003). Yet, during the 1970s questions regarding agricultural origins and developments drove microbotanical analyses into the spotlight (Rovner 1971).

Dolores Piperno (1998) provided novel evidence of plant utilization from Neotropical residue studies on the origins of agriculture using a combination of evidence from multiple microremains (pollen, phytoliths, and starch grains). Residue studies have sought to investigate a variety of research topics such as early dispersals of domesticated plants (Nieuwenhuis 2008; Pagán-Jiménez 2011c; Pagán-Jiménez et al. 2015; Perry et al. 2007b; Piperno et al. 2009), variability of Neandertal subsistence activities (Henry et al. 2011), and reconstructions of hunting technology (Barton et al. 2009). Promising research has also been generated from directly dating recovered botanical residues (Zarrillo et al. 2008) and by assessing extensive cultural change and stability (Fullagar and Field 1997). However, the integration of cutting-edge analytical techniques to provide new lines of evidence to old research questions, such as the domestication origins of key agroeconomic crops using multiple proxies from trace-elements, starch, and aDNA, have provided richer understandings of ancient human-plant interactions on a scale and eminence previously inconceivable (Zarrillo et al. 2018).

Starch grain morphology was first investigated more than one hundred years ago and continuously helps to classify and identify plant taxa (Meyer 1895; Nägeli and Nägeli 1858; Reichert 1913). Compared to other plant microfossils, such as phytoliths or pollen, the analysis of starch for archeological purposes is relatively new. The initial works of Ugent et al. (1982) and Loy et al. (1992) initiated a surge of interest in ancient starch research. More recently, ancient starch analyses have been applied to studies of stone tool functions, which has helped to track the emergence of plant domestication, ranges of human mobility, evolution of human diets, land use patterns, and vegetation histories (e.g. Field et al. 2009; Fullagar et al. 2006; Henry et al. 2011; Herzog 2014; Liu et al. 2010; Piperno and Holst 1998; Therin et al. 1999). Over the last 20 years, ancient starch analyses have helped to better understand technological developments and human behaviors in many areas of the world (Barton and Torrence 2015). There are still a diversity of methodological approaches to recovery, analysis, and identification of starch and to interpreting culinary modifications of plants (Atchison and Fullagar 1998; Barton and Torrence 2015; Barton et al. 1998; Lentfer and Boyd 2000; Liu et al. 2014; Pearsall et al. 2004; Piperno 2006b; Torrence and Barton 2006; Torrence et al. 2004). However, comprehensive descriptions of starch grain characteristics is still the core of most analyses, which include starch size, shape, angularity, facets, and surface features (Loy et al. 1992; Mercader et al. 2018a; Pagán-Jiménez 2015).

1.3 A brief synopsis of Greater Caribbean archaeobotanical investigations

It is out of the scope of this dissertation to provide a systematic report of the entire Greater Caribbean region's archaeobotanical investigations. Instead, several significant and relevant studies are summarized. It has been established there was long-term use and consumption of manioc in continental Neotropical areas (Piperno 2006a; Piperno and Pearsall 1998; Sheets et al. 2012). However, in the insular Caribbean, the recovered microbotanical remains of manioc have been limited or practically nonexistent (Berman and Pearsall 2008; Mickleburgh and Pagán-Jiménez 2012; Pagán-Jiménez 2007a:127; Pagán-Jiménez 2009; Pagán-Jiménez 2011a; Pagán-Jiménez 2016). Thus, current archaeobotanical data is still inadequate to reconstruct insular Caribbean contexts surrounding the dispersal and use of manioc.

Earlier in Caribbean archaeological research, isolated finds of zamia plant remains from a domestic cave in the Dominican Republic contributed to reports of macroremains (Veloz Maggiolo and Vega 1982). Although, considering the plant presently grows in front of the same cave, the interpretations and validity of these ancient remains are dubious. However, pollen recovery and analysis identified the presence of zamia and several other economically important plants including tobacco (*Nicotiana* sp.) and maize at the Sanate site in eastern Dominican Republic (Fortuna 1978). Zamia pollen was also identified at the site of Rio Jobá in northern Dominican Republic (Fortuna in Veloz Maggiolo et al. 1981). Notably this was important because currently zamia is unknown in northern Dominican Republic, thus this is more evidence that it is problematic to extend modern environmental records into the past.

Deborah Pearsall's (1983; 1985) research of macroremains initiated full-fledged systematic paleoethnobotanical analyses in the Caribbean. Subsequently, Lee Newsom (1988; 1991; 1992; 1993) began to identify archaeological macro plant remains from Haiti, followed by Puerto Rico, Bonaire, and the Lesser Antilles. Macrobotanical research in the Greater Caribbean region provided useful information, particularly about arboriculture, but did not recover empirical evidence for many of the presumed key agroeconomic plants (Dickau 1999; Newsom 1988; Newsom 1991; Newsom 1992; Newsom and Wing 2004; Piperno and Pearsall 1998). During this time, Deborah Pearsall (1989) expanded her research area into The Bahamas combining macroremains and phytolith analyses.

More recently, other plant microfossils have been studied in the Greater Caribbean. Typically, pollen does not preserve well in arid regions and buried archaeological deposits of humid tropical areas, but waterlogged deposits can hold substantial paleoecological information (Burney et al. 1994; Castilla-Beltrán et al. 2018; Higuera-Gundy et al. 1999; Hodell et al. 1991; Jones 1997; Lane et al. 2014; Pagán-Jiménez 2016; Siegel et al. 2015). Pollen from sediments recovered from two archaeological sites El Curro and Puerto Alejandro in the Dominican Republic provided early evidence of maize approximately dating to 3450 BP (Fortuna in Sanoja 1989).

From more recent archaeological contexts (1000-1500 CE), Linda Perry (2004), analyzed traditionally associated manioc related tools—ground stone tools and flaked microlith artifacts for starch content from the Los Mangos del Parguaza site in Venezuela. She did not recover manioc remains, but did recover evidence of other geophytes—arrowroot (*Maranta* sp.) and ginger (Zingiberaceae) from some of these tools and maize was recovered from every sampled artifact from her study. This study illustrates some of the consequences of generating inferences regarding plant use from artifact form alone.

Not only maize, but also manioc, sweet potato, achira (*Canna indica* L.), chili pepper (*Capsicum* sp.), beans, and guáyiga starch remains have been recovered from pre-Saladoid ('Archaic Age') contexts in the Caribbean (Chinique de Armas et al. 2015; Pagán-Jiménez 2007a; Pagán-Jiménez 2009; Pagán-Jiménez 2011c; Pagán-Jiménez et al. 2005; Pagán-Jiménez et al. 2015). Evidence of early plant use in the Caribbean has been highlighted in much of Dr. Jaime Pagán-Jiménez's research (Pagán-Jiménez 2011c; Pagán-Jiménez 2012; Pagán-Jiménez et al. 2005; Pagán-Jiménez et al. 2019; Pagán-Jiménez et al. 2015). Contexts with Ostinoid (600-1550 CE) material remains have revealed the use of the some of the same plants previously listed in adition to leren (*Calathea allouia* (Aubl.) Lindl.), arrowroot (Marantaceae), palms (Arecaceae), and yams (Dioscoreaceae) (Pagán-Jiménez 2009). The later three plant families of which remains have been recovered across all periods investigated by Dr. Pagán-Jiménez (Pagán-Jiménez 2007a; Pagán-Jiménez 2009; Pagán-Jiménez 2011c; Pagán-Jiménez and Oliver 2008; Pagán-Jiménez et al. 2005; Pagán-Jiménez et al. 2015). Analysis of starch recovered from dental calculus from both pre-Saladoid and Ceramic Age contexts allowed Mickleburgh and Pagán-Jiménez (2012) to demonstrate a prevalence of maize remains, which was interpreted as consistent and unrestricted use of maize as well as a diversity of root crops used by Indigenous insular Caribbean Peoples.

Starch analyses to investigate botanical culinary practices will not provide indications of staple dietary plants, but they can help us interpret "cultural" staple plants (i.e. which plants were favored, targeted, or used ubiquitously). There were a few starch analyses carried out in the central Bahamas, Cuba, and Dominican Republic, these analyses suggested that starchy plants were brought to the central Bahamas as part of a phytocultural complex (Berman and Pearsall 2008), that "fisher-gatherers" in precolonial Cuba actively managed exotic plants (Chinique de Armas et al. 2015), and that precolonial Indigenous Peoples of Dominican Republic transformed starchy plants into pastes then cooked them in clay vessels (Pagán-Jiménez in Ulloa Hung 2014) (Table 1.2).

Table 1.2
Previous starch analyses in the northern Caribbean.

Sites and artifact types	**Plant types identified**										**Reference**
Three dog, The Bahamas, chert microliths		maize	cf. manioc			chili		cf. cocoyam			(Berman and Pearsall 2000; Berman and Pearsall 2008; Perry et al. 2007b)
Macambo 2, Cuba, clay griddles	zamia	maize		sweet potato	bean			cf. cocoyam			(Rodríguez Suárez and Pagán-Jiménez 2008)
Canímar Abajo, Cuba, dental calculus	zamia	cf. maize		cf. sweet potato	bean		cf. arrowroot				(Chinique de Armas et al. 2015)
El Popi, Dominican Republic, clay griddles and *ollas*		maize		sweet potato	bean						(Pagán-Jiménez in Ulloa Hung 2014)
Edilio Cruz, Dominican Republic, clay griddles, bowl, and millstones	zamia	cf. maize	manioc	sweet potato	bean	chili	arrowroot		cannaceae	cf. hypoxis	(Pagán-Jiménez in Ulloa Hung 2014)

Equally essential to his empirical evidence are Dr. Jaime Pagán-Jiménez's contributions towards archaeological practice and anti-colonial conceptual frameworks (Pagán-Jiménez 2003; Pagán-Jiménez 2004; Pagán-Jiménez and Rodríguez Ramos 2008). His most resonant written contributions towards this dissertation were his early insights regarding precolonial human-plant interactions (Pagán-Jiménez 2007a; Pagán-Jiménez et al. 2005). His main contentions to the archaeological establishment allowed him to indicate: 1) human population movements were coupled with plant dispersals in the Antilles and continued with long-distance exchange networks of phytocultural practices; 2) early use of processed and cooked plants predated Ceramic Age Sites (i.e. plants were transformed into meals prior to the use of clay vessels); 3) clay griddles were multipurpose and not indicators of manioc cultivation; 4) wild plants were systematically and consistently used; 5) maize was introduced earlier than believed and had unrestricted access and use (Pagán-Jiménez 2007a; Pagán-Jiménez 2008; Pagán-Jiménez 2013; Pagán-Jiménez et al. 2019; Pagán-Jiménez et al. 2015; Rodríguez Suárez and Pagán-Jiménez 2008). This list of insights is continuously evolving.

Dr. Mary Jane Berman and Dr. Deborah Pearsall have also been largely influential for this dissertation. Their early work together has provided evidence for the use of domesticated geophytes in The Bahamas as well interpretations of maize agriculture on San Salvador (Berman and Pearsall 2000). In addition, their questions and answers about transported landscapes to The Bahamas have provided avenues for more questions extending these investigations (Berman and Pearsall 2000; Berman and Pearsall 2008). Dr. Berman's consistent call for systematic use of botanical analyses was a pleasure to read and inspirational (Berman 2011b; Berman et al. 2013; Berman et al. 1999).

Peter Siegel et al. (2015) has also encouraged the systematic use of paleoenvironmental analyses. Their dynamic and robust investigations across nine islands of the southern Caribbean effectively added another demonstration of how microbotanical data can be used to provide information regarding human mobility and early transported landscapes (Siegel et al. 2015). However, from their interpretations of phytolith data they stated, "There is no evidence that first colonists introduced new cultigens or exotic plants in general" yet importantly they also add that only through interdisciplinary research will we further the understanding of landscape including plant use (Siegel et al. 2015).

Lee Newsom was a pioneer for her area of research. It cannot be ignored that the study of macrobotanical remains was brought to the Caribbean via Lee Newsom's research, where it produced useful information and interesting interpretations regarding plant use, particularly arboriculture (Newsom 1988; Newsom 1991; Newsom 1992; Newsom and Deagan 1994). She set out to investigate diet and human adaptations in the insular Caribbean and the comprehension of plant use laid out in her dissertation was nothing short of monumental (Newsom 1993). While not a novel approach, the combination of botanical and faunal analyses provided a robust picture of Caribbean lifeways (Newsom and Wing 2004). The researchers mentioned in this section are some of the giants I referred to earlier that have helped provide a great view for the case studies in this dissertation. As the last frontier of initial human-plant migrations and the first place in the Americas to experience the full effects of European colonization, the Greater Caribbean region offers a unique opportunity for an examination of intercultural dynamics and culinary practices.

1.4 Approaching archaeobotanical investigation to reveal culinary practices

An aim of this dissertation is to comprehend tangible relationships between Indigenous Caribbean Peoples and plants woven within their culinary practices. Interpretations of these human-plant interactions contribute to understanding Greater Caribbean legacies. Another goal of this project is to refine our understanding of Indigenous Caribbean culinary histories during the late precolonial period. There is also an endeavor to add to what was known conceptually and methodologically from previous microbotanical analyses (Berman and Pearsall 2008; Pagán-Jiménez 2007b; Perry 2004). Providing views of botanical foodways has been critical for understanding phytocultural dynamics (Pagán-Jiménez 2013), transported botanical environments (Berman and Pearsall 2008), and cultural niche constructions (Pearsall 1988; Perry et al. 2007a).

1.5 Theoretical framework

For the purpose of this dissertation, foodways was defined as the foods consumed and the profusion of related behaviors including production, preparation, and presentation of such foods (Welch and Scarry 1995), in addition to forest management, the collection of wild plants, and ultimately the use of kitchenware and the bodily gestures necessary for culinary practices. These include learned behaviors for slicing, pounding, mixing, grinding, and baking etc. Because the majority of case studies that form this dissertation work with artifacts from the Bahama archipelago and incorporate ideas of transported landscapes, an approximate date of 800 CE was chosen as the beginning of the late precolonial period, which is when there is evidence for established occupations in The Bahamas (Berman et al. 2013). To help understand transported vegetal environments an importance of this dissertation lies on the identifications of exogenous botanical species that require human assistance for propagation. The perspective of cultural niche construction (Smith 2016; Zeder 2016; Zeder and Smith 2009) is another axis which is central to discussions in the case studies, but it is incorporated and interlaced with ideas of transported landscapes (Anderson 1967; Berman and Pearsall 2008; Pagán-Jiménez 2013; Pagán-Jiménez et al. 2019), and practice theory (Bourdieu 1977; Lave and Wenger 1991; Wenger 1998). The correlation of these theories makes it possible to reveal the agency of food in processes of adaptations and as elements of culinary identities.

Transported landscapes provide many benefits for the transporters; perhaps above all, the humanization and consistent supplies of food motivated the transportation of botanical landscapes (Anderson 1967; Berman and Pearsall 2008; Pagán-Jiménez et al. 2019; Rodríguez Ramos et al. 2013). The identifications of exogenous plants imply at least mobility and exchange; or when exogenous plant complexes are consistently identified, they could be a part of a predetermined mental plan for reconstructing consistent humanized vegetal niches.

Foodways is one part of lifeways that deeply entangles cultural niche constructions. Cultural niche construction explains processes where human practices cause changes to their environments that modify evolutionary selection pressures (Laland et al. 2007; Wollstonecroft 2011). The human-plant interactions in the case study areas must have been influenced by both environmental constraints and affordances; as well as cultural practices such as plant management strategies, exchanges with other human groups, and culinary practices. However, because of the limited diachronic perspective allowed by the investigated archaeological sites, this dissertation is unable to comment on long term evolutionary components and had to take the following stance on cultural niche construction. If a cultural niche is considered the way humans make a living (Lambert 2018), then an epitome for human niches are food products, which culinary practices created.

Botanical culinary practices include many behaviors and things used to create meals such as the selection of plants to cultivate, harvesting and foraging particular plants, cooking techniques, additional flavors, and food preparation technologies (Ayora-Diaz 2015; Debevec and Tivadar 2006). Ancient starch analysis is a method to reconstruct and understand some of these things and behaviors through the identifications of plants and interpretations of which and how culinary practices caused damage to the plant organs. Throughout the case studies, interpretations of culinary practices help to illuminate the nuanced ways plants were used in the past. One of the ideas to test is if the culinary practices were successful and positively reinforced through cultural transmissions in local or regional communities then there must be a patterned use of plants at multiple stages in the production process (Eerkens and Lipo 2005; Zeder 2016). Alternatively, if the culinary practices were unsuccessful, new culinary practices should have emerged and be archaeologically detectable such as the replacement of exogenous plant ingredients with endogenous ones or discontinuing the use of starchy plants. This is possible by investigating multiple types of artifacts at the same archaeological site. Thus, multiscalar analyses of clay griddles and shell artifacts were carried out (Ciofalo et al. 2019; Ciofalo et al. 2020). These types of artifacts were previously demonstrated to have processed starchy plants in other investigations (Allen and Ussher 2013; Pagán-Jiménez 2007b; Rodríguez Suárez and Pagán-Jiménez 2008). In addition, these types of artifacts have been archaeologically recovered from many Ceramic Age sites in the Greater Caribbean (Hofman and van Duijvenbode 2011; Keegan and Hofman 2017). The recovered and identified starchy plant remains help explicate associations drawn between ethnic identities and culinary practices. Furthermore, the identified culinary practices will tie the data together offering a view of cultural niche constructions and ancient foodways.

1.6 Methodology

Because of copious amounts of rainfall in tropical areas and consistent high temperatures, organic remains decompose quickly in humid soils (Babot 1996; Pearsall 2003). The varying environmental conditions in the Neotropics make it problematic for the successful recovery of preserved organic remains because there are varied local conditions of soil pH, temperature, and humidity (Carbone 1980; May and McLellan 1973). Macrobotanical remains are unlikely to preserve unless the archaeological contexts are anoxic (waterlogged), extremely arid (dry), carbonized, or possibly mineralized (Pearsall 2015:108). In contrast to macrobotanical preservation, microbotanical remains (spores, pollen, phytoliths, and starch grains) have had a higher success rate of preservation and recovery in the Greater Caribbean region (Pearsall 1989; Piperno and Holst 1998; Piperno and Pearsall 1998:217; Piperno et al. 2009; VanDerwarker et al. 2015). Ultimately starch analysis was chosen for this dissertation because it has the unique ability to infer culinary practices (human-plant interactions for creating and modifying dietary plants), as well as demonstrate the direct association between starchy plants and the sampled artifacts (Dickau et al. 2007; Pagán-Jiménez 2013). Thus, starch analysis has the ability to answer the research questions and starch preserves exceptionally well in tropical environments (Perry 2004).

Initial sampling of approximately 200 artifacts (presumed kitchenware made from clay, limestone, and bivalve shells) was carried out. Because of the nature of the raw materials of these artifacts, two different starch-sampling methods were employed. Clay artifacts are more likely to be damaged from soaking in water, so they were sampled using a dry scraping method detailed in Chapters 4 and 5. Shell and lithic artifacts are typically more durable and thus able to be soaked in water without damage, so they were submitted to ultrasonic sampling, which is described in Chapters 2 and 3.

Ubiquity analysis is one method commonly used to statistically understand and interpret results from botanical data (Dickau 2005; Newsom and Pearsall 2003; Pagán-Jiménez et al. 2015). The total number of samples that contain a plant taxon expresses the percentage presence (ubiquity) (Pearsall 2018). Using ubiquity analysis, the comparative use of certain plants over others may be projected. However, interpretations do not suggest a plant’s contributions to overall diet.

Instead, the more a plant taxon was ubiquitously recovered amongst the sample spectra, the more likely it was frequently used and possibly integral for local culinary practices (Pagán-Jiménez et al. 2019). The only way currently to answer the research questions is through methods that have been constructed by several pioneers in paleoethnobotany over the last 200 years. Due to time constraints, reference collection availability, and the following aims discussed in the next section, the decision was made to prioritize starch analysis over other types of botanical analyses because it has an enormous potential for generating the data needed for a discussion of the research questions (Loy et al. 1992; Pagán-Jiménez 2011a; Perry 2004).

1.7 Aims

A key aim is to infer culinary practices within and amongst the case study sites. Plants are a crucial component of food choices throughout the world. Their multiple uses including their preparation contribute to formation of cultural memories (Pesoutová 2019). The ways people created meals contributes towards formation of self and group identities (Hastorf 2016:223). Bodily gestures are able to reaffirm shared cultural memories, which help people connect on a deep level with the people that share those bodily gestures and memories (Caballero-Arias 2015). In this case, gestures and movements, such as behaviors towards plant preparation constitute culinary practices. Understanding the connections between culinary practices and the technical choices past humans made allow for interpretations of plant processing and investigations of cultural niches.

Starch analysis is a unique archaeobotanical technique because it allows direct associations amongst plants, artifacts, and human practices (Pagán-Jiménez 2013; Pearsall et al. 2004). While starch recovery and analysis has started to solidify its techniques and protocols (Pagán-Jiménez 2007a; Pearsall 2015). However, doubt remains regarding authenticity of the results including if and why starch preserves in humid tropical regions (Barton and Torrence 2015; Collins and Copeland 2011; Mercader et al. 2018b). We may not fully understand the reasons for starch preservation but we have a clear understanding of human practices that make starch accessible and useful substances for different cultural needs (Beck and Torrence 2006; Oliveira et al. 2015; Pagán-Jiménez et al. 2017). Regardless of the many preservation biases affecting starch taphonomy, many studies have also demonstrated that starches survive after being exposed to variations in depositional contexts (tropical variations of moisture, temperature, acidic, and alkaline conditions) and culinary practices such as elevated temperatures (toasting, roasting, charring, baking, boiling), amylase digestion (fermenting), pressure (grinding, pounding, scraping), (Babot 2003; Barton 2009; Crowther 2012; Henry et al. 2009; Mickleburgh and Pagán-Jiménez 2012).

The primary aims of this dissertation have been designed to collect all the necessary information for answering the research questions. The aims are also relevant for the broader context of using a foodways approach to archaeobotanical investigation. Through this multi-layered research design, this dissertation will contribute novelty to the discipline.

1.7.1 Primary aims:

1.) Infer starchy botanical culinary practices.
2.) Provide a view of cultural niche constructions and related human-plant adaptation strategies.
3.) Demonstrate the appropriateness of starch analysis for providing novel insights in regions with limited organic preservation.
4.) Contribute evidence to the growing database of human-plant interactions.

That which is eaten sustains communities and links societal formation because meals are representative of belief systems, social identities, and existence (Crouch and O'Neill 2000; Twiss 2007). Food is a social lubricant and deeply engages with identity. As such, understanding food choices used to create meals can contribute towards interpreting elements of group identities. More than food choices a foodways approach for investigations helps expose social lives and may enable discussions of economies, politics, and symbolic features of meals (Dietler 1996; Dietler 2007; Hastorf 2016; Pagán-Jiménez 2013). Indeed, culinary practices and their products are a large part of the foundation for quotidian life. As such, investigating culinary practices may enable richer understandings and deeper discussions regarding demographic pressures, increase in social stratification, overexploitation, the arrival of new people, mobility and exchange, shifting preferences and values, and/or climate change, which can all be causes of variation in culinary practices (Cooper and Peros 2010; Pagán-Jiménez et al. 2019; Twiss 2012). This is because foodways contains a range of daily and unique practices such as food acquisition, production, preparation, presentation, and consumption of foods. Starch analysis is an exemplary method for reconstructing these human-plant dependencies, particularly culinary practices. The aims of this dissertation are achieved through answering the research questions.

1.7.2 Primary research question:

How did starchy culinary practices vary in the case study areas?

The research involved to answer this simple yet profound question will also answer a host of corollary sub-questions: Which plants were processed? Which human-plant adaptation strategies were likely employed? Which cultural niches were constructed? How does this new data contribute to previous archaeological understandings of botanical foodways? These questions will be explored through four case studies investigated by sampling artifacts from five archaeological sites and analyzing them for starch content.

1.8 Case studies and dissertation outline

Four case studies will be investigated, each contending and adding information upon previous archaeological understandings of botanical foodways. Investigating foodways has been integral for the study of cultures, which creates a richer understanding of phytocultural complexes, transported landscapes, cultural niche constructions, and elements of culinary identities. Paleoethnobotanical analyses have just started to be applied on the archaeological sites of Long Island, The Bahamas and central Nicaragua. Starch analysis is an exemplary method for reconstructing human-plant dependencies, particularly culinary practices. In addition, there has never been a comparison of botanical foodways between the Greater Antilles (the presumed origin of transported foodways) and the Bahama archipelago. Thus, this dissertation is organized in six chapters including the introduction and a final synthesis. Chapters 2 and 5 are pioneering starch analyses to initiate archaeobotanical research at the LN-101 and Barillas sites respectively. Chapters 3 and 4 initiate archaeobotanical research at the Palmetto Junction site but include comparative analyses with El Flaco and La Luperona to create a richer understanding of plant use on multiscalar levels. Chapter 6 is a synthesis of the previous chapters to provide concluding remarks and situate the case studies in their space of Greater Caribbean archaeobotany.

Starting at the site most furtherly North from this dissertation is an investigation of the LN-101 site on Long Island, The Bahamas. Chapter 2, titled 'Determining precolonial botanical foodways: starch recovery and analysis, Long Island, The Bahamas' is a case study focused on the sampling and analysis of eight artifacts. The sampled artifacts consist of four limestone microliths, presumably used as grater chips set in a wooden board for grating dietary plants, two bivalve shells, presumably used to deskin geophytes, and two limestone handstones, thought to have ground or scraped plants. These artifacts were recovered from the LN-101 archaeological site (cal. 1088 ± 68 CE) on Long Island, Bahamas (Keegan and Pateman n.d.). Multiple earth ovens were discovered at this site, but also there were practically no clay vessel remains recovered. Thus, we wanted more information regarding which and how plants were being processed, prepared, and possibly cooked at this site. In addition, it was not considered that grater board teeth were created from limestone resources but these sampled microliths were morphologically similar to chert microliths recovered from other sites in The Bahamas so we wanted to investigate if they were used to process plants (Berman and Pearsall 2008). Overall, this case study will provide integral data regarding regional-specific plant processing and new information about human-plant interactions that involved limestone artifacts. The study of limestone microliths is unique and expands upon previous archaeological considerations of grater board functions and manioc use in the Greater Caribbean (Debert and Sherriff 2007; Pagán-Jiménez 2013; Perry 2002a; Perry 2004; Perry 2005; Rodríguez Ramos and Pagán-Jiménez 2006). This case study may be viewed as a supporting flank for the midline or "meat" of this dissertation's next two case studies. The decision to use this case study as a supporting pillar was partially opportunistic. After learning that the archaeological site was in The Bahamas, and the materials included shell artifacts, this case study aligned with the core of the research design. The results are not directly comparable with the other case studies because of dissimilar sample sizes, but they certainly create a more nuanced understanding of precolonial foodways.

Because the sample size of shell artifacts sampled in the previous case study was relatively small, there was a need for a larger sample size to investigate if the use of shells was similar or if there were patterned variations. Chapter 3, titled 'Starchy Shells: Residue analysis of precolonial northern Caribbean culinary practices' is a case study focused on samples and analysis of starch content from 60 shell artifacts, presumably used to scrape geophytes and modify other dietary plants. These shell artifacts were recovered from archaeological contexts further south than the previous study to expand the regional perspective of shells used to process plants in the northern Caribbean. The residues were recovered from shells thought to have been associated with plant processing from the archaeological sites of El Flaco (cal. 1309 ± 81 CE), La Luperona (cal. 1352 ± 60 CE) both located in northwestern Dominican Republic, and Palmetto Junction (cal. 1391 ± 41 CE) located in the Turks & Caicos Islands (Hofman and Hoogland 2015a; Hofman and Hoogland 2015b; Hofman et al. 2018; Sinelli 2015). Ethnohistorical narratives have characterized shell tools exclusively as manioc peelers (Fernández de Oviedo 1851 [1535]:270; Fernández de Oviedo 1959 [1526]; Las Casas 1876 [1561]:147). Yet archaeologists have envisioned a broader set of functions and more diverse suite of processed plants were involved with bivalve shell tools (Antczak 1998; Antczak and Antczak 2008; Boomert 2000:324; Carlson 1993; Keegan et al. 2018; Lammers-Keijsers

2007:52; O'Day and Keegan 2001; Petitjean-Roget 1963; Ruiter 2009; Van Gijn et al. 2008). With a large sample size, this case study contributes a robust interpretation of human-plant-artifact interrelationships by elucidating which plants were processed and clarifying possible shell artifact functions. The roles of shell artifacts in starchy botanical foodways contributes to ongoing discussions regarding culinary practices in the northern Caribbean and related precolonial foodways in the Greater Caribbean (Berman and Pearsall 2008; Pagán-Jiménez 2013; Pagán-Jiménez et al. 2019; Rodríguez Ramos 2016).

If the culinary practices were entangled in cultural niche constructions, there must be a patterned use of plants at multiple stages in the food production process. Thus, another phase in plant preparation process is investigated, the use of clay griddles. Chapter 4, titled 'Late precolonial culinary practices: Starch analysis on griddles from the northern Caribbean' was carried out to create a more holistic view of starchy foodways in the northern Caribbean, this case study compares 45 samples analyzed for starch content that were recovered from clay griddles, presumably used to cook or prepare dietary plants and animals. These clay griddles were recovered from the same three sites- El Flaco, La Luperona, and Palmetto Junction. This case study compared foodways amongst sites with a focus on clay griddles, because they were one of the common artifacts presumed associated with preparing plants and archaeologically recovered from all three sites in this study. Earlier preconceptions envisioned clay griddles exclusively connected with the production of manioc flatbread in the Caribbean (see DeBoer 1975; Rouse 1992 12, 84, 133; Wilson 2007 83, 109). Other starch analyses of insular Caribbean griddles indicated their use with a broad suite of dietary plants but not manioc (Table 1.1). This case study investigated clay griddles from these three archaeological sites to clarify if the pattern of a broad spectrum of plants were prepared with these griddles as well.

Regarding unifunctional griddles, archaeologists who work in Central America have similar preconceptions to archaeologists who work with insular Caribbean artifacts. The standard Central American archaeological discourse presumed only maize was prepared on griddles (McCafferty 2011). This bias was also connected with alleged migrations from Mesoamerica around 800 CE, led by groups whose staple foodways consisted of maize *tortillas*[3] cooked on griddles (Gorin 1990). Chapter 5, titled 'Uses of pre-Hispanic kitchenware from central Nicaragua: Implications for understanding botanical foodways' is a case study that provides the

[3] Flat-bread.

second supporting flank for this dissertation by investigating culinary practices in central Nicaragua at the Barillas site (cal. 1261 ± 37 CE) which revealed unique finds of ceramic griddle fragments (Donner and Geurds 2018).

This chapter was created to help answer questions about how clay griddles were used in Central America and expand the scope of this dissertation to the continental mainland. This part of the dissertation will demonstrate my adaptability to work outside of the insular Caribbean and simultaneously help investigate patterns of human-plant interactions in another area of the Greater Caribbean. Geographically, the Greater Caribbean region includes Nicaragua (Rodríguez Ramos 2010). Culturally, the Greater Caribbean has been argued to include coastal Nicaragua (Hofman et al. 2010). While no shell or limestone artifacts were recovered from the Barillas site, a high density of clay artifacts were recovered from stratigraphic contexts. After these finds were discussed, it was clear how this case study would be relevant to the overarching project. This case study in Nicaragua was carried out from six samples recovered from clay vessels (four flat vessels and one bowl shaped vessel). These samples were analyzed for starch content to help reconstruct pre-Hispanic culinary practices and evaluate the presumptions of unifunctional griddles in the Greater Caribbean. Furthermore, this case study constitutes innovative and novel research as the first archaeobotanical research in central Nicaragua.

Chapter 6, titled 'Final Thoughts' is a synthetic chapter of the major paleoethnobotanical findings of this dissertation and offers concluding remarks. This chapter also explores the theoretical implications in archaeobotanical interpretations of variations of culinary practices. In addition, limitations of this type of research are clearly explained coupled with recommendations for future research.

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