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Publication Date
2011

Peer reviewed|Thesis/dissertation

Paradigms and Syntagms of Ethnobotanical Practice in Pre-Hispanic Northwestern Honduras

By

Shanti Morell-Hart

A dissertation submitted in partial satisfaction of the

requirements for the degree of

Doctor of Philosophy

in

Anthropology

in the

Graduate Division

of the

University of California, Berkeley

Committee in charge:

Professor Rosemary A. Joyce, Chair
Professor Christine A. Hastorf
Professor Louise P. Fortmann

Fall 2011

Abstract

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The relationships between people and plants are complex and highly varied, especially in the mosaic of ecologies represented across Southeastern Mesoamerica. In studying plant use in the past, available technologies and methodologies have expanded and improved, allowing archaeologists to pursue more nuanced approaches to human-plant interactions and complicating previous models based on modern ethnographic accounts and indirect archaeological evidence. In this thesis, I explore various aspects of foodways and ethnobotanical practice in Formative and Classic Northwestern Honduras. My primary data are the actual paleoethnobotanical remains recovered from artifacts and sediments at four sites: Currusté, Cerro Palenque, Puerto Escondido, and Los Naranjos. These remains include microbotanical evidence in the form of starch grains and phytoliths, and macrobotanical evidence including charred seeds and wood.

Interweaving practice-based and linguistic-oriented approaches, I structure my work primarily in terms of paradigmatic and syntagmatic axes of practice, and how these two axes articulate. I view ethnobotanical practices in terms of possible options available (paradigms) in any given milieu and possible associations (syntagms) between elements. I ground my arguments in previous ethnographic, ethnohistoric, and archaeobotanical descriptions of plant practices and plant materials in Southeastern Mesoamerica.

In my study of 116 bulk macrobotanical flotation samples, 26 microbotanical sediment samples, and 21 microbotanical samples from artifacts, I pursue several pools of questions. Some questions have to do with rethinking how foodways are understood in ancient Southeastern Mesoamerica, and others treat how these foodways can be compared along different axes of activity. I focus on uses of underground storage organs (such as roots and tubers) and the broad spectrum of practices engaged by agriculturalists (including gathering from and managing non-cultivated areas), complicating the traditional maize-beans-squash model posited uniformly for Southeastern Mesoamerica.

The analytical portion of the thesis is organized along dimensions of human-plant activity: the spectra of ethnobotanical practices, the interplay between ethnobotanical practices and artifacts, contexts, and spaces, and the transformations and continuities in ethnobotanical practice over time. I also assess the complementarity of microbotanical and macrobotanical approaches in analyzing plant practices of ancient Southeastern Mesoamerica. I primarily focus on taxa richness, relative abundance, diversity of species, charred material densities, and associations between elements of botanical practices.

Some associations between elements of practice persist over time, implements, contexts, and spaces, while other associations shift, relative to transformations in paradigmatic options and/or syntagmatic associations. Broadly, there is a strong representation of underground storage organs such as calathea and manioc, and a wide diversity of plants referencing a wide array of practices. This spectrum of practice encompasses a range of action from the cultivation of domesticated cultivars to the processing of wild plants. Throughout this thesis, I argue for the utility of a linguistic practice-based approach in paleoethnobotanical analysis and the incorporation of multiple lines of paleoethnobotanical evidence, in assessing past foodways and human-plant interactions.

This book about the past is dedicated to the future.

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Acknowledgments

I have been extremely lucky in life if sometimes unlucky in research. Here is an extensive (though not comprehensive) acknowledgment of and enormous THANK YOU to the following acquired and biological kin. It's arranged kind of like an archaeological deposit-- the most recent and intensive at the top and most distant yet persistent at the bottom, with some jumbling in between.

First, my dissertation committee. Over my years at U.C. Berkeley, Christine Hastorf and Rosemary Joyce have provided endless support. They are unbelievably brilliant scholars, and unbelievably helpful mentors. I thank them multiple times in these acknowledgments, and throughout the dissertation, but it is a wildly inadequate expression of my gratitude. Thank you, both, so very much. Louise Fortmann has done an amazing job as outside committee member and representative of the Environmental Studies and Policy Management program. I can't thank her enough for taking me on rather late in the game, and I wish that I'd had the opportunity to work with her throughout my grad student years.

I owe enormous debts to the many scholars and colleagues who have influenced my paleoethnobotanical course of research. I have greatly enjoyed the use of Charles Micsicek's donated Mesoamerican plant collection, and greatly appreciated the massive body of Mesoamerican paleoethnobotanical work by David Lentz. These two scholars have been the groundbreakers in Southeastern Mesoamerican paleoethnobotany. My more immediate colleagues and current mentors include Chris Morehart, Stephanie Simms, and Lucia Gudiel. I hope to produce work half so brilliant, and always appreciate their input, whether on microbotanical remains or lucha libre. I was extremely fortunate to have benefitted from mentorship at the Smithsonian Institution's Archaeobiology Laboratory: Dolores Piperno and Linda Perry taught me more than I ever could have imagined about microscopy, processing samples, identifying microbotanical remains, and navigating the labyrinth of the Pod. I can't imagine the shape of my research without them. Arunima Kashyap, Amanda Henry, and Bruce Smith were other Smithsonian plant geniuses, and I appreciated their many insights. New collaborators Jade D'Alpoim Guedes, Tina Warinner, and John Mac Marston have provided several incredible forums for paleoethnobotanical collaboration, an endeavor also undertaken by the hundreds of members of the Archaeobotany Listserv. I feel fortunate to be part of such a collaborative and welcoming community of scholars.

Early mentors in paleoethnobotany at UCB included David Goldstein, Bill Whitehead, Maria Bruno, Alex Chevalier, Steve Archer, Emily Dean, Rachel Cane, and Kirsten Tripplett. I owe Rachel Cane an especial debt, as she was one of my strongest early mentors, and generously shared macrobotanical data from Puerto Escondido for this thesis. Mio Katayama, Minkoo Kim, David Palmer, James Coil, Jennifer Salinas, Katie Chiou, Theresa Molino, Chia-Chin Wu, and John Chenoweth are also collaborators, friends, and fellow plant nerds. My dear friends Burcu Tung and Angela Locke helped me enormously in photographing and cataloging hundreds of plants in botanical gardens in Mexico and Honduras. Over the past few years I have worked especially closely with Alan Farahani and Rob Cuthrell, masters of paleoethnobotany, mathematics, software, random internet ephemera, and tacky clipart. I have benefitted enormously from their cleverness, and feel badly for sometimes eating their share of lab cookies. Christine Hastorf has been my primary paleoethnobotanical mentor over the years, training me in paleoethnobotanical methods, environmental archaeology, and foodways studies, as well as guiding me to train others in these fields. She has fostered not only individual academic growth but also a wonderful community of scholars and friends. I have greatly enjoyed learning from everyone in the Paleoethnobotany Laboratory, and will miss our seminars, haikus, and Thursday dinners filled with homecooked and occasionally suspect foods.

Currusté Field Crew 2008, atop structure in West Plaza.

Although this thesis combines the products of work of literally hundreds of seasonal employees and volunteers, I was only able to work with a few of them, at the site of Currusté. I owe huge thanks to the great field crews, whose members included Wendy Benitez, Rodolfo Mendoza, Narciso López, Albán Pineda, José María Alvarado, Sofía Argueta, Marco Antonio Benitez, Waldina Benitez, Daniel Bonilla, Santos Catalina, Junior Alexander Cruz, Héctor Rafael Cruz, Daniel Guifarro, Gustavo Guifarro, Johana Guifarro, Roberto Guifarro, Juana Hernández, Suany Vanessa Guillén, Mary L'opez, Rigoberto López, Reyna Mendoza, María Salome Meza, Roberto Meza, Melvin, Santana, Luís Larios, Joaquin, Isis Rapalo, Herson Rapalo, Iris Padilla, José Antonio Trigueros, and José Ángel Vallecillo, among others. I worked especially closely with Rodolfo, Wendy, Albán, Daniel G., José Antonio, and Luís, and appreciated their knowledge, skill, and help with the use of *vos*. I hope they forgive all of my *tú* mistakes. The hundreds of flotations were bravely carried out by Iris, Wendy, Gustavo, Joaquin, and Luis, even when plagued by mentally unstable geese. Huge thanks go to the Guifarro family in general, not only for all of the help provided on-site, and all of the support provided at the end of the day, but for the opportunity to work on lands that once belonged to their family. Jeanne Lopiparo (Project Director), Esteban Gomez, Nicole Anthony, Cordelia Frewen, Laura O'Rourke, Angela Locke, Rodrigo Maldonado, Emma Saunders and Ruth Mathews were a pleasure to live with, work with, and watch sing karaoke. I could not have resisted malaria without their special recipes for health tonics. Enormous thanks to Julia Hendon, Rosemary Joyce, and Jeanne Lopiparo for the opportunity to work with their data and materials. They've helped to pull me from the wreckage of several exploded dissertation projects. Rosemary Joyce, especially, was instrumental in facilitating most of the work, financially, institutionally, and personally. I am sorry for any headaches this caused, but enormously appreciative.

Thanks also go to Geraldina Tercero, Teresa Campos de Pastor, and several employees of IHAH, including Carlos Acosta, Santiago Escobar, Eva Martínez, Isabel Perdomo, and Aldo Zelaya, for assisting and facilitating work on-site and in the IHAH laboratory. My broad thanks to the Instituto Hondureño de Antropología e Historia, who granted both permission and support to work at the site of Currusté. I wish this organization peace from further political upheaval, and wish it always could have been so in the past. Honduras will greatly miss the leadership and guidance of IHAH Director Dario Euraque and Minister of Culture Rodolfo Pastor Fasquelle, for reasons both academic and civic. I am very sorry that their program was never fully realized.

To my mentors in the Anthropology Department, Rosemary Joyce, Christine Hastorf, Bill Hanks, Kent Lightfoot, Pat Kirch, Ruth Tringham, Meg Conkey, Steve Shackley, Laurie Wilkie, Terrence Deacon, Rus Sheptak, and Junko Habu: I am lucky to have worked with so many of you over the years, whether as student, researcher, or GSI. I will miss Kent's punches to the arm, Pat's Hawaiian shirts, Meg's good advice, and Steve's (tall?) tales of the field. I will miss Ruth's spirited mentorship from the bottom of endless Anatolian excavation pits, if not her disapproval of my "overly large" trowel and field music selections. Bill Hanks' work underlies and informs much of my own, and I continue to appreciate his insights and mentorship in all things Yucatán and linguistic. I would also like to thank the anthropology admission committee who first let me into such a magical place filled with such brilliant people.

I spent perhaps too much time with my fellow grad students at UCB. This includes the paleoethnobotany-oriented students and mentors already mentioned, as well as cohort members Burcu Tung, Andy Roddick, Sara Gonzalez, Jon Daehnke, Doris Maldonado, Lee Panich, Sven Ouzman, and Donna Gillette. Although Andy, I should clarify -- not really, if you think about it. Dear friends and colleagues from outside my cohort and laboratory include Commander Katy Killackey, Colleen Morgan, Kari Jones, Paolo Pellegatti, Mark McCoy, Anna Brown-Ribeiro, Alexander Andreeff, David Cohen, Teresa Dujnic Bulger, Eric Blind, Kim Christensen-Schwarz, Darren Modzelewski, James Flexner, Jerry Howard, Jillian Swift, Tsim Schneider, Liz Soluri, Di Hu, Anna Harkey, Brandon Nida, Elliot Blair, Alex Baer, Tom Sapienza, Scott Hutson, Bonnie Clark, Michael Ashley, John Matsunaga, Ashley Lipps, Peter Nelson, Kat Howlett-Hays, Heather Law, Annelise Morris, Lizzy Ha, Kira Blaisdell-Sloan, Julie Wesp, Matt Sayre, Nicole Anthony, and Estéban Montes Gomez. Your nicknames are too many to put here, and not always suitable for polite company, but know that I affectionately attach them to some of my favorite people in the world. My twin sister Doris supported me enormously through the years and taught me impeccable espanglés, but never failed to remind me I was *hija del lechero*. I lived with so many of you, and loved every minute. Thank you for your casual brilliance, your musical tastes, and doing my dishes, even though I *swear* they weren't mine.

To the helpful administrators in the Archaeological Research Facility and Anthropology Department, thank you for bringing grace to crisis, whether in the form of administrative wrangling, stamped signatures, GIS negotiation, or laboratory flood rescue. To Ned Garrett, Bettina Lewis, Tom Bottomley, Cecilia Mafnas, Kathleen Van Sickle, Tomeko Wyrick, Sue Wells, Linda Eason, and Nico Tripcevich, especially, my deepest thanks. My thanks also to the funding institutions who provided me so much financial support over the years: The Lowie-Olson fund, the Stahl fund, the Center for Latin American Studies, the Tinker Foundation, the Robert and Alice Bridges fund, the Abigail Reynolds Hodgen Publication Fund in the Social Sciences, the Society of Sigma Xi, the Dean's Normative Time Fellowship, the Foreign Language and Area Studies granting agency, the Committee on Research of the Academic Senate Grant in the Humanities, and the Anthropology Department.

For many years I was a beneficiary of the University Research Apprenticeship Program at Berkeley (URAP). Several students in particular weathered years of research, even when it was far outside their major course of study. Monica Parks and Maral Tavitian were an enormous help in the processing of samples, as well as digital documentation and GIS modeling. Erika Blecha carried out years of macrobotanical analysis. Sarah Davidson aided in macrobotanical sorting, but went on to do an excellent set of illustrations, the bulk of which I use in this dissertation. Allie Barden worked extremely hard to perfect not one but three GIS models of Honduran sites, laying the groundwork for years of analysis. I would also like to thank the many brilliant undergraduate students I have worked with over the years, through courses at UCB, Colorado College, and Patten University at San Quentin, as well as through various field projects in Mexico and Honduras. I hope you came away with half as many insights and ideas as those you left to me.

My deepest love and appreciation to my Yalahau extended family: Jennifer Mathews, Scott Fedick, Kathy Sorensen, Jeffrey Glover, Olivia Navarro-Farr, Stephanie Simms, Lucia Gudiel, Chris Morehart, Reiko Ishihara, Dominique Rissolo, Fabio Amador, Shannon Hogan, Carole Leezer, Beth Morrison, Dawn Digrius**.** My deepest thanks. I was fortunate to learn so many tricks of the trade, and am incredibly lucky to have worked with so many fellow plant nerds. Many of them have carried me over the sands of research, leaving behind only one set of footprints. Now is also as good a time as any to forgive Kathy for taking the last popsicle, and forgive Jen for the endless Clight outbreaks. Scott Fedick remains one of my primary role models, in everything from car mechanics to jungle ecology. Jen Mathews remains one of my primary mentors and dearest friends. I would also like to thank the many seasonal employees at Rancho Santa Maria who helped us throughout the years and fed me tidbits of ethnobotanical information. Many of them also obliterated us on the *cancha de fútbol,* which I can only attribute to home court advantage. Don Alfredo, Cruz, Cheyla, thank you especially. At the community of Naranjal, many people shared many meals and stories, opening up their homes and giving me huge insights into how some plants even *work*. The Cupul Chi family, especially-- Claudio, Benancia, Hermalinda, Arnolfo, and Don Ignacio-- I can't thank you enough. I wish I had all of your culinary secrets.

To my mentors at the University of Texas at San Antonio and the Center for Archaeological Research: James McDonald, Laura Levi, Dan Gelo, Robert Hard, R.E.W. Adams, Steve Tomka, and Donna Edmondson, thank you. I learned so much from you about everything from theoretical approaches to public outreach. Fellow grad students Daniel Kreutzer, Carole Leezer, Sarah Lynn Luna, Kris Alstat, Liz Cameron, Toni Figueroa, Tony Lyle, Ruth Mathews, Brian King, and Kevin Hanselka, thank you for taking me under your wing, and over to Hills and Dales. I am extremely lucky to still receive the wisdom of The Heidra: Heide Castaneda and Faidra Papavasiliou. One head breathes economic anthropology, the other breathes medical anthropology, and each belongs to one of my favorite conversationalists in the world. They also win at New Orleans.

My mentors and friends from long ago excavations in New Mexico: Samantha Ruscavage-Barz, Dave Barz, Wetherbee Dorshow, Dan Wells, Kelly Gillis, M.C., William Penner, Berenika, Hiroki Ide, Hollis Lawrence, Mary Walling-Blackford, and Che, canine slayer of desert lizards. They taught me the value of CRM archaeology done well, and made me a much better field archaeologist. I wish I saw more of them more often.

My thanks also to mentors and friends from long long ago excavations in Peru: Hilda Ayala Chuchon, Jose Ccencho, Carlos Batchi, Isabel Flores Espinosa, Mario, Nancy Rivero, Ophelia Rivero, Leda Rivero, and Renzo the dentist with surplus tools. This was a very different sort of archaeology than I have ever done, and I remain hugely grateful for the opportunity to work at the Huaca Pucllana and live in the heart of Miraflores, under the guidance of so many great people. I am glad no guinea pigs were harmed during my time there, but I appreciated the offers to sample them.

I am hugely grateful to my friends from Wesleyan who have kept me grounded in the greater world. First, Area 51: Allison Radecki, Ben Winkler, Dan Birdsall. The possum in the couch misses us, I am sure. Ben read too much of my senior essay, and I remain forever indebted. Dan was director of the whiteboard. Allison, master of all canetoadom, has been one of my dearest friends from the very beginning, and has endlessly enriched my understanding of food and foodways. The Hall of Justice and its honorary members: Allison, Ari Voukydis, Mara Voukydis, Chad Carter, Pete Olson, Nate Smith, PSam Smith, Abe Forman-Greenwald, Lynn Chen, Tom Kawano, Ike Walker, Dan Gartner, Sam Sober, Flo Turkenkopf, Annie Hesslein, Karen Carrea, Owen Pollock, Bex Schwartz, Dave Giles, Daisy Estremera, Laura Reiss, Jenny Leib, Nick Miller. I lived with some of you, there are others I just wish that I had, and there are only a few that I wish that I hadn’t. Thanks also to my randomest friend and Scrabble archenemy, Tatian Greenleaf. And all of the ferrets. So many ferrets. Professors whose influence persists include Susanne Fusso, Nathan Brody, Douglas Charles, Carlos Sifuentes, and Anne Lorimer. I also owe especial thanks to my departed dog, Sacha, who chose my undergraduate institution by eating spaghetti off the Wesleyan brochure instead of the others. Good dog, Sacha.

My dear friends, family, and mentors in Mérida, my thanks are not enough. The Aranda/Suarez family took such good care of me that they will never get rid of me. Lesvia, Alberto, Thania, Talia, thank you. Mentors, friends, and fellow students at the Universidad Autónoma de Yucatán: Alberto Romero, Ana Maria, Myrta, John, Mauricio Germon Roche, Alvey Carrillo, Jose Carlos the “Ratóncito", Carlos Antonio, Lupita Zetina Gutierrez, thank you for sharing Mérida with me. I wish I could share it with you more often.

Thanks to my extended family of piranhas at the Feathered Pipe Ranch: Crystal Water, Kari Bradley, Gabrielle Malina, Howard Levin, Chris Petaja, Kris Kegel, Bridget O’Hara, Danny Libby, Josh Safronoff, Winter Safronoff, India Supera, VJ Supera, Emmet Gallagher, Peter Heredia, Beth Demetrescu, Gail and Paul Wilson, Heidi, Tom, Sean, and Amy Ryan, Joni Nelsen, Mike Willing, J.V. Bennett, and Kim Schleicher. Thank you for making so many summers and travels fun and educational. The gossip never gets old, and neither do you guys.

My love and appreciation to my dearest friends and adopted family from the formative years at Capital High: Amber Moreen, the late Carly Nelson, Nikki Johnson Spinelli, Sara

Boutilier-Wakefield, Chanda Wong Beppu, Angie Yuhas, Judy and Denny Moreen, Carey Schmidt, and Kim Ryan. You were the greatest, and I wish I could see all of you every winter break. Let's have a Canyon Ferry reunion one of these days, eh?

And of course, my family: the thousand and one Morells and those who married them: Richie, Jill, Billy, Mary, Annie, Jerry, Noreen, Wanda, Martin, Genevieve, Julian, Donna, Lucy, Dan, Michael, and Carolina, who fostered my love of archaeology (if not always, ah, legally in those early years) the great outdoors, and good reads. To my cousins, and yes, I will name them all: Julie, Jeff, Erin, Chelsey, Tom, Brian, Katie, Kelly, Sophie, Georgie, Faolain, Alex, Michael, Jon, Nick, Michael, Camille, Brianne, Merium Olivia, Michael, and any I might have missed, especially if they are also named Michael. My great uncle Jack Vessels, who has unsuccessfully tried to teach me to sing my way through life. To the many fewer Harts and those who married them: Tom, Edwina, and Victor, and my cousins Edwin and Ted, who remain some of the most interesting people I have ever met, much less been related to. In memory of those who have passed on: my grandparents Thomas and Veronica Hart, my uncle Victor Hart, my grandfather Abe Morell, my uncle Richie Morell, and my grandmother Merium Morell, who fostered my love of travel and writing. Thank you, especially, to everyone who taught me how to drive. I love all y'all.

And finally, my mom, Jane Morell-Hart, my dad, John Hart, my brother/best friend Daniel Morell-Hart, and my boyfriend Tim Wyatt. I love you dearly and thank you hugely for all your years of one million kinds of support. My mom biased me toward ancient oddities. I’m sorry I never learned not to touch stuff in all those antique stores. My dad biased me toward teaching. I wish I was as dedicated a scholar. Danl was always up for a good debate, whether over the allocation of Barbie funds in early years or the interpretation of Erving Goffman’s work in later years. Of course I am always right and he is always wrong, but I defer to his greater expertise on the snow leopard. mrrnrrmrr. Tim is both evil computer genius and love of my life. He makes everything fun and/or interesting and/or funny. I’m just sorry I was so late to the game.

I am undeservedly fortunate to have had so many mentors and supporters. Errors in scholarship are entirely my own. Thank you for everything, everybody.

> "Even today, hundreds of years after the Maya civilization disintegrated, the descendants of the Maya still look upon corn for 80% of their diet. They eat maize with every meal of the year, day in, day out.... the failure of that one crop is a disaster to them. To the Maya corn is considered sacred... without maize the Maya would have lacked the leisure and the prosperity to erect their pyramids and temples. Without their mystical love and respect for corn, it is doubtful they would have submitted to the building program directed by the hierarchy, and endured their submission for such a long time." (Alducin 1992:24)

So goes much of the popular literature on not just the Maya, but most cultures living in the broader region of Southeastern Mesoamerica. This is a neat and simple story that connects dots effortlessly between food, farming, society, and power. It is a story that draws straight lines between the homogenized Maya groups of the present, and the homogenized groups of the past. Alducin conjures the image of a simple people who have persisted on a single staple crop for "hundreds of years," a crop around which an entire religion is constructed, a religion from which an entire hierarchy is based, and a hierarchy upon which extractive labor relations are predicated. The Maya, in this story, are timeless, static, and utterly at the mercy of a single plant, the failure of which "is a disaster to them". There is no recourse but maize, no religion but that devoted to its success, and no non-essential labor but that dictated from the literal and figurative top of the religious pyramid.

Alducin's popular story is the one many of us learned, and many of us continue to learn, inundated as we are with ever-expanding narratives of "collapse", its environmental underpinnings, its societal implications, and its historically recursive nature. It's such a comfortably parsimonious story that we are almost tempted to stop there; to take such a story as fact and not problematize it further. But how might this simple story be critically assessed? How might it be complicated? How might it be complemented? Many of my thesis questions address the themes presented by such narratives: the spectra of foodways and plant use, the loci of daily activities, the diversity of intra- and inter-community ethnobotanical practice, and the dynamic nature of societies and their foodways over time.

When I first began to study Mesoamerica, it was as an exchange student in Northern Yucatán, and it was this stint that convinced me to continue in the region. I signed up to volunteer with the Yalahau Regional Human Ecology Project, in Quintana Roo. One of the project directors, Scott Fedick, introduced us to the many wild foods available in the Maya wetlands, some of which we tasted from the blade of his machete. Work with local communities further revealed a wide array of plants used in everyday activities. It was also at this time that I was introduced to some of the (then-current) paradigms of plant food use by the Pre-Hispanic Maya, from maize to ramón.

Further readings when I returned from the field pulled me deeper into the world of Mesoamerican foodways. However, I felt shortchanged by the literature, in terms of the plant taxa it represented-- even the kinds of data represented seemed very limited. I also mourned the overall lack of focus on the quotidian. As someone obsessed with historical re-enactors and historical re-creations-- the Colonial Williamsburgs of the world-- I was disappointed by the lack of "day-in-the-life" archaeological interpretation.

When starting out as a new graduate student, deciding where to work was easy. I wanted to continue in Mesoamerica, and put my Latin American Studies degree to good use, so I began my graduate student career as a would-be Mayanist. My training included studies of modern conversational Yucatec, immersion in regional literature, and compilation of a large database on plants and their uses in the Maya area, both modern and ancient. I actively sought to research ancient Maya foodways and society, and was fortunate to receive funding for several pilot studies in Quintana Roo. Equally valuable were the many informal experiences I had with fellow crew and community members. These introduced me to a wide array of plant and food practices related to the ecology of the northern Yucatan Peninsula.

However, my projected career drastically changed, thanks to apocalypse-level hurricanes, forest fires, difficult landowners, and permit issues with my first three dissertation projects. I then moved to a wonderful site in Northwestern Honduras, Currusté, as my fourth dissertation site. However, I subsequently lost access to 75% of my carefully excavated data, thanks to the 2009 coup that removed integral officials from office, leaving no one legally authorized to issue export permits. Luckily, I was saved by a vast collection of artifacts and sediments housed right in the U.C. Berkeley laboratory of Rosemary Joyce, a collection already excavated by various researchers working at other sites in Northwestern Honduras. It is this regionally-wider data set that I here explore and interpret.

Overall, this thesis is meant to be a study of *fields*-- the fields where archaeologists work to obtain their data, the fields where food is grown and harvested, the fields of databases where data are categorized, and the fields of practice where the social is produced, reproduced, maintained, and transformed. This concept of field is rooted in my understanding of Pierre Bourdieu, and owes a debt to William Hanks. Through this process, I make every effort to present Mesoamerican foodways through daily ethnobotanical practice, a mode learned through years of working with Christine Hastorf. I begin by grounding my work in theoretical approaches, and various means of modeling foodways. I then continue with a discussion of the background of my archaeological data, and how I designed research strategies to pursue specific thesis questions. After theoretical, historical, and methodological grounding, I turn to the data itself, interpreting results along the axes of archaeobotanical types, daily practice, implements, space, context, and time. I have found that, although many ideas about Mesoamerican foodways are supported by this study, some conceptual artifacts do not entirely parallel the data from actual artifacts.

What am I after?

This study is centered on several broad thesis pursuits. These have to do with: 1) the complementarity between microbotanical and macrobotanical data; 2) the spectra of economic plant taxa and their associated practices, focusing on a) root crops and non-domesticates, as well as b) schemes by which we classify taxa and practices; 3) associations and disassociations between artifacts and taxa; 4) differences and similarities over space, in taxa and associated practices; 5) differences and similarities over contexts, in taxa and associated practices; and 6) transformation and continuity over time, in taxa and associated practices.

Essentially, my first questions have to do with rethinking how we look at foodways, and my latter questions treat how we can compare them. My goal is to restructure current models, then operationalize comparisons between data sets. I ground my studies in linguistic anthropology and practice theoretical perspectives, and focus on foodways as a particularly fruitful area to discuss daily practice. The overall work is a targeted exploratory data analysis, incorporating different data sets, locations, and time periods.

I here pursue a better understanding of foodways, society, and the links between the two. The four archaeological sites studied are ideal in this pursuit, due to their location, size, architectural density, and temporal variation. They have provided an ideal setting in which to study specific relationships between foodways and social organization, as well as to examine general ideas surrounding foodways of pre-Hispanic Mesoamerica.

How is this thesis organized?

Broadly, this study is arranged into two major parts: background and analysis. This first chapter is meant to be an introduction to the work, and the subsequent six chapters provide dense background. The background is rather protracted**,** to position my work in the rich and extensive set of literature which precedes it. The subsequent analytical portion is also divided into six chapters, according to different perspectives of the data set, or “axes” of plant use.

The second chapter draws together various theoretical strands that I incorporate and weave into the work. The third chapter hones in on approaches to foodways, emphasizing those which I employ in this study. The fourth chapter describes perspectives of foodways in Southeastern Mesoamerica, incorporating ethnographic, ethnohistoric, and archaeological analogies. The fifth chapter is a broad overview of the four sites whose data I interpret. The sixth chapter describes the specific paleoethnobotanical methods I employed in order to pursue my research goals. The seventh chapter describes my overall research design.

I describe and interpret the results of my analyses in Chapters Eight through Thirteen. The eighth chapter is a broad comparison of the results of macrobotanical analyses with the results of microbotanical analyses. The ninth chapter engages the practices represented by the various plant taxa recovered through paleoethnobotanical analyses. I proceed with the analysis of paleoethnobotanical remains in the tenth chapter, where I compare different plant taxa recovered from artifacts and their associated practices. The eleventh and twelfth chapters focus on the plant taxa recovered from sediments in various locations of the sites, as nodes of practices in different locations. I have divided this data between categorized spaces (as related to built and negative space) and categorized contexts (as related to artifacts and features). In the final analytical chapter, I focus on the results of comparisons between temporal periods. The final chapter of the thesis draws together the results of the preceding analyses, taking the form of a lightly-sketched framework of foodways in Southeastern Mesoamerica, with suggestions for future research. Appended to these sections are methods and protocols for the microbotanical sampling, paleoethnobotanical analyses, and unknown recovered macrobotanical taxa.

What does this work contribute?

Michael Herzfeld writes that “History can be danced, felt, smelled, and, yes, spoken; ...every act and every sensory experience is a potential carrier of links with the recent and more distant past” (2001:13). Artifacts, plants, and places can all arguably be such carriers, though not always for millennia nor in a direct-historical sort of way. The disjuncture, intra-socially between past perceptions of foodways, and inter-temporally between past and present perceptions of foodways, has provided the means by which the interpretive gap has widened. In this thesis, I hope to narrow the gap by attempting to leave out "typologies" of subsistence and space, and instead focus on the component attributes of foodways and place. That is, instead of operating under the assumption of what "type" of macrobotanical assemblage will be found, or leaving out paleoethnobotanical information altogether, I hope to loosen normalized "types" in the landscape of Mesoamerica. I instead focus on what *range* and *variety* might tell us about past foodways practices, and their relation to the social dynamic.

I hope that the significance of my research is manifest in six ways. First, that it is comparatively useful for archaeologists working in socially complex agricultural societies who are interested in the ways that plant use varies with culinary equipment and spatial location. Second, that it provides an illustration of the potential of multiple paleoethnobotanical methods for recovering a wider range of plants. This rich potential has thus far been realized for only a small range of plant use, primarily ritual and agricultural. Third, that this study will contribute one of the first studies in Honduras to look at foodways through paleoethnobotanical analyses, as indeed it is one of only a handful of such studies in Southeastern Mesoamerica. Fourth, for the archaeology of this time and place, these are representative sites of a wide array of daily activities likely found throughout Mesoamerica, and thus the approach taken in these investigations could be applicable in many other areas. Building upon previous studies provides a unique opportunity to complement those data already collected, and I hope that this thesis will provide a comparative case study for research at Mesoamerican sites in other areas and time periods.

Moreover, I seek to further active collaboration between community members and archaeological projects, and to continue dialogue between U.S. and Honduran scholars. From the outset, I aimed to interweave the interests of various stakeholders into a collaborative endeavor which sought not simply to produce information to further my own academic career, but to utilize information in a way which benefitted the hosting community and increased the understanding of this region in general. I hoped that the research carried out at this site would grant personnel (students, Honduran scholars, local community members, and volunteers) experience in archaeological techniques in general, and in applying paleoethnobotanical methods specifically. What I found was that local community engagement provided the opportunity for reciprocal learning about botanical practices, both past and present. It was through such engagement that I sought to enhance theories of foodways through archaeological means, to enrich discussions of social organization, and to recover and describe paleoethnobotanical materials that, thus far, were only posited to exist.

2. Theoretical Underpinnings and Broader Conversations

What theoretical perspectives inform my work?

Some of this thesis is simply meant to fill "holes" in the archaeobotanical record (identifying root crops and non-domesticates), and some of this thesis treats methodological questions (the complementarity of botanical data types, and the ways by which we classify taxa and practices). However, a number of my questions are oriented more toward the social dynamic. But where to plunge into the social dynamic? Drawing together multiple theoretical strands is a curious exercise. In my case, I wanted to make use of materials I had learned over the years, materials that sometimes make strange bedfellows. My starting point was practice theory, with heavy borrowing from linguistic anthropology. This made sense, considering my mentors in the U.C. Berkeley Anthropology department. However, the botanical aspects of my thesis demanded attention through other approaches as well, including cultural ecology.

This section, then, is devoted to the odd marriage of some of these perspectives, in order to better get at associations and disassociations between artifacts and taxa, differences and similarities over spaces and contexts, and transformation and continuity over time, in taxa and associated practices. I begin with practice theory perspectives, outlining the major figures and ideas that I make use of here. Following this discussion, I outline a few theoretical approaches to language, describing paradigmatic and syntagmatic axes as related to language and foodways, and articulating the two axes with each other. I then link practice theory approaches to linguistic approaches and cultural ecology approaches, in order to discuss the context of daily practice, intelligibility and competency, and text and speech acts. I weave approaches to foodways throughout, although this topic is the more narrow focus of the next chapter. Overall, the intertwining of these approaches may seem overly fussy and complicated, but after over a thousand hours at the microscope, ruminating like a goat, believe me, it could have been much worse.

Outline of theoretical approaches: practice

Why should archaeologists employ practice theory? According to Loic Wacquant and Pierre Bourdieu (1992:3), it "throws a manifold challenge at the current divisions and accepted modes of thinking... [through] utter disregard for disciplinary boundaries, [through] the unusually broad spectrum of domains of specialized inquiry it traverses... and [through] its ability to blend a variety of sociological styles, from painstaking ethnographic accounts to statistical models [in order to] abstract metatheoretical and philosophical arguments." (See also Giddens 1979:46-47).

Theories of practice straddle such apparently dichotomous areas as subjectivism and objectivism, symbolic studies and material studies, theory and research, structure and agency, microanalysis and macroanalysis (Bourdieu and Wacquant 1992; Giddens 1979). This middle ground is staked out through the study of practice. "Practice", in this sense, is comprised of "regulated improvisation", the dynamic mediation between the internal and the external

(Bourdieu 1977, 1990; similarly to Giddens 1979:56). It is that which subjects do, make, maintain, and transform, and is neither entirely effect nor entirely activity, as it encompasses both routinized habits and acts of varying degrees of "consciousness"(Bourdieu 1977, 1990; Giddens 1979).

Doxa is one element of this approach which governs, and is governed by, practice. It is the realm of the undiscussed, the routinized, the unproblematic, the taken-for-granted (Bourdieu 1977; Bourdieu 1990:83). It is comprised of the "relations of order which... are accepted as self-evident" (Bourdieu 1984 [1979]:471). In other words, it is that which "‘goes without saying’ because it comes without saying"(Bourdieu 1977:167). *Doxa,* once ruptured, in a moment or process of "disillusionment", is cast into either "orthodoxy", whereby it is actively regulated, legitimated, and/or consecrated, or "heterodoxy", by which it is actively challenged, refuted, and/or modified. If *doxa* emerges through that which is undiscussed, *as* that which is undiscussed, then orthodoxy and heterodoxy emerge both through discourse, and *as* discourse (Bourdieu 1977:168).

Charles Sanders Peirce (1998: 336-337) similarly notes:

> Belief is not a momentary mode of consciousness; it is a habit of mind essentially enduring for some time, and mostly (at least) unconscious, and like other habits, it is (until it meets with some surprise that begins its dissolution) perfectly self-satisfied. Doubt is of an altogether contrary genus. It is not a habit, but the privation of a habit. Now a privation of a habit, in order to be anything at all, must be a condition of erratic activity that in some way must get superseded by a habit.

Doxa, from a Peircian perspective, would be a sort of 'sum of consequences' of experience. In this perspective, the constant "experiments" in daily life produce results, results which affect human conduct. These experiments battle "unchanging ideas", especially in cases where "some experience equivalent to an experiment has brought its truth home… more intimately than before [the experiment]" (Peirce 1998: 340). Purposive action occurs through a belief in phenomena understood through experience, and, consequently, "the sum of the experimental phenomena that a proposition implies makes up its entire bearing upon human conduct"(Peirce 1998:340).

Situated within, and emerging from, the present state of a field, our *doxa* constitute how we perceive others' *doxa*, and this in turn helps to define our own *doxa*. The following quote nicely illustrates the process of such inculcation:

> A man breaking his journey between one place and another at a third place of no name, character, population or significance, sees a unicorn cross his path and disappear. That in itself is startling, but there are precedents for mystical encounters of various kinds, or to be less extreme, *a choice of persuasions to put it down to fancy*; until– "My God,"says a second man, "I must be dreaming, I thought I saw a unicorn." At which point, a dimension is added that makes the experience as alarming as it will ever be. A third witness, you understand, adds no further dimension but only spreads it thinner, and a fourth thinner still, and the more witnesses there are the thinner it gets and the more reasonable it becomes until it is as thin as reality, the name we give to the common experience. . . . "Look, look!"recites the crowd. "A horse with an arrow in its forehead! It must have been mistaken for a deer! (Stoppard 1967:21)

In such a way, regardless of whether or not the *actuality* exists ("a unicorn") there is a layered, constructed, and reconstructed *reality* ("that was a horse with an arrow in its forehead") which is repeated and reified, sometimes without evaluation of truth or even argumentation (has the horse been tracked down to verify everyone’s assumption?) What happens, then, should we *be* confronted with our own set of assumptions? Stoppard, again, has an illustrative quote: "All your life you live so close to truth, it becomes a permanent blur in the corner of your eye, and when something nudges it into outline it is like being ambushed by a grotesque" (Stoppard 1967:39).

If *doxa* is a sort of "practical knowledge", the tacit assumptions regarding the stakes of the game, the set of understandings grounded in embodied beliefs, then *habitus* is a sort of "practical sense", the unconscious knowledge of the movements of the game, the set of dispositions grounded in embodied actions. *Habitus* references the "habits of mind", the "realm of the possibles", and is both dispositional and postural, consisting of habits of thinking as translated corporeally (Hanks, personal communication, 2004). That is, *habitus* is both practice and the point out of which practice emerges. Through the *habitus*, subjective reality is pre-formed, and thus the scope of *habitus* is broader than either "intention"or "orientation". *Habitus* is dialectically related to *doxa*, which is itself subject to perpetual transformation through practice (Hanks, personal communication, 2004).

Habitus, *doxa,* and practice are also inseparable from *fields*. Fields are comprised of relationships, and are the spaces of positions and position-takings (Bourdieu 1993). Fields have characteristics which vary in different dimensions and hinge on temporality and heterogeneity (similar to de Certeau 1984 and Giddens 1979), only becoming "units" of organization when the analytical focus is on *boundary* (Bourdieu 1993). The boundaries of "fields" lie at the limits of the extent to which endemic contestation and oppositions reach. In the course of daily practice, if *habitus* and field emerge in accord, *doxa* can be defined as the relationship between them (Bourdieu 1990:68). Thus, attunement of *habitus* to field is an indicator of *doxic* inculcation. We are disposed to practice through that which is taken-for-granted, and that which is taken-for-granted *remains* taken for granted, as we are continuously disposed to practice in a way which leaves the unsaid unstated. Practice is thus the product and producer of a recursive algorithm which incorporates *habitus*, *doxa*, and *field*, each a sort of sub-algorithm which both produces and is produced by the other components.

In just such a way, foodways, as an aspect of daily life, are constructed through layers of practice, and, in turn, formulate future practice. They are transformed and reified through daily and ritual activities, which are governed by prior activities involving food. Foodways are part belief and part custom, and thus can influence *doxa* and *habitus*. The practices and ingredients involved in a meal depend on fields, both social and physical, which are in turn dependent on them. However, in order to understand how certain foods and food practices are patterned or anomalous in certain contexts and spaces, and how these patterns and anomalies transform over time, I needed to understand the movement of these practices and positions. As the interplay between practice and *doxa* (Bourdieu 1990 [1980]) is roughly analogous to the interplay between paradigm and syntagm, text and context, (as well as space and place, following de Certeau 1984), I turned to perspectives which incorporate language.

Outline of theoretical approaches: language

The foundations for a linguistic approach to foodways have been laid through the work of Ferdinand de Saussure (1986 [1966]). Two of the basic concepts he invokes are the *langue* (a system of words) and *parole* (a speech act). The Saussurean legacy brings us aspects of structure, in a model which incorporates two axes: the paradigm and the syntagm. These two axes, intended to understand language, can also be applied to aspects of foodways. Each is dependent upon the other, in the same way that *doxa* and *habitus* are trialectically related to practice.

There are a few direct inheritors of the Saussurean model. Indeed, in pursuit of "cuisine", many authors draw analogies between ingredients and *langue*, cuisine and *parole* (Weismantel 1988, Soler 1997, Counihan and Van Esterik 1997, Barthes 1997 [1961], Douglas 1997). These approaches are often marked by the binary use of *langue* and *parole*, as well as a more structuralist commitment to meaning. In one key example, Lévi-Strauss, in formulating his triangle of Raw, Cooked, and Rotted, states that "the cooking of a society is a language in which it unconsciously translates its structure-- or else resigns itself, still unconsciously, to revealing its contradictions" (Lévi-Strauss 1997:35). He assumes that his triangular structural posit is the underlying schematic of every culture, and any cultural differences are simply "modifications".

Elaborating on this early schema, Mary Douglas attempted to add diachrony, local variability, historicity, and meaning. She notes "the meaning of a meal is found in a system of repeated analogies. Each meal carries something of the meaning of the other meals; each meal is a structured social event which structures others in its own image" (1997:45). Douglas, in her study of her own family's meal planning, pursues syntagmatic relations and 'meaning' of foods, approaching "the degree to which a family uses symbolic structures which are available from the wider social system" (1997:43). Edmund Leach (1964) brought in a non-discursive dimension to these discussions, in considering what is *not* good to eat. Adrienne Lehrer considered "cooking vocabularies", still from a very structuralist perspective, but focusing more on the syntagmatic axis than the paradigmatic. She compiled a list of primary semantic relations including concepts of incompatibility, complementarity, antonymy, conversenenss, hyponymy, and synonymy (1972:156).

In a more nuanced approach, Mary Weismantel views foods as both symbols and signs (1988). Through her work among the Zumbagua, she draws distinctions between food "paradigms" which are relational to other systems, and food "syntagms" which are relational to other items on a plate. In Weismantel's linguistic metaphor are contrasted diet/form/sign/system/langue and cuisine/content/symbol/expression/parole. From this discussion, Weismantel links together food signs underlying everyday practice, food symbols used in ideological discourse, and practice and power relations which produce and are produced by them. She finds the overall "semiotic structure" of Zumbagua cuisine is pan-Andean, although she identifies certain aspects as the result of local history.

Conversely, Stahl has rallied against what she terms "logocentric approaches to meaning" (2002: 827), as being too rooted in "the diverse legacies of Saussurean linguistics (Levi Strauss 1963; Saussure 1999), semiotics (Barthes 1967, 1972, 1983; Baudrillard 1981), dialogic approaches (Bakhtin 1981), discursive perspectives (Foucault 1972), and a conviction that cultural worlds, like texts, are open to decoding or exegesis through reading." Although this may be accurate in the literature she cites, approaches to linguistics since 1985 have incorporated elements of practice theory, in fields such as emergent grammar and conversational discourse analysis.

It is apparent that paradigmatic and syntagmatic relations of speech have long been the fodder for explorations of foodways. Why is a linguistic approach so often invoked? Perhaps partially because, at a very basic level, a universal quality of human life is language, and another is food. This is not to imply that there is a one-to-one analogy between the forms, mechanisms, and expression of each, but rather that each is deeply seated in our collective culture history and our biological hardwiring. In my case, a linguistic framework and approach is the best fit, I've found, when incorporating elements of practice theory and aspects of foodways. It is also the most malleable, in terms of integrating ecology, history, and context. Moreover, it is quite amenable to looking at data from different perspectives and at different scales. Perhaps this renders the framework too broad– like an astrological prediction so general that it can fit anyone, at any time. But I've found this breadth helpful, when thinking about the different qualities and elements of foodways, in an area that is data-meager in terms of actual paleoethnobotanical remains, but rich in the sorts of associations that may be drawn between different elements.

In addition to the more Saussurean approaches, I draw in aspects of Peircean semiotics (study of language), pragmatics (particular area devoted to use), and indexical expressions (practices which are not intelligible without knowledge of previous use).

Why Charles Sander Peirce, and not simply Ferdinand de Saussure? A semiotic approach to foodways, from a Peircean standpoint, incorporates more practice, and is less rigidly structuralist in its formulation. This use of Peirce, following Preucel, "does not privilege language as the model for semiotics, rather it offers a more general model which incorporates language, social practices, and material culture" (2006:90). Indeed, semiotic approaches more of the Peircean stripe are amenable to incorporation of the work of Bourdieu, de Certeau, Giddens, and other practice theorists. By incorporating these approaches, and using Peircean precepts, I am able to piece together an historical, contextual perspective on foodways that "attends to moments when the habits of taste are diverted or interrupted, to resist the notion of fixity and gain an appreciation for the extent to which the habits of taste are not a 'finished set of rules" but rather a "repertoire of possibilities" (Stahl 2002: 832).

In such a semiotic framework, there is still a strong relationship between "the knowledge of a language and "speech acts" (de Certeau 1984:33), or the paradigmatic realm of possibility and the syntagmatic associations between elements. In this way, social activities are instantiated at the moment of intersect between time, context, and space, and transformation occurs as a matter of course (following de Certeau 1984:33; Giddens (1979:54). However, before invoking them, I should first characterize my use of paradigmatic and syntagmatic axes, and the dynamic between them.

The paradigmatic axis

> "At its annual national conference Saturday, the American Association of Vegans and Vegetarians released results of a detailed in-house study determining that the common beef cow is actually a plant, 100 percent fit for vegetarian consumption."

This article, titled "Desperate Vegetarians Declare Cows Plants" (*The Onion*, 2000:9), goes on to detail the reasoning behind the new semantics. As the piece illustrates, however facetiously, classification has the power to alter analytical interpretation, social behavior, and even perception itself. Similar arguments have long been articulated in the work of Douglas (1997 [1975]) and Levi-Strauss (1997 [1968]), among others, in terms of thinking through the concepts of "edible" and "inedible".

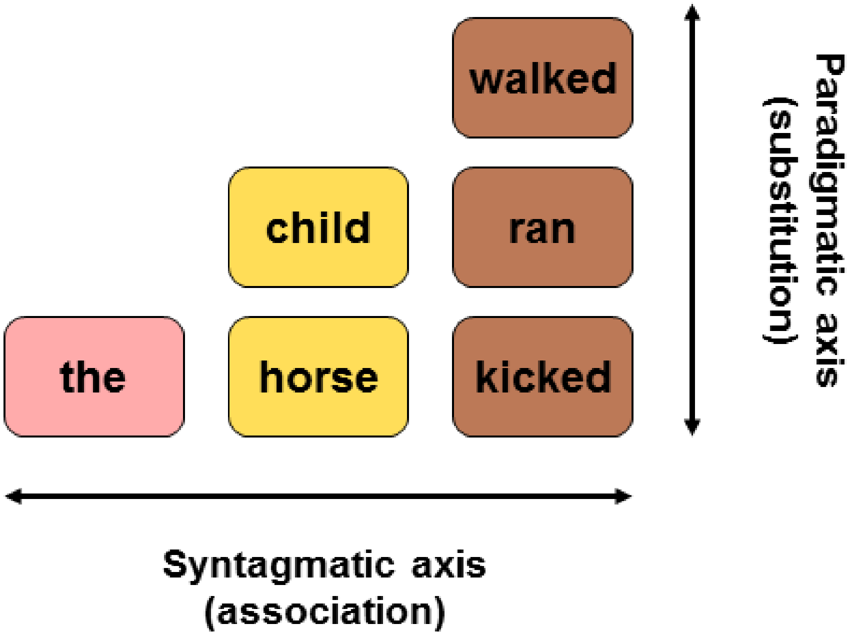


Figure 2.1. The articulation of the paradigmatic and syntagmatic axes in speech.

Essentially, the paradigm is a set of similarly-classified elements within a category **(Figure 2.1)**. It is the vertical set of possible options for each category, along the axis of substitution (Chandler 1994, 2007). In terms of foodways, there exists a population of nutritionally available foods which include things such as fruits, seeds, animals, insects, and even human beings. This can be contrasted with a paradigm of *culturally* available foods, which do not usually include all of the above. In terms of practice, paradigms of foodways appear as patterned substitutions of elements.

As far as the perception and/or construction of paradigmatic elements, foodways are highly fluid– witness the changes in categories just over the past 50 years in our own food culture. In archaeology, when pursuing foodways, the relevant data is usually farmed out to different specialists– the zooarchaeologist, the paleoethnobotanist, the spatial analyst, etc., and/or partitioned into different segments of reports– plants, fish, animals; etc.. This leads to disjunctures in terms of practices viewed, as, for example, "procuring" is divided into hunting, collecting, growing, "processing" is divided into butchering, grinding, cooking, etc. This also sets up a bias in terms of how foods are categorized– usually, in terms of "meats" and "plants".

Essentially, these are types based on ecofact/artifact form. There are functional divisions, as well, such as those found in nutritional analyses: divisions into carbohydrates, proteins, nutrients, water, and fats. Then there are categorical mixtures of form and function: staples, proteins, condiments, vegetables. In one recent work, Robb (2007), when discussing culinary prehistory as *habitus* and "taskscape", identifies four basic food groups: potential food resources which were never or seldom eaten, bulk staples of the diet including grain and legumes, supplementary food resources such as "flavors", and socially-consumed meat proteins.

Contemporary formulations of four-food groups, and more recently, food pyramids, show the slippery nature of these designations.

Indeed, positing a set of paradigms is tricky business. So what is the best way of approaching foodways linguistically? By biological necessities ("protein", "carbohydrate" "salt", etc.)? By modern-day categories ("bread" "meat" "condiment" etc.)? There is always a danger, in constructing such typologies or categories. Without revisiting the arguments of Spaulding and Ford ("Are types 'real'? Are they constructed by the researcher? How can we approach them?"), I would argue that there is real value in producing some sort of heuristic framework of potential categories. Ultimately, the question is: are such categories meaningful in the past? For as Lehrer (1972:169) has cautioned, in constructing such a schema of foodways, it is potentially "a neat model of cooking practices, but it does not serve as an accurate model of how cultures are likely to categorize their own cooking practices, at least as revealed by the semantic structure of the lexical field."

One option is to devise categories based on sets of attributes, dependent on the type of questions pursued (nutrition, ritual use, ecological provenance, etc.) Approaches such as correspondence analysis of attributes can be utilized to cluster different taxa, spaces, or artifacts into broad categories. A single taxon, for example, has a designation in terms of Latin taxonomies, folk nomenclature, part, DNA makeup, chemical signature, etc. Each of these categories has a particular utility, dependent on a particular research question. For example, foods such as acorns may be found ubiquitously across a community, in a multitude of contexts, ubiquitously on grinding stones and human teeth, on a wide diversity and large number of artifacts, indicating a likely staple food by modern standards. This could match the paradigm as set up by ethnographic and ethnohistoric accounts, as well as what meager archaeobotanical work has been carried out at other sites.

There are many complicating factors. Feast foods and quotidian foods, for example, are not perfectly mutually exclusive categories, insofar as their differentiation may depend on a variety of factors within much overlap occurs. That is, there may be ingredients particular only to feasts, and/or preparation particular only to feasts, and/or quantities particular only to feasts, and/or servingware particular only to feasts, and or settings particular only to feasts, etc. (following Hastorf and Weismantel 2007). Their contexts may vary as well, and it could be along the syntagmatic axis alone (here, as temporal) that marks a food as a feast food– when given on a particular day marked outside quotidian meals.

Whether or not they are only meaningful to the researcher, if grounded in real empirical patterns, I argue that there is some merit in searching for paradigms of foodways, so that associations may be drawn between elements of a data set. My work is partially concerned with the mechanisms by which foods are classified, and the moments when, in the course of a food act, *doxa* is ruptured, leaving a space for reflective decision-making in paradigmatic classification. In the process of such reflection, the typologies of the paradigmatic axis are cast and recast. It is along the axis of association, however, that practices emerge.

The syntagmatic axis

The syntagmatic axis can be defined as the horizontal placement of elements (spatial, temporal, or associative), along the axis of positioning (Chandler 2007). It essentially marks how the elements of the paradigm combine, in different ways, as a dynamic interplay between different contexts, timing, and availability. The syntagmatic associations are, essentially, "what goes with what", as conditioned by particular situations. When considering the flow of speech, this is similar to Giddens' observation (heavily referencing Heidegger): "that which makes the thing what it is precedes the thing" (1979:54).

Giddens frames time and space as understandable *only* in relation to objects and events, instead of framing the spatiotemporal context as a simple receptacle of experience (1979:54). In other words, "Being appears to us, in time, as the Becoming of the Possible" (Giddens 1979:54). Giddens, however, modifies Heidegger's schema with the addition of a paradigmatic axis. He conceptualizes agency (here synonymous with "actions of an agent") as a continuous flow of conduct, similar to an ongoing syntagmatic collection of associations, but cautions that this must be examined within "a broader theory of the acting self" (1979:55). In terms of relationships between associated elements, Giddens claims that "the sense of linguistic items can only be sought in the practices which they express and in which they are expressed" (1979:38). Hanks (1990) and others have used similar concepts of deictics and indexicality to consider language, space and place as relational entities.

Such factors as scheduling, seasonality, agricultural production, cultural preferences, personal tastes, ritual values, etc., all have enormous impact on the syntagmatic associations of foodways. Syntagmatic associations may be between foods and tools, foods and practices, foods and other foods, foods and spaces, and foods and contexts, among others. For example, acorns may be boiled in baskets but not roasted in firepits, consumed daily but never for feasts, ground but not cut, eaten with meat but not with roots, and so on. Each instance of such associations, when aggregated with others, provides a possible pattern of associations that helps to define the syntagmatic axis of cuisine.

As with paradigmatic substitutions, difficulty lies in identifying syntagmatic arrangements, especially for archaeologists accustomed to identifying food bundles in terms of nutritive aspects only. As Giddens has noted, patterns of interaction are situated in time, and "only when examined over time do they form 'patterns' at all" (1979:202). He draws special attention to the serial nature of activity between participants and the effect of timing on practice. In one South Pacific community, the members cultivated high-labor investment yams, simply to switch up their usual diet of low-investment high-yield taro (Pat Kirch 2008, personal communication). The paradigmatic substitution of yams for taro, in this case, had more to do with timing and food boredom than caloric input or output. There are many such examples of tastes dictating the associations or timing of elements along the syntagmatic axis (e.g. Rosen 1997).

Articulation of the paradigm with the syntagm

Overall, I consider "paradigms" as the sets of possible options, concepts, or activities, guided by practices as they unfold along the syntagmatic axis. I consider "syntagms" as the sets of associations formed through the selection of options, concepts, or activities, from the limited paradigmatic axis. The paradigm and the syntagm are usually conceptualized as the y and x axes, respectively, of a matrix. As context, syntagm, and paradigm interplay, the result is a set of syntagmatic consequences; a sort of "time-line" or collection of inter-dependent elements. In this matrix, the dynamic interplay between paradigm and syntagm is both producer and product of practice. Transformations in either relations between elements or the available paradigmatic subset can produce changes in the other. The options taken during the course of a speech act can be likened to the cognitive concept of chaîne opératoire (Schlanger 1994), although in this case, a grammar is instantiated, differing from traditional Saussurean approaches in which the grammatical template is used as a sort of yardstick against which individual speech acts are measured.

"Grammars" of foodways are instantiated, maintained, transformed, and reiterated by the daily practice that is in turn shaped by these "grammars". In a two-dimensional and over-simplified way, these relationships could be expressed as follows: practice (regulated improvisations) = habitus (dispositions) to x as influenced (through practice) by *doxa* (assumptions) of y as influenced (through practice) by field (space of positions and position-takings) in which z) = practice (regulated improvisations) = ... ad infinitum. Such iterations and reiterations, through daily meals and feasts, can result in the innovation of foodways and the production of novel forms of recipes, practice, process, and performance. Again, this linguistic model, when applied to foodways, is not meant to represent THE grammar, but rather A grammar. It is mean to be a sort of "average" of knowledge thus far, a range of *possible* practices.

Approaches to subsistence, in the anthropology of ancient societies, is usually conceived as static, with external pushes toward transformation. Such transformation is usually couched in terms of crisis. However, the set of relations imposed on the paradigm occurs through more than just crisis-- the pressures of syntagma in practice, and contextual factors including history, society, ecology, and biology. This can have paradigmatic consequences, similar to the overlap of fields, in the Bourdieuian sense (Bourdieu 1990; Bourdieu and Wacquant 1992) or switching of footing, in the Goffmanian sense (Goffman 1981). That is, linguistically it results in not just the substitution of a noun for an adverb, or a different sort of noun, but rather an alteration of the available set of terms, which may eventually result in the formation of a new paradigm; an addition (as opposed to an alteration) of an available category.

In terms of foodways, defining both axes, and articulating them together, is a daunting task. Following Chandler, "The description of any semiotic system involves specifying both the membership of all of the relevant paradigmatic sets and also the possible combinations of one set with another in well-formed syntagms." For example, in a 1A-2B pattern of meal construction, similar to that outlined by Mary Douglas (1997 [1975]), proteins are interchangeable, carbohydrates are interchangeable, and vegetables are interchangeable, within the "grammar" of a meal. Alter the syntagmatic relationship, and you can have a 2A-1B pattern, as is found in a "carb-free" Atkins-style diet. But alter the paradigmatic axis, and you have a different set of "carbs" themselves- effectively, an entirely different folk taxonomy. Where once "carbs" were the realm of bread, pasta, and potatoes, now for some of us "carbs" include beans, which once were considered "proteins", and fruits, which were once lumped into the category "fruits and vegetables", etc. etc. What might be a meal, in this case for a Southeastern Mesoamerican household of the pre-Contact period, would likely involve a very different set of paradigms and syntagms—potentially a "condiment" category, a "maize-based food" category, and "accompanying starchy food" category (very hypothetical example in **Figure 2.2**).

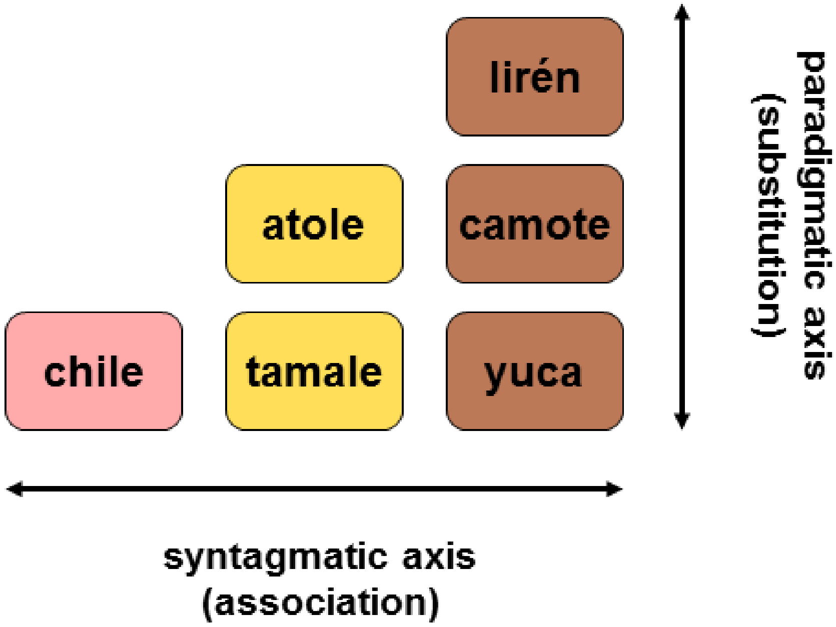


Figure 2.2. Very hypothetical example of a pre-Hispanic "meal" in Southeastern Mesoamerica.

Taking this idea a step further, alter the contexts, and both the paradigmatic and syntagmatic range of possibilities change, becoming narrower or expansive. Ecological factors such as seasonality affect the availability of certain "carbs", cultural factors such as "organic" or "conventional" designations affect the desirability of certain "carbs", physiobiological factors such as food sensitivities affect the digestibility of certain "carbs", and historical factors such as repetitiveness of foods affect the timing of certain "carbs". Substitute "plants" for "carbs" in these relationships, and "practices surrounding plants" cannot be equated with "uses of plants" nor even "activities involving plants", as plants here are both products and producers of practice. Such complex relationships are expressed archaeobotanically often in subtle ways.

Adaptation, or "making do", is a good example of how different elements of the model articulate. Andrea Adolph, in her portrait of foodways during World War I (2009:163), elucidates coping mechanisms employed by desperate British cooks who found themselves short of supplies. In one example, she describes the "culinary trickery" of substituting fish with Jerusalem artichokes and anchovy paste. Such culinary swapping, here called "making do", is set up as the dynamic interplay between culinary expectations and subversive everyday tactics. Food here is thus made to be iconically similar to fish, an index of kitchen craftsmanship, and symbolic of times where sumptuous meals were more the order (a sort of "remembrance of repasts.") The context of this act is the "ecology" of wartime. The adaptation, the coping, is the paradigmatic shifting of Jerusalem artichoke in place of fish. This paradigmatic shift would not be possible without history, without the syntagm of 'speech acts' which have led to the expectation that fish is proper to eat, kitchen craftsmanship is expected, and invocation of the once-familiar is preferable to the jarring actuality of wartime foodways. The flow of food *doxa*, interrupted by transformations in availability of supplies, has led the wartime cook to an orthodoxy involving anchovy paste, in order to preserve the paradigm of fish. The practices may be heterodoxic, but the intent is entirely orthodoxic.

Problematically, there is the issue of the interminability of the speech act and its repercussions. Is the speech act a dish, a meal, a set of daily meals, a set of weekly meals, or the set of meals within a year? This has dramatic consequences for both axes– the syntagmatic and the paradigmatic. If we look at a particular dish, certain elements will be present– maize masa, water, and salt, for example. Perhaps this particular dish is usually served with chile. Perhaps this dish is served with chile for breakfast, but without chile for lunch. Perhaps this dish is, on a daily basis, served only for breakfast and lunch, and never for dinner. Perhaps this dish is served almost every day of the year, except for particular feast or fast days. Already the atole, a relatively common and simple dish, is in need of a complicated flowchart, a set of algorithms, a Venn diagram, or all of the above, to describe its relationship to other foods. In these cases, there is a high degree of variability between elements or sets. There is a temporal or qualitative difference (breakfast vs. lunch, or work day vs. celebratory day) that impacts its placement in a set of associations (is eaten with chile or without chile), or its possible substitution (is replaced on feast days by roasted deer and sweet potatoes).

In my own work, I consider syntagms, in terms of associations between elements, and paradigms, in terms of possible substitutions of elements within a set. For example, are there "staple carbohydrates"– root crops vs. maize or are root crops separate from maize? My intent is to outline possible paradigmatic substitutions, and possible syntagmatic relations. What are the paradigmatic substitutions, in terms of available elements within a particular category of food (consuming maize in place of root crops, for example)? Furthermore, over time, what syntagmatic relationships change, interwoven as they are with transformations in ecology and society (the disappearance of certain root crops, for example)? Finally, what are the syntagmatic re-combinations, in terms of foodstuffs in a particular place and time, and what are the syntagmatic re-associations, in terms of combinations of foodstuffs over time (the pairing of maize with ritual contexts, for example)?

The context of daily practice

In the same way that speech acts do not take place in a vacuum, foodways are nested in particular fields-- complex interweaves of historical, cultural, ecological, and biological contexts. That is, the paradigmatic and syntagmatic axes of food practices are historically contextualized, governed by *doxa* and *habitus*, situated in ecological contexts, and interactive with neurobiological factors such as pleasing flavor and food allergies.

Goffman alludes to the interplay of three primary matters in speech: ritualization (*habitus* and *doxa* formation; embodiment), participation framework (give and take of discourse; the "ecology" of discourse & its participants), and embedding (allusions and meanings). He claims that, "when we speak we can set into the current framework of participation what is structurally marked as integral to another, enacting a dozen voices to do so"(1981:4). Temporal-spatial characteristics "are routinely drawn upon by social actors in the sustaining of communication– a phenomenon of no small importance for semantic theory" (Giddens 1979:208). Moreover, the syntagmatic flow is guided by a particular set of ecological, cultural, biological, and historical relations at a particular time. These relations are what de Certeau labels "the possibilities offered by circumstances"(1984:29). Hanks, of these circumstances, similarly notes "certain forms of interaction that would be *semiotically* possible... are *socioculturally* impossible because of the nature of the fields in which they occur" (Hanks 1990:76, emphasis added).

Linguistic scholars have long noted the impact of broader contexts on individual practices. As Peirce noted, in the nineteenth century, "the... circle of society (however widely or narrowly this phrase may be understood) is a sort of loosely compacted person, in some respects of higher rank than the person of an individual organism" (1998:338). Context and the speech act, ultimately, are perhaps irreducible outside of heuristic exercise. Insofar as we are able to get at them independently, however, there are questions to be asked, in terms of the influence of context on both syntagm (in terms of association, relationships between terms, sequencing, and timing) and paradigm (in terms of the set of options available in a particular instance).

Ecology and history are the two primary contextual variables that have been addressed by authors discussing foodways (as noted in Hastorf and Weismantel 2007). However, social context constrains (and is constrained by) such aspects of foodways as edibility, ecology constrains (and is constrained by) seasonality, cultural values, etc. Adolph (1993:163), relying on the work of other scholars, discusses such constraints, and draws out implications of wartime food-switching acts. She notes that:

> …Such practices are what Certeau discusses as "*la perruque*" (wig), a method of deception by which "order is *tricked* by an art" [Certeau1984:26, original italics]. The practitioner of "la perruque" cunningly takes pleasure in finding a way to create gratuitous products whose sole purpose is to signify his own capabilities through his *work* and to confirm his solidarity with other workers or his family" (Certeau1984:25), as does the housewife who refuses the lowest common culinary denominator and instead opts to reinvent the ways in which limited supplies of food can be thought of.

In describing the tactical flexibility of foodways practice, even in times of war, Adolf's arguments are similar to the way which Giddens distinguishes between "wants" and "empirical wants". He notes that empirical wants are "what people actually want in a given time and place" (Giddens 1979:189) which is "conditioned and confined by the nature of the society of which an individual is a member" (1979:190), e.g., the substitution of chicory for coffee.

In the landscape of human lifeways, places and spaces provide fields within which practices unfold, fields that are also modified in the course of practice. Archaeologists are long accustomed to the analysis of "activity areas", but I argue that these can be productively split into "contexts" and "spaces", somewhat akin to what de Certeau terms 'places' and 'spaces'. He describes places, modalities of action, and formalities of practice—aspects which might be hearkened to fields, paradigms, and syntagms. Following de Certeau (1984:36), the establishment of places results in a triumph of place over time, by reducing risk "through capitalization of acquired advantages [and] preparation for future expansions." In essence, the practices which unfold within a given context both define that context and are defined by it.

The transformations of "speech acts"-- the enactment of various foodways practices—formulate places, contexts, and spaces, even as they are formulated by them. In considering contexts and spaces, Giddens emphasizes the use of the term "locale", as for him it "is a preferable term to that of ‘place' [in that] it carries something of the connotation of space used as a setting for interaction" (1979:202). Locales, in his schema, are defined as nodes of spatial and platial contexts. Goffman partially defines virtual locales through what he terms "footing". Whereas Goffman differentiates between 'front' and 'back' regions, Giddens uses more gradations of reflexivity and practical consciousness. Regions are usually defined, he points out, in terms of time-space relations: "the separation of ‘living space' from ‘sleeping space' in homes is also differentiation in times of use" (Giddens 1979:207). In terms of foodways and fields, footing could be seen as analogous to the temporary positioning of people in a particular activity area, and helps to account for the overlap of areas. That is, what places may be used for husking maize at particular times of the day may be used for tool-making at other times.

Ultimately, it is difficult to separate the field of positions and position-takings from the syntagmatic and paradigmatic axes, as it is an exercise in disassociating elements of a tightly interwoven model. However, I here define "fields" as the locales of practices, and divide them into contexts and spaces. The syntagmatic associations, then, are crafted between given plant taxa and other plant taxa, plant taxa and the artifacts used with them, and practices and plant taxa. The unfolding of practice over time leads to transformations in foodways, both in terms of their association with locales or fields, and in terms of associations between the elements of foodways.

Text, speech acts, and foodways

Borrowing from de Certeau, "the speech act is at the same time a use *of* language and an operation performed *on* it" (1984:33). This formulation highlights the importance of practice. Speech acts influence what can be subsequently uttered (the syntagm), and the shape of future utterances (the paradigm). Speech is, as de Certeau puts, it, "realizing, appropriating, being inscribed in relations, being situated in time" (1984:33).

These ideas are similar to those inherited from emergent grammar. Hopper (1998) postulates that the rules for linguistic structure emerge as language is used. He claims that features of grammar are learned experientially, rather than pre-existing as innate rules in the human mind. Such an approach is used in linguistic discourse analysis and Conversational Analysis, which deal with the relationship between language structure and actual language use. In Conversational Analysis, the emphasis is the interaction, and the practice of language. Performance, here, is de-emphasized as a simple index of idealized competence.

In contrast with speech acts, text, as Giddens (1979:43) summarizes, is "the concrete medium and outcome of a process of production, reflexively monitored by its author or reader." He finds that the knowledge used in production of a text by an author is mostly tacit and practical (or embodied), an "awareness" of features and audience and "mastery of a certain style." Within this text, the author is "an acting subject, reconstituted in the making of the text…neither a bundle of intentions, nor... a series of ‘traces’ somehow deposited within the text" (Giddens 1979:44).

Referencing Bourdieu’s *habitus*, and how practical knowledge is embodied, Butler (1997) further notes that speech is a bodily act, differentiated from written text. She also claims that body speech is not the same as language utterance, although both speech acts are performed bodily. In this schema, speech act and body expression can even be at odds. For Butler, *habitus* operates according to performativity, and social performatives are ritualized and sedimented through time (formation of the *habitus).* In this way, "the interpellation as performative establishes the discursive constitution of the subject as inextricably bound to the social constitution of the subject" (1997:154). Similarly to how it is conceived in Bourdieu's work, the practice of speech here emerges as a sort of citational chain (1997:155).

Texts and speech acts are comprised of signs. As Peirce defines it, "a sign is anything, of whatsoever mode of being, which mediates between an object and an interpretant; since it is both determined by the object *relatively to the interpretant*, and determines the interpretant *in reference to the object*, in such wise as to cause the interpretant to be determined by the object through the mediation of this 'sign'" (1998:410). If a sign has no interpreter, Peirce claims that its interpretant is a "would be", that is, "what it *would* determine in the interpreter if there was one" (Peirce 1998:409). Giddens further defines two ways in which meaning is employed: what someone *means* to express and what an expression *means*. He notes "the consequences of actions chronically escape their initiators' intentions in processes of objectification" (Giddens 1979:44).

Foodways are somewhat comprised of speech acts, in their embodied aspects, and somewhat comprised of texts, in their material aspects. A "speech act", in terms of food practices, could be the expression of a meal, a set of daily meals, or a combined cuisine. It could be the set of food-related practices that take place in a particular location over time (grinding, cooking, serving in an area of the patio). It could also be a particular food-related practice that takes place in different locations over time (grinding maize in the patio, inside structures, etc). This presents the question: are there exclusive relationships, or preferences, expressed in the patterning of ingredients as related to food-related locations as related to food-related artifacts? And are they analogous to preferences of particular words, particular settings, and the interactions between the two?

Perhaps a rough analog could be made between what is spoken and what is left unspoken, and which materials are present and which are notably absent. These materials could be correlated to practices. However, in the process of consumption, although things are discarded, the *ways* of using them are left ephemeral (following de Certeau 1984:35). In this sense, foodways can be text-like. Practices of consumption "circulate without being seen, discernible only through the objects that they move about and erode" (de Certeau 1984:35). For structuration, situations, and practice, observability is variable, and often dependent on the text-like qualities of foodways, and the means by which they are inscribed.

Intelligibility, inculcation, and competency

As the social life is produced and reproduced, it formulates and is formulated by "skilled activities" (Giddens1979:40). Foodways, like speech acts, involve aspects of intelligibility, inculcation, and competency, in the course of their performance. For this reason, the execution of various foodways is dependent on many factors, not least of which is the actual embodiment of practices such as bread-making.

In terms of learning, acquisition of knowledge can be defined as the mediation between the structures that practices organize, and the dispositions they produce (de Certeau 1984:57). As with the acquisition of language, in foodways there is a need for tutelage and practice. Internalization of structures occurs through learning, and externalization of achievements (habitus) occurs through practices. In this way, practices (expressing the experience) correspond adequately to situations (manifesting the structure). As Bourdieu has noted:

> Inculcation and appropriation [are] needed in order for objective structures, the products of collective history, to be reproduced in the form of the durable, adjusted dispositions that are the condition of their functioning, the habitus. [Habitus] is constituted in the course through which agents partake of the history objectified in institutions.

> [Habitus] is what makes it possible to inhabit [these] institutions, to appropriate them practically, and so to keep them in activity, continuously pulling them from the state of dead letters, reviving the sense deposited in them, but at the same time imposing the revisions and transformations that reactivation entails. [emphasis and sentence breaks added]. (1990:57)

Rigid structuralists emphasize the semiotic and the semantic rules of language. "Intelligibility" would thus be dictated by the execution of a speech act, and the degree to which it conferred particular meanings or experiences to the listener or reader. Food practices, similarly, would be negotiated simply with skill levels, execution, and "success" of reception.

However, text is both "autonomous" (materially instantiated outside the individual) and itself a "situated production" (Giddens 1979:42). This introduces a disjuncture between the 'object' and 'concept' aspects of the monolithic Saussurean "signified". Rigid structuralism does not account for subjective *interpretation* (knowledge of/location within social conventions) of texts, which must be differentiated from "literary competence" (knowledge of language). Intelligibility can thus have to do with the level of competence in reproduction, as well as differences in what constitutes "good" food. That is, preferences for plain meat and potatoes versus highly-seasoned foods would affect the reception of a dish, regardless of the skill and competency of the chef who prepared it.

In both models of practice and models of language, we see such interconnectedness of text and context, language and social practice. In the execution of social practice, there are aspects of 'enunciation'. According to de Certeau (1984:33), enunciation presupposes: "1) a realization of the linguistic system through a speech act that actualizes some of its potential; 2) appropriation of language by the speaker who uses it; 3) postulation of an interlocutor (real or fictive) and thus the relational contract or allocution (one speaks to someone); 4) the establishment of a present through the act of the 'I' who speaks." However, the execution of foodways cannot be entirely conflated with the *performance* of foodways.

The performative aspect of food-making (borrowing from Latour 1986 and Butler 1988) is affected by the destined or conceived "audience" of a dish (following Mauss 1954). Even when alone, as Peirce (1998:338) notes, "a person is not absolutely an individual. His thoughts are what he is 'saying to himself,' that is…to that other self that is just coming into life in the flow of time. When one reasons, it is that critical self that one is trying to persuade."

Intelligibility could have to do with the reception of any aspect of foodways– where persons are seated during a meal, for example, and what they are served (following Appadurai 1981). This is not necessarily a discursive intelligibility, but may be encoded through bodily positioning and practical knowledge. Personal and cultural messages are encoded in and through food, and how these messages are received is the concordance between the intent of the encoder (whether discursively or nondiscursively encoded) and the reception of other participants toward whom these codes are directed.

Peirce's triadic formulation – sign, interpretant, object– provide a space for transformation, over time. By expanding the basic Saussrean dyad of signifier-signified (i.e. form of the concept-conceptualized), and incorporating the space for interpretation, this removes some of the static structural aspects, and adds possibility for doxic ‘puncture’. This results in sometimes deliberate transformations of paradigms and syntagms. For example, de Certeau defines rhetoric as the 'practices of creating shadows and ambiguities, and citations" (1984:101). He differentiates these from tropes, which are "catalogued by the rhetoric" and "deviations to the system."

There are also nondeliberate means by which transformation may occur. Butler (1988), in addressing performance, notes that no citation is ever a perfect replica of the previous iteration. Peirce has claimed that cognition arises by a continuous process (1958:42), and as Giddens has noted (1979:40-41), "there is no reading of a text, but only readings." Goffman also notes that "we rely on our audience to take the part for the whole, and cooperatively catch our meaning" (1981:2). Austin (1975) notes something similar in defining perlocutionary effects, where, unlike the locutionary acts which describe the linguistic function of an utterance, the effect on the interpreter of the act is emphasized. Thus, there is room for transformation in the process of interpretation. This provides space for transformation with every "iteration" of performance. That is, it is not only children, learning recipes from their parents, or learning how to harvest, or any one of a multitude of practices, who are the purveyors of unintentional innovation, i.e., the "imperfect copies" of an apprentice. Transformation can occur as simply a matter of course, in the flow of practices which are neither heterodoxic nor orthodoxic, but simply *doxic*.

In considering inculcation, intelligibility, and competency, if foodways, as language, are constant points of re-formulation, there is a difficulty in deciding what is tactically "making do", that is, what is heterodoxic departure or stylization, and what is ecological consequence, in terms of transformations seen over time and space in food practices.

Final thoughts

Bourdieu hearkened his schema of practice to gaming in a casino (Bourdieu and Wacquant 1992: 98-101). In this analogy, he compared each game to a field, *doxa* to the implicit belief in the stakes of the game, and *habitus* to the modes of the players, with the various game chips as the aspects of social (and other) capital that could be moved from game field to game field. As a penny poker aficionado, I am delighted by this metaphor. However, I would link it to linguistic aspects, as well, in terms of fields where conversation takes place, and the *habitus* and *doxa* which govern the associations and substitutions of the paradigmatic and syntagmatic axes and are in turn governed by them.

But to provide a more food-oriented metaphor, I would use the analogy of a busy kitchen. Each location of activities helps to define, and is defined by, unstated habits in terms of how the food is prepared, and unstated beliefs in what constitutes a particular dish or meal, as well as the movement of particular objects and ingredients suitable to the task at hand. Each field is defined by the materials, space, and activities carried out there, in the same way that each field helps to define these elements, and in the way these elements define each other. In a busy kitchen, salads are prepared in certain places, by certain people, using certain ingredients and techniques, at certain times of the day and certain days of the week, following certain beliefs as to what constitutes a salad, where and how it is prepared, when it is prepared, and who prepares it. It is this metaphor that I will extend into the past, though considering *atoles* more often than salads.

My broad intent is to outline possible paradigmatic substitutions, and possible syntagmatic relations. Among the questions I address are: What adaptations do people make in their foodways, as responses to external and internal factors (shifting to novel food resources, for example)? What are the paradigmatic substitutions, in terms of available elements within a particular category of food (consuming maize in place of root crops, for example)? Over time, what syntagmatic relationships change, interwoven as they are with transformations in ecology and society (the disappearance of certain root crops, for example)? What are the syntagmatic re-combinations, in terms of foodstuffs in a particular place and time, and what are the syntagmatic re-associations, in terms of combinations of foodstuffs over time (the pairing of maize with ritual contexts, for example)?

Giddens claims that all social activity is necessarily situated in "three intersecting moments of difference: temporally, paradigmatically (invoking structure which is present only in its instantiation) and spatially" (1979:54). My approach is similarly practice-based, linguistically-oriented, historically-contextualized, and spatially-focused. It is also engaged with a qualified materiality, as the transitory nature of food (if not culinary equipment) introduces an additional complexity. Food occupies a sort of liminal space; exists as practice and material in both body and mind. It is both paradigm and syntagm, ingestible and action. It can be icon, index, and symbol, or all three in overlap. The complexity of the problem is such that I devote a separate section to foodways alone. Specific approaches to food are highlighted in the next chapter, and related to the broader approaches to human activities outlined here.

3. Foodways and Ethnobotanical Practice

In the previous section, I described how certain scholars can contribute to how we think about foodways, when framed or re-framed in terms of practice and linguistic approaches. In this segment, I synthesize aspects of foodways literature that relate to this broader theoretical approach. In the subsequent chapter, to outline the specific set of Mesoamerican expectations and analogies related to my thesis inquiries, I combine ethnographic, ethnohistoric, and archaeological studies.

I here begin with a background of material explored in foodways literature. I turn to this literature, because it engages the ways that food practices, as an element of broader practice, enter the social dynamic. Why frame questions vis-à-vis this topical node? As someone with a long-term interest in foodways, both academically and personally, the research indulges my basic neophilic curiosity. I hope my work will aid in reconfiguring some of our taken-for-granteds, in terms of foodways broadly and Mesoamerican foodways in particular. Moreover, I consider foodways to be an ideal setting in which to explore practice, much the same way that I consider linguistic models to be a helpful way to view foodways. I present the following synthesis as something of an outline of broad approaches to aspects of foodways, then relate these ideas to my specific thesis interests. First, however, I spend some time defining the term "foodways" itself.

What are "foodways"?

Multiple authors have addressed foodways, in their regard of both past and present societies. In some studies, foodways themselves are the explicit pursuit, while in others, discussion of foodways is limited to footnotes. Most researchers, however, follow some version of the term as first defined by Jay Anderson in 1971: "The whole interrelated system of food conceptualization, procurement, distribution, preservation, preparation, and consumption shared by all members of a particular group" (Anderson 1971:2).

Though the term was not always defined in this way, the subject matter itself has long been explored. Foodways, in some way or another, have always been touched upon in ethnographic and anthropological literature, and not just for biological reasons. This inclusion may be because "in spite of the interdisciplinary nature of food studies... anthropology dominates the field... because anthropology is holistic by definition" (Counihan and Van Esterik 1997:1). Though long forming a part of broader anthropological studies, there have even been entire ethnographies explicitly directed toward foodways (e.g. Young 1971; Weismantel 1988; Ohnuki-Tierney 1993).

Authors who pursue foodways and related topics agree that food is an integral part of society and behavior. Some have even argued that food cannot *exist* outside of society and behavior. For these reasons, as Johannessen suggests, we should view food "not simply in its caloric or nutritional dimension, but in the fuller context of its production, storage, distribution, preparation, and presentation in a social and cultural setting" (Johannessen 1993:182).

Foodways have been approached through methods semiotic (e.g. Soler 1997 [1973]), structuralist (e.g. Lévi-Strauss 1997 [1966]), materialist (e.g. Harris 1997 [1985]), practice-oriented (e.g. Bourdieu 1984 [1979]), and combinations thereof (e.g. Weismantel 1988). Such a variety of approaches is not unexpected, as food lies at the interstices between subsistence and art, ecology and economy, materialism and symbolism. With these thoughts in mind, in the following subsections I briefly explore foodways through five thematic clusters: construction of the "edible"; medicines and pathologies; ingredients and cuisine; acculturation and inculcation; politics and ritualization; and identity, aesthetics, and embodiment.

How do potential foods become edible?

In spite of the wide range of potential foods available in a given ecological niche, it is not availability alone that determines what is actually eaten. And although some foods are believed to be dubious (e.g.: insects) and/or in need of extreme processing (e.g.: acorns), the ultimate rational claims of caloric value and nutrient content are those most often employed in discussions of "edibility". This remains perhaps one of the greatest flaws of optimality models (e.g. Binford 1980; Bettinger 1991; Harris 1989) and their permutations. Calculus is not the manner by which most people obtain calories, and, moreover, caloric intake is not the only reason why people eat. How, then, do foodways emerge in a given ecology, from a given historical context, or through a given individual? How is "edible" defined, and *who* defines it? What ultimately becomes the paradigm of "foods"?

It is usually taken as self-evident that the foods people eat were at some point "discovered" to be edible. ("'Twas a brave man that ate the first oyster", etc.) Humans are subject to the "omnivore's paradox", described by Fischler as a sort of double bind in which the omnivore is torn between feelings neophobia and neophilia toward new foods (Fischler 1980). However, as many authors have noted, "food" is more than a biological given-- it is a social construction, molded by individual tastes and preferences. Edible/inedible classifications are dynamic and historically contextualized, as "the boundary between 'natural' inedibles and the cultural binarity of edible/inedible is a fuzzy one," subject to immediate social context and current identity of the consumer (Falk 1991:759,761). For this reason, what is potentially edible is not always regarded as food (Soler 1997:55; Falk 1991:759; Farrington and Urry 1985:145; Fischler1980:940), and furthermore, what is considered "food" is not always actually *edible*.

The adoption of new foods occurs through syntagmatic associations, and paradigmatic substitutions. These aspects are usually couched as food patterns and classificatory schemes (Wetterstrom 1978; Farrington and Urry 1985). Brian Hesse notes the multiple ways through which "food" is constructed: through the "cultural-historical" (ethnic/political, ethnic/religious, and symbolic/linguistic factors) and through the "cultural ecological" (environmental, "initial settlement", hygienic, agricultural, and political factors) (Hesse 1990). He finds that "edibility", far from being reducible to any single factor, is usually the result of several. Similarly, Eugene Anderson identifies the Chinese classificatory system for foodstuffs as a combination of traditional and folk biological relationships (Anderson 1997 [1988]). In this schema, foods are classified according to yin/yang (balancing properties), humors (regulating and altering properties), *pu* (strengthening properties), *tu* (poisoning properties), *ch'ing* (cleaning properties), and combinations thereof.

Once identified as "edible", an element "will have to be converted into food through certain rituals of transformation" (Hamilakis 1999:39). Lyons and D'Andrea elaborate this idea, stating "new foods are more likely to be accepted if they can be prepared with existing technology, substitute for customary ingredients, and either hold or enhance the food product's value in traditional social contexts" (2003:516).

However its elements are collected and patterned, the diet of the human omnivore must meet one important requirement: that of *variety* (Fischler 1980:937). In the pursuit of nutritional satisfaction and/or risk management of potentially dangerous foods, there is a constant push towards neophilia. In spite of this push, as Rozin et al. note in their article on "disgust", there is also a myriad of reasons for a substance to be considered distasteful: undesirable sensory properties, anticipated consequences of eating it, and conceptualizations of its nature or origin (Rozin, et al. 2000). Indeed, judging by the quantity of literature on the matter, researchers appear more excited by what people have opted *not* to eat, rather than what they actually do consume.

Food taboos are an ongoing theme in foodways literature. Michael Young (1971) elucidates multiple food-kinship relations among the Kalauna, noting that each child possesses a system of food taboos, inherited primarily through the father (Young 1971). Many other authors approach the construction of the "inedible" by addressing taboos as presented in Leviticus. Soler notes that "there is a link between a people's dietary habits and its perception of the world" (Soler 1997 [1973]: 55). She finds that animals are defined as "unclean" because they are anomalous in their relation to other classes of animals (pigs, in this case, because they simultaneously occupy several classes) and are therefore "unthinkable" as food (1994:63.) This can be juxtaposed with Marvin Harris' approach, where "the most important food aversions and preferences of four major religions...are on balance favorable to the nutritional and ecological welfare of their followers" (Harris 1997 [1985]:79).

Douglas, as well, approaches the issue, claiming that it is part anomaly (ala Soler) and part economy (ala Harris), with the addition of history: pork is not eaten because pigs defy classification, because they carrion, and because they are reared as food by economically-competing non-Israelites (Douglas 1997 [1975]). It is such categorization problems that led Douglas to surmise the reasoning behind food taboos (here food distastes). As she notes, pre-formed categories can inform our tastes themselves. For this reason, when faced with new edibles, those unfamiliar with the "acceptable" foods of a local society will likely find categorically distasteful what is taken-for-granted by others. As Douglas notes, it is such inability to acknowledge the edible, even with the visible evidence of others consuming it, that often leads us to reinforce the categories of "edible" and "inedible" in our own foodways, as we are confronted with challenges to their orthodoxy.

Such examples illustrate the multiple forces at work in the creation and maintenance of both the edible and its antithesis. It is from this starting point that ingredients are formed, and through these constructions that cuisine emerges.

How is cuisine formed and reformed?

"Cuisine" is defined by Fischler as "a body of practices, representations, rules and norms based on classification, one of whose essential functions is precisely to resolve the omnivore's paradox" (1988). In pursuit of "cuisine", many authors draw analogies between ingredients and *langue,* and cuisine and *parole* (Weismantel 1988; Soler 1997; Counihan and Van Esterik 1997; Barthes 1997 [1961]; Douglas 1997). The formulation and reformulation of cuisine does appear to be easily analogized, using linguistic approaches, whether or not a particular scholar makes use of paradigmatic and syntagmatic modeling.

Lévi-Strauss, in formulating his triangle of Raw, Cooked, and Rotted, states that "the cooking of a society is a language in which it unconsciously translates its structure-- or else resigns itself, still unconsciously, to revealing its contradictions" (Lévi-Strauss 1997:35). He assumes that his triangular model is the underlying schematic of every culture, and any cultural differences are simply "modifications". Elaborating on this schema, Douglas attempts to add diachrony, local variability, historicity, and meaning. She notes "the meaning of a meal is found in a system of repeated analogies. Each meal carries something of the meaning of the other meals; each meal is a structured social event which structures others in its own image" (1997:45). Douglas, in a study of her own family's meal planning, pursues syntagmatic relations and 'meaning' of foods, approaching "the degree to which a family uses symbolic structures which are available from the wider social system" (1997:43).

In a more semiotic approach, Mary Weismantel views foods as both symbols and signs (Weismantel 1988). Through her work among the Zumbagua, she draws distinctions between food "paradigms" which are relational to other systems, and food "syntagms" which are relational to other items on a plate. In Weismantel's linguistic metaphor are contrasted diet/form/sign/system/langue and cuisine/content/symbol/expression/parole. From this discussion, Weismantel links together food signs underlying everyday practice, food symbols used in ideological discourse, and practice and power relations which produce and are produced by them. She finds the overall "semiotic structure" of Zumbagua cuisine is pan-Andean, although she identifies certain aspects as the result of local history, similar to the way in which Tamara Bray (2003) differentiates between the available foodstuffs and emergent culinary practices of the Inka empire (detailed in reference to its use in class formation). However, it is often at the level of the individual that cuisine is maintained, as "certain features of cuisine are sometimes retained even when the original language of the culture has been forgotten" (Fischler1988:280). For this reason, Farrington and Urry (1985: 150), in a more strict artefactual sense, believe that culinary traditions need to be emphasized in prehistoric studies, as specialized knowledge and skills used to transform objects into useful resources, even "art".

Regardless of how the syntagms and paradigms of foodways are constructed and transformed, some attention must be paid to aspects of foodways traditionally categorized separately.

What is the relationship between "food" and "medicine"?

As Fischler (1988:280) notes, "Every food is believed to have an effect on the body... [and thus] every food has medical significance." Indeed, there is a great deal of overlap between what modern allopathic approach has divided into "food" and "medicine". Mennell (1997:324) describes how moderation in eating was often used as a treatment for various illnesses during the medieval period in England. Nina Etkin and Paul Ross discover, in the course of their research in northern Nigeria (1994), "Almost all the 'wild' plants we discuss as foods appear on our master sample of plants used for medicinal purposes... [suggesting that] the local pharmacopoeia informs food selection" (1994:85). Similarly, Anderson finds that in Chinese traditional medicine, "diet therapy grades into herbal medicine with no sharp separation" (1997 [1988]:81). In his study, he notes that people following the tenets of traditional Chinese medicine react to physical distress by changing what they eat. Anderson elaborates on the impact that this intersect between medicine and food may have had on other practices: "Many plants and animals that would not otherwise have been domesticated, or kept in domestication, were grown because of their alleged medical values" (1997 [1988]:89). Such diversity of cultivated plants (in addition to knowledge and use of wild plants) may also have led, Anderson argues, to better nutritional support during times of famine.

As addressed by Dorothy Shack, the pathologies experienced by the Gurage of Ethiopia may sometimes not be physical, but rather emotional, relating to individual histories of nutritional deprivation (Shack 1997 [1969]). She claims that erratic and inconsistent breast feeding in infancy lead to anxiety surrounding sustenance later in life. Shack also notes that *ensete,* the staple crop (in 1969) of the Gurage people, is used on occasion as medicine to treat patients believed to be possessed by evil spirits (1997 [1969]:121). This crop, enmeshed in almost every aspect of daily life, thus serves double duty as quotidian food and specialized medicine. William Shack further addresses the overlap of food as medicine among the Gurage, noting that butter, either taken internally or applied as a poultice, can "effectively remedy a digestive upset or relieve uncomfortable aches and pains" (1997 [1971]:127). He notes, as well, that in cases of possession, the appetite of a possessing spirit must be fed as though it is that of the patient, sometimes through the patient's ravenous consumption of foodstuffs (Shack 1997 [1971]).

Meigs addresses the issue of individualized responses to sustenance, noting, "Food does not nourish by virtue of its innate properties. The same sweet potato that nourishes one person will cause debility and sickness in the next" (1997 [1988]:98). Similarly, Barthes claims that although food does have an obvious physiological function, "this strength is immediately sublimated and placed into a specific situation" (1997 [1961]:25). Barthes cites as an example the ways in which new food values, once accepted by "the masses", constitute "nutritional consciousness". Specifically, he identifies a tension in French society (of 1961) between traditional gastronomic and modern nutritional values (1997 [1961]:27).

Concepts of health and nutrition do appear to be relational, and closely tied to the sociological. Less addressed in foodways literature, however, are the impact of food sensitivities, allergies, gout, diabetes, parasites, dental caries, and other minor pathologies. Such topics are only approached if connected with mortality rates, and rarely with daily discomforts or necessary routine changes as experienced by individual subjects, such as those discussed by Reinhard, et al. (1986). Further studies may better explore these aspects of medicine and pathology.

How do people become acculturated through food, and how do foodways become inculcated?

However ingredients, cuisine, and medicine are categorized and patterned, this occurs through an ongoing process of acculturation and inculcation. The unfolding of the paradigm and the syntagm takes place through the same channels of socialization that guide behaviors, and in turn are guided by them. As Bourdieu outlines, inculcation and appropriation are needed "in order for objective structures, the products of collective history, to be reproduced in the form of the durable, adjusted dispositions that are the condition of their functioning, the habitus" (1990:57).

Foods, like language, are not fixed in their formulations, and inevitably involve learning of some sort. Mennell (1997) notes this in his discussion of the "civilizing of appetite". Such top-down control works best if the social structure which enables it is both inculcated *and* maintained. A doxic break-- a loss of assumption that everyone is participating, and moreover *believing*-- can result in very heterodoxic friction. Following Fischler (1988), although "raw" foodstuffs can be "civilized" (with the addition of familiar ingredients, and the molding into familiar forms), the lingering unfamiliar can betray a "wild" food. Although certain foods can be verbally and grammatically marked as "edible", as any babysitter can attest, there may be a continued issue of palatability in the *parole* of meals.

Several authors further elaborate the manner by which children acculturate. In Young (1971:41), children are "bound to those who fed them" (siblings, parents, neighbors, etc.). Perhaps partially for this reason, eating among some groups is seen as a closed and private activity, shared comfortably only among familiars. The contentious process of acculturation is also explored by Weismantel (1988), here viewed in demands by Ecuadorian children for imported, processed bread and arguments over meal times.

Similarly, Allison (1991) describes the manner by which mothers in Japan prepare special foods for their nursery age children, foods which simultaneously embody societal expectations, institutional demands, and desires for self-expression. In this example, food "codes" are elaborated by the mother, as a way of conforming but also expressing her creativity (in a way similar to de Certeau’s "tactics"). In a sense, this is the tension between the mother’s "power to" (use of individuality and creativity in *obento*) and the state’s "power over" (nursery school rules as enforced by the teacher and expressed to the mother) (Allison 1991).

Food always has meaning outside of subsistence. It usually has multiple meanings, encapsulated even within one ingredient, of one meal, for one person. Though less durable than architecture and clothing, and thus less a perpetuated site of embedded memory, food plays just as large a role in identity formation. Appadurai discusses individual identity as constructed through food, in terms of how individuals are appraised in their behavior regarding food– their "manners" (1981:504). Similarly, in directly linking memory to identity, Barthes states that "feelings of inferiority were [sometimes] attached to certain foods and that people therefore abstained from them" (1997 [1961]:24). As Allison notes in regards to school lunches prepared by mothers in Japan, "the *obento* is a representation of what the mother is and what the child should become" (Allison 1991:302). Gender, specifically, can be partially constructed through food (Barthes 1997 [1961]; Arnott 1991; Bynum 2008). Citing studies of men’s and women’s body self-image, abstention from food, and control of preparation, Counihan and Van Esterik state that "men’s and women’s power are continually expressed through their control over food resources [and] their complementarity or opposition in food roles" (1997:5).

At the level of the group, Powers and Powers (1984:42) note that special kinds of ritual foods may be prepared and consumed by members of a community in a way that symbolically states their identity. Similarly, Allison (1991) claims that certain foods may be used to embody the "rules and patterns of ‘group living’" (1991:302). Barthes states that food can be commemorative in that "food permits a person... to partake each day of the national past" (Barthes 1997 [1961]:24). Barthes links this "national past" to historical methods of preparation and cooking, finding that these practices can symbolize an aristocratic tradition and/or the survival of a romanticized rural society.

In terms of acculturation and identity, several authors draw connections between these social phenomena and foodstuffs. Barthes notes the evocative qualities of subsistence, stating that "food brings the memory of the soil into our very contemporary life" (1997:24). Echoing these ideas, Hamilakis highlights the importance of the sight, smell, and taste of food, which can draw out the senses and generate remembering (1999:40). Hamilakis emphasizes the importance of studies of food aesthetic, as "food consumption is primarily an act of *incorporation* which involves emotions, pleasures and feelings" (1999:39). Bettina Arnold similarly posits the use of servingware in legitimation and differentiation, as specifically related to aesthetics (1999). Bray, in one specific example, discusses how the use of variable servingware furthered the Inka empire. She states that, "The elaboration of a distinctive [Inka] state vessel assemblage suggests a conscious strategy aimed at creating material symbols of class difference in the context of state-sponsored feasting events" (2003:2).

But what of the aesthetic of the food *itself*? Tastes, in an analog to constructions of "edible" and "inedible", are molded in the social dynamic. Indeed, Fischler (1980:939) finds that it is often difficult to tell whether it is cultural shifts which determine "natural preferences", or tastes which have induced cultural shifts. Falk approaches what she terms "tastescapes", through the sensation of foodstuffs and foods, as well as the ways which representation limits sensation (Falk 1991). In fact, tastes, as Farrington and Urry argue (1985:154), could even be responsible for the first practices of cultivation, as juxtaposed with the usual "staple crop" arguments.

There is not a unilateral correlation, however, between "flavors" and "tastes". Allison (1991) notes that another key element of foodstuffs is appearance, in terms of color, texture, and thematic juxtapositioning. In her discussion of Japanese *obento* boxes for nursery children, she claims that "presentation is critical... to the degree that how food looks is at least as important as how it tastes and how good and sustaining it is for one's body" (1991:298). Lyons and D'Andrea (2003) comment that the colors of certain types of food have the potential to affect the symbolic value of these foods. They further posit that changes in cooking technology could be attributed to effects of taste, texture, and format of foods, among others. These attributes of food can also serve to trigger memories of previous food events and experiences, as noted by Lupton (1994:668). Sutton echoes these arguments, with the addition of the remaining senses, as well, in order to redirect attention to "the ways that societies divide up the work of the senses differently" (Sutton 2001: 13). Such thoughts may be the impetus behind much of nouvelle haute cuisine, which strives more for presentation and experience than subsistence and nutrition.

Weismantel (1988:7) claims that "It is because they are ordinarily immersed in everyday practice in a material way that foods, abstracted as symbols from this material process, can condense in themselves a wealth of ideological meanings." That is, foods are often "un-marked", a naturalized part of the everyday (similarly to Bourdieu 1984 [1979]). As she notes, the use of rice in the place of barley on an Andean plate can index socioeconomic affluence, a meal's "starch", household struggles between mothers and children, globalization of available products, dominant Hispanic ideologies, resistance to and assimilation of these ideologies, ethnic positioning, and flavor preferences, any of which is either contested or taken for granted in a given mealspace. Similarly, Powers and Powers (1984:40) find that foods can derive more symbolic importance from the *manner* in which they are prepared and eaten, than any intrinsic qualities that they possess. For example, although compositionally almost identical, corn tortillas and corn tamales occupy very different places, in terms of form, manner of preparation, labor invested, and symbolic importance.

As many of these authors have noted, there is a dynamic between broader social mores, in the crafting and the consumption of food, and in the creation, maintenance, and subversion of food's paradigms and syntagms. Beyond inculcation, acculturation, and identity, however, social positions themselves can be transfigured through foodways, in the course of negotiation within household and society, as well as between them.

How do foodways interact with sociopolitical life and ritualization?

David Sutton claims that "Anthropological work has produced a broad consensus that food is about commensality-- eating to make friends-- and competition -- eating to make enemies" (2001:5). From household to community to region, such social power is negotiated in the kitchen. As Counihan and Van Esterik proclaim, "[Food] is a central pawn in political strategies of states and households. Food marks social differences, boundaries, bonds, and contradictions. Eating is an endlessly evolving enactment of gender, family, and community relationships" (1997:1).

Commensality and food-sharing are often critical aspects of community gatherings, for many reasons. As Tamara Bray notes, playing host can have enormous social importance, in terms of what is served and how it is presented. Such aspects are expressed and transformed materially. As Linda Brown and Andrea Gerstle describe in their discussion of feasting in Pre-Hispanic Cerén, the creation of a feast has very recognizable material correlates. It takes special materials to prepare and present necessary feast items– not just specialized foodstuffs. These aspects may play into maintenance of relations, transformations of relations, and the general movement and shoring-up of social capital.

Feasting is a topic of anthropological literature that even has entire volumes devoted to it (e.g. Dietler and Hayden 2001). This may be because food-sharing is indeed "the medium for creating and maintaining social relations both within and beyond the household" (Counihan and Van Esterik 1997:3). When approaching feasting and commensality, many authors begin with the work of Marcel Mauss, and his focus on the way in which reciprocal gift exchanges bind community members together in relations of mutual reciprocity (Mauss 1954). Dietler (1996) enumerates several kinds of feasts, and the most prominent role that each plays: entrepreneurial feasts (empowerment), patron/role feasts (legitimation based on quantity), and diacritical feasts (legitimation based on style). Within the feast itself, Powers and Powers (1984:73) identify predictive indicators of food distribution as the number of persons in attendance, the manner in which attendants perceive themselves, and the location of the kitchen.

The specific implications of feasting on personal obligation are discussed in many works. William Shack notes that among the Gurage of Ethiopia, there are certain ritual and social situations which force participants to eat gluttonously even when they have no hunger to begin with (1997 [1971]:129). He finds that among the Gurage, "eating as a nutritional act, to get one's fill, is socially discouraged; on the other hand, eating to the full is indulged a social act through which to gain the satisfaction of personal prestige and status" (1997 [1971]:134). Michael Young describes the occasional relationship between feasting and fasting, in his work on the social value of food among the Kalauna. Essentially, in Young's schema, food is a mechanism for both punitive action and status acquisition. However, counter-intuitively, food abundance is also seen as "bittersweet" (1971:33) because of concomitant intensive sociality and reciprocal obligation. Anna Meigs, directly referencing Mauss' ideas of reciprocity, finds that among the Hua of the Papua New Guinea highlands, gifts of food actually entail a giving of part of the corporeal self, just as the social self is formed through such gifts (Meigs 1997 [1988]).

Furthermore, she reveals that such gifts of food can be even more important than genealogical ties in defining familial relationships (Meigs 1987).

It is not only through the large scale and the public that commensality negotiates power relations. At the household level, as well, relations among family members are often constituted and reconstituted at the dinner table, through the interplay between food, subjectivity and familial relationships (Lupton 1994; Arnott 1991). This can result in "transformations in diet and cuisine...produced through the interaction of individual actors whose desires clash" (Weismantel 1988:4). Weismantel notes that this can result in an actual change of familial positions, and sometimes constituency of the household itself. In her study in Ecuador, she found that women of the household can signify relative status distinctions, based on the amount of meat in the soup that they serve to each family member. Appadurai (1981) also elaborates the ways in which conflict can arise between groups or individuals, because of or through issues surrounding food--conflict he terms "gastro-politics". At the household level, this can be expressed in the form of preferential seating, earlier serving, more numerous courses, or food which is expensive, labor-intensive, or concentrated (Appadurai 1981).

As Young (1971) and Weismantel (1988) point out, food, and by implication the services connected with it, hold potential as a means of social control. Relations of domination and resistance can be expressed through food practices, just as food symbols can be used in ideological discourse. Tensions easily arise in the relationship between production and consumption, especially when these practices are not performed by the same person. Such tensions are inherent in the food relations between waitstaff, the "producers" of food, and the clientele who consume. Although Young and Weismantel use linguistic metaphors to describe the practices surrounding food, a more direct link can be found in the actual language surrounding food. Reciprocal obligations between waitstaff and client can provide an opening for social manipulation, evident in the language in which such relations are couched (Steingarten 1997). And such language, when used to fullest advantage, can provide the means by which a Chile's waitress maximizes the gratuity left by clientele (personal experience).

The social logic of foodways is often predicated on power relations as related to class (Bourdieu 1984 [1979]; Barthes 1997 [1961]). What, then, constitute "elite foodways"? Some authors define this as comparatively *intensive* food production, whereas others define this as comparatively *extensive* food production. In her intensive model, Bray (2003) differentiates between the everyday culinary practices and the haute cuisine of the Inka elite class (Bray 2003). She finds that the cuisine of Inka nobility was characterized by better quality ingredients, more time in processing, and more elaboration in presentation. That is, the base Andean diet was similar in terms of components, but varied in terms of manipulation. Bray also notes that foodstuffs were often exchanged as gifts between royals. Gumerman (1994) also references the haute cuisine of the Inka, comparing it with the extensive haute cuisine of the Aztecs. In this case, he finds that Inka did not necessarily pursue diversity, as here the *quantity* of camelids and other prized foods index elite foodways. However, in the Aztec area, he finds that elites did not necessarily pursue quantity of one or two foodstuffs, as in this case the *number of taxa* represented (at royal meals) index elite foodways (Gumerman 1994:80).

Stephen Mennell also notes differences in foodstuffs as related to status, with attention to the ways in which nobility were subject to fluctuations in frugality and extravagance. He differentiates between quantity and quality of food, noting that after the Middle Ages in England, once food supplies began to be fairly stable, better-off groups in society began a process of conspicuous consumption and competitive emulation, resulting on pressure on nobility to eat better *quality* foods, as it was becoming physically impossible to simply eat *more* (1997:326). He cites this period as resulting in the emergence of "taste", as distinguished from "hunger" (physical need of food) and "appetite" (mental awareness of desire for food). He claims that knowledge of food and a discriminating palate became part of the makeup of the courtier, and *quantitative* displays were subsequently scorned by early self-described gastronomers. Arnold (1999) and Bourdieu (1984 [1979]) similarly note 'successive emulation events' in which multiple tiers of society attempt to acquire elite status markers, leading the elite to acquire new, more exclusive markers (see also Miller 1995).

Social interconnections can also be embodied and inculcated through food at the para-societal level (Allison 1991). Indeed, many authors focus on the ways that foods can affect and even legitimate power operating at a regional level. Weismantel (1988) and other authors note the ways that food symbols can be used to resist and/or assimilate dominant political modes that marginalize certain identities and privilege others. Food is implicated in more spiritual matters, as well. As Appadurai notes, "in Hindu thought, food, in its physical and moral forms, *is* the cosmos. It is thought to be the fundamental link between men and gods" (1981:496).

Society is comprised of multiple different groups and individuals that consume resources for a myriad of reasons, including the economic, the political, and the ideological. For this reason, diet in society should be viewed both holistically *and* in terms of variation, as foodways emerge through different groups and individuals often with contrasting interests (Gumerman 1994: 80). In his study of the dietary transition of marine to terrestrial food reliance in the Neolithic U.K., Mike Richards claims that "The adoption of a domestic animal by hunter-gatherers who were already subsisting on mainly animal protein - from marine sources… might have required less structural change in society" (Richards 2003: 35). He finds that a distinct and fairly rapid shift from marine foods to terrestrial foods may have had to do with strong spiritual and religious associations with cattle, as evidenced by their ritual treatment.

Similarly, Hamilakis (1999) describes the ways in which certain crops (olives and grapes) were adopted and grown extensively, as responses to demands triggered by broader social and political conditions. Farrington and Urry (1985:153) also elaborate on the effect of exchange over distances in increasing the value of food commodities, thus elevating them to "exotics" which may have "led to attempts to establish them outside their natural ranges".

However they play out, whether within the household or outside of it, the dialogue between paradigm and syntagm produce practice just as they are formed through it. The substitutions chosen and the associations linked together inform the practices surrounding food, creating the "speech acts" of subsistence.

How do foodways articulate with broader theoretical frameworks, and what are the implications in terms of this study?

We see that foodways, as the aspects of practice connected to food and enacted through it, exist paradigmatically as the "edible" and sometimes overlap with the "medicinal". Ingredients and cuisine construct the paradigm and the syntagm of foodways, just as they are constructed through them. Acculturation and inculcation develop paradigmatic sets and the syntagmatic associations, much as they are developed through them. Sociopolitics and ritualization reveal the interplay of the paradigm and the syntagm, just as they are revealed by them. Practice is interwoven throughout, as the flow of a language which governs and is governed by food.

In my own work, I try to frame paradigmatic and syntagmatic axes of foodways, considering the ways that they are immersed in meaning, and contextualized by daily practice. My intent is to outline possible paradigmatic substitutions, and possible syntagmatic relations. This intention plays out differently, depending on the questions I am asking.

In terms of the complementarity between microbotanical and macrobotanical data, this topic is more methodological in nature. This question has more to do with the means of approaching research questions more fully, by approaching the highest possible recovery of plant taxa. By using complementary methods, this approach better crafts the paradigm and syntagm of plant practices. In using multiple kinds of data, I can better get at the basic ingredients involved in foodways of Northwestern Honduras, as well as possible associations and substitutions that reflect politics, socialization, ritualization, and inculcation. In drawing together these various strands of foodways and ethnobotanical practice, I follow a broad schematic outlined in **Figure 3.1.**

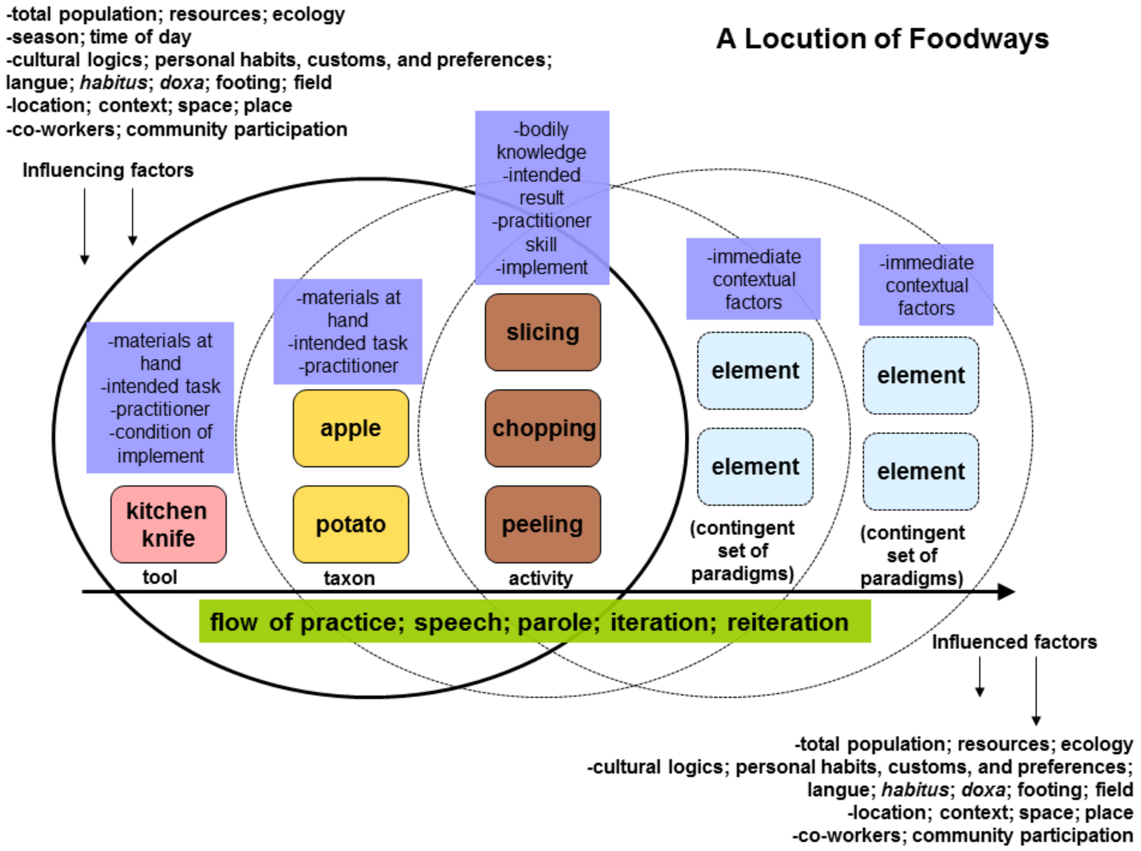


Figure 3.1. An example of a "locution" of foodways.

In discussing particular taxa and their associated practices, and the methods by which they are classified, I consider paradigmatic substitutions, in terms of potential "categories" of foods and foodways that may have been present in the past. By examining the broad spectrum of plant taxa available, I am able to craft a more whole picture of paradigms and syntagms of plant practices. In finding previously unaccounted-for plants, and evaluating practices associated with already-known plants, this allows me to expand the possible range of plants and plant practices. Specifically, in my case, I wanted to find evidence of plants such as root crops, and elucidate the possible roles of non-domesticates. I hoped to gain a better picture of the edible, of medicines, of cuisine, as well as a better view of acculturation, politics, socialization, and ritualization.

With these bases in place, I then seek to find associations and disassociations between artifacts and taxa, differences and similarities over spaces and contexts. My approach is similar for each of these three topics. I consider syntagmatic relationships, in terms of combinations of different plant taxa in a particular artifact or place, and associations between particular combinations of plant practices and a particular artifact or place. As we've seen, from *entendres* of cuisine, to the performativity of food-making, to the execution of a dish, to the destined "audience" of a dish, to the embodiment and inculcation of practices, to the distinction between performance and execution, to innovation of new foods and practices, to, importantly, the dynamic social interplay of what constitutes "good food" and "good to think" food, different taxa have paradigmatic roles to play, and different practices and materials associated with them.

As the best way of looking at the language of daily life is through the *practice* of daily life, I pursue activities, explicitly. By exploring food as an aspect of this language, I seek to define potential ingredients of foodways, a broader range of plant practices, and the articulation of the paradigm and the syntagm through practice. I also pursue the transformation in the syntagmatic associations and paradigmatic substitutions over time, as well as evidence of their continuity. Foodways are language, are practice, are semiosis. Acculturation, inculcation, sociopolitics, socialization, ritualization, and innovation are all marked in the passage of time, whether through doxic flow or punctures within it.

As demonstrated in the wider anthropological body of literature, there is a broad range of food languages, and high diversity within them. In the following chapter, I detail specific aspects of daily practice that I view through foodways, narrowing my view to Mesoamerica. Although practices worldwide provide a good set of possible foods and behaviors, I use analogies from Mesoamerica to craft a more region-appropriate hypothesis of food paradigms and syntagms.

4. Paradigms and Syntagms of Foodways in Southeastern Mesoamerica

In the previous sections, I discussed various aspects of and approaches to foodways, and related them to broader linguistic modeling. However, to outline the specific set of expectations and analogies in Southern Mesoamerica, I now combine ethnographic, ethnohistoric, and archaeological studies of foodways in this area, in order to orient them toward my specific research questions.

I use sources from the broader region of Southern Mesoamerica, from the Maya area to southern Central America, due to the overall scarcity of literature on the topic in Northwestern Honduras alone. I employ ethnohistory, ethnography, and paleoethnobotanical studies, to set up expected paradigms and syntagms of plant use. Again, as I emphasize in previous chapters, this paradigm is not meant to represent *the* grammar, but rather *a* grammar. It is meant to be a sort of "average" of knowledge thus far; a range of possible practices. It is against these expectations that, in later chapters, I compare my archaeological data set, and explore patterned relationships.

I start by exploring traditional models of foods and foodways in Southern Mesoamerica. I then define an abbreviated set of practices, to serve as a paradigm of plant use and foodways. I explore how foodways are used as proxies for social dynamics in Mesoamerica, and the implications of this approach. Then, I turn to "neglected" taxa in the record of pre-Hispanic foodways, focusing on root crops and non-domesticates. In order to broaden the conversation to practice, I discuss classificatory schemes of plant taxa. Finally, I explore specific analogs of practice from Southern Mesoamerica, in terms of recorded associations and disassociations between artifacts, taxa, and practices, differences and similarities over spaces and contexts, and transformations and continuity over time.

How are expectations of foods and foodways in Southern Mesoamerica commonly structured?

Discussions of foodways in Southern Mesoamerica are not new, dating even to Friar Diego de Landa’s sixteenth-century descriptions of foods and meals prepared by the people he encountered. Since that time, foodways, whether couched in terms of subsistence or symbolism, have emerged in the literature with surprising regularity. Within this literature, the traditional focus has been on agricultural production and ceramic servingware, with little emphasis on the "in-between" and the "after" of practices – cuisine preparation, presentation, and food refuse disposal. In Mesoamerica, this is partially due to the nature of the archaeological record that the archaeologist is given. Household sites are most often gradually deserted, leaving behind only a small quantity of "de facto" refuse, as compared to household sites that are rapidly deserted due to factors such as volcanic eruptions, where many goods are left behind in situ (following Manzanilla and Barba 2008). This leads to a skewing of data toward architecture and durable artifacts that have been deliberately discarded, and a heavy use of non-archaeological information to fill in the gaps left behind by organic and removed artifacts.

For many years, ethnographic and ethnohistoric explorations of foodways often served as the starting point of discussion, whether or not this approach was made explicit. Many early works began with Friar Diego de Landa’s sixteenth century account of "The Things of Yucatan". Other oft-cited works included the extended accounts of Alfonso Villa Rojas and Robert

Redfield (1962 [1934]). In their ethnographic account of the early twentieth century, these scholars claimed that the people of the Maya community of Chan Kom shared a "common fund of practical knowledge" and that the oldest forms of this practical knowledge were those "least subject to change". As defined by Redfield and Villa Rojas, a major common fund was the set of practices related to foodways, and they noted that "all the women cook the same foods in the same manner [with few exceptions]" (1962 [1934]:32).

Since these early works were produced, multiple other studies have emerged, including Thomas Killion's work on houselots in Veracruz (1990) which has proved enormously popular in studies regarding Mesoamerican foodways, especially as they are related to disposal and activity areas. Indeed, working models of foodways in pre-Hispanic Mesoamerica are most often a product of the ethnographic literature available (e.g. Killion 1992; Atran 1993; Gillespie, et al. 1993; Vogt 1969). Many researchers rely on ethnographic and ethnohistoric archives, in order to formulate conclusions regarding plant uses in the past. For this reason, ethnohistoric accounts that describe swidden agricultural practices have long been dominant in studies of ancient Mesoamerican foodways (Tozzer 1941; Hellmuth 1977). Even now, as archaeologists increasingly reject this model of subsistence structure for any time period but the Late Postclassic, there has remained a focus on exclusively cultivated food sources (Killion 1990).

There are many complications to such direct-historic approaches when regarding foodways. Verifying direct descendency of populations, as well as assuming that modern inhabitants of a site live under a static set of practical rules handed down for generations, presents obvious challenges. Linda Perry has noted that, "Considering the magnitude of post-contact changes... archaeological data are a more reliable indicator of prehistoric activities than are modern ethnographic analogues" (2001:264).

Due to the problems and gaps in the ethnohistoric record, archaeologists in Southern Mesoamerica have made the most of what archaeological record is available. Although preservation of *in situ* and organic evidence in this region is a complicating factor, archaeological investigations have managed to produce a bountiful yield of foodways data through nine pathways in particular: macrobotanical evidence, microbotanical evidence, relict forests, soil chemical signatures, human bone stable isotope signatures, iconographic and textual representations, artifact analyses, spatial studies, and architectural studies. Studies of features and spaces have proved popular (e.g. Harrison and Turner 1978; Kepecs and Boucher 1996; Levi 1996; Zier 1992). Another study even details the correspondence between architecture location in the site of Coba and those "relict taxa" remaining in the immediate area, considered to be "escaped species" of home gardens and orchards (Folan et al. 1979). Overall, such studies are primarily focused on production, ecology, and political economy, and virtually never on the daily practices such as preparing, presenting, and disposing food. It is only in a few instances, usually functional analyses of ceramic materials, that these latter topics are even broached (e.g. Hendon 2003).

As interest in extensive agricultural practices has waned, and interest in intensive agricultural practices has waxed, a hole remains in most models of Mesoamerican foodways. Very recently, this hole has begun to be filled with models that account for such factors as entomophagy (Ramos-Elorduy and Moreno 1989), wetlands management (Fedick 1996), and/or agroforestry (Atran 1993). However, paleoethnobotanical approaches, as a more time- and funds- consuming pathway with few available specialists, are rarely pursued and/or scantily published. It is telling that in a book such as *Continuities and Changes in Maya Archaeology: Perspectives at the New Millenium* (Golden and Borgstede 2004) paleoethnobotany is granted little space, with only two references in seventeen chapters. However, when approaching the full spectrum of foodways, from conception to disposal, paleoethnobotanical studies still appear to bear the greatest harvest, as evident in the works of various authors explored below (Lentz 2001; McNeil 2002; Reed 1999; Crane 1996).

In my own work, I make use of four pathways: macrobotanical evidence, microbotanical evidence, artifact analyses, and spatial studies. I take a first look at the primary evidence of plant taxa, and then relate this evidence to the practices that accompany them. These practices, however, are gleaned from a variety of sources, including ethnographic, ethnohistoric, and archaeological documentation. For this reason, I now turn to the analogs themselves.

How are foodways used as proxies for social dynamics in Mesoamerica?

Approaches to foodways have commonly sprung from a direct tie between social decision-making and landscape. For this reason, foodways studies that focus on agricultural practices have long been popular in the Mesoamerican area. From discussions of land management (Fedick 1996; Dunning 1996) to water management (Scarborough 1993) to studies of paleoethnobotanical materials themselves (Lentz 2001; McNeil 2002; Reed 1999; Crane 1996), when discussing food in the Maya area, agricultural practices are usually the focus. Sometimes these studies are produced with models of social dynamics in mind, while sometimes these studies are used as a means to *produce* models of social dynamics.

Other studies, such as skeletal analysis and ceramic analysis, have also been applied directly in foodways studies, with less of an emphasis on agriculture. In one example, John Gerry (1998) and Christine White et al. (2001) study components of social life such as class, gender, and geography, utilizing skeletal analysis. Servingware has also proved especially fruitful ground in the discussion of Maya foodways. Julia Hendon postulates the construction of social relations at Copán, Honduras "through feasting and the rituals of giving and receiving, honoring and shaming, and creating and resolving indebtedness" (2003:207). Using ceramic evidence from different residential contexts, Hendon demonstrates the ubiquity of feasting, not only at the large-scale and ceremonial, but at the residential as well. Hendon, though emphasizing a hierarchical model, finds that negotiation (intra-class *and* inter-class) was likely in terms of both social ranking and identity.

Working further south at the site of Joya de Cerén, Linda Brown (2001) also leans toward a hierarchical model, but one which focuses on a smaller scale than those posited for larger sites. She emphasizes a small-scale hierarchy, posed by the ethnographic and ethnohistoric literature, in which there are either ceremonial houses or *cofradias*. The servingware, metates, and spatial orientation associated with these structures, whether "ceremonial houses" or *cofradias,* index the large-scale and/or the sumptuous. A "leader", in this community, is painted as one with control over ceremony (Brown 2001). Implicitly, Brown also invests this person with central social, political, and ideological responsibilities and privileges, although they may actually reside *variably* in persons, lineages, and sodalities, and are seasonally-dependent and yearly-dependent, and therefore more heterarchical (over time) than hierarchical. Such conclusions are similar to those drawn by Joyce and Hendon (2000).

Through the ethnographic documentation and archaeological discussion, I have found that foodways are differentially manifested, but not necessarily hierarchically conceived nor hierarchically implemented. That is, the sorts of plants utilized in the past, and the practices associated with them do not follow a *de facto* hierarchical arrangement from collected to grown, nutritionally inferior to nutritionally superior, lower-status to higher status, and all other such oppositions which are placed as given corollaries to the hierarchy of food. My findings indicate that in the past, foodways were heterarchically organized, in the sense that different aspects of foodways emerged hierarchically in different and sometimes opposing ways, both transforming and being transformed by daily practice.

The disjuncture, intra-socially between past perceptions of foodways, and inter-temporally between past and present perceptions of foodways, can provide the means by which the interpretive gap widens. I here attempt to narrow this gap by attempting to leave out subsistence "typologies" and instead focus on the component attributes of foodways. That is, instead of operating under the assumption of what "type" of botanical assemblage will be found, (based on the location of the assemblage), or leaving out botanical information altogether (as an untested assumption), I hope to loosen these normalized "types" in the landscape of pre-Hispanic Mesoamericans and instead focus on what range and variety might tell us about past foodways.

Spectra of Taxa and Associated practices

In considering the plant taxa recovered from the archaeological record of Southern Mesoamerica, there are many different approaches that can be taken. The story most commonly told, however, began with de Landa's sixteenth century accounts, and was subsequently bolstered by the ethnographic studies mentioned above.

The intensive cultivation of maize is considered to be the spur for increasing population density and social complexity throughout Mesoamerica (similarly to Perry's studies in Ecuador). In this narrative, corn, beans, and squash are considered the cornerstone of society and its survival, with most social and ritual practice oriented toward ensuring high agricultural yields. In this model, the primary locus of food production is the *milpa*, a field where the "trinity" of cultivars is produced. The "trinity" of cultivars, their associated assumed practices, and concomitant presumed societal structure are taken for granted. The *milpa* is prepared by slashing and burning "virgin" areas, then planting occurs in the cleared field. Periodically, as the soil nutrients are depleted, these *milpas* are left fallow, until used again several crop cycles later. Overall, the organization of society is based on the organization of this agricultural production. The management of the landscape is oriented toward agricultural production, with some acknowledgment of the use of forest products and fallow fields.

Built into this model are the assumptions that: 1) the primary mode of subsistence is agricultural production, 2) the primary means of agricultural production is through an extensive *milpa* system that begins with slashing and burning, 3) the primary agricultural product is maize, and 4) all other plant products are incidental, superfluous, complementary, or sumptuary. Moreover, classification of various plant taxa is predicated on functional assumptions of their uses.

Even with the incorporation of paleoethnobotanical data, the maize *milpa* paradigm is difficult to escape. Cameron McNeil (2002) obtained sediment cores from two bodies of water in the Copan Valley, Honduras. Although McNeil's work is ongoing, she determined that there were periods of deforestation marked by pollen of *Zea mays*, interspersed with periods of reforestation. This evidence implicates the large role of maize in the diet of pre-Hispanic settlers, to the extent that surrounding ecology was modified to accommodate this taxon.

Similarly, Kevin Johnston et al. (2001) utilize palynological data to conclude that the Las Pozas, Guatemala area was occupied during the abandonment in other major cities, as evidenced by a marked increase in savanna and grass species in the laguna core at this time period. However, these authors believe agricultural practices to have taken place predominately outside of the immediate area of Las Pozas settlement, as only one pollen grain of maize was encountered in the segment of the sediment core which corresponds to human occupation.

This story, however, is not as clear-cut as it seems at first glance. In order to complicate the model, I here consider evidence from various sources, focusing on three topics: root crops, non-domesticates, and classificatory schemes.

Root crops

One aspect of pre-Hispanic foodways that has long suffered neglect is that of root and tuber crops. Bronson (1966), in grappling with the "mysterious" extent and height of Maya populations, turned to root crops for answers. He states that, in terms of subsistence, "The 'given' which seems… most vulnerable is that the Maya subsistence economy was based fundamentally on corn" (199:255). Based on data on modern root-crop distribution, information from early Conquest times, lexical, and nutritional data, he makes a strong argument for the use of root-crops in pre-Hispanic times. Cathy Crane, stating "the role of root crops in the Maya diet is unknown" (1996:271), has also called for an increased attention to root crops.

Although many historical accounts (e.g. de Landa 1978 [1566]) and archaeological sources (e.g. Lentz 2000; Sheets 1982) outline the potential importance of these foodstuffs in daily life, the incorporation of these sources into broader archaeological discussions remains rare. Early ethnographers noted that tubers were eaten in season, and included manioc [*Manihot esculenta*], jicama [*Pachyrhizus erosus*], sweet potatoes [*Ipomoea* spp.], and yams [*Dioscorea* spp.] (Redfield and Villa Rojas 1962 [1934]:38). Tozzer noted that *camotes* (sweet potatoes) and *yuca* (manioc) were sometimes eaten in the place of beans, boiled and eaten with chile pepper. In the sacred book *Chilam Balam*, the sweet potato is identified specifically as an item among the four sets of objects belonging to the "Four Quarters of the World" (Roys 1967 [1933]:63), suggesting its importance in the cosmological as well as the quotidian.

In modern Honduras, in Paya communities, Lentz (1993:361-3) has observed the cultivation of sweet potatoes, yams (introduced), and both sweet and bitter varieties of manioc. He notes that manioc is harvested twice a year, and that fields are replanted until the farmers note that the yields are declining. This crop is prepared through peeling, washing, soaking, mashing, and leeching, and then the mash is roasted and consumed. He finds, overall, that many Paya people, both linguistically and through their crops, may be strongly tied to South American cultures.

In archaeological studies, Sheets (1982, 2002, 2010) has found evidence of a diversity of root crops cultivated at La Joya de Cerén, including manioc and sweet potato, thanks to the layer of volcanic ash that preserved their cavities *in situ* in the process of cultivation. He has even found evidence that the practices of different farmers in bounded and separate fields may be identified, based on the variety of techniques used in the field production of manioc (Sheets, personal communication 2010). Miksicek, in an earlier study (Hammond and Miksicek 1981), identified fragments of manioc stems at the site of Cuello, Belize. Overall, the sketch of root-crop use and production is very ephemeral when only macrobotanical data is considered, but can be bolstered with the addition of microbotanical data. In at least two examples, Pohl et al. (1996) and Pope et al. (2001) have identified manioc pollen associated with anthropogenic activity.

The importance of root crops may have changed with the passage of time. As indicated by artifact residue studies further south, in Ecuador, root crops may have been important in earlier time periods and less so in latter time periods. However, as Perry (2001:261) has noted in her own starch grain studies, manioc-based agriculture was not necessarily supplanted by the entry of maize, nor did maize agriculture occur concomitantly with the production of late-period ceramics. Such a model of shifting plant importance may be applicable in southern Mesoamerica, as well. Overall, the importance of root crops cannot be discounted, for any time period. It is likely that small households were cultivating a combination of root crops prior and in addition to maize, from northern South America through southern North America, beginning in the early Formative period and stretching into the modern day.

Non-domesticates

Although much work is left for the incorporation of root crops as potentially-important cultivars, researchers are beginning to look to non-domesticated resources, as well, to broaden discussions of foodways. Increasingly, archaeologists are rejecting the swidden model of agriculture for any time period but the Late Postclassic, and there is a diminishing focus on cultivated food sources alone as the primary source of subsistence (Killion 1990). Scott Atran (1993) has rethought the once-ubiquitous model of Maya swidden agriculture, proposing instead a subsistence model with an increased reliance on forest management practices. Atran gives an overview of how the modern Itza of Petén, Guatemala, integrate field cultivation with tropical-forest management, and suggests that this type of subsistence strategy involves a symbiosis that cyclically sustains the Itza culture by regenerating the forest's biodiversity. He makes the claim that the "collapse" of Late Classic civilization may even be attributable to a turn from the multi-cropping and tree-tending systems of earlier time periods toward a more intensive and parasitic agro-engineering system that pivoted around fewer cultivated species and crop cycles.

Other scholars have also outlined the prominent role of non-domesticate species. As described by Hanks in his ethnographic work, from the forest, "firewood, food, medicine, and miscellaneous household commodities are acquired and consumed by individual marriage units" (1990:108). Some parts of the forest are set aside as reserves, while others are selectively logged and reforested with precious-wood seedlings (Anderson 1995:141). Trees, in milpas and dooryard gardens, can be protected wild trees or planted orchards (Anderson 1995:142). Hanks (1990:316), Anderson (1995), and Redfield (1950:172) have noted the many economic tree species planted and/or tended in modern Maya communities. Anderson (1995) documented 44 tree species which produce fruit or other edible products.

Dooryard gardens are proximate hosts to many of these taxa, and in milpas, trees can be used as weed and grass control. As Anderson states, "[the farmers] cut most of [the trees] off at a foot or two above ground, leaving them to resprout. Useful trees, especially chicosapote and thatch palm, are left intact or pruned high but left standing" (1995:142). Some of these species are planted, while others are the result of spontaneous growth which is later protected. In orchards, according to Anderson (1995:143), "Trees are propagated by sophisticated grafting and cutting techniques. Most young trees come from local nurseries and informal propagation, but some people travel as far as the great citrus center of Oxkutzcab to buy young trees." Wherever planted or tended, however, Redfield and Villa Rojas (1962 [1934]:32) noted that, in Maya communities, "people are willing to uproot an unprofitable fruit tree in order to plant a better."

Additionally, and similar to home gardens, milpas contain "pachpakal" areas that are the parts of the fields where "a wide variety of crops and medicinal herbs is planted" (Anderson 1995:142). Anderson lists at least 20 species of medicinal herbs that generally left in the milpa, and in one case, an herbal healer had 50 medicinal species growing in his milpa and garden. Such species are grown through practices of selective preservation, transplantation, and/or seeding (1995:142).

In Diego de Landa's time, maize and other seeds were retained in granaries to be sold at a later time (de Landa 1978 [1566]:38). de Landa detailed many sorts of plant and animal ingredients, including aspects of their appearance, flavor, and/or aroma. He also described the uses of various species for medicinal, edible, ornamental, and ceremonial purposes, and included in some cases details of planting and tending practices (de Landa 1978 [1566]:101-107). Included in Landa's list of flora ingredients are balche *(Lonchocarpus* sp.) roots, maize of many varieties (*Zea mays*), beans of many varieties (*Fabaceae* spp.), peppers of many varieties (*Capiscum* spp.), "melons" *[Cucurbitaceae* spp.], "millet" [*Amaranthus* sp.?], a "root fruit" [*Pachyrhizus erosus?*], various tubers and roots, a salad leaf [*Cnidoscolus aconitifolius*?], "black seed-nuts similar to the carob bean" [*Fabaceae* spp.], "mulberries" [?], hogplums (*Spondias mombin*), wild grapes (*Vitis* sp.), "long fruit with red meat" [*Pouteria sapota*], a similar "smaller fruit" [*Manilkara zapota*], "ox" fruits (*Brosimum alicastrum*), papaya (*Carica papaya*), uayas (*Talisia oliveformia* spp.), guavas (*Psidium guajava*), "fruits with a green thick skin" [*Annona* spp.?], "fruit similar to pineapple" [*Bromelia pinguin*], "small yellow fruits" [*Byrsonima crassifolia*], "on"/avocado (*Persea* sp.), "artichokes" [*Hylocereus* sp.?], annatto (*Bixa orellana*), palm fruits (*Arecaceae* spp.), and palm kernels (*Arecaceae* spp.) (de Landa 1978 [1566]:101-107).

At sites such as Aguateca, Guatemala, Joya del Cerén, El Salvador, Yarumela, Honduras, and Copán, Honduras, there is bountiful evidence for pre-Hispanic arboriculture, as shown in the work of David Lentz (1991, 2001). In his work in Honduras, Lentz remarks on the importance of tree species, as well as other agricultural products (Lentz 1991). He posits some uses for the various plant species encountered, and the potential practices surrounding their production and processing. At the sites of Aguateca (rapidly abandoned) and Cerén (volcanically preserved) Lentz discusses production, diversity, and use of botanical products in the Maya area. He again highlights arboriculture, as a complement to agriculture, particularly in his discussion of dooryard gardens. Lentz indicates that at Cerén, fruit-bearing trees were planted in dooryard orchards, whereas the site of Aguateca demonstrated an increased level of tree production in the form of palms. Lentz cites the economic importance of these arboreal taxa, noting, "palms are easy to grow, produce abundant calories and require little care; they were an excellent resource for a society with a burgeoning population and limited land for agriculture" (Lentz 2001). At Yarumela, Lentz finds evidence of the use of guanacaste (*Enterolobium cyclocarpum)* and cashew *(Anacardium sp.)*—key food species still in use in Southern Mesoamerica today.

Additional work by Payson Sheets has also revealed the variety of practices utilized in agricultural production at Cerén (Sheets 1982). From the macrobotanical remains, Sheets notes a spectrum of seed, root, and tree crops cultivated, as well as their integration with noncultigens. Through these studies, Sheets explores the range of agricultural products and practices as indexed by the variety of subsistence technologies and farming techniques, both extensive and intensive.

The use of archaeobotanical methods has also proved useful at Copán, Honduras. At this site, David Reed distinguishes between cultigens such as maize, beans, squash, and nance (*Byrsonimia* sp.), and non-cultigens such as palms, gourd (*Crescentia cujete*), hackberry (*Celtis* spp.), and frijolillo (Reed 1999). Reed declares these latter foods to have been "supplemental or famine foods" (1999:185), likely due to modern uses of these foods and current conceptions of palatability. This evidence is similar to the recovery of diverse foods in the Orinoco Basin, much to the south. The plant assemblage at sites there indicated a "mixed subsistence economy involving the collection and/or cultivation of several root crops, arrowroot, guapo and ginger, (not manioc), the cultivation of maize at a higher level of intensity than at [other sites], and a reliance upon wild-collected or tended palms" (Perry 2001:240-1).

There are also the aspects of non-domesticate products consumed in ways other than as foodstuffs. Lentz et al.. (2005), focusing on pine products as trade commodities, argue that the differential distribution of this resource can be linked to socio-political organization. They find that pine products were important components of the political economy during the Late and Terminal Classic periods of Xunantunich, commonly linked to ritual activities, construction, and fuel.

Overall, there is an extended and rich history of the use of non-domesticates by various peoples throughout Mesoamerica, from the deep past into the present. Whether as foodstuff or used in some other way, a variety of plants were and are used for a wide array of purposes, and involved in a wide array of practices.

Classificatory Schemes

Beyond the ingredients themselves, many practices have been under-represented in archaeological literature. In his book *Referential Practice: Language and Lived Space among the Maya* (1990), William Hanks provides a contemporary ethnographic view of the food practices of people of Oxkutzcab, in the northern Yucatan. Sheets (1982), in his review of practices at Joya del Cerén, finds evidence of various activities, including field ridging, planting, weeding, intercropping, harvesting, storing, and processing. He also estimates the time likely taken for such practices. It is from these initial points that I have parceled foodways practices into somewhat arbitrary categories, from perception and production to consumption and disposal. In this way, I can discuss foodways in terms of practices related to spatial organization, agriculture and collection, preparation, serving, consumption, disposal, and cleaning.

Some of my first questions, when combing the literature, had to do with: what taxa are commonly utilized? For this reason, I began by constructing a large database of potential economic taxa, and have since supplemented this list with additional references. Second, I wanted to know: what practices accompany these taxa? Some practices are noted in the database, but I have also set up a broad schema of practices, as a set of potential paradigms and syntagms in the language of foodways (see below). Rather than relying on traditional designations such as "wild" or "weed", etc., to define both biological qualities as well as functions of plants, in this snapshot of potential associated activities a single taxon can be associated with a multiplicity of practices, and a single practice can be associated with multiple taxa.

Within this schema, I must make the caveats that 1) I am focusing on foodways, and not many secondary activities related to foodways; 2) this is by no means a comprehensive list; and

3) these are not mutually-exclusive nor immobile categories of practice. Moreover, this outline is a representation of my *own* set of categorizations, and not necessarily those of the past.

Producing	*Procuring*	*Processing*	*Preserving*	*Consuming*	*Cleaning*	*Scheduling*
Organizing (people, things, and spaces), Scheduling	Digging	Peeling, Slicing, Grinding, Cutting, Beating, Extracting	Storing	Serving	Disposing	Weather-watching
Gardening	Picking	Soaking, Treating, Leaching	Smoking	Presenting	Sweeping	Planning
Farming	Gathering	Cooking, Toasting, Baking, Stewing, Steaming, Burning, Molding, Roasting, Brewing	Drying	Exchanging	Washing	
Planting, Intercropping	Harvesting	Seasoning, Salting	Fermenting	Adorning	Fire-banking	
Cutting, Clearing	Exchanging	Building, Weaving, Painting, Pressing, Dyeing		Eating, snacking		
Fallowing (and bee-keeping)	Cutting	Fire-building, fire-stoking		Treating, medicating		
Tending, Weeding, Managing, Pruning		Water-retrieving		Fueling		
Shading				Ritually practicing		
Watering, Channeling, Field ridging						
Burning						
Digging						
Repelling insects and animals						
Fertilizing						
Bolstering						

Encompassing these practices more broadly is the practice of "task-scaping" (Ingold 1993). This concept has to do with the assumption that activity areas are not only loci for single activities, nor simply locations of overlapping activities with material traces, but are rather nodes of layered social production and reproduction, both discursive and non-discursive. Activities at such nodes include story-telling, reprimanding, joking, gossiping, explaining, singing, gendering, debating, teaching, correcting, learning, controlling, enabling, helping, co-operating, flirting, arguing, complaining, ignoring, considering, deciding, and scheduling, among many others. The confluence of these activities is what identifies areas as "taskscapes" (Ingold 1993). Although many of these are practices we can't get at directly, we can imagine them as additional strands and layers in the fabric of paleoethnobotanical practice, when we find the materialization of aspects of these activities.

More than simply trying to move past the limitations of such categories as "weeds", by modeling activities in this way I seek to move more inductively from practices to broader social dynamics. Usually, models are constructed through a nomothetic approach that begins with assumptions of foodways (derived from ethnohistoric and ethnographic literature), and deduces social dynamics from these models of foodways.

Associations and Disassociations between Artifacts, Taxa, and Practices

Discussions of tools and artifacts associated with foodstuffs are often sidenotes to other studies. There are, however, many rich associations that may be drawn from the available research. In the language of foodways, understanding associations between elements, and disassociations between elements, are key to understanding practical logics that may inform food practices and be shaped by them.

Broadly describing materials associated with the kitchen, Hanks finds that many tools and other items are freely shared between co-residential families (1990:109). He notes that the composition of these kitchen tools is diverse. The cooking fire within the kitchen is generally comprised of three large stones, upon which rests the olla or comal (Redfield and Villa Rojas 1962 [1934]:35; Hanks 1990). This is the center of activity– and even the word for "kitchen" and "hearth" in Yucatec Mayan is the same (Redfield and Villa Rojas 1962 [1934]:35). The wall behind the fire is "customarily left open, so that smoke and heat can escape in the draft" (Hanks 1990:331; personal observation). Near the fire are located utensils and condiments (Hanks 1990:331) and the small three-legged utility table where tortillas are patted flat (Redfield and Villa Rojas 1962 [1934]:35; personal observation). Serving utensils and larger supplies and tools hang from or are wedged into the walls (1990:331). Other miscellaneous supplies are stored in the rafters on the opposite end of the room as the fire. The eating table is in the middle of the room, within reach of the woman's traditional place by the fire but away from the smoke (Hanks 1990:331).

Water for consumption is either stored in buckets inside the courtyard between the kitchen and cleaning areas, or in two separate areas: the kitchen, for consumption, and outside, for washing water (Hanks 1990:334). In 1931, Redfield (1950: 37) reported that women in Chan Kom were slowly replacing their traditional ceramic water jugs with metal pails, but that the women still made many trips to the wells to retrieve water for cooking and washing. Girls and women generally retrieved the water for cooking, and younger boys retrieved the firewood for the fire (Redfield and Villa Rojas (1962 [1934]: 68).

Redfield and Villa Rojas (1962 [1934]:36) describe various sorts of gourds used in cooking, serving, and storage of foods and water (also in Redfield 1950). They also detail several sorts of ceramics and their uses (ibid.). To light the fire, they claim that "flint and steel are known, but no longer used," whereas there was still at that time an occasional use of the fire-drill (ibid.:37). Similarly, Redfield notes that in the 1940's, the stone handmill (metate) was still used, "as when the family must rise early and must first make tortillas to take along to the milpa" (1950:36). He also reveals that "the handmill itself is taken along to the milpa with other necessaries when a stay of several days is planned" (ibid.). Redfield and Villa Rojas also note that corn husks are cut open with a sharpened stick or a pointed instrument (1962 [1934]:45)

In terms of vessels, there is a great deal of evidence available. Rough-ground corn masa is sometimes made into a drink, which in early mission times was drunk from "a vessel or gourd formed from the rind of a fruit that grows on a tree" (de Landa 1978 [1566]:34; personal observation). (More finely-ground corn masa was also made into a drink, thickened over the morning fire into a sort of "curd" and served hot as the first meal of the day [de Landa 1978 [1566]:34, see also Tozzer 1907:52]).

Residues of foods have been recovered directly from artifacts in the Maya area. Obsidian blades recovered from the site of Cerén were analyzed for different protein residues (Sheets 2002), and deer and dog were identified, as well as human (likely an accidental cut). Grant Hall and other researchers utilized chemical analyses to ascertain the use of a vessel containing an unidentified food residue, recovered from the undisturbed Tomb 19 at Rio Azul, Guatemala (Hall et al. 1990). Study of the brown residue from the closed vessel by chemists at Hershey Foods Corporation indeed revealed the chemical signature of cacao (Hall et al 1990).

Later work at Colha by Terry Powis et al. has further confirmed the use of cacao in ritual contexts, through analysis of residues in several burial-context spouted vessels (Powis, et al. 2002). Joyce and Henderson (2006, 2007) have also found ample evidence for the use of cacao, in formative period Mesoamerica. Making use of the chemical signatures of *Theobroma cacao*, they have observed the likely use of formative-period vessels in the fermentation of cacao fruit. They argue that in latter time periods, the cacao beans were utilized to make chocolate drinks, but had started as byproducts of the earlier fermented fruit drinks (ibid; Joyce and Henderson 2010).

Epigraphic evidence has also been used to identify the associations between vessels and foodstuffs. Residue analysis was undertaken due to the anomalous form of the vessel at Rio Azul and nine attached stucco medallions. The medallions were translated by David Stuart to read that the vessel's contents included 'chocolate drink', which converged with the chemical analyses of the vessel contents (Hall et al 1990:141). The presence of this taxon in a ritual setting, as well the glyphic marker identifying it, index the special role of cacao in Maya foodways.

Synthesizing the work of other authors, Hull (2010) draws together evidence from many sites in the Maya area. She notes the use of glyphs which identify pulque, atole (dried boiled, "green or new corn", ground parched corn, bitter, and chocolate-flavored), tamales (iguana, turkey, deer, fish, and others), cacao ("wild", "fresh", and "sweet"), fermented honey drink, and *sakaha'*, a ritual libation.

In southern Mesoamerica, there is a rich assemblage of artifacts and tools available for study. Work thus far undertaken indicates the strong potential for associating particular practices and taxa with artifacts and tools, even when epigraphic or contextual information is unavailable. It is likely that there were multiple uses for a single tool or artifact, just as multiple tools and artifacts could be used in association with a single taxon. Such associations can be assessed using microbotanical methods (following Piperno 2006, Perry 2001, 2005).

Differences and Similarities over Spaces

Similarly to artifacts, the marking and designation of different spaces, and the practices carried out through them, are also linked to the broader language of foodways. In terms of locations of food activities vis-à-vis built spaces, there are several authors who have approached this topic. Thomas Killion (1990) divides sites into agricultural and settlement places, proposing a version of household subsistence that is based on a dual cropping zone model, comprised of an "infield" and an "outfield." The "infield" is a composite of intensive agricultural practices, whereas the "outfield" is reserved for extensive agricultural use. Nowhere in this model, however, is there room for noncultivated and nonresidential spaces, as he and others elaborate later for the site of Sayil (Killion 1992). Similar ideas can be found in the work of Anderson (1995) and Hanks (1990). In Hanks' schema is identified a series of locational noun stems "denoting the various social and personal spaces of an actor. These include one's *-otoc* 'house, abode' (inalienably possessed), *nah* 'house, fields, proximal region of', *kahtalil* 'homestead, residential compound', and the actor's several habitual workplaces, such as one's *soolar* 'yard, orchard', *paarselaa* '(irrigated) field', and *kool* '(unirrigated) plot (milpa)'" (1990:91).

Additionally, Hanks notes the use of various terms to indicate the degree of domesticity, from *soolar* as a fenced or physically bounded area, fabricated spaces as *otoc*, and *nal* as 'home', implying residential or planted lands. At the other end of this spectrum lie *kool* 'unirrigated milpa' and parsela 'irrigated field' (1990:315). Hanks notes linguistic divisions that index perceptions of ecology. He distinguishes between *k'aas* 'forest' and *kaah* 'town, inhabited space', where "the former is a natural place one traverses while hunting, gathering firewood and medicines, and looking for appropriate land to cultivate.... [and] agricultural land, both irrigated and rain fed, lies in an intermediate position between fully social and fully natural space" (1990:306-307).

However, over time, contexts may become blurred, as families shift residences and milpa plots, to the extent that an area may alternate as a cultivated and a residential place (Hanks 1990:316). Moreover, the very line between "cultivated" and "residential" places is not fixed (ibid.). Eugene Anderson (1995) finds that such English language oppositions as natural/cultural are not applicable at all in the Maya area. As he claims, "for a Maya, there is no sharp boundary between gardens, fields and the wild. The forest is a managed source of all kinds of utility goods and less tangible benefits. The gardens and fields reproduce, to some extent, the forest's structure... and are allowed to go partially wild. Many of the garden plants are actually native plants that come up spontaneously and are then protected" (1995:147). This management occurs to such an extent that Anderson describes the ecology of Quintana Roo as "a giant dooryard garden" rather than a "natural forest" (1995:146). As he states, "Deliberate burning, coppicing, selective preservation... selective cutting, and planting are all processes that have affected the entire forest for thousands of years" (1995:146).

Fedick and Morrison (2004), in their work in the Northern Maya Lowlands, have recovered archaeological evidence that wetlands were at least partially utilized to produce soils and algaes. This nutrient-rich material was dried and transported, to enrich upland garden plots and cultivated trees. This activity, perhaps related to the harvesting of food resources in the wetlands, would have sent community members to designated spaces outside the home, and semi-transformed spaces closer to the home, similarly to Hanks' notes on the re-designation of spaces (1990:316).

Much as with artifacts, it is likely that there were multiple uses for a single designated space, just as multiple spaces were utilized in association with a single taxon. Such associations can be assessed using microbotanical methods (following Piperno 2006, Perry 2001, 2005), as identified through traces in sediments.

Differences and Similarities over Contexts

Contexts, designated areas identified by associated features and artifacts, operate in a way similar to that of designated spaces, with the caveat that they may overlap and combine with particular spaces. Various authors have approached the different sorts of contexts found in association with Southern Mesoamerican foodways, not only just the kitchen areas of interior spaces. In terms of this basic locus of food production, as Redfield (1950) described it,

> "The kitchen, invariably of poles and thatch, remains the center of the family life; here the women spend most of their time, and here old and young eat, the food handed around, served from the little three-legged table by the fire...In the kitchen the talk goes on and most of the associating of husbands and wives, parents and children" (Redfield 1950:31-2).

It appears as though, in general, "cooking eating, firewood storage, fire maintenance, and often bathing and dishwashing take place inside the [kitchen and patio]" (Hanks 1990:333). Hanks describes traditional Maya kitchens as "separate thatch structures, set within the yard behind the main houses" (1990:106), and may or may not be physically connected to the main house. Richard Wilk finds that dwellings of nuclear families are smaller than extended/complex households, which possess more cooking facilities and more rooms in general (Wilk 1983). Hanks argues that, "Only the poorest houses lack a kitchen structure, where food is prepared and consumed" (1990:322).

Redfield and Villa Rojas (1962 [1934]:45) described the process by which maize was removed from the field and prepared, detailing aspects of activity loci: "Corn is taken from the husks as it is harvested... and the kernels then and there removed from the ear... The grains are knocked from the ears... by placing them in elevated racks...and hitting them with sticks....The harvest is brought to the village in the form of grain and is stored in round thatched granaries in the house."

Meals, whether daily or festive, were often followed by washing the hands and mouth, as noted in Landa’s sixteenth century account. In contemporary times, women wash utensils, serving ware, and other kitchen items near the kitchen, or in specific cleaning areas (Hanks 1990:334). As Hanks notes, "women spend significant portions of any week washing at the basin, looking out on the yard from its perspective. Usually the basin is covered by a thatch roof or shaded by a tree, to help the women stay cool while laboring at it" (1990:332). Subsequently, dishes and other materials are then dried outdoors on some sort of elevated surface (Hanks 1990:334).

In terms of archaeobotanical research, results of work by Bozarth and Guderjan (2000) indicate a select deposit of certain food-related taxa in different ritual contexts. Studies of soil chemical signatures have also proved fruitful in revealing food practices associated with quotidian contexts. Linda Manzanilla and Luis Barba define activity areas in Classic period Coba and Teotihuacan, by plotting soil chemical concentrations (Manzanilla and Barba 1990). These authors discuss the utility of chemical signature studies, as juxtaposed with artifact and ecofact studies, in that chemical deposits are "invisible and intangible," representative of activity by-product, and unable to be re-used or vertically or horizontally displaced. Utilizing the premise that the household is "essentially an activity group," they discuss "activity areas" as the minimum spatial units of archaeology that have social meaning. The authors claim that Classic Mesoamerican households were formed by more than one nuclear family, where individual nuclear families are defined by the number of food-consumption areas associated with them.

The work of Chris Morehart has implications for variation in practices surrounding both agricultural production and "symbolic ethnobotany". He synthesizes the paleoethnobotanical research done by several other authors, with a focus on burials, ritual, and cave use in Belize. He examines archaeobotanical remains with potential for economic utility, as well as those with potentially symbolic meanings, in relation to cosmology and mythology, and associated with different contexts (Morehart 2001, 2004). Linda Brown and Andrea Gerstle also utilize paleoethnobotanical data to support ideas of Structure 10, a special-use building, at Cerén (Brown and Gerstle 2002). Macrobotanical remains (maize cobs, achiote, and squash seeds), in combination with architectural analysis, as well as processing, storing and serving artifacts, strengthen the authors' argument for the varying use of special-function contexts in connection with Structure 10. Morehart (2001, 2004) and Brown and Gerstle (2002), much like Hall (1990) and Powis et al. (2002), identify various taxa used in ritual contexts, such as cacao, achiote, squash seeds, palms, and maize, thus indicating their special importance in Maya foodways.

Overall, as with artifacts and spaces, the association between various contexts and various food practices holds potential in helping to trace the "language" of foodways. The paradigms and syntagms described in ethnographic and archaeological literature provide a basis against which evidence from sediments may be compared.

Transformation and Continuity over Time

As with language, foodways and their associated artifacts, spaces, and contexts are far from static and are transformed through the course of practice, just as practices emerge through these media. For this reason, tracking changes and continuity in patterns of foodstuffs over time can reveal transformations and continuity in food practices themselves.

In one publication, Miksicek (1990) reviews taxa and likely agricultural practices in a wetlands area of Belize. In this ecological context, he finds evidence for a change over time from occasional and intermittent planting to regular flood-recessional cropping. Similarly to McNeil (2002) and Johnston (2001), he reveals data that support the model of deforestation over time, which he associates with swidden agricultural practices.

Using settlement density and skeletal isotope data as factors, Christine White et al. reach conclusions through their own data from Altun Ha, Belize (White, et al. 2001). They find a lack of continuity in dietary practice over time, as after the Early Classic there is a marked decrease in C4 foods. However, their conclusions are somewhat undercut by the vast time period which the data encompass (approximately 1750 years) and their geographic zonation methodology (focused exclusively on the center of the site).

Cathy Crane (1996) utilizes pollen and carbonized ethnobotanical remains from the Late Formative site of Cerros to reveal changes and continuities of subsistence and, by implication, agricultural practices. She indicates that the cultivation of staple crops like squash and maize maintained prominence over time, whereas utilization of alternate resources increased at about 100 B.C. Interestingly, she claims this use of non-staple crops, such as tree fruits, also corresponded with an increase in social stratification (Crane 1996).

Further to the north, in central Mexico, Brumfiel (1991) uses ceramics to investigate changing patterns of women's domestic activities in the Basin of Mexico under Aztec rule. She tracks the relative frequencies of cooking jars and tortilla griddles, over time, arguing that as tribute demands increased, tortillas became relatively more prominent in the quotidian diet, replacing atoles and tamales.

Such transformations, whether viewed through evidence in artifacts, human remains, sediments, botanical elements, or landscape, reveal the fluid aspects of foodways. Are there foodways that are markers for a particular time period? That is, could some be identified as chronotopes, in the same way that certain artifact and architecture types are used? Moreover, can certain patterns of foodways be discerned, which might indicate either a confluence or a departure from previous paradigms? I sought to answer such questions, aware that previous research had already revealed the processes through which aspects of foodways continue or discontinue over time.

Summary

The anthropological literature has left a rich set of analogies that are often applied wholesale in studies of ancient Mesoamerican foodways. However, we see here the ways in which archaeological approaches, especially those employing paleoethnobotany, have complicated this direct-historical picture of the past. My own data set redraws these sketches, in the approach to different sorts of data, and the paradigms and syntagms of taxa use. This broader set of analogs gives us a set of possible options, concepts, or activities, which are formed and re-formed in relation to the sets of associations formed through the selection of options, concepts, or activities. It gives us a range of possible practices, and a spectrum of possible foods. In this study, I take the models from the literature, both theoretical and specific to Mesoamerica, and apply them to four sites in Northwestern Honduras. In the following chapter, I detail why these sites are ideal as nodes of study, and describe the context of the paleoethnobotanical data I employ.

5. Ancient Communities and Ecological Contexts

In previous chapters, I introduced my research and its questions, the theoretical grounding of my interpretations, and analogous practices within and outside of Mesoamerica. Here, I consider the four sites that provide the context and the content for my studies of Pre-Hispanic plant practices. This set of information provides the basis and backdrop for my research design, the topic of the subsequent chapter. It is with this background in mind that I addressed my research questions, and developed specific methodologies and sampling strategies to obtain my primary data.

In this chapter, I synthesize work on the history and ecology of the region. I begin with broader settings, focusing on geographical and ecological frames, social and material contexts, and historical trends and trajectories. From here, I explore some of the particulars of each of the four sites, providing a more immediate background for my work at each of these ancient communities. I consider periods of human occupation, types of data available, and aspects of lifeways broadly in each community. Finally, I discuss why these sites, in particular, are well-suited to help address my thesis questions, in terms of both data and context.

Geographical and Ecological Frames

The four sites of this study all come from the Northwestern portion of Honduras **(Figures 5.1 and 5.2).** This region lies in close proximity to the Motagua-Polichic Fault Zone, inland, and the Swan Island Fault zone, in the Caribbean (Marshall 2007). The proximity to the northern edge of the Chortis tectonic block has resulted in a topography characterized by several mountain ranges, termed the Western Rifted Highlands (ibid.). Broadly, the elevation of these areas varies from 300-900 meters above sea level. The lithology of Northwestern Honduras is characterized by a combination of Mesozoic sediments, Tertiary sediments, and Paleozoic metamorphic rocks (ibid.). Nestled within the mountain ranges are multiple river valleys. The periodic flooding of these rivers deposits large amounts of alluvium to lower elevations, resulting in broad transformations of waterways and shifts in settlement, as well as the burial of sites through deposition (Joyce and Henderson 2001). The region is partially defined by several rivers which eventually drain into the Sula coastal plain, including the Comayagua, Ulua and Chamelecon, and the basin of Lake Yojoa (Joyce 1985).

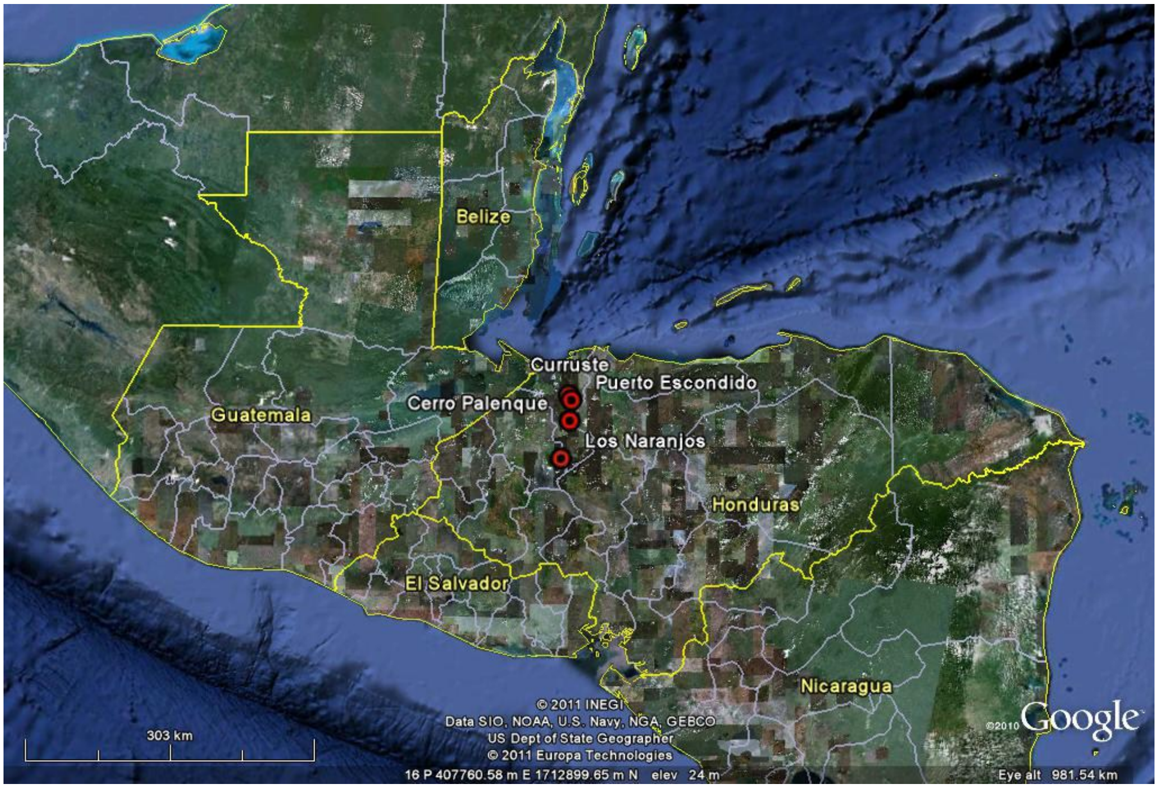


Figure 5.1. Location of four sites in Northwestern Honduras, in relation to modern geographical boundaries.

In terms of climate, the region is marked by a dry season from January to May and a rainy season from May to January, punctuated by a slightly dryer period in July, termed the "caniculum" (Joyce 1985). Seasonal streams, termed *quebradas*, fill during heavy rains. Although there are seasonal differences in temperature, the largest temperature variations occur within the space of a day, rather than over the course of a year (Hendon 1987). The riverine and lacustrine environments of these four ancient communities are marked by vertical differences in microenvironments, as well as seasonal variations in locations and volume of flowing water. Broadly, however, all lie within a region of Tropical rainforest and wet Tropical highlands (Marshall 2007). The riverine areas are marked by highly agriculturally productive soils, similar to those of the lower Usumacinta in Guatemala, and the area is marked by a fairly broad range of habitats (Pope 1987).

As Henderson and Joyce (2004:2) note, faunal resources are highly diverse, including "Caribbean marine species, waterfowl, tropical riverine species, and both lowland and upland terrestrial species available within a radius of approximately 70 km." Archaeological faunal remains recovered from ancient communities in the region have revealed the use of large animals such as deer and peccary, as well as bird bones in the Formative period, the addition of canids in the Classic Period, and the addition of opossum, fish, and turkey in later periods. These faunal assemblages have also encompassed a variety of small to large mammals, and later components include tapir, turtle, and turkey (Henderson and Joyce 2004). Overall, there is a noted increase in fauna diversity for later time periods, which may reflect differential preservation, but also an expansion of resources utilized during periods of greatest settlement. Evidence from Cerro

Palenque also indicates the use of various species in activities likely unrelated to subsistence (Henderson and Joyce 2004).

Pope (1987:115) has identified the "intensive use of alluvial and colluvial fan and upland soils... with less intensive use of northern gallery forest, abandoned levee, and tributary plain soils" in the Classic Period. He suggests that the best soils may have been reserved for commercial use and/or avoided due to their propensity for flooding. Henderson and Joyce (2004:3) hypothesize that "high soil fertility and habitat diversity... were among the factors that allowed a large agricultural population to live in rural farming settlements in situations of relative affluence."

Historic records document the production of high-quality cacao in this area in the 16th century (Henderson et al. 2007). Present-day agriculture is marked by banana plantations and sugarcane in Currusté, Cerro Palenque, and Puerto Escondido areas, and by cacao and pineapple cultivation in the Los Naranjos area. Broadly, the region is currently marked by a patchwork of small family farms.

Social and Material Contexts

In addition to their ecological and topographical characteristics, the communities of this region are distinguished from Maya communities to the north and other Central American communities to the south in terms of intra- and inter-site interaction and materials. Although intensive trade with Maya neighbors has been noted, this region is made culturally distinct by its ceramics and settlement (Joyce 1985, Hendon 1987). The extent of Copan-related Maya sites appears to be demarcated by the sites of Zumbadora, La Florida, and La Entrada, none of which is closer than 85 km from the sites of this study (Hendon 1987) and potentially even further. Overall, the area of this current study is marked by communities that did not employ the Maya writing system or iconography on monuments or architecture (Joyce 2008). In the sixteenth century, spoken languages of this area included Chibchan languages (Lenca and Paya) and Tol (Joyce 2008).

The materials of daily life at the four communities of my study are represented by both durable and nondurable remains. These remains index the biographies of people, places, spaces, and things. What is extremely notable for the area, in contrast to Maya centers to the west and southwest, is that there is a "lack of dramatic differentiation of material assemblages between the centers and outlying sites" (Lopiparo 2003:281). The large agricultural population lived in relative affluence, "as measured by the diversity of household possessions, including exotic material and luxury items" (Henderson and Joyce 2004:3). Moreover, throughout the region, "archaeological sites are characterized by small absolute size (the largest regional centers contain remains of hundreds of buildings), by diverse types of pottery vessels, figurines, and other artifacts, and by distinctive stone carving styles, especially of portable objects" (Joyce 2000:1).

Broadly, this area of Northwestern Honduras seems to evidence heterarchical modes rather than those which are purely hierarchical, or egalitarian. Heterarchical conceptions of community often foreground variation found within place relations in terms of architecture, geographical location, number of associated buildings, and artifact remains. In their comparison of Cerro Palenque and Cuyumapa Valley sites, Joyce and Hendon (2000:157) determine that "the overlapping of distinct communities in the Cuyumapa drainage, with multiple scales of variation and multiple principles of settlement organization, can be seen as evidence of heterarchy." They find this to be an example of 'coordinate networking', where, "relative ranking forms a basis for joint action, rather than for the exercise of control" (Joyce and Hendon 2000:157). In contrast, at Cerro Palenque, "lack of long-term history was addressed through the testimony of a deliberately crafted large-scale setting [a single ballcourt, etc.] for the enactment of a common, hegemonic community identity" (Joyce and Hendon 2000:158). Thus, heterarchy is exemplified both at the community level, at Cuyumapa Valley, and at the regional level, between the two site zones (Joyce and Hendon 2000).

The concept of heterarchy has been discussed by others working in the Maya area. Dunning et al. (2003), at the community level, note the variety of ways through which households could navigate risk and gain, by maintaining a heterarchy of positions and methods, here strongly tied to ecology. Potter and King (1995) argue against the idea of craft specialization controlled hierarchically from a central place, finding instead that specialization is tuned into spatial relationships and natural resource distribution. They cite, as factors in this heterarchical schema, the "patchiness" of resources and high biological/geological diversity, combined with seasonality. Overall, at a regional level, they find heterarchy to be a more applicable concept than hierarchy, as it does not conflate subsystems within a single vertical structure.

Describing the landscape almost fractally, Fedick (1996:316) notes that "as one moves from the scale of local landscapes toward broad regional levels, what was once a heterogeneous landscape at the local level might become a homogenous element within a larger regional landscape." The reverse may also be possible, in cases where spatial patterns at a fairly homogenous site may actually contrast with regional patterns (Joyce and Hendon 2000). Overall, for this part of Northwestern Honduras, Henderson and Joyce note that the relatively high standard of living is marked by a low degree of sociopolitical centralization, and during the Classic period, could be viewed as "a landscape of wealthy independent farming households" (2004:3).

The durable material culture of the area is typified by platform mounds (whether earthen, rubble, stone, or in combination); structures housing various activities in a variety of forms and composition (wattle-and-daub, pole and thatch, stone, or in combination); ceramic vessels of various types, forms and sources; ceramic figurines, ocarinas, and stamps of various forms and sources; aspects of adornment such as earspools, pendants, and beads; groundstone including manos and metates; obsidian tools of various forms and sources; and a few chert tools of what appear to be locally available materials. Various combinations of these materials mark in-situ disposal practices, architectural fill, and funerary and ritual deposits. Debris from production, including figurine molds and lithic debitage. Architecture appears to have often gone through cycles of renovation, sometimes taking place over hundreds of years. The mounds and buildings structure spaces, and the material culture and features mark varying places of activity. These spaces and places overlap in complicated ways, and vary over time and occupational periods, in the constant process of constitution and re-constitution of practices and landscapes (see Joyce, Hendon, and Lopiparo 2009).

Nondurable remains recovered from these four sites include botanical remains (the detailed subject of this thesis), faunal remains, and human remains, as well as indirect evidence of pole and thatch imprints in fired daub from buildings. The botanical remains are recovered from a variety of contexts and spaces, and represent debris, portable artifacts, and architecture construction. The faunal remains are recovered from a variety of contexts and spaces, and represent debris, worked tools, and deliberate ritual practice. The human remains are recovered from ceremonial and funerary deposits representing deliberate ritual practice, and as isolated elements occurring in fill.

Historical Trends and Trajectories

Northwestern Honduras has witnessed occupation from the Archaic Period up through the Colonial Periods. However, I here narrow my discussion to those time periods in which the data and communities of my study are situated.

The Formative Period is characterized by a series of phases that reveal increasing sedentism, increasing reliance on cultivation, and increasing participation in wide-reaching trade networks (Joyce 2000; Joyce and Henderson 2001; Joyce and Henderson 2010). This trade is marked by the movement of artifacts such as ceramic vessels, obsidian, and jade, as well as iconography strongly related to that of the Olmec area (Joyce 2000, Joyce and Henderson 2001). The earliest evidence for agriculture dates to the Archaic Period, at the sites of Los Naranjos and El Gigante rock shelter (Scheffler 2009), and from pollen cores at Aguada Pedapilla (Rue et al. 2002; Webster et al 2005). Subsequent periods are marked by intensification, in the Early Formative, to a plateau of fairly stable cultivation through the rest of the Formative and Classic Periods (Rue 1987, 1989). The earliest architecture consists of perishable buildings marked by post holes, with later phases marked by these as well as less perishable buildings. Monumental architecture is first noted in the Middle Formative period (Joyce and Henderson 2001; Joyce 2004). Trade networks seem to have shifted over time, as tracked through ceramics and obsidian sources (Joyce and Henderson 2001).

Two broad spheres of interaction are noted in the southern Mesoamerican area during the Late to Terminal Classic periods (Joyce 1986). The sites of the present study correspond with a set of trade networks linking the Ulua Valley with Belize and the Maya Lowlands. Ceramics from the Ulua Valley during this time period share attributes with vessels from the Lowland Maya area, including cylindrical form and polychrome painting (Joyce 1986). Pacific shell such as *Spondylus* and jade artifacts are exotic items found to the south and west, likely traded through the southern Highland sphere via Central Honduras. As Contact period Ulua Valley traded cacao (and other perishables) heavily with neighbors along the coast and to the west, it is very likely that this was a central exchange item in the earlier periods, as well (Henderson 1979; Joyce 1986).

During the Terminal Classic Period, the northern Caribbean coast trade area and the southern Highlands trade area appear to have become increasingly differentiated (Joyce 1986). Following the dramatic depopulation of southern Maya cities at the end of the Terminal Classic period, the Ulua valley became more isolated, and only some trade is apparent with Central Honduras (Joyce 1986). The transition into the Early Postclassic period is marked by a decline in population at some sites throughout Northwestern Honduras, as manifested in architecture and artifacts dating to this period (Joyce 1986). This transition to the Early Postclassic is also a period of decrease in all exotic trade goods, "as obsidian declines in frequency and jade and shell are absent" (Joyce 1986:325).

During the Terminal Classic or Early Postclassic, there is evidence of population redistribution, and settlements shift to more dispersed and smaller sites during the Postclassic. However, the identification of Postclassic sites is hampered by their tendency to be located along river banks and at ground level (Pope 1985). This has led to an unfortunate paucity of archaeological data for this time period, although Pope (1985) notes that ethnohistoric accounts detail densely populated sites during the Contact period, several hundred years later.

The sites that provide data for the current study were occupied from the Early Formative through the Late Postclassic. Samples came from only part of these occupation spans, specifically the Middle Formative, early Classic, late Classic, and Terminal Classic periods. Los Naranjos and Puerto Escondido both provided data from Formative period contexts, while Puerto Escondido also provided early Classic data. Cerro Palenque and Currusté provided data from the Terminal Classic period.

Figure 5.2 Locations of Currusté, Puerto Escondido, Cerro Palenque, and Los Naranjos in Northwestern Honduras.

Los Naranjos

The site of Los Naranjos occupies the Northeastern portion of the Lake Yojoa basin, at 635 meters above sea level (Rue 1987, 1989). The site lies 85 km from the Caribbean, between the lower Ulua Valley and the Comayagua Valley. The immediate lacustrine ecology is complemented by that of the surrounding rugged hills. Vegetation at the site shifts from lakeside ferns and sedges, to lower elevation deciduous tropical forest, to higher elevation upland deciduous forest, to highest elevation pine-oak montane forest (Rue 1987,1989). The community of Los Naranjos had a long history, extending from the Late Archaic period occupation, as marked by the pollen record (Rue 1987, 1989), through the Formative, Classic, and Postclassic Periods, as marked by architecture and artifacts (Baudez and Becquelin 1973; Joyce 1991).

A pollen core removed from Lake Yojoa for analysis revealed varying percentages of plants over time. The pollen recovery, however, must be qualified by the fact that many plants currently in the area are insect-pollinated, meaning fewer grains drop into the lake and become incorporated into sediments (Rue 1987, 1989). Rue found that the earliest levels are marked by high percentages of tree species. Subsequent early agriculture in the Archaic Period, ~2,800 BCE, is marked by Cheno-ams and maize, with low relative percentages of other grasses. Agricultural intensification is later marked by increases in sunflower family, ragweed, and other disturbed- and fallowed-area plants. From ~1,000 BCE to modern times, the pollen record evidences no major vegetational changes, aside from a short period of potential abandonment and reforestation marked by pine tree pollen. Crucially, the period of abandonment marked by depopulation of nearby large Maya city centers does not appear to have occurred at this site, based on the relatively static pollen record during the Terminal Classic period (Rue 1987, 1989).

At the time of their construction in the Middle Formative period (900-400 BCE), the pyramids of Los Naranjos were as large as any built elsewhere in Central America (Joyce 2004). Structure I of these monumental earthen platforms rises to a height of 19 m and a basal area of 7500 square meters (Baudez and Becquelin 1973:21-23). Like similar platforms at other contemporary Mesoamerican sites, they do not appear to have initially had a funerary function. However, later in history, they are used for funerary purposes (Joyce 2004). The earliest construction phases of these structures show buildings at a maximum of 13 m in height (Baudez and Becquelin 1973:23). Ditches ringing the site center extend 5 km to the surrounding area, and define the zone of monumental platforms (Joyce 2004:23). Later construction stages framed plaza spaces, centering the earlier monumental platforms that are augmented in volume (Joyce 2004).

The paleoethnobotanical data from this site encompasses six kinds of contexts and at least four kinds of spaces, and consists of both light fraction macrobotanical samples and microbotanical extractions from obsidian artifacts **(Table 5.1).**

Puerto Escondido

Puerto Escondido lies in the lower Ulúa Valley, and is defined as a "small but wealthy" community (Henderson et al. 2007) located in a fertile floodplain. Settlement is clustered along a tributary of the Chamelecón River, which at various times was a tributary of the Ulúa River (Joyce 2011).

Earliest occupation at this site comes from deposits approximately 3.5 m below ground surface that date between 1600-900 BCE, in the Early Formative (Henderson and Joyce 1998, 2004; Joyce 2003, 2004a, 2004b, 2004c, 2007, 2008; Joyce and Henderson 2001, 2002, 2003, 2009, 2010; Joyce et al. 2004; Luke et al. 2003). Occupation persisted through the Late and Terminal Classic Periods, until approximately 1000 CE (Joyce 2004, Joyce and Henderson 2002). Multiple occupation phases brought with them multiple construction episodes, each identified by stratigraphic sequences and radiocarbon dates (Joyce and Henderson 2001, 2002a, 2002b). Some plastering and stone facing appears to have been carried out beginning in 1100 BCE, although the earliest architecture is comprised of perishable superstructures constructed with posts (Joyce 2004). Up until 900 BCE, the architecture included rammed-earth walls and wattle and daub houses (Joyce 2004). Joyce posits that these types of architecture "would have been subject to erosion and would have required regular maintenance" (2004:18). Some demolishing appears to have taken place, and this debris formed the base for subsequent construction periods (Joyce 2004). Beginning around 900 BCE, debris from previous buildings was incorporated into new architecture, in some cases having been previously burned (Joyce 2004). Plasters and stone facings, as with some earlier architecture, were noted. These structures also mark the first evidence of human burials in architecture, in addition to caching of vessels (Joyce 2011).

The Classic period occupants of Puerto Escondido built structures with foundations of the same rammed earth supporting walls of wattle and daub or pole and thatch. These buildings were located on raised earthen platforms formed by the residues of earlier construction phases. They were organized in small groups around open spaces, in which are found small, clay-lined pits (some burned) and deeper pits with restricted openings (bell-shaped pits). Burials were located under house floors or immediately adjacent to them (Joyce 2011).

Artifactual evidence has revealed a fairly high standard of living with a relatively low scale of economic differentiation (Joyce 2011). Overall, a wide variety of ceramic vessels are represented. Obsidian was imported from both local and distant sources (Joyce et al. 2004), marine shell and stone from distant locations (Joyce 2011). Many symbolic elements recovered from Puerto Escondido share similarities with Olmec communities in the Gulf Coast of Mexico (Joyce 2011). Analysis of ceramic vessels revealed the storage and fermentation of cacao beverages by 1050 BCE (Henderson et al. 2007; Joyce and Henderson 2007).

Faunal remains have revealed a steady decline in deer and other large mammals from the Middle Formative through the Terminal Classic, and a concomitant increase in diversity of faunal species exploited. No canid bones were recovered from this site in association with the Formative period, which is consistent with other areas of Northwestern Honduras until the Classic period (Henderson and Joyce 2004). The faunal remains represent both subsistence practices and non-subsistence practices (Henderson and Joyce 2004).

Funerary contexts have revealed transformations over time- early burials are rare and deliberately placed "in a special-purpose architectural feature" or potentially in distant caves (Joyce 2011:36) while later burials are common and found "under interior house floors, adjacent to house walls in the exterior yard space, and reused storage pits" (Joyce 2011:35-36).

The paleoethnobotanical data from this site encompasses nine kinds of contexts and five kinds of spaces, and consists of both light fraction macrobotanical samples (analyzed by Rachel Cane) and microbotanical extractions from obsidian artifacts **(Table 5.1).**

Cerro Palenque

Cerro Palenque lies in a hilled area, at the nexus of the western Ulúa, Blanco, and Comayagua rivers. The area is marked by a smaller Late Classic occupation, and much larger Terminal Classic occupation (750-950 CE) (Joyce 1985, 1991; Hendon 2010). The Classic period occupation shows ties to the Maya lowlands, in particular Belize, and includes products of long distance exchange from Central Mexico, green obsidian from the Pachuca obsidian source (Joyce 1988).

During the Terminal Classic period, the Ulúa Valley area formed part of a system of extraction by Classic period Pasión region centers (Joyce 1986). Cerro Palenque grew to become the largest known center in the precolumbian Ulua Valley (Joyce 1991). However, the collapse of Pasión region trading partners led to a shift in trading practices. For this reason, dense populations may have dispersed, with the dramatic shift in social ties and material trade.

At its population height between 850 and 950 CE, the community settlement of Cerro Palenque was comprised of over 500 structures, with the largest concentration of monumental architecture centered in a Great Plaza and ballcourt. Adjacent to the ballcourt was a residential compound distinguished by having larger platforms than other residential compounds in the settlement (Hendon 2010). Continuous paving links this residential area with the ballcourt. Hendon (2010) posits that residents of the ballcourt residential group hosted broad-scale feasting events, connected with ballgames. Architecture in other areas is marked by mixed wattle-and-daub and stone construction. Multiple phases of construction are documented, including ritual deposits.

Several middens excavated in this residential compound reveal differences between depositional contexts. The West mound deposit has a collection oriented more toward food serving and consumption, as evidenced by fine-paste wares, whereas at the South deposit there was more emphasis in ceramics on food preparation and storage (Hendon 2010). Kilns were also excavated (Hendon 2010; Hendon and Lopiparo 2004; Lopiparo and Hendon 2009). Additional evidence for ceramic production came from sherds from mold-made vessels and figurines, and pieces of molds to produce them, recovered in adjacent trash deposits.

Based on the types of non-local ceramics present, Hendon (2010) proposes that the residents of Cerro Palenque, during the Terminal Classic Period, had contact with eastern neighbors in the Cuyumapa river area, as well as the Lake Yojoa area, and communities in Belize and El Salvador. Exotic marine shell also marks ties with coastal communities. Obsidian samples indicate various sources from Guatemala and Honduras, although obsidian from Guatemala became less common during the Terminal Classic and from fewer sources, as residents turned more toward local obsidian sources (Hendon 2010).

The paleoethnobotanical data from this site encompasses at least three kinds of contexts and at least two kinds of spaces, and consists of both light fraction macrobotanical samples and microbotanical extractions from obsidian artifacts and ceramic sherds **(Table 5.1).**

Currusté

Currusté is a large regional center located in the Lower Ulua Valley area. Preliminary analyses of ceramic sherds have indicated occupation dating to the Late Classic and Terminal Classic period (750-1000 CE) (Lopiparo 2008). The site, strategic in its location along trade networks and amidst rich local resources, sponsored the production of fine artisan wares, and large communal gatherings for annual rituals (Lopiparo 2008).

Early survey and excavations, conducted by George Hasemann in the 1970s, had demarcated the central core of the site and outlying groups in the surrounding hills. Excavations at the site from 2007-2009 were focused on the reconstruction of both quotidian and special practices including foodways, large-scale events, and ritual activity (Maldonado et al. 2009). One particular emphasis of studies in 2007 and 2008 were excavations directed toward recovering evidence of foodways from residential areas in the north and south residences of the site—contexts and spaces I describe in subsequent chapters. Other excavations were directed toward the large central plaza and the southeast corner of the plaza, connecting the area to the southern residential area.

Excavations by our team and by Hasemann et al. have revealed a series of floors and surfaces, evidence that the area had been repaved various times with various clays and gravels, an undertaking requiring an enormous labor investment (Lopiparo 2008, Hasemann et al. 1977). This attention to plaza areas, in combination with the decreased focus on monumental architecture, may indicate more of an emphasis on "horizontal monumentality" in place of "vertical monumentality" (Lopiparo 2008). Excavations in plaza areas revealed the presence of a large deposit of smashed ceramic vessels, in addition to a series of large figural incensarios arranged above several bundles of human long bones and skulls. Such practices at this site mark cycles of life and the environment, ritual practices that "assured the rebirth and renovation, both physical and metaphysical, of the site and its inhabitants" (Lopiparo 2008:50).

Excavations in the residential areas were marked by multiple occupational surfaces, several fill and occupational episodes, and the intentional burning and razing of structures. At other sites in the region, such activities have been associated with termination and dedication, within both public and residential domains (Lopiparo and Hendon 2008). Bajareque (burned daub) fragments were abundant, due to the multiple razing and construction episodes. Several funerary contexts were excavated, as well, marked by very few grave items-- a common feature of Ulua Valley burials during the Classic Period (Lopiparo 2008). Many figurines were recovered, in addition to various lithic materials and ceramic sherds. The artifacts reveal the exchange, production, and consumption of both local and imported materials (Lopiparo 2008).

The paleoethnobotanical data from this site encompasses eight kinds of contexts and five kinds of spaces, and consists of both light fraction macrobotanical samples and microbotanical extractions from sediment samples **(Table 5.1).**

Northwestern Honduras: An Ideal Setting for Foodways Exploration

These four sites have provided a unique opportunity to pursue my research topics, for several reasons. First, there is a strong background of work already completed, including mapping, architectural and off-architecture excavations, and ceramic analyses. Second, as larger community centers, these four sites represent a nexus of diverse activities and thus potentially a wider range of plants and plant uses, as reflected already by the wide array of artifacts already recovered. Third, a diverse set of contexts, spaces, and types of paleoethnobotanical data were available for study from across these sites. Fourth, several time periods are represented by these sites, enabling discussion of continuity and transformation in foodways over time.

When choosing among available sources of data for my dissertation, there were several parameters I wanted to observe: the presence of complementary data sets, the availability of artifacts for analysis, and a diversity of times, contexts, and spaces represented. My objective was to be able to draw broad comparisons between elements, and sketch patterns in the data. The studied loci of each site provide a variety of spaces in terms of circulation, containment, layout, etc., and a variety of contexts, in terms of features. Moreover, as they represent groups of varying social status, this enabled the recovery of a higher diversity of plants and plant uses (as represented also by the high diversity of elements of material culture already recovered). The opportunity to study ethnobotany over time, in terms of diverse occupation periods, was also crucial.

Site	Sediment contexts (#samples)	Sediment spaces (#samples)	Types of samples (#samples)
Cerro Palenque	high density midden (3), kiln (5), special deposit (1), unknown (1); Total=10	outside (2), patio(3), unknown (5); Total=10	light fraction (10), obsidian artifact (4), ceramic sherd (4); Total=18
Puerto Escondido	ashy deposit (1), burial matrix (4), burned deposit (1), hearth (7), high-density midden (1), interior surface (3), lined pit fill (12), matrix between (2), special deposit (1); Total=32	adjacent (15), interior ground str (3), interior mound str (10), outside (2), patio (2); Total=32	light fraction (32), obsidian artifact (6); Total=38
Los Naranjos	architect fill (2), collapse matrix (1), high-density midden (1), interior surface (1), matrix between (5) pit fill (3); Total=13	adjacent (4), between (1), interior ground str (3), outside (3), unknown (2); Total=13	light fraction (13), obsidian artifact (7); Total=20
Currusté	architect fill (6), burned deposit (1), collapse matrix (1), external surface (2), interior surface (3), low-density midden (25), matrix between (31), matrix with carbon (3); Total=72	adjacent (14), interior ground str (2), interior mound str (8), outside (27), patio (22); Total=72	light fraction (62), sediment samples (26); Total= 88

Table 5.1. Sites, contexts, spaces, and types of data available from each, with number of samples analyzed.

Overall, the richness of the data set at each site enabled me to ask questions of the data that would have been impossible at data-impoverished sites (usually due to preservation issues) and sites where only one type of data was obtained (usually due to collection or storage issues). The diversity of contexts, spaces, artifacts, time periods, and communities was optimal in revealing patterns and anomalies of practice over a variety of landscapes.

Summary

The four ancient communities encompassed by my study represent a wide array of social dynamics and daily activities. Concepts of social dynamics permeate multiple areas of conceived daily practice. The implications of these models on ideas of foodways in the Maya area range from the ecological to the demographic to the economic to the symbolic. Whether vertical, horizontal, or a combination of the two (following Potter and King 1995), these ideas often remain static and system-based, in spite of those studies that demonstrate otherwise (Joyce and Hendon 2000, Potter and King 1995). Decision-making, as its causes and effects are perceived, is related directly to ideas of how food is conceived, produced, and consumed. As social dynamics are often found transcribed onto landscape, daily practices surrounding food are considered part and parcel of this transcription. Where simply "translating" landscape is often seen as the first and last step in analyzing social dynamics, foodways are left as the unanalyzed "givens", products of the textual landscape from which they were conceived.

The four archaeological sites that comprise my paleoethnobotanical study area are diverse in their materials and ecologies, but not so dissimilar as to be incomparable. Overall, these four sites from Northwestern Honduras were ideally suited to answer my broad thesis questions, in terms of the quantity and quality of data available, in addition to their positions relative to each other in a heterarchical and temporal framework. Although complementary data sets from each site would have been optimal, there was still an enormous amount of information to be gleaned from the available materials. In the next chapter, I consider the ways that I approached my thesis questions and operationalized them by devising sampling strategies and specific protocols.

6. Paleoethnobotanical Methods

In prior chapters, I have outlined the background of my research vis-a-vis foodways literature, and particularized my questions to this region of Southeastern Mesoamerica. I nested these pursuits within a broader theoretical perspective that draws heavily from linguistic and practice approaches. It is the middle range, then, that is left to be discussed—the nuts and bolts of model testing. If I could, I would ask the dirt and artifacts themselves— who used them, what they were used for, what was deposited where. Since I can't, I have to use various methodologies to get at these questions through proxies. I have primarily made use of the techniques associated with paleoethnobotany, as I find them the ideal means through which to approach foodways, daily practice, and structuration. I consider paleoethnobotany to be the primary vehicle through which the "language" of daily food practices can be sketched.

I was fortunate enough to have training in macrobotanical techniques under Christine Hastorf, at U.C. Berkeley, and training in microbotanical techniques under Dolores Piperno and Linda Perry, at the Smithsonian institution. I have also benefitted enormously from conversations with fellow students Rob Cuthrell, Alan Farahani, Christopher Morehart, Stephanie Simms, Rachel Cane, and Matthew Sayre, who have helped me to hone various techniques and protocols. Ethnobotanical experiences were greatly enriched by work with Benancia Cupul Chi and Claudio Cupul Chi, in Naranjal, Mexico.

The kind of work paleoethnobotanists do is what gets us labeled as plant nerds. Because it is a niche within a niche discipline, people have limited exposure to the methods and the interpretations of paleoethnobotany. This even includes fellow archaeologists. So although the general idea in this chapter is to elucidate specific protocols, I would like to demystify the process of paleoethnobotany a bit, and attempt to make it more accessible. Otherwise, my interpretations are going to seem as though they're built on real magic at best, and smoke and mirrors at worst. In this section, I outline the specific paleoethnobotanical methods I utilized in order to answer each of my research questions. I begin, however, with an overview of the methods associated with paleoethnobotany, to orient my work in terms of general protocols.

Paleoethnobotany as a method

Drawing on Volney Jones (1941) and subsequent self-identified ethnobotanists, Gary Martin defines ethnobotany as the study of "how local people interact with the natural environment" (Martin 1995:1). This very basic premise can be expanded to form the theme integral to both paleoethnobotany and archaeobotany: how people of the *past* interacted with the natural environment.

Although some authors treat archaeobotany and paleoethnobotany as synonyms (e.g. (Miksicek 1987) Popper and Hastorf differentiate these two terms by identifying paleoethnobotany as the study of human and plant interactions, and the study of archaeobotany as simply that of plant remains, regardless of cultural interaction (Popper and Hastorf 1988:1). Karl Butzer and Leslie Freeman state that "paleoethnobotany refers to the analysis and interpretation of archaeobotanical remains to elucidate the interaction between human populations and plants" (Butzer and Freeman 1988:ix) while Deborah Pearsall defines paleoethnobotany almost identically as "the study of the interrelationships between human populations and the plant world through the archaeological record" (Pearsall 2008:xix). To date, paleoethnobotanical approaches have been used in discourse on social change, ethnicity, plant taphonomic processes, diet and subsistence, plant-use practices, crop origins, and evolution of agricultural systems, among other topics. Archaeobotany, though also a prime tool in the analysis of such questions, has a multitude of other uses, from environmental reconstruction, to demographic characteristics, to morphological alterations related to domestication (Popper and Hastorf 1988). As paleoethnobotany is most closely aligned with studies of foodways, it is the expansion of this topic that I pursue here.

The field of paleoethnobotany first emerged as tables of botanical remains, appended to early archaeological reports. However, beginning sometime around the 1930's, paleoethnobotany began an historical move from purely qualitative to quantitative approaches, as researchers realized that they could move beyond simple taxonomic determinations. At this time, researchers began to question "the origins of plant domestication, dietary change... trade or tribute, [and] the use of plants in rituals" (Popper and Hastorf 1988:3). Both qualitative and quantitative approaches have been brought to bear on such discussions of human-plant interactions, often in complementary ways. The use of qualitative information hinges upon an understanding of the ecology and potential utility of plants, and can be used to address questions surrounding seasonality, nutritional data, analogous uses, and distribution, among others. The use of quantitative information hinges upon representative sampling and quantifiable variables, and can be used in statistical analyses which act as replicable results of spatial and temporal comparison.

Paleoethnobotanical approaches hold much potential in the area of foodways, as a means by which to analyze the residues of human practices. As noted in the previous chapter, foodways studies have implications for every aspect of human life, from the political to the psychological. However, past foodways studies utilizing paleoethnobotany traditionally zeroed in on issues simply of "subsistence". Such studies necessarily emphasized the role of food production, not presentation, consumption, and disposal. As will be explored further on, paleoethnobotanical remains can be used to approach practices of everyday life, related not just to the basic necessity of subsistence, but also to the richness of experience associated with the tending, recovery, preparation, and consumption of foods. Just as some authors have moved from "subsistence" to "foodways", so have paleoethnobotanists moved from lists of taxa to discussions of actual cuisine.

The subjects of paleoethnobotanical analysis are many, including pollen (Fish 1994; Rue 2002; Reinhard, et al. 1986), stable isotopes (Ambrose 1993; DeNiro and Hastorf 1985), phytoliths (Piperno 2006; Andres et al. 2000; Miller Rosen and Weiner 1994; Ishida, et al. 2003; Madella et al. 2002), starch grains (Balme and Beck 2002; Piperno and Holst 1998; Piperno et al. 2000), organic residues (Evershed 1993; Heron and Evershed 1993), and macrobotanical remains (Pearsall 2008; Hastorf 1999). The use of such diverse methodologies has served to better elucidate many practices previously "invisible" to archaeologists. There is also great potential in the use of *multiple* lines of paleoethnobotanical evidence to answer research questions. For example, in their study of pollen, parasites, and macrobotanical remains, Reinhard et al. (1986) identify variation in plants utilized by two different households. The authors use these complementary types of data to identify differing practices (market purchase as juxtaposed with home-growing) and thus class differences between the occupants of each household (Reinhard, et al. 1986). It is such complementary work that I chose to pursue in my own dissertation work, as a means of making certain taxa more visible, and getting at the sorts of practices underrepresented by traditional foodways studies in this area.

Overall, given the incredible potential of paleoethnobotany in answering questions related to foodways, it made sense to utilize these techniques in my studies. I now turn to the various paleoethnobotanical methods I utilized during the course of my research, here tailored toward my specific research questions and the data themselves.

How can different taxa be made more visible in the archaeological record?

One of my primary research foci is methodological, having to do with simply increasing visibility of certain taxa and practices in the archaeological record. This is necessary, as mentioned in previous chapters, due to a traditional reliance on ethnohistoric and ethnographic evidence to draw interpretations about past foodways. That sort of evidence, though invaluable when considering archaeobotanical remains, requires massive temporal upstreaming and cannot be applied directly. As Linda Perry found in the case of alleged "manioc scrapers" in the Orinoco Basin, "Manioc may have been important in the early Holocene [evidence in other areas], but then became more rare as other crops replaced it" (Perry 2001:268). The wholesale translation of historic-period and contemporary documents into past lifeways can sometimes obfuscate the archaeological record. In order to test assumptions about foodways in the deep past, I pursued complementary methodologies, by recovering both macrobotanical and microbotanical remains, as outlined by Deborah Pearsall (2008). I present here a very broad sketch of these two primary methods, and the sorts of data recoverable by each. However, I first turn to broad sampling strategies, to delineate the methods dictated by various approaches.

From site to field to lab to interpretation, multiple authors note the issues inherent to sampling (Dennell 1976, Jones 1985, Miksicek 1987, van der Veen 1985), all surrounding the questions of where, how much, and why. Sampling strategy involves decisions about which portions of site, which features of site, and which *portions* of features of a site to sample (following Pearsall 2008:100). Martin Jones (1985:123) addresses the need for implementation of rationalized sampling strategies to allow for multiple data sets from multiple sites. Additionally, although it is often difficult to ascertain what an "off-site" context entails, comparative samples from outside the cultural context are ideally taken for comparison (Pearsall 2000:401). Such comparative sampling allows the paleoethnobotanist to better associate plant remains with human activity, as a means of attempting to assess the natural "background noise". However, this sort of comparative sampling is not without its issues, inherent in the designation of "natural" as opposed to "cultural" areas (Gleason 1994).

Pearsall (2008:66-8) distinguishes between six sampling methods used on archaeological sites: 1) no sampling (collection *in situ* or from screen only), 2) random or probabilistic sampling (complete random selection), 3) judgmental or purposive sampling (selection based on location), 4) systematic or interval sampling (selection based on an applied pattern) 5) stratified sampling (sequencing of sampling techniques), and 6) total or blanket sampling (sampling from every excavated unit). These methods of sampling vary in amount of randomness/bias, percentage of site represented, percentage of features represented, and quantity of time represented (usually expressed as depth). Marijke van der Veen recommends dividing features into "archaeologically recognisable categories" from which a random sample is to be taken (1985:167). Archaeological projects commonly utilize judgmental sampling strategy where food preparation, storage, or disposal areas are hypothesized. However, more systematic sampling improves the reliability of comparative analysis.

Once at the level of the excavation unit, Pearsall (2008:69-75) defines six types of samples for recovering macrobotanical remains: 1) bulk or point samples (taken randomly from one point within a unit), 2) pinch or scatter or composite samples (composites of sediment collected randomly throughout a unit), 3) column samples (taken after excavation from matrix profile or cores), 4) grab or non-random or judgmental samples (taken from specifically desired locations within a unit), 5) screen "samples" (removed from screen as spotted) and 6) point-provenance samples (taken from excavation unit as spotted). Authors tend to focus on scatter and bulk sampling as the most reliable techniques (Lennstrom and Hastorf 1992, Pearsall 2008).

Bulk sampling enables the collection of discrete activities across a floor, whereas scattered samples produce the best "average" of a site, and predict trends. These are not mutually exclusive techniques and either or both are applicable, contingent on specific research questions. In some cases, a stratified sample approach may be taken. In one study, Mollie Toll uses a two-level sampling strategy, by taking random samples from across the site of Pueblo Alto at Chaco Canyon, and later returning to particular loci for more detail. Her results lead her to determine that rooms had distinct and differing uses (Toll 1988). Whatever the sampling strategy used, paleoethnobotanists emphasize the importance of consistently collecting one type of sample across a site.

Sampling continues even into the laboratory. When sampling within a collected sample, sorting experiments are useful to gain an idea of recovery rates and methods, and aid in determining a sufficient subsample size. Subsampling may be decided based on sediment volume, number of specimens, or individual species (Pearsall 2008). Van der Veen and Fieller (1982:288) differentiate between three procedures for selecting samples of carbonized plant material: "grabsampling" (haphazardly selecting), "cumulative sampling" (averaging results of subsamples until the law of diminishing returns comes into effect), and "random sampling" (probabilistically selecting random samples of the same size) (van der Veen and Fieller 1982). Random sampling is most often used, by systematically splitting a sample (with a riffle box or a grid) into equal fractions which are each considered representative of the sample as a whole.

How much material constitutes an adequate sample? The quantity of sampled material, at every stage, should be concordant with research questions and logistical conditions. In terms of numbers of samples taken on a site, Miksicek notes that about 30 samples would generally be an adequate number of samples to identify the more common species preserved on an archaeological site (1987:237). More samples are necessary to recover rare taxa, and thus increase the range of taxa represented. An adequate sample size can be determined by volume of sediment or number of seeds recovered. Initially, it is useful to have a cursory idea of the density of material recovered from a particular context. Standardizing the quantity of sediment recovered is the more common way of enabling reliable statistical analysis (Miksicek 1987:236, Pearsall 2008:69,75), although wildly varying sample sizes are more the norm and protocols are adjusted accordingly (Jones 1987). When using the seed-count method, van der Veen (1985) recommends a ballpark figure of 541 seeds per sample, after which point, she claims, the law of diminishing returns comes into effect. However, she notes that "the more heterogeneous the material under study and the more detailed or demanding the level of analysis, the larger the sample size required" (1985:172).

The sampling strategies selected have direct implications on the sort of data recovered, and the sorts of questions that may be answered. I further detail my broader research design in the next chapter, but here present an overview of the specific paleoethnobotanical methods I utilized in the field and the laboratory. The combined results of the macrobotanical and microbotanical studies were recorded on paper forms, and then entered and tabulated in a Microsoft Office Access database, for use in Excel and ArcMap calculations.

Macrobotanical samples

Although some researchers do recover larger macrobotanical fragments directly from excavation units and/or screens, there are three more preferable ways of recovering macrobotanical material. Dry sieving is one method of recovery, though the small size of materials makes this technique more difficult and time consuming, as both light and heavy fractions are combined (Pearsall 2008). Another method is that of "nested screening", where samples are sent (using water) through a set of geological sieves, also maintaining light and heavy fractions together (Wagner 1988). However, it is the flotation technique that is most often utilized in the recovery of macrobotanical material, as this method offers the best recovery rate and the least damage to botanical remains (Struever 1968; Wagner 1988; Minnis and LeBlanc 1976; Watson 1976; Pearsall 2008).

The flotation technique was employed in the recovery of macrobotanical remains at all four sites in Northwestern Honduras. In this technique, water was added to the soil sample and agitated, and macrobotanical remains (the "light fractions") were recovered from the material which floated to the surface **(Figure 6.1)**. Deflocculating agents such as baking soda were used occasionally in this process, to aid in the loosening of clay from macrobotanical remains (Pearsall 2008). At the site of Currusté, a modified SMAP flotation machine (Watson 1976) was constructed and used on-site. Similar flotation methods were utilized at the other three sites. After extraneous sediment had been removed and the sample was fully dried, the light and heavy fractions of the samples were exported for analysis at the Paleoethnobotany Laboratory at U.C. Berkeley, under the direction of Christine Hastorf.

In the laboratory, the light fraction samples were first scanned, to judge the relative density of charred archaeobotanical remains. Scanning took place under binocular dissecting microscopes, using reflected light from fiber optic light sources, at a range of power between 5X and 30X. Scanning was initially utilized for an overall assessment of the samples, whereas sorting was utilized later for detail and actual identification. In this procedure, items were not actually removed from the sample, but identified and noted. Scanning a sample is less involved than actually sorting, and is useful as a preliminary tool or as a means of ascertaining whether a given sample is going to be sorted (Toll 1988).

Figure 6.1 Sequence for macrobotanical processing and analysis: collection of 10L bags of sediment, flotation using modified SMAP, observation under low microscope power, and view of macrobotanical sample.

Once samples had been judgmentally sorted according to relative densities, the process of sorting began. In this process, the light fractions of the floated sediment samples were divided according to particle size, using geological sieves. This was done to facilitate and expedite the process of sorting, and to concentrate a certain range of particle sizes within a certain degree of magnification. Charred materials, and other materials such as bone or snails, were removed from the sample, once identified under the microscope. Hand-sorting consisted of removal of this material, and some basic identification was initially performed to designate wood, parenchymous tissue, seeds, etc. A variety of tools were employed to aid in this endeavor (probes, dental picks, tweezers, etc.). The heavy fractions of each sample were also sorted, when available, although in this case the materials (all of a larger size) were not pre-sorted in geological sieves.

After diagnostic specimens were removed for classification, and non-diagnostic specimens were removed for (hopefully) later classification, the process of identification began. The morphological attributes used in identifying macrobotanical specimens generally included size, shape of the macrobotanical specimen’s "footprint", surface patterning, and other related morphological characteristics such as presence or absence of testa. Unfortunately, identification of macroremains is one of the more problematic parts of paleoethnobotanical methodology. Plant morphology is often drastically altered through taphonomic processes, complicating identification (Stewart and Robertson 1971; Boardman and Jones 1990; Hubbard and al Azm

1990; Smith and Jones 1990). For this reason, many remains were left unidentified, and other unknown or unrecognized potentially-diagnostic specimens were drawn so that someone might eventually identify them.

Those specimens that were identifiable were compared with materials in the modern reference collections housed in the Paleoethnobotany Laboratory, and with images in books and online. Categorization of botanical remains is the basis from which all subsequent analysis emerges. Of vital importance in the identification of macroremains was the assembly of a comparative collection, through photos and actual botanical materials maintained in the Paleoethnobotany Laboratory (Fosberg 1960). Udelgard Körber-Grohne cautions that in distinguishing between species, we must be aware of the wide range of species that might be encountered (1991). For this reason, much use was made of an historic seed reference collection, as well as a Mesoamerican seed reference collection generously donated by Charles Miksicek. A few specimens were also collected by myself or other researchers working at sites in Mexico and Honduras.

Once identification was complete, where possible, the portion of the macrobotanical specimen as well as taphonomic process were noted, as additional clues as to the potential processing of the specimen (Fosberg 1960; Pearsall 2008). After they were catalogued, macrobotanical specimens were curated in gelatin capsules and labeled boxes, with accompanying site information.

Microbotanical samples

Analyses of macrobotanical remains were carried out by myself (Morell-Hart 2003, 2004, 2005) and Rachel Cane (2001). These analyses resulted in a potential array of domesticated and non-domesticated species. However, many expected species remained wildly under-represented, or completely absent. For this reason, I turned also to microbotanical extraction procedures, to recover starch grains and phytoliths.

The microbotanical analyses were carried out on two classes of materials: sediments and artifacts. In both cases, I extracted phytoliths, but in the case of sediments, I did not attempt to extract starch grains. This is due to the fact that, in the process of the heavy chemical processing involved in extractions from sediments, starch grains are heavily damaged and usually completely lost (Barton et al. 1998). Moreover, work carried out by researchers in a wide variety of sediments, climates, and contexts has revealed that starches remain more abundant on artifacts than in sediments, even when heavy chemical processing has not taken place (Barton et al 1998). This is likely related to heavier microbial activity in aerobic sediment microenvironments. As Perry has noted, "Examination of different soils will yield distinct quantities of starch granules dependent upon both their physical properties and their resident populations of decomposers" (2001: 185). Indeed, following Perry (2001:267), I anticipated that "soil analyses [would be] only effective in young sites or soils poor in organic matter."

Fortunately, starches preserve fairly well in the anaerobic microenvironments of pores in ceramic sherds, and fissures in chipped stone tools. Perry states that this is due to the "likelihood that the surfaces of the tools in the soil create a boundary layer effect, or a microclimate, in which starch residue is likely to preserve" (2001:180 following Piperno et al. 2000).

The sediment samples were processed following techniques I had learned from Dolores Piperno, both in person at the Archeobiology Laboratory of the Smithsonian Institution and through her literature (e.g. Piperno 2006), in person from Linda Perry at the Smithsonian and through her literature (e.g. Perry 2001) and in person from Rob Cuthrell at the U.C.B. laboratory. Sediment samples from Currusté were taken as small "pinch" samples of 200 mL from the larger bulk flotation samples, before they were processed (**Figure 6.2)**. This was done to get the range of microbotanical remains from throughout each locus, as the bulk macrobotanical samples had also been taken from throughout each locus.

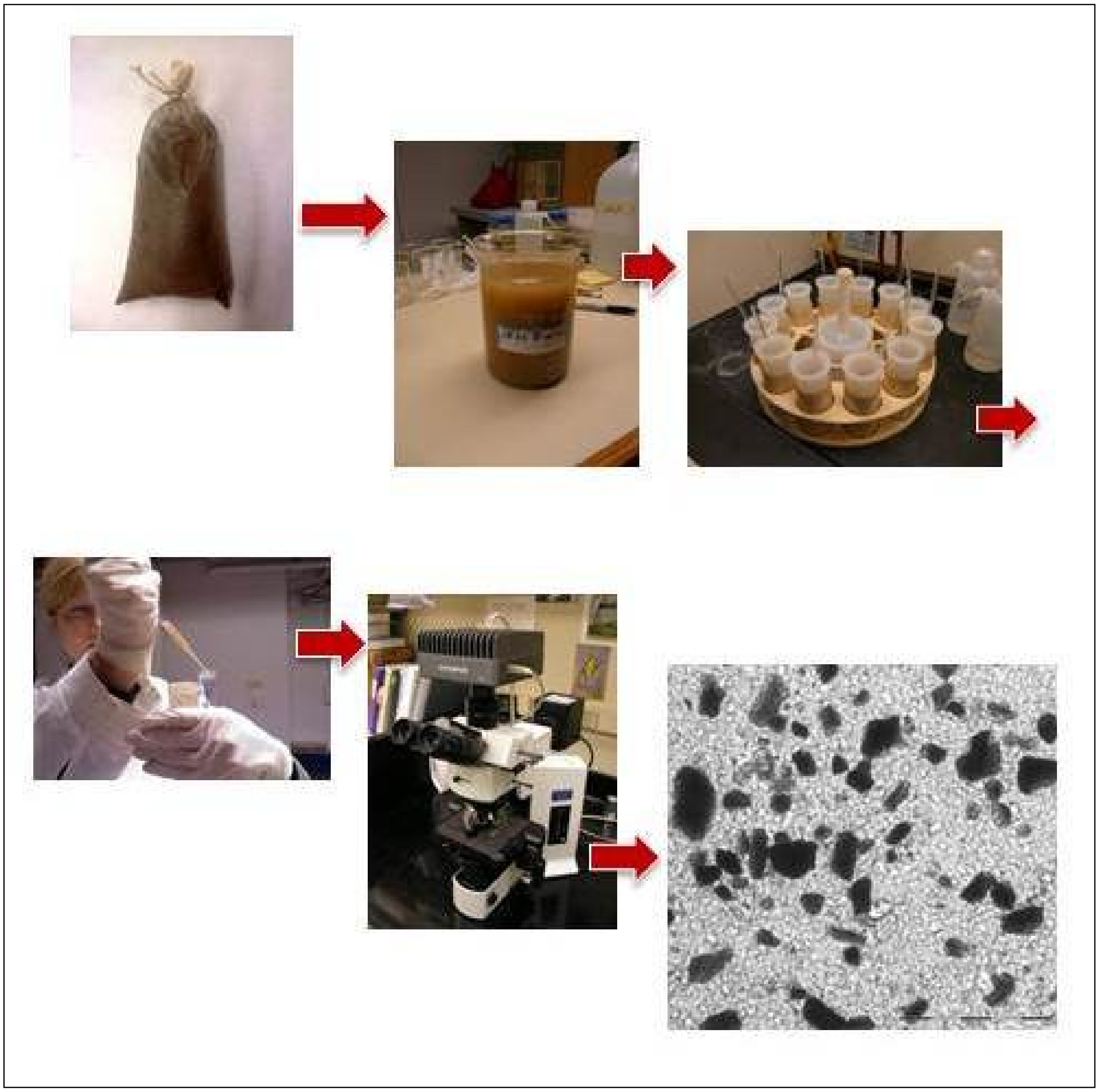


Figure 6.2 Sequence for phytolith extraction and analysis: collection of 200 mL sediment sample, deflocculation and removal of clays, microwave digestion, flotation of phytoliths, observation under high microscope power, and view of phytolith sample.

Once in the laboratory, the sediment samples were deflocculated in warm water with sodium hexametaphosphate, in order to separate clay particles out of the sample. The sediment samples were then divided into silt and sand fractions, to facilitate and expedite the process of sorting, and to concentrate a certain range of particle sizes within a certain degree of magnification (as is done with macrobotanical samples). The sediments were then processed in an MDS-2000 microwave, in a solution of chemicals to remove carbonates, organic materials, and humics. The chemicals used in this process included hydrochloric acid, nitric acid, and hydrogen peroxide. The microwave was used in order to speed up the digestion time of the different materials. The phytoliths were then floated out of each sample using a heavy liquid solution of sodium polytungstate. The removed phytolith extracts were then dried with acetone.

These extracts were mounted with immersion oil on a glass slide, and viewed under a transmitted light Nikkon microscope at different magnifications. Phytoliths were counted to 100 on each of two slides, in each of two different size fractions, for a total count of 200 (following Piperno 2006), as a general representative sample, and identified to the smallest possible taxonomic designation. The rest of the slide was then scanned for other less common phytoliths, and other microremains such as raphides and crystal druses.

For the artifact extractions, I followed a much different set of protocols (**Figure 6.3)**. As indicated by studies of stone tools in Australia, starch forms in soil are often different than on tools, so not contaminated by soil-borne starches (Atchison and Fullagar 1998). For this reason, I completed two separate extractions for the artifacts: a primary wash to remove adhering residues, and a secondary sonication to remove embedded materials in fissures and pores. Although many researchers (e.g. Piperno 2006; Perry 2004) recommend a set of three extractions, I carried out only two. The reasons for this were purely out of a need for alacrity in completing the study, as well as a lack of surrounding matrix associated with any of the artifacts. Some researchers extract from 1) sediment immediately surrounding the artifact, 2) sediment immediately adhering to the artifact, and then 3) material embedded within the microenvironments of the artifacts themselves.

Such studies allow for tracking between residues in the surrounding matrix and residues resulting from artifact use. As I carried out only two extractions—from the adhering sediment and from the artifacts themselves—I am therefore constrained in the kinds of assumptions I make regarding artifact use. Materials recovered from the adhering sediment I relegate to general "taxa encountered and likely utilized and/or processed", whereas residues sonicated from the artifacts I classify as likely associated with actual use of the artifact. These assumptions make my interpretations "safer", but also limit them, as residues recovered from adhering sediment may actually be associated with the artifact use.

For each artifact to be sampled, I first removed the adhering sediment by rubbing all surfaces of the artifact in distilled water, using powder-free latex examination gloves. Although some researchers use toothbrushes for this procedure, I avoided this practice as some of the artifacts may later be analyzed for usewear. Such analyses are complicated by scratching even from the softest of toothbrushes (Hester 1997). Moreover, I could dispose of the gloves after processing each artifact, eliminating some of the potential contamination possible through re-using the toothbrush, and eliminating the time required to sterilize the toothbrush between uses. After removing this residue, I centrifuged the sample at 5,000 rpm for five minutes, to concentrate the residue into a small plug at the base of the tube. During this process, I maintained the residue extracts in the processing water, so as to avoid potential damage to starch grains by re-desiccating them.

After removing the adhering matrix as one sample, I placed the artifact in another beaker of distilled water, and sonicated it in a Baxter Ultrasonic Cleaner, at level 2. Sonication took place for 10 minutes in the case of obsidian artifacts, and one minute in the case of ceramic artifacts. In the case of both artifacts, the surfaces exhibiting potential wear were those immersed in the water, while other surfaces were kept clear. This process extracted the residue embedded within the pores and fissures of each artifact, ideally only as related to usewear of the lithic tool or ceramic vessel. Exactly as with the adhering residue sample, I concentrated this residue through centrifugation at 5,000 rpm for 5 minutes, maintaining the residue in the original processing water.

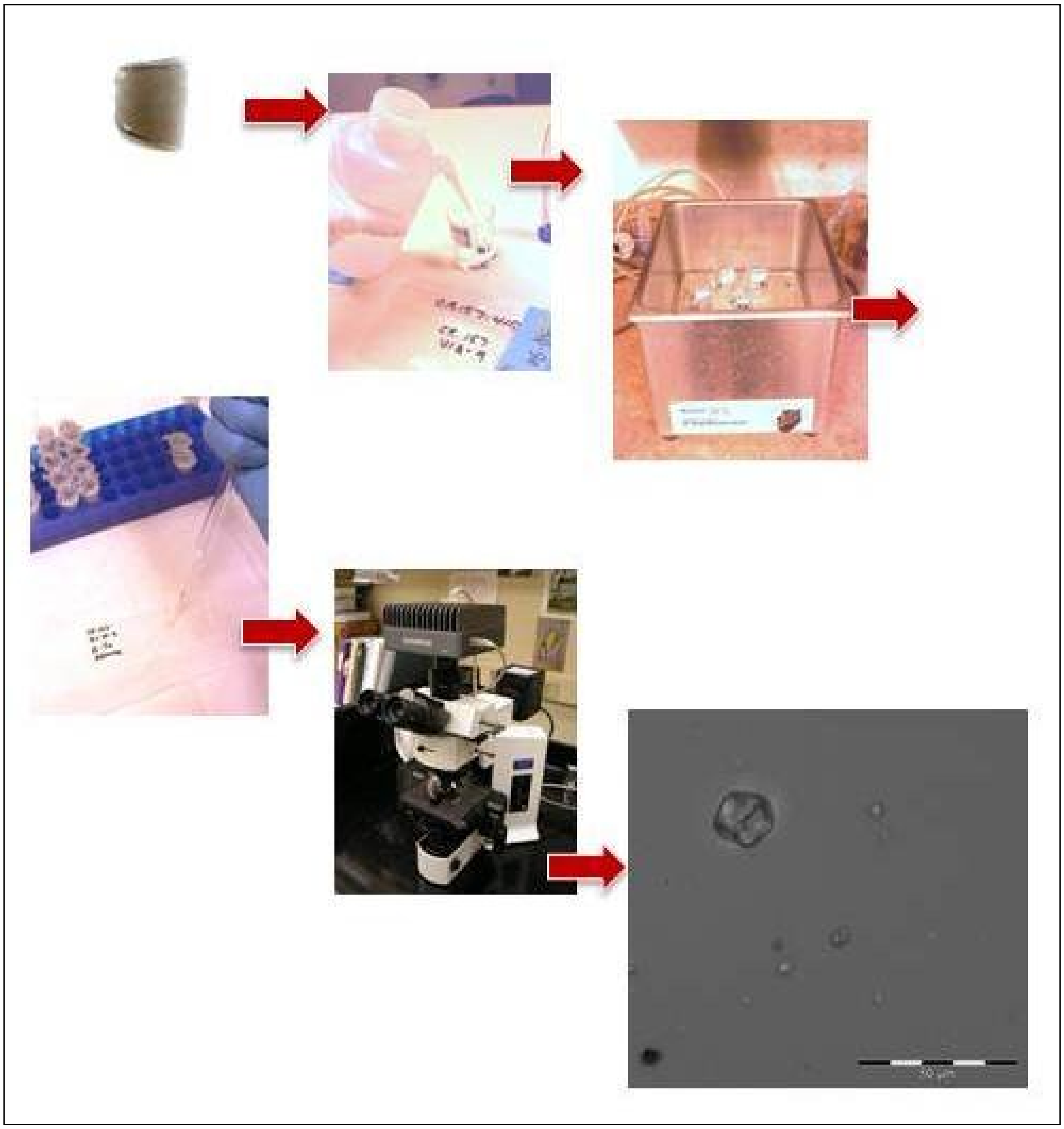


Figure 6.3 Sequence for microbotanical extraction from artifacts through sonication and analysis of material: preparation of artifact, addition of distilled water, sonication in labeled beakers, mounting on slide of centrifuged material, observation under high microscope power, and view of artifact sample (*Zea mays* starch grain).

As in the case of the sediment extractions, I mounted each adhering and sonicated residue sample on a glass slide. However, I did not use immersion oil to mount either of these samples, as had been done in the case of the sediment samples. Each sample was then viewed under a transmitted light Nikkon microscope at different magnifications. Phytoliths and starch grains were counted to 200, or to the maximum available quantity (Piperno 2006), and identified to the smallest possible taxonomic designation. The rest of the slide was then scanned for other less common phytoliths and starch grains, and other microremains such as raphides.

Summary

Paleoethnobotanical approaches are indispensable in the analysis of ancient plant practices. Macrobotanical remains, phytoliths, and starches were all employed in the current study, extracted from sediment samples and artifacts. Each type of paleoethnobotanical analysis entailed a different type of sample and a different set of protocols, yielding different and complementary results.

The results of each particular analysis are detailed in subsequent chapters. Moreover, as mentioned, the macrobotanical and microbotanical studies were augmented through previous analyses carried out by other researchers, including GS/MC and faunal analyses. Other complementary analyses are available, but not employed here, including stable isotope and pollen studies. However, as I discuss later, the complementary macrobotanical and microbotanical analyses carried out did reveal a high diversity of taxa, some previously unrecovered in this region. In the following chapter, I detail the specific methods I used to maximize recovery of data, and the middle-range questions I set up in order to answer my broader research questions.

7. Research Design

In the previous chapter, I outlined many of the methods and protocols I utilized in approaching my research topics. In this chapter, I address the core questions of my research, and how I designed my research around these questions. I also engage some of the details of how I recovered the data, although I leave many specific protocols to the appendices.

In terms of types of evidence, I take into consideration spatial contexts, temporal contexts, the morphology of chipped stone and ceramic sherds, the macrobotanical remains recovered from light and heavy fractions of bulk flotation samples, and the microbotanical remains recovered from sediments, chipped stone, and ceramic sherds. My broad intent was to recover the highest possible diversity of plant taxa, and use this data to draw comparisons between taxa, spaces, contexts, and artifacts. Based on prior experience with archaeobotanical materials in this region, I anticipated finding evidence of a wide array of non-domesticated plants from flotation samples, and encountering remains of root and other storage tissues from microbotanical samples. I also hoped to be able to compare spaces, contexts, artifacts, and time periods, in terms of these plants and their associated practices. For this reason, I attempted to include a diversity of spaces and discrete contexts (where available), as well as data from different time periods.

In terms of overall design, I build in as much complementary data as possible. This entails matching different sorts of macrobotanical data (from flotation samples and heavy fraction samples) with microbotanical data (from sediments and artifacts). As the materials available vary from site to site, I here focus on different manipulations of ubiquities. That is, rather than using absolute numbers of particular taxa, to get an overall view of taxa use I start with the presences and absences of different plant taxa in the archaeological records of these four ancient communities. I also look for patterns between plant taxa, contexts, spaces, artifacts, and time periods, and in latter chapters consider these in terms of theories of practice and language.

In designing my research, I began with bulk flotation samples from Currusté—my original dissertation site—then matched available sediment samples, to create paired sets of macrobotanical and microbotanical samples. When my original dissertation focus shifted, I then attempted to recover the same sorts of information from the other three sites, broadening my research to other time periods and locations. In total, I have analyzed 116 macrobotanical samples, 26 sediment samples, 17 obsidian tool samples, and 4 ceramic sherd samples, again, matching data sets by locus wherever possible, to maximize complementary data. I look at materials from 7 different sorts of spaces, and 15 different kinds of contexts, detailed in the following sections.

There are some problems I attempt to account for, such as the lack of matching contexts and/or spaces for similar artifacts and sediments, the lack of matching artifacts for similar contexts and/or spaces between sites, and the variation between sampling strategies between sites, including different quantities of sediments, different artifact classes available, and different volumes of flotation samples. However, the transformation of my original data set has allowed for a better view of changes over time, as well as permitted the incorporation of additional types of data in many contexts and times. The results of these analyses are applied to my specific comparisons in latter chapters.

In the following passages, I detail how my methods were operationalized, arranging these methods by broad research questions. As I have already addressed increasing visibility of taxa in the archaeological record, in the previous chapter detailing methods of microbotanical and macrobotanical analysis, I limit my discussion in this chapter to the rest of my research questions.

To what extent are root crops represented, and with which spaces, artifacts, and practices are they associated?

Although the microbotanical and macrobotanical analyses were carried out to recover the highest diversity of taxa possible, of particular interest to me were taxa associated with underground storage organs, such as roots and tubers. As discussed in an earlier chapter, ethnographic and ethnohistoric scholarship indicates these taxa were likely important components of foodways, both in the everyday and during special occasions. However, they have largely remained unexamined in traditional accounts of past foodways, due to their extremely low recovery rates in archaeobotanical assemblages.

Root crops are recoverable as charred macrobotanical remains, from bulk flotation samples. However, due to various processing activities and taphonomic processes, they have been largely absent from macrobotanical samples in this region, with the exception of unidentifiable small bits of parenchymous tissue. For this reason, I focused on the use of microbotanical analyses to recover evidence of underground storage tissue use. I made use of published results from various journals and reference volumes, to put together a list of likely potential recoverable taxa. A pilot study I had completed on obsidian tools from the site of Los Naranjos had already revealed the potential of this method in recovering evidence of root crop use, including lirén (*Calathea* sp.), manioc *(Manihot esculenta)* and sweet potato *(Ipomoea batatas)*. In most cases, this was the only method of recovering information about the underground storage tissue of a particular species.

Before beginning the archaeobotanical analyses, however, I first needed to assemble a modern reference collection, for comparison with the archaeological materials. In assembling this modern reference collection of starch grains and phytoliths, I followed Piperno (2006), to identify recoverable taxa from the region. I also made use of lists of known economic taxa from the region, as cited in ethnobotanical, ethnographic, and ethnohistoric sources (fully cited in previous chapters). Moreover, I incorporated information from other archaeological sites, though some distant, where such taxa had been utilized (Sheets 2010; Pohl 1996; Lentz 1999, 2000). Once I had assembled a list of known economic taxa with likely diagnostic microbotanical forms, I obtained fresh samples of these plants for study. I then made approximately twenty slides and took photos of those taxa I had not studied previously during my time at the Smithsonian Institution under Dolores Piperno.

In terms of the archaeological materials, I attempted to maximize recovery of these taxa wherever possible. At the site of Currusté I took samples from a variety of spaces, artifacts, and contexts. In working with materials already housed in the Central American Archaeology Laboratory, I also chose artifacts from a variety of contexts and spaces, although my options were somewhat limited by the materials available. The results of this sampling strategy were twofold: 1) maximizing recovery of underground storage tissue residues, and thus making them "visible", and 2) maximizing the ability to track underground storage tissue practices through a variety of spaces, contexts, and artifacts, over the course of time.

To what extent are non-domesticated taxa represented, and with which spaces, artifacts, and practices are they associated?

Another focus of my research, in terms of plant taxa, were non-domesticates and/or those taxa considered to be "wild" or "weeds". As discussed in the previous chapter, and similarly to root crops, these taxa were likely important components of daily and ritual life, but thus far have largely remained unexamined due to lower recovery rates and/or interest on the part of many researchers.

Much as evidence of many underground storage tissues is recoverable only through microbotanical analyses, evidence of many non-domesticates is recoverable only through macrobotanical analyses. Recovery from flotation samples, though borderline tragic, does result in a much higher diversity of taxa than is available purely through microbotanical studies. This is partially due to the sorts of parts that are both durable and diagnostic. Many domesticated species have large and diagnostic starch grains and phytoliths, but may lack (for a variety of taphonomic reasons) recoverable macroremains. Many undomesticated species lack large and diagnostic starch grains, yet have durable and recoverable charred seeds and other botanical parts.

For the paleoethnobotanist, the natural environmental context of paleoethnobotanical remains has direct importance on their taphonomy and thus recovery. Differential preservation is related to cultural factors and plant biology (Jones 1941; Schiffer 1976; Dennell 1976; Bohrer 1986; Miksicek 1987, 1990; Hillman 1991; Pearsall 2008; Gee 1991). Additionally, many factors such as bioturbation, chemical composition of the soil, climate, and hydrology of a region can all impact the preservation of plant remains (Miksicek 1987, 1990; Miller 1989; Schiffer 1976). So much so that Popper and Hastorf (1988:5) have declared that "differential preservation of plant remains presents the greatest challenge to paleoethnobotanical analyses." All such site formation processes produce the context from which the archaeologist, in yet another formation process, removes the botanical material for study.

As in the case of my microbotanical sampling strategy, in terms of the actual archaeological samples, I attempted to maximize recovery of these taxa wherever possible. In an attempt to get at the highest possible species recovery, I increased the size of the flotation samples at Currusté to 40 Liters, floated 10 L at a time. However, due to the coup in Honduras, only an incomplete set of 10 L samples were removed, reducing the actual flotation volume to a quarter of my intended size. The remaining sediment volumes are 4-10 Liters, as this was the common bulk flotation sample size taken from the other three sites.

At Currusté, I took samples from a variety of spaces, artifacts, and contexts. I had less control over those flotation samples already taken at the other three sites, but did match their contexts and spaces to those of Currusté wherever possible. As in the case of recovery from underground storage tissues, the results of this sampling strategy maximized recovery and maximized my ability to track practices associated with these taxa over a variety of spaces and contexts, and over time. Fortunately, I also had a material from a diverse set of contexts and spaces at Puerto Escondido, Los Naranjos, and Cerro Palenque. However, these had been judgmentally selected for analysis (in the post-processing stage) and were therefore more limited in diversity at each particular site.

How can we re-consider the way we frame practices associated with different taxa, artifacts, spaces, and contexts?

Due to the wide variety of taxa collected through microbotanical and macrobotanical remains, and contextualized according to different spaces, contexts, times, and associated artifacts, I feel better positioned discuss the practices associated with these taxa. In exploring activities associated with various taxa, I hope to reframe them in more complicated ways than are often reflected in the literature. As discussed in the previous chapter, many authors create false dichotomies between "wild" and "domesticated", "food" and "medicine", etc. Even within paleoethnobotanical literature, this is somewhat commonplace in spite of cautions by authors in other disciplines (e.g. Etkin 1994).

By reframing my questions in terms of practices, I hope to better account for overlap between taxa, artifacts, contexts, and spaces. For example, a single plant may be associated with different practices, processed in different kinds of spaces, found in different contexts, and associated with different artifacts. By focusing on patterns of *practices*, versus just presence or absence of taxa, I can better account for the varied biographies of these plants, and the more complex ways they were interwoven with those of the sites' inhabitants.

As described in previous chapters, I make heavy use of ethnographic and ethnohistoric resources in order to draw together analogous plant uses, by taxon (such as maize), artifact (such as cutting tools), space (such as interiors of structures), or context (such as hearths). I also review archaeological sources, where possible, to consider the possible associations between various taxa and various practices such as processing, serving, disposal, etc. I link practices to each class of material evidence, and supplement this data with additional lines of evidence where available.

In terms of sampling strategies, as in the case with my other research questions, I utilize the available complementary paleoethnobotanical data sets, over a variety of spaces, contexts, and artifacts. By dispersing the data collection in this way, I hoped to provide a fuller view of daily practices, and better view the shape of the patterns and associations between them.

What are the associations and disassociations between specific artifacts and taxa?

In the field at Currusté, my original intent had been to match ceramic, groundstone, and chipped stone artifacts with the bulk flotation samples and small sediment samples recovered from the same excavated loci. In the course of excavation, I hoped to recover at least two of each artifact class, where available. I sampled from every loci associated with my selected excavation units. Before any washing had taken place, I set aside all available groundstone (as the total number of artifacts was only five), and a combination of lithic blades, bifaces, and utilized flakes (where available). By locus, the obsidian blade fragments were selected first for visible residues, second for evidence of usewear, third for portion of the artifact (medial fragments being ideal), and finally for size, in order to maximize the likely cutting or scraping surface. Other chipped stone tools were selected on the basis of uniqueness (chert and scrapers were rare), and visible evidence of usewear and retouching. I selected up to eight unwashed ceramic sherds for analysis, per locus, first where visible residues were noted, second for portion of the ceramic vessel (basal fragments being ideal, followed by body fragments, then rim fragments), third for a variety of ceramic types, and finally for size, in order to maximize the likely "pooling" surface of microbotanical remains.

After export of these materials, my intent was to subsample in the lab, making use of microscopes to ascertain usewear and other aspects, to further guide my sampling strategy. Thanks to the Honduras coup, and the entrapment of the entire collection of selected materials, I was unable to make use of any of the artifacts I had excavated and subsequently prepared for shipping. (They are still neatly boxed and catalogued, ready for export and analysis, should anyone want to brave the permitting process.)

Fortunately for me, Rosemary Joyce had a selection of previously-excavated artifacts curated in her laboratory, many of them from sites where I had previously carried out macrobotanical analyses (Morell-Hart 2005, 2006) or had access to materials and data of other paleoethnobotanical researchers (Cane 2001). Even more fortunately, a good portion of these was unwashed, and a good variety of obsidian tools was represented. Unfortunately, many fewer ceramics were represented, and all of these had already been washed. Many of them were also heavily eroded, as evidenced by only a few fragments of slip remaining in the interiors of the sherds. No groundstone was available. In sampling from this curated collection, my goal was first to match various artifacts with loci where I had previously carried out macrobotanical research, and second to maximize the recovery of microbotanical remains from various artifact classes.

In the paleoethnobotany lab, two samples were taken of each artifact, where available: adhering sediment and sonicated material. The adhering sediment sample results I used only for broad site analysis. This material may have been adhering to the artifact, as a result of use, or may be material that came from the surrounding matrix, as a result of post-use depositional processes. I was hesitant to assign this material definitively to either category, so I put the results of this material into analysis of broad site-level sets of taxa recovered, and transformations over time. Moreover, as the artifacts were not likely deposited in the area of their use, but appear to have been fragments discarded after use, I did not attempt to match microbotanical evidence with specific contexts and spaces.

Overall, I wished to compare specific types of artifacts to the taxa recovered from them, match specific taxa to artifacts associated with them, compare taxa and practices associated with different artifact classes, and track these changes over time and between sites.

What are the apparent differences and similarities, over space, in practices and taxa?

Even before beginning excavation, I had decided to differentiate between "spaces" and "contexts" for analytical purposes. The reasoning behind this was primarily my review of analogous evidence (e.g. Hanks 1990; Sheets 2002; de Landa 1978) that showed how multiple spaces could be associated with a single context (indoor and outdoor hearths, for example), and multiple contexts could overlap in a single space (outdoor low-density middens and hearths). I here categorize spaces as areas defined by built space, whereas contexts I categorize by activities, using the variety and quantity of recovered artifacts, as well as associated features. I categorized specific kinds of spaces according to location, mostly having to do with proximity to mounds (pathways, dumping areas, etc.), public/private space (access); interior/exterior of structure; interior/exterior of patio; etc.

Between the four sites represented, I was able to compare spaces from two sites associated with each time period, in order to get an "average" of results per site for each spatial category, and an "average" of results per time period. This was to get at possible "grammars" of spatial use, as related to plants and their associated practices. I made use of the macrobotanical evidence recovered from the bulk flotation samples, and the microbotanical evidence recovered from the small sediment samples. I matched these samples wherever possible. As previously mentioned, I did not make use of the materials recovered from artifacts, due to their (likely) secondary deposition, and the difficulty in determining the origin of adhering microbotanical evidence on the surface of an artifact.

In my initial excavation formulation, acquiring a diversity of spaces was my primary goal. As contexts were not visible at the surface, and not enough information could be gleaned from shovel test pits (where available) as to how to define a particular context, spatial categories ultimately guided my selection of excavation units at Currusté. I optimized my sampling strategy at Currusté by first defining a set of spatial categories (as listed in **Table 7.1**), then selecting three of each type. Due to time constraints, I was only able to excavate two 1x2 units of each type fully, and in some cases three units. I took bulk flotation samples and small sediment samples for analysis from each locus excavated.

Platform	atop a platform mound, but NOT inside of a structure
Adjacent	immediately (within 1 m) adjacent to a platform mound or structure
Interior mound str	interior to a structure ALSO ATOP a platform mound
Between	area between structures and/or platform mounds
Patio	comprised of area surrounded by cluster of platform mounds and/or structures
Outside	outside of area comprised by patio group
Interior ground str	interior to a structure NOT atop a platform mound

Table 7.1. List of spatial categories and descriptions.

As with the artifacts, my selected materials were affected by the Honduras coup. I was unable to export roughly 75% of these flotation samples for analysis. This led me to make use of the previously-analyzed materials at the three other sites. As there were no small sediment samples available for analysis from these sites, the entirety of my microbotanical data comes from the small sediment samples at Currusté. However, I was fortunate enough to have at least one sample of each spatial category represented, using the full collection of materials from all four sites.

After analysis of the microbotanical samples (detailed in the previous chapter), all of the data was input into ArcMap GIS models of each site, and plotted in a variety of ways which are detailed in subsequent chapters. My overall goals, as with the artifacts, were to compare specific types of spaces to the taxa recovered from them, match specific taxa to the spaces associated with them, compare taxa and practices associated with different spatial locations, and track these changes over time and between sites.

What are the differences and similarities between contexts, in practices and taxa?

As outlined in terms of spaces, contexts were defined according to activities, using artifacts and features as proxies for these activities. Part of the trick lay in defining liminal areas, like the defined "porches" of modern society that may have been the kitchens of the past. As I had inherited sets of macrobotanical samples already judgmentally selected according to criteria outside of my study, I tried to craft categories that would be flexible enough to accommodate the data from all four sites. As with the spatial categories, not all contexts are represented for each site, but at least one of each context is represented between all four sites.

Low-density midden	disposal area with low density of material. may contain ash or carbon.
High-density midden	disposal area with high density of material. may contain ash or carbon.
Special deposit	matrix with special deposit of ceramic (in-situ smashing or placing) or other items (such as human bone, non-burial)
Burned deposit	primary burning context that is not a hearth, but related to special activity
Kiln	matrix interior to kiln feature
Hearth	material from hearth (primary burning context)
Ashy deposit	ashy deposit, though not primary burning context. mostly ash, few artifacts. may be a pit.
Matrix with carbon	matrix containing carbon, though not primary burning context
Matrix between	amorphous occupational deposit between identified surfaces
Collapse matrix	matrix surrounding stones that includes wall fall/collapse-- sometimes combined with deliberately added additional matrix
Architect fill	structural or platform fill-- separate from collapse
Burial matrix	matrix within burial context
Lined pit fill	fill from interior of clay-lined pit, not ashy
Pit fill	fill from interior of a pit, -not- clay lined, not ashy
External surface	discrete use surface exterior to str & platform mound
Platform surface	surface atop platform mound but OUTSIDE structure
Interior floor surface	floor interior to structure (whether structure is atop or off-platform mound)

Table 7.2. List of contextual categories and descriptions.

Excavation strategy at Currusté had been guided by spatial categories, whereas contexts emerged incidentally in the course of excavation. Post-coup, my analysis, as with spaces, proceeded using macrobotanical data from bulk flotation samples from all four sites, and microbotanical data from small sediment samples from Currusté only. In the lab, as with data associated with various spaces, I made use of all available macrobotanical data, regardless of context. Moreover, since the microbotanical data was already paired with the bulk flotation samples, this data set came already pre-selected. As with the artifacts and the spatial categories, my intentions were to compare specific types of contexts to the taxa recovered from them, match specific taxa to the contexts associated with them, compare taxa and practices associated with different nodes of activities, and track temporal and inter-site changes and continuities.

What are the apparent transformations and continuities, over time, in practices and taxa?

I was fortunate in that, of the sets of materials Rosemary Joyce had in her lab, two broad time periods were represented: the Formative and the Classic. Each of these time periods may be further parsed into smaller increments, as defined in Chapter 5. However, to maximize the number of samples per time period, and thus bolster comparability, I have clustered results into the two broader Formative and Classic time periods.

To explore changes over time, I collated the analyses by taxon, artifact, context, and space (as detailed above), and compared these results by time period. I incorporated, as well, the analysis of the adhering sediment from the artifacts. Ultimately, my selection of materials was not guided by time period, other than a desire to have roughly comparable artifacts, contexts, and spaces from each time period. For this reason, a few additional sediment samples and/or artifacts were selected, outside of those matched with macrobotanical samples already analyzed.

Summary

Overall, to approach my research questions, I made use of a variety of methods, a variety of data classes, and a variety of artifactual, spatial, contextual, and temporal categories. Although my samples and sampling strategies were not optimized according to my original research design, the good fortune I had in securing substitute data from Rosemary Joyce helped me to expand my research program into multiple time periods and sites. For this reason, my post-coup research design was crafted to maintain close comparative data between taxa, artifacts, spaces, and contexts, using matched samples, where available, from a single excavated locus.

I was also fortunate in that each data set could answer a diverse set of questions. Macrobotanical analyses of bulk flotation samples could be used to address taxa, practices, spaces, and contexts. Microbotanical analyses of small sediment samples could be used to address taxa, practices, spaces, and contexts. Microbotanical analyses of artifacts could be used to address taxa, practices, and object biographies. The combined analyses could follow change and continuity over time.

When compared with analogs in the literature, these combined data sets expand the known range of practices and taxa identified in Southeastern Mesoamerica, the paradigms and syntagms of botanical grammars, and the means by which they unfold over time and space. It is comparisons of these data sets that I begin to explore in the subsequent chapter, starting with the biographies plant taxa recovered.

8. Complementarity between Microbotanical and Macrobotanical Data

In previous chapters, I have described my broad methodology and research design, following my wider research questions. In this chapter, I hone in on linking results to research design through complementary micro- and macrobotanical methods. I compare analyses of sediment samples, artifacts, and flotation samples, keeping my narrative limited to comparisons of taxa richness and broad ubiquity of various taxa. In subsequent chapters, I more fully explore results pertaining to specific taxa, artifacts, contexts, spaces, and time periods.

In Southeastern Mesoamerica, applications of macrobotanical methods have been few, either as specific components of paleoethnobotanical studies or as general explorations of foodways. A quick review of research projects in the area reveals that the use of macrobotanical materials recovered from archaeological sites is not a common occurrence, with only the handful of sources cited in previous chapters. Moreover, although some studies have made good use of chemical signatures (Hall 1990; Henderson and Joyce 2007; Joyce and Henderson 2010) and phytoliths (Bozarth and Guderjan 2004; Lentz 1996), until now, no study exists which systematically compares results of microbotanical and macrobotanical analyses.

Microbotanical analysis, in the form of phytoliths, has had but limited impact in Southeastern Mesoamerican studies. In fact, Bozarth and Guderjan (2004) claim to be the first to analyze these paleoethnobotanical remains. In their study at Blue Creek, Belize, these researchers sample Early Classic ritual deposits from monumental architecture, Late Formative/Early Classic ritual deposits from a residential barrio, a controlled stratigraphic column from a Late Formative/Early Classic midden, and a sample from a ditched agricultural field. Their results indicate the use of *Heleconia* sp., palms (*Arecaceae* spp.), and cucurbits (*Cucurbitaceae* spp.) in the monumental area ritual cache, maize (*Zea mays)*, agave (*Agavaceae* spp.), cucurbits, and palms in the context of the residential barrio, maize and cucurbits in the midden column, and only palms from the ditched agricultural field (Bozarth and Guderjan 2004).

Complementary studies could do much to enhance our understanding of foodways in this region, as noted by researchers who lament the various taxa "lost" to us through formation processes that preserve some macroremains and not others. These researchers describe the problems facing paleoethnobotanists when attempting to make use of only one source of botanical data. In one study, B. Turner and Charles Miksicek (1984) approach the prehistoric agriculture of the Maya lowlands through the macrobotanical remains of economic plant species. They review evidence surrounding staple crops such as maize, and discuss "problematic" expected species such as cacao (*Theobroma cacao*), tubers and root crops, amaranth (*Amaranthus* sp.), and ramón (*Brosimum alicastrum*), which leave few to no macrobotanical traces . These authors also note the absence of material from some commonly consumed species such as beans *(Fabaceae* spp.), tomatoes *(Lycopersicum esculentum*), and various roots and tubers (Turner and Miksicek 1984). Similarly, Lentz (1991) notes the significant absence of macroremains of tubers, tobacco *(Nicotiana* sp.), cacao, and ramón, in Southeastern Mesoamerican samples.

As these scholars have indicated, macrobotanical sources can bring much to light, but can also constrain our interpretations. The limitations of purely macrobotanical research have implications for the perceived diversity of economic plants utilized in Mesoamerica, and the many daily practices they index. In pursuing complementary data sets, I analyzed 116 macrobotanical samples, 26 sediment samples, 17 obsidian tools, and 4 ceramic sherds, again, matching data sets by locus wherever possible. In total, I was able to match 17 artifacts with light fraction samples, and 16 sediment samples with light fraction samples. Four of the artifacts have no light fraction matches, 10 sediment samples have no light fraction matches, and 83 light fractions have no matches with either sediment samples or artifacts. Unfortunately, none of the sites had sediment samples, artifacts, and light fractions all concurrently available for analysis.

In the following sections, I compare taxa richness as indexed by recovered microbotanical and macrobotanical taxa. I focus on overall recovery rates, and then detail comparisons between sites. I discuss recovery of each taxon by origin, presenting a table of all of the recovered taxa and the source of their paleoethnobotanical remains. I then compare taxa richness, as recovered through sediment samples matched with light fraction samples, at Currusté. In assessing taxa richness as indexed by microbotanical remains on artifacts, I look at broad differences, then draw comparisons between artifact classes. Turning to recovery and taxa diversity across time periods, I contrast the two time periods of my study broadly, then compare sites within each time period. Finally, I consider the cost-benefits of each paleoethnobotanical approach, the sorts of information exclusive to each, and the implications for a broader view of ethnobotanical practice.

Comparisons of overall taxa richness

In terms of the broad spectrum of potentially economic plants, at least 122 taxa are represented between all four sites. In this count, the total number of "Unknown" seed species was added to the 91 identified or partially-identified taxa. I did not include other "Unknown" botanical parts in this tally. Although it is unlikely that the set of unknown starch grains, phytoliths, and macrobotanical parts matches exactly with this set of unknown seed taxa, it was the minimum number of distinct taxa I could use with confidence. I did not want to overestimate the number of taxa, and accidentally duplicate a taxon by treating multiple unidentified parts belonging to it as separate taxa.

Table 8.1 lists every taxon recovered, (by narrowest identified clade), the origin(s) of each recovered taxon, the botanical part recovered from each origin, the number of loci where each taxon was recovered, the number of loci where multiple kinds of data were recovered for each taxon, and the potential additional origins where each taxon could be recovered.

Table 8.1: Microbotanical and macrobotanical comparison of taxa recovered.

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
Acrocomia sp.			13	3	Adhering Sediment; Sonicated Material
	Light Fraction	endocarp			
	Light Fraction	exocarp			
	Heavy Fraction	endocarp			
	Sediment Sample	phytolith			
cf. Apiaceae sp.			1	N/A	N/A
	Light Fraction	seed			
Arecaceae spp.			46	10	None
	Adhering Sediment	phytolith			
	Light Fraction	endocarp			
	Light Fraction	spine			
	Sediment Sample	phytolith			
	Sonicated Material	phytolith			
Amaranthus sp.			2	N/A	N/A
	Light Fraction	seed			
Annonaceae spp.			3	0	Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
cf. Annona sp.			1	0	Adhering Sediment; Sonicated Material; or Sediment Sample; or under "Annonaceae sp."
	Light Fraction	seed			
Artemisia sp.			2	0	Light Fraction; Sediment Sample; Sonicated Material
	Adhering Sediment	phytolith			
Arundinoideae spp.			4	0	Adhering Sediment; Sonicated Material; Light Fraction; or under "Poaceae spp.": Light Fraction
	Sediment Sample	phytolith			
Asteraceae spp.			8	0	Sonicated Material
	Adhering Sediment	phytolith			
	Sediment Sample	phytolith			
	Light Fraction	seed			
Asteraceae sp. 1			6	0	Sonicated Material; Adhering Sediment; Sediment Sample; or under "Asteraceae spp.":
	Light Fraction	seed			
Asteraceae sp. 2			1	0	Sonicated Material; Adhering Sediment; Sediment Sample; or under "Asteraceae spp.":
	Light Fraction	seed			
Asteraceae sp. 3			1	0	Sonicated Material; Adhering Sediment; Sediment Sample; or under "Asteraceae spp.":
	Light Fraction	seed			
Asteraceae sp. 6			1	0	Sonicated Material; Adhering Sediment; Sediment Sample; or under "Asteraceae spp.":
	Light Fraction	seed			

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
Attalea cohune			4	0	N/A or under "Arecaceae spp.": Adhering Sediment; Sonicated Material; Sediment Sample
	Light Fraction	endocarp			
Bambusoideae spp.			31	0	Sonicated Material; Light Fraction; or under "Poaceae spp.": Light Fraction
	Adhering Sediment	phytolith			
	Sediment Sample	phytolith			
Boraginaceae sp.			1	N/A	N/A
	Light Fraction	seed			
Bromeliaceae spp.			5	0	Light Fraction
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
Burseraceae spp.			4	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Butia capitata			1	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Byrsonima crassifolia			4	N/A	N/A
	Light Fraction	seed			
Calathea sp.			13	0	Light Fraction
	Sonicated Material	phytolith			
	Adhering Sediment	phytolith			
	Adhering Sediment	starch grain			
	Sediment Sample	phytolith			
Canna sp.			1	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Carica papaya			1	N/A	N/A
	Light Fraction	seed			
Celtis sp.			5	0	Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
	Adhering Sediment	phytolith			
Cactaceae sp.			1	N/A	N/A
	Light Fraction	seed			
cf. Carex sp.			1	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
cf. Cecropia peltata			1	N/A	N/A

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
	Light Fraction	seed			
cf. Chenopodiaceae sp.			1	N/A	N/A
	Light Fraction	seed			
Chenopodium sp.			1	N/A	N/A
	Light Fraction	seed			
Chloridoideae spp.			26	0	Adhering Sediment; Sonicated Material; Light Fraction; or under "Poaceae spp.": Light Fraction
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
cf. Chrysobalanaceae sp.			0	N/A	N/A (not Hirtella sp.)
	Light Fraction	seed			
Crotalaria sp.			1	0	Adhering Sediment; Sonicated Material; or under "Fabaceae sp."
	Light Fraction	seed			
Cucurbita spp.			12	0	Light Fraction
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
Cucurbita andreana			4	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Cucurbita maxima			4	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Cucurbita moschata			3	0	Adhering Sediment; Light Fraction; Sonicated Material
	Sediment Sample	phytolith			
Cyperaceae spp.			4	0	Sonicated Material
	Adhering Sediment	phytolith			
	Sediment Sample	phytolith			
	Light Fraction	seed			
Cyperus sp.			9	0	Light Fraction; Sonicated Material; or "Cyperaceae sp.": Light Fraction
	Adhering Sediment	phytolith			
	Sediment Sample	phytolith			
Dactyloctenium sp.			1	0	N/A; or "Poaceae sp.": Light Fraction, Adhering Sediment; Sonicated Material
	Light Fraction	seed			
Eleusine sp.			1	0	N/A; or "Poaceae sp.": Light Fraction, Adhering Sediment; Sonicated Material
	Light Fraction	seed			

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
Euphorbiaceae spp.			5	0	None
	Light Fraction	seed			
	Sediment Sample	phytolith			
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
Fabaceae spp.			10	0	Adhering Sediment; Sonicated Material; Sediment Sample; or "Phaseolus sp."
	Light Fraction	seed			
	Light Fraction	testa			
Fabaceae sp. 2			1	0	Adhering Sediment; Sonicated Material; Sediment Sample; or "Phaseolus sp."
	Light Fraction	seed			
Fabaceae sp. 3			1	0	Adhering Sediment; Sonicated Material; Sediment Sample; or "Phaseolus sp."
	Light Fraction	seed			
Galphilma glauca			1	N/A	N/A
	Light Fraction	seed			
Hedeoma sp.			5	N/A	N/A
	Light Fraction	seed			
cf. Hedyosmum sp.			1	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
Heliconia sp.			2	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
Hirtella sp.			12	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
cf. Indigofera sp.			1	N/A	N/A
	Light Fraction	seed			
Ipomoea sp.			3	0	
	Adhering Sediment	starch grain			Light Fraction; Sonicated Material
	Adhering Sediment	crystal druse			
Lagenaria sp.			1	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
cf. Lamiaceae sp.			5	N/A	N/A
	Light Fraction	seed			
cf. Lepidium sp.			1	N/A	N/A
	Light Fraction	seed			
Lozanella sp.			6	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
Magnoliaceae spp.			7	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
Mammillaria sp.			5	N/A	N/A
	Light Fraction	seed			
Manihot sp.			4	0	Light Fraction
	Sonicated Material	starch grain			
	Adhering Sediment	starch grain			
Maranta sp.			4	0	Adhering Sediment; Light Fraction
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
Marantaceae sp.			23	0	Light Fraction
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
cf. Myrsinaceae sp.			1	N/A	N/A
	Light Fraction	fruit			
Nicotiana sp.			3	N/A	N/A
	Light Fraction	seed			
Oenothera sp.			1	N/A	N/A
	Light Fraction	seed			
cf. Oxalis corniculata			1	N/A	N/A
	Light Fraction	seed			
Panicoideae spp.			40	0	Light Fraction
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
cf. Panicum sp.			1	N/A	N/A; or "Panicoideae spp.": Adhering Sediment, Sonicated Material, Sediment Sample
	Light Fraction	seed			
Parmentiera aculeata			1	N/A	N/A
	Light Fraction	seed			
cf. Persea americana			1	N/A	N/A; or nondiagnostic sclerid
	Light Fraction	seed			
cf. Phaseolus sp.			3	0	Sonicated Material; Sediment Sample
	Light Fraction	cotyledon			
	Adhering Sediment	starch grain			
Pinaceae sp.			2	0	Sonicated Material; Adhering Sediment; Light Fraction
	Sediment Sample	phytolith			

Taxon:	**Origin:**	**Part:**	**#Loci:**	**# Loci with multiple origins:**	**Potential additional origins:**
Poaceae spp.			6	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	rachis			
	Light Fraction	seed			
Poaceae sp. 1			3	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	seed			
Poaceae sp. 2			5	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	seed			
cf. Poaceae sp. 3			1	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	seed			
Poaceae sp. 4			1	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	seed			
Poaceae sp. 5			1	0	likely in Pooideae; Chloridoideae; Bambusoideae; Panicoideae; Arundinoideae : Sonicated Material Adhering Sediment, Sediment Sample
	Light Fraction	seed			
Pooideae spp.			24	0	Light Fraction; or "Poaceae sp."
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
Potentilla sp.			10	N/A	N/A
	Light Fraction	seed			
Protium sp.			1	0	Light Fraction; Sonicated Material; Adhering Sediment
	Sediment Sample	phytolith			
cf. Rosaceae sp.			1	N/A	N/A
	Light Fraction	seed			
cf. Salvia hispanica			1	N/A	N/A
	Light Fraction	seed			
Salvia sp.			3	N/A	N/A
	Light Fraction	seed			
cf. Scirpus sp.			1	0	likely under "Cyperaceae sp.": Sediment Sample; Sonicated Material; Adhering Sediment
	Light Fraction	seed			
Setaria sp.			1	0	Sediment Sample; Adhering Sediment; Sonicated Material; or "Poaceae spp."
	Light Fraction	seed			
Sisyrinchium sp.			1	N/A	N/A
	Light Fraction	seed			
cf. Smilacaceae sp.			1	N/A	N/A
	Light Fraction	seed			

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
Smilax sp.			1	N/A	N/A
	Light Fraction	seed			
Trichomanes sp.			13	0	Light Fraction; Adhering Sediment; Sonicated Material
	Sediment Sample	phytolith			
cf. Verbena sp.			1	N/A	N/A
	Light Fraction	seed			
cf. Veronica sp.			1	N/A	N/A
	Light Fraction	seed			
Zea mays			43	9	NONE
	Light Fraction	cob			
	Light Fraction	cupule			
	Light Fraction	kernel			
	Adhering Sediment	starch grain			
	Adhering Sediment	phytolith			
	Sonicated Material	starch grain			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
UNKN seed spp. (N= >25)			39	Unknown	Unknown
	Light Fraction	seed			
UNKN phytolith spp. (N= >24)			47	Unknown	Unknown
	Adhering Sediment	phytolith			
	Sonicated Material	phytolith			
	Sediment Sample	phytolith			
UNKN starch grain spp. (N= >3)			18	Unknown	Unknown
	Adhering Sediment	starch grain			
	Sonicated Material	starch grain			
	Sediment Sample	starch grain			
UNKN other macrobotanical (N= >19)			101	Unknown	Unknown
	Light Fraction	bud			
	Light Fraction	endocarp			
	Light Fraction	exocarp			
	Light Fraction	fiber			
	Light Fraction	fruit			
	Light Fraction	leaf			
	Light Fraction	lump			
	Light Fraction	nutlet			
	Light Fraction	peduncle			
	Light Fraction	pericarp			
	Light Fraction	resin			
	Light Fraction	rhizome			

Taxon:	Origin:	Part:	#Loci:	# Loci with multiple origins:	Potential additional origins:
	Light Fraction	schizocarp			
	Light Fraction	spine			
	Light Fraction	stem			
	Light Fraction	testa			
	Light Fraction	thorn			
	Light Fraction	wood			
	Light Fraction	nutshell			
UNKN other microbotanical (N = 5)			4	Unknown	Unknown
	Adhering Sediment	crystal druse			
	Adhering Sediment	cystolith			
	Adhering Sediment	raphide			
	Sonicated Material	storage tissue			
	Sonicated Material	vascular tissue			

A total of 59 taxa were recovered from microbotanical samples at 44 loci, and the average number of taxa recovered from loci with microbotanical samples is 1.34 taxa. A total of 83 taxa were recovered from macrobotanical samples at 116 loci, and the average number of taxa recovered from loci with macrobotanical samples is 0.72. However, the macrobotanical data are skewed toward higher diversity, as more samples were taken and thus there were more potential opportunities for distinct taxa to be recovered.

In comparing each site, a minimum of 67 taxa were recovered from 72 loci at Currusté, 23 from 32 loci at Puerto Escondido, 46 from 17 loci at Los Naranjos, and 32 from 18 loci at Cerro Palenque. When drawing comparisons between the average minimum number of taxa recovered from each locus at all four sites and the total average, Currusté has the greatest taxa richness (58%), followed by Los Naranjos (40%), then Puerto Escondido (27%), then Cerro Palenque (27%). A quick hypothesis would be that people at the site of Currusté made use of a more diverse suite of plants than those at other sites, thus granting them a larger "vocabulary" to work with in the language of foodways.

However, these percentages must be contextualized. These are not standardized numbers, either in terms of volume of sediment floated per locus at each site, nor in terms of number of loci sampled at each site. It has been demonstrated that increases in flotation volumes and numbers of samples result in increases of taxa richness (van der Veen and Fieller 1982, see also Lennstrom and Hastorf 1992). Therefore, these may be apple-orange assessments, in terms of the range of plant diversity. Some sites had bulk sediment volumes as low as 3.5 liters, other sites, 10 liters. One site had as few as 17 loci represented, another as many as 72. Standardizing flotation sizes for loci and sites, while excavating, would address this problem, but this is rarely possible where loci volumes are extremely variable, and such variability defines deposits in the archaeological record. Again, it might be said that we see a broader vocabulary represented at the site of Currusté, but by the same token, we have more fragments of text from this site to analyze.

Comparisons of taxa

Comparisons may also be made between various taxa, in terms of their microbotanical and macrobotanical visibility. In Figure 8.1, I tabulate the number of loci where each taxon is recovered, in cases where this number is greater than one, to give a snapshot view of taxa in order of ubiquity. These numbers partially reflect the complementarity of macrobotanical and microbotanical data-- each data type filling in ubiquity gaps the other leaves behind—as well as partially reflecting the ubiquity of certain taxa across many sites and time periods.
There are many taxa that have micro and macro overlap, in terms of their visibility, but there are also those which can be viewed only through one sort of proxy. In Figure 8.2, I indicate what sort of proxy evidence was available for each taxon, and where several proxies overlap. Ultimately, the absence of proof is not necessarily the proof of absence, but as far as providing a potential framework, it is clear that different species are often represented by different proxies.

In terms of taxa with multiple proxies, the most common species are in the *Arecaceae* (palm) family, and *Zea mays* (maize). These taxa all have durable macrobotanical remains, and highly diagnostic phytoliths, making them much more visible in the archaeobotanical record overall. For the taxa with overlapping origins of data, this provides a neat additional means of cross-tabulating results, and supporting tentative identifications, as in the case of various *Arecaceae* (palm) species.

There is a variety of taxa I have identified only through macrobotanical evidence, most notably many herbaceous and woody species not usually defined as "economic". In terms of species absent from the macrobotanical record, this may have to do with cultural processes and the ways that plants are processed and utilized. This would include seeds that are small and consumed with the fruit, as in the case of some *Bromeliaceae* species. This may also have to do with biological characteristics, such as species whose economic parts do not leave recoverable charred macrobotanical traces-- as in the case of *Calathea* (lirén) species-- unless recovered under the anonymous "lumps" category. This may also have to do with biological properties, such as seeds that are extremely small and/or fragile, as in the case of some *Burseraceae* species. Alternatively, it may have to do with a sampling error, as in the case of *Arecaceae* (palm) species, where incredibly well-preserved endocarps may have been recovered *in situ* by excavators collecting carbon samples for dating purposes. In all cases, missing species may have been recovered through wood fragments, but recovered wood remains are unidentified at this time.

Other varieties of taxa I could identify only through microbotanical evidence, most notably in the case of underground storage organs (such as *Calathea* and *Manihot)* and many subfamilies of *Poaceae* (grass) species. This family is something of a catch-all in terms of macrobotanical remains, but in terms of microbotanical remains, is marked by high phytolith diversity. Many more subfamilies are represented by phytoliths than were identifiable through macroremains (which are fewer to begin with). The greater representation of subfamilies, through the use of microremains, helps us to identify different potential uses such as thatching, matting, and basketry (detailed in Chapter 9). The broader representation also helps us to define a broader ecological diversity, as some of the species are more xerophytic (e.g. *Panicoideae* spp.) and others are more wetland-loving (e.g. *Chloridoideae* spp.). Curiously, *Cucurbita* (squash) species were also recoverable primarily through their phytolith remains, even though taxa in this genus have fairly durable botanical parts, previously recovered from other sites in Southeastern Mesoamerica.

As with the macrobotanical "missing" species, recoverability may have to do with biological aspects, as some plants do not produce known diagnostic phytoliths, (such as *Boraginaceae* spp.), and some plants produce phytoliths that are identifiable to the family or genus level but not the species level. Recovery could also be subject to cultural processes. In some cases, plants whose parts are used for economic reasons are not cut or chopped, and therefore would not be recovered from blades, or would not be served as food, and therefore would not be recovered from ceramic vessels. I further detail the connection between macrobotanical remains and various plant practices in Chapter 9.

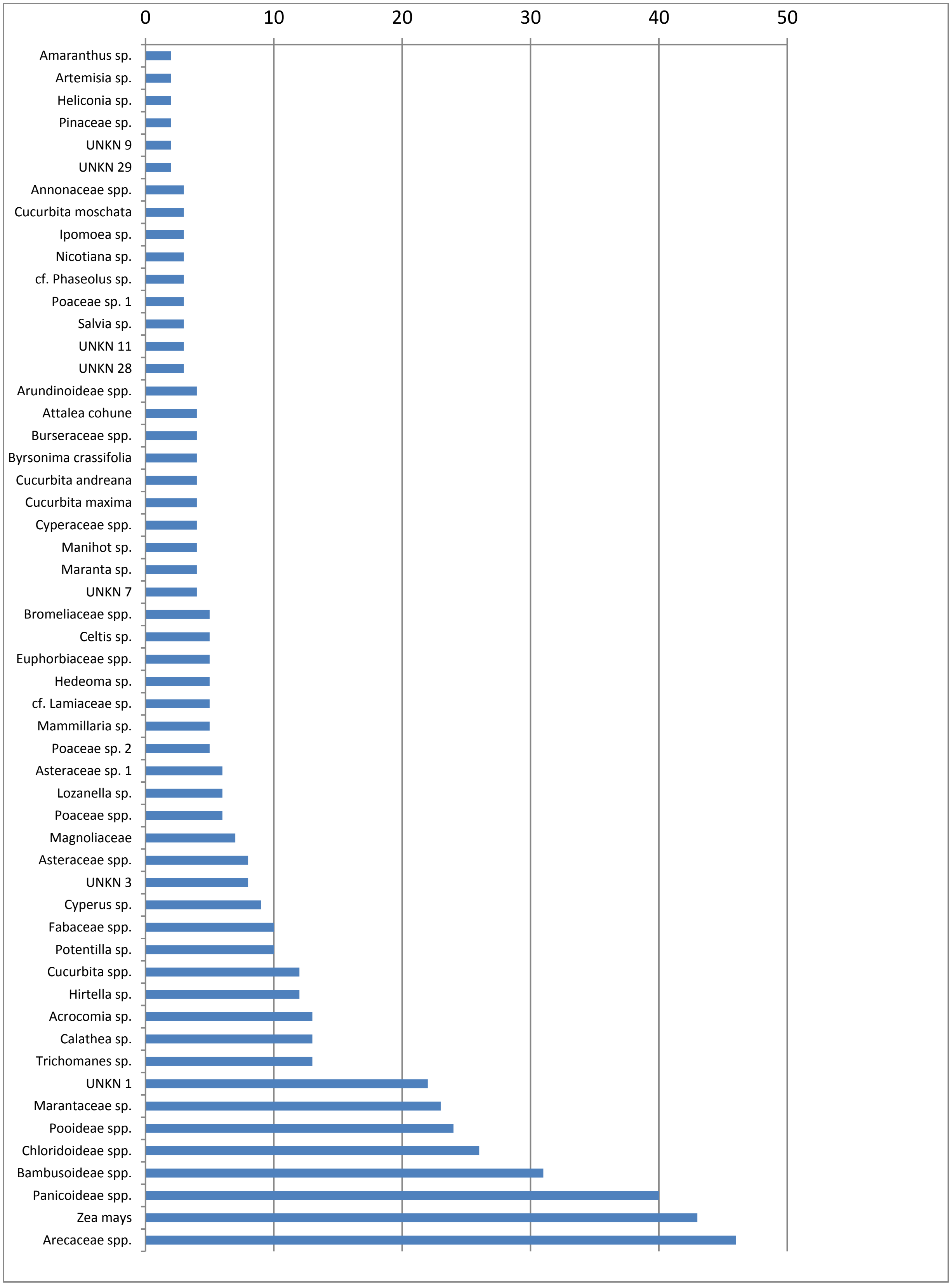


Figure 8.1: List of taxa recovered from more than one locus, in order of ubiquity.

Comparison of taxa recovery and richness in sediments

At the site of Currusté, where I had both bulk flotation samples and small sediment samples, a total of 67 taxa were recovered from 72 loci. 53 of these taxa were recovered from 26 loci using microbotanical evidence, whereas 35 taxa were recovered from 62 loci using macrobotanical evidence. The average minimum number of taxa recovered per sample, using microbotanical proxies, was fairly high (15.16). This is significantly higher than the average minimum number of taxa recovered per liter using macrobotanical proxies alone (2.94).

I was able to compare sets of macrobotanical and microbotanical samples within a single locus at 16 of the loci at Currusté. To tally these results, phytoliths from grass (*Poaceae*) subfamilies were tentatively matched with seeds from unknown or known *Poaceae* species. Wood consistently overlapped, in terms of woody phytoliths and charred wood fragments, but are not included in this tally. Moreover, unknown seeds may correspond with unknown wood or lumps, and any of these may correspond with unknown phytoliths. For this reason, unknown phytoliths were also not included in my tally. In 11 loci, there was some overlap between species, helping to strengthen tentative identifications and/or interpretations for the presence of dual proxies. In 5 loci, there was no overlap between species. In these cases, taxa were *only* recovered by one method or the other, and thus would not potentially have been recovered had only one method been used. On average, per locus, 12.13 taxa were recovered, and only 10.88 of these taxa overlapped in terms of recovery methods.

Figure 8.2 illustrates, broadly, what species are recoverable by which method, and demonstrates the range of taxa available using macrobotanical methods, microbotanical methods, or both. However, even in cases where a taxon could have been recovered from both flotation and microbotanical extraction (as in the case of *Zea mays*), this was not always the case. My interpretations of this discrepancy will be further discussed in subsequent chapters, on a case-by-case basis.

As compared to the overall average of taxa recovered per locus, at Currusté, using only one method would have significantly shifted the ubiquity of each recovered taxon, and severely constrained the range of taxa recovered overall. This is partly due to the nature of the evidence, as noted above in terms of phytolith recoverability and diagnostic aspects. However, in those cases where proxies did not overlap, the answers may be found in the specific practices related to each plant and/or location, and/or differing sampling practices.

Comparison of recovery and taxa richness in artifacts

At the three sites other than Currusté, I recovered microbotanical remains from implements and vessels, though not independently from sediments. Although an extremely quick and cheap extraction process, these data do not come without obstacles. As mentioned in previous chapters, there are inherent difficulties in assessing botanical deposition on tools. Complicating factors include: "washing of artifacts by the users, the order in which plants were processed with the tools, the ability of the lithic surface to capture and retain starch particles, and various post depositional processes" (Perry 2001:257), among others.

Using only the sonicated material, microbotanical remains were recovered from 21 artifacts in 18 loci. The total number of taxa recovered from artifacts is 20, whereas the total number of taxa recovered from bulk flotation samples is 83. Clearly, there are many more flotation samples analyzed than artifact samples, and so this makes for a somewhat weak comparison. This is also a much smaller number than the average microbotanical recovery rates for sediments (per locus), where much more material is yielded. In spite of these challenges, however, it is interesting to note that a fairly respectable 17% of total taxa (from all sites, both starch grains and phytoliths) was recovered using only the sonicated material from artifacts at these three sites.

On average, a minimum of 3.57 taxa were recovered from the sonicated material of each artifact, which is higher than the average 2.94 taxa recovered per bulk flotation sample (per liter), but far lower than the average 15.16 taxa recovered from each phytolith sediment sample. These numbers are skewed by the fact that adhering sediment was not included in the number of taxa recovered for each artifact, as, again, this material may have come from the surrounding matrix. The data are also somewhat skewed, as previously mentioned, by the low preservation rate of the macroremains.

Comparison of recovery techniques, taxa richness, and time

In order to get a sense of variation over time (and possibly in preservation), I compared recovery rates and diversity of taxa recovered for each time period. The minimum number of taxa represented in the Formative period, at the sites of Los Naranjos and Puerto Escondido, is 45. The total minimum number of taxa recovered from the Classic period, at the sites of Puerto Escondido, Currusté and Cerro Palenque, is over twice that number (n=101). This is a significant difference. However, only 30 samples are represented in the Formative period, whereas five times that number (n=158) are represented in the Classic period. In this sense, roughly quintupling the number of samples in the Formative period would have yielded roughly quintuple the number of taxa, in an unlimited diverse population (similarly to Lennstrom and Hastorf 1992), potentially marking greater taxa richness in the Formative.

Each of these calculations of taxa richness can be compared to the total number of taxa represented in the combined time periods (n=122). Overall, 83% of the taxa were recovered from the Classic, whereas 37% of the taxa were recovered from the Formative period samples. In total, 21 taxa recovered from Formative Period samples were not recovered from the Classic samples, whereas 77 taxa recovered from the Classic samples were not recovered from the Formative period samples. This, again, is could be correlated with the number of loci sampled for each time period, although it is interesting to note that, in spite of the enormous number of loci sampled in the Classic, fifteen taxa remain absent at this time period that were recovered from the Formative period. I elaborate on this discrepancy in Chapter 13, but I will note that it is possible some species utilized in the Formative were not utilized in the Classic.

Summary

This study supports the claim that the more loci sampled and the larger the samples, the higher the taxa richness, until the maximum population number is eventually reached. The time required for each type of analysis varies, as bulk sediment flotation can take several days, sediment micro-sample processing can take several weeks, and artifact processing can take under an hour. For the highest taxa richness in this semi-tropical environment, *per sample,* if only one method is to be used, the sediment samples are the most productive, followed by artifact samples and then bulk flotation samples. If the goal is the recovery of herbaceous and non-domesticated species (aside from grasses), the best proxy is the macrobotanical data recovered from the bulk flotation samples. Taxa directly associated with artifacts, obviously, are only attainable through microbotanical analysis of sonicated material from those artifacts. The majority of taxa used for underground storage tissues, such as manioc, lirén, and sweet potato, were also recovered most frequently from artifact samples, either in the sonicated material or in the adhering sediment.

Although each method has its strengths, ultimately I have found it is best to work with all sets of data, as they produce complementary results. Macrobotanical remains provide a set of species that do not produce diagnostic microbotanical remains, and vice versa. Had I studied only flotation samples, roughly 32 taxa would have remained invisible. Had I investigated only small sediment and artifact samples, 56 taxa would have remained invisible. Moreover, macrobotanical remains index a set of practices having to do with contexts and spaces that artifact analyses can't provide, whereas microbotanical remains index a set of practices having to do with implements and vessels that sediment samples can't provide.

Redundant data for a single taxon help to cross-check plant presence. There are 27 taxa, overall, with both microbotanical and macrobotanical evidence. Multiple data for a single taxon can help to specify a particular activity. The presence of maize kernels versus cob fragments versus leaf phytoliths, give us different views of the practices associated with this plant, as they unfolded over different places and times. Such data can identify discrete past activities, from cutting to serving to disposing. I further detail the spectrum of practices associated with various taxa in the next chapter, and detail practices associated with various contexts and spaces in latter chapters.

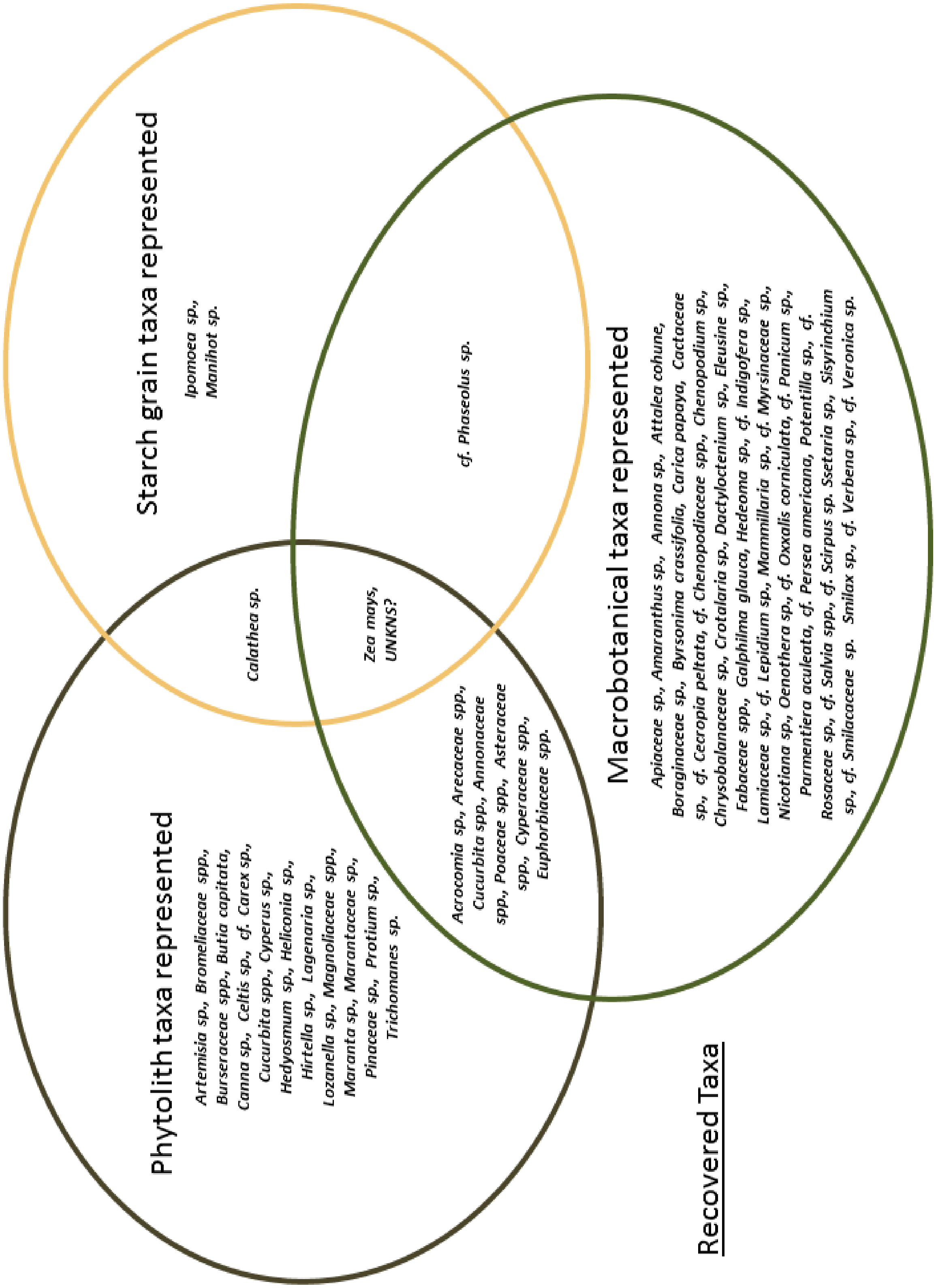


Figure 8.2. Complementarity and overlap of types of analysis, as reflected in taxa recovery.

9. The Broad Spectrum of Taxa and Practices Associated with Individual Plant Species

"*[Annona glabra]* is often utilized along the Atlantic coast of Central America for bottle stoppers and floats for fishing nets and lines. The fruit is insipid and seldom eaten by people but there is a popular belief, perhaps correct, that it is eaten commonly by alligators."
Standley and Steyermark 1946

As the above quote illustrates, there is more to plant use than simple consumption. Plants are woven into the discourse of everyday life as foods, as gifts, as tools, and even as urban legends. During the course of my research, I wanted to reconsider the way that we frame practices associated with different taxa, artifacts, spaces, and contexts. Basically, I wanted to tackle the "laundry list" problem, which remains pervasive in our practices as archaeobotanists.

A fruitful way of going about this, I thought, might be borrowed from practice theory and linguistic approaches, as detailed in previous chapters. I think it is our habit, and not just as paleoethnobotanists, to sometimes create false dichotomies between such concepts as "wild" and "domesticated", "food" and "medicine", etc. (Etkin 1994). By reframing my questions in terms of practices, I hoped to better account for overlap between taxa, artifacts, contexts, and spaces. For example, a single plant may be associated with different practices-- grown *and* collected; condiment *and* medicinal; processed in different kinds of spaces; found in different contexts; and associated with different artifacts.

In Chapter 4, I detailed the various analogs I used to frame plant practices. At a more basic level, however, I also needed details about the plants themselves. Toward this end, for the past several years I have been compiling a broad database of economic plants of Southeastern Mesoamerica (available upon request). This database, though far from complete, is the source of a large set of ethnobotanical data that I here draw upon. The data include details about archaeologically recovered species, as well as ethnographic and ethnohistoric information pulled from various volumes of Guatemala, Honduras, and the northern Yucatan peninsula (e.g. Standley and Steyermark 1946, Arellano Rodriguez et al. 2003, Nelson Sutherland 1986, and Roys 1965). Compiling this sort of information is not without its problems. As phylogenic information is under constant revision, so, too, is the database. Primarily, I have had to revise information related to subfamilies in the grass (*Poaceae)* and bean *(Fabaceae)* families, as well as broader family names which have undergone changes due to modern research on plant genetics. There are also problems regarding common names, which can vary wildly from dialect to dialect and even community to community.

In the previous chapter, I explored various means by which we can recover plant taxa, and the implications of using these methods separately or in tandem. In this chapter, I focus on the plants themselves, and the various ways they are incorporated into daily life. By focusing on patterns of practices and associations, instead of simple presence or absence of taxa, I hope to better account for the varied biographies of these plants, and the more complex ways they were interwoven with the biographies of the sites' inhabitants. These "biographies" of taxa diverge slightly from formation process approaches, but also attempt to incorporate N- and C-transforms, following Schiffer (1972).

I first view broad ubiquities of the recovered plant taxa, and various aspects related to practice. I present ubiquities of botanical remains, as related to different artifacts, contexts, spaces, and time periods. I then highlight taxa related to three areas: agricultural production, such as the cultivation of maize; the use of underground storage organs, such as root crops; and the use of non-domesticates, such as small herbaceous species. Overall, this chapter presents a detailed view of various recovered taxa, in relation to other taxa, practices, contexts, spaces, artifacts, and temporal changes. The subsequent chapters will address contexts, spaces, artifacts, and temporal changes, as related to these plants and their associated practices.

Complications in calculations

There are several types of quantitative processes that can be applied to paleoethnobotanical information. Exploratory statistics are a series of techniques utilized to "get to know" the data. Generally these are partly quantitative and partly qualitative-- such explorations of data were the subject of the last chapter. Descriptive statistics summarize information without engaging in algorithmic calculation. Analytical statistics are used for probability and predictability– that is, to assess, for example, whether a sample is representative of a population as a whole (Ford 1988). Lennstrom and Hastorf (1992) outline four "common quantification schemes" that make use of exploratory and descriptive statistics: ubiquity analysis (number of loci of particular taxa as present/absent across the site), density analysis (quantity of all materials per unit volume), diversity analysis (number of taxa represented per sample), and relative presence analysis (percentage of taxa relative to each other at each locus). Useful as such quantitative techniques are, they are not without their difficulties, also outlined by Lennstrom and Hastorf (1992: 217-218). In this chapter, my emphasis is on ubiquities of taxa, as viewed under various conditions. In subsequent chapters, I employ taxa richness analysis, density analysis, and relative presence analysis. I do not make use of absolute counts (total numbers of a taxon in each sample), as detailed in Popper (1988).

In general, ubiquity can be tricky to calculate and interpret. What reflects actual use, versus preservational and processing distortion? Considering the narratives of plant practices from ethnographic sources, how do we expect to encounter various plant taxa in the archaeological record? In a universe where all plants are used in exactly equivalent percentages, and have equivalent diagnostic parts-- which decompose at the same rate and are equivalently recoverable-- ubiquities would be even. Actual ubiquity, however, is influenced by different means of processing taxa and subsequent preservation, and is not a passive reflection of actual use. For example, the plant *Artemisia* was recovered from only two samples, through phytolith evidence only. Ethnobotanical and archaeological analogs lead us to believe this plant was not likely a staple of any kind, and so has a lower "starting" ubiquity than other commonly-used plants. Its recoverability is then further diminished through ethnobotanical practices. First, considering the few kinds of activity that include bringing *Artemisia* seeds near fire, few charred macroremains are likely to have been produced. Second, considering the likely limited amount of complicated processing for this plant, a smaller distribution of microremains would have resulted.

Moreover, broad ubiquities of plants are difficult to calculate when combining different kinds of data. It is hard to define ubiquities across the board, as some taxa are recoverable only through microremains, while others only through macroremains. In my case, there are three main implications of this problem: potential overlap between taxa, potential overlap between samples, and potential overlap between clades. For this reason, I here detail my "fixes" to these analytical issues.

Resolving the taxon overlap problem

In terms of anatomical elements of taxa which are recoverable *and* diagnostic, some plants are identifiable only through microbotanical elements, some only through macrobotanical elements, and some through both, as detailed in the previous chapter. Complicating this, in the case of palm species, some phytoliths are diagnostic to the species, and others only to the family, but all are produced in a given plant. In order to attempt to resolve resultant problems of overlap, I had to outline a series of parameters. My basic idea was to calculate a maximum possible ubiquity for each taxon, then divide this number by the total potential ubiquity of each taxon. The actual total ubiquity for each taxon was thus calculated as a percentage total of the maximum potential ubiquity **(Table 9.1).**

A taxon could overlap, in a given locus, if it was recoverable through both macrobotanical and microbotanical remains. In these instances, the taxon would be counted only once at that locus. So, in the cases where maize was recovered through both phytoliths and cupules, at a single locus, I marked it only once for that locus. By the same token, although *Cucurbitaceae* species *could* have been recovered through macroremains, since none were, there was no chance of overlap, and thus there was no locus where *Cucurbitaceae* microremains and macroremains were combined.

This manner of combining data sets does not address issues of different methods of propagation. For example, if *Ipomoea* were propagated vegetatively, by cutting off segments of the tuberous root and planting them to grow new tuberous roots, then harvesting before the plant went to seed, it would be impossible to recover *Ipomoea* seeds. Uncertain though I am, however, as to how production occurred, I have left the maximum potential ubiquity to include the prospect for *Ipomoea* macroremains, as well.

For maximum possible actual ubiquity, I combined taxonomic categories, as detailed in **Table 9.1.**

Acrocomia = _Acrocomia_ phytoliths, _Acrocomia_ macroremains, and _Arecaceae_ phytoliths
Annona = _Annona_ seeds and _Annonaceae_ phytoliths
Annonaceae = _Annonacaceae_ phytoliths and _Annona_ seeds
Arecaceae = _Attalea_, _Acrocomia_, and _Arecaceae_ macroremains and _Butia, Acrocomia_ and _Arecaceae_ phytoliths
Arundinoideae = _Arundinoideae_ phytoliths and _Poaceae_ spp. macroremains
Asteraceae = _Asteraceae_ phytoliths and _Asteraceae_ spp. macroremains
Attalea = _Attalea_ macroremains and _Arecaceae_ phytoliths
Bambusoideae = _Bambusoideae_ phytoliths and _Poaceae_ spp. macroremains
Burseraceae = _Burseraceae_ phytoliths and _Protium_ phytoliths
Butia = _Butia_ and _Arecaceae_ phytoliths, and _Arecaceae_ macroremains
Chloridoideae = _Chloridoideae_ phytoliths and _Poaceae, Eleusine_, and _Dactyloctenium_ seeds
Chrysobalanaceae = _Chrysobalanaceae_ seeds and _Hirtella_ phytoliths
Cyperaceae = _Cyperaceae_ spp. and _Scirpus_ macroremains, and _Cyperaceae, Carex_, and _Cyperus_ phytoliths
Dactyloctenium = _Dactyloctenium_ seeds and _Chloridoideae_ phytoliths
Eleusine = _Eleusine_ seeds and _Chloridoideae_ phytoliths
Euphorbiaceae = _Euphorbiaceae_ macroremains, _Euphorbiaceae_ phytoliths
Fabaceae = _Fabaceae_ spp., _Phaseolus, Indigofera,_ and _Crotalaria_ macroremains
Lamiaceae = _Lamiaceae, Hedeoma,_ and _Salvia_ macroremains, _Artemisia_ phytoliths

***Panicoideae* = *Panicoideae* phytoliths and *Poaceae* spp., *Setaria, Zea,* and *Panicum* seeds**
***Panicum* = *Panicum* seeds and *Panicoideae* phytoliths**
***Poaceae* = *Poaceae* spp., *Panicum*, *Dactyloctenium, Eleusine,* and *Zea* macroremains, and *Arundinoideae, Bambusoideae, Chloridoideae, Panicoideae, Pooideae,* and *Zea* phytoliths**
***Poaceae* sp. 1 (etc.) = *Poaceae* sp. 1 (etc.) seeds, and phytoliths from subfamily (*Panicoideae*) with maximum**
***Pooideae* = *Pooideae* phytoliths and *Poaceae* spp. seeds**
***Setaria* = *Setaria* seeds and *Panicoideae* phytoliths**

Table 9.1. Combinations of potentially overlapping taxonomic categories.

Resolving the sample overlap problem

In terms of recovered taxa, I calculate ubiquity by locus, not by sample, as there could be locus overlap between artifacts, microbotanical samples and macrobotanical samples **(see Figure 9.1)**. Moreover, artifacts are highly subject to secondary deposition, and so microremains affixed to an artifact are less likely to correspond to the locus from which the artifact is recovered. In cases where botanical remains were recovered from both the microbotanical and macrobotanical samples corresponding to a single locus, for each taxon or possible taxon, I collapsed the set of results, counting the locus only once.

Moreover, due to the fact that taxa have varying recoverable diagnostic remains, I calculated potential ubiquities according to the availability of paleoethnobotanical types for each taxon. In some cases, either microremains or macroremains were not recoverable, as they were not produced by the taxon, not diagnostic, and/or not likely to preserve. So, out of 116 macrobotanical samples, 26 sediment samples, 17 obsidian tools, and 4 ceramic sherds, I calculated potential ubiquity in some cases out of a total of 116 samples, where no identifiable microremains were possible. Other taxa are calculable only through microremains (as with unknown phytolith species), and so I used 26 loci as the total potential ubiquity. Other potential ubiquities included all types of data (as in the case of *Zea mays*, which has identifiable starch grains, phytoliths, and macroremains), and so I calculated potential ubiquity as a total 126, as 16 of the sediment samples and bulk flotation samples overlap at a single locus. Other taxa ubiquities I calculated using tools and macroremains only (such as *Ipomoea*, which has no identifiable phytoliths but does have identifiable starch grains).

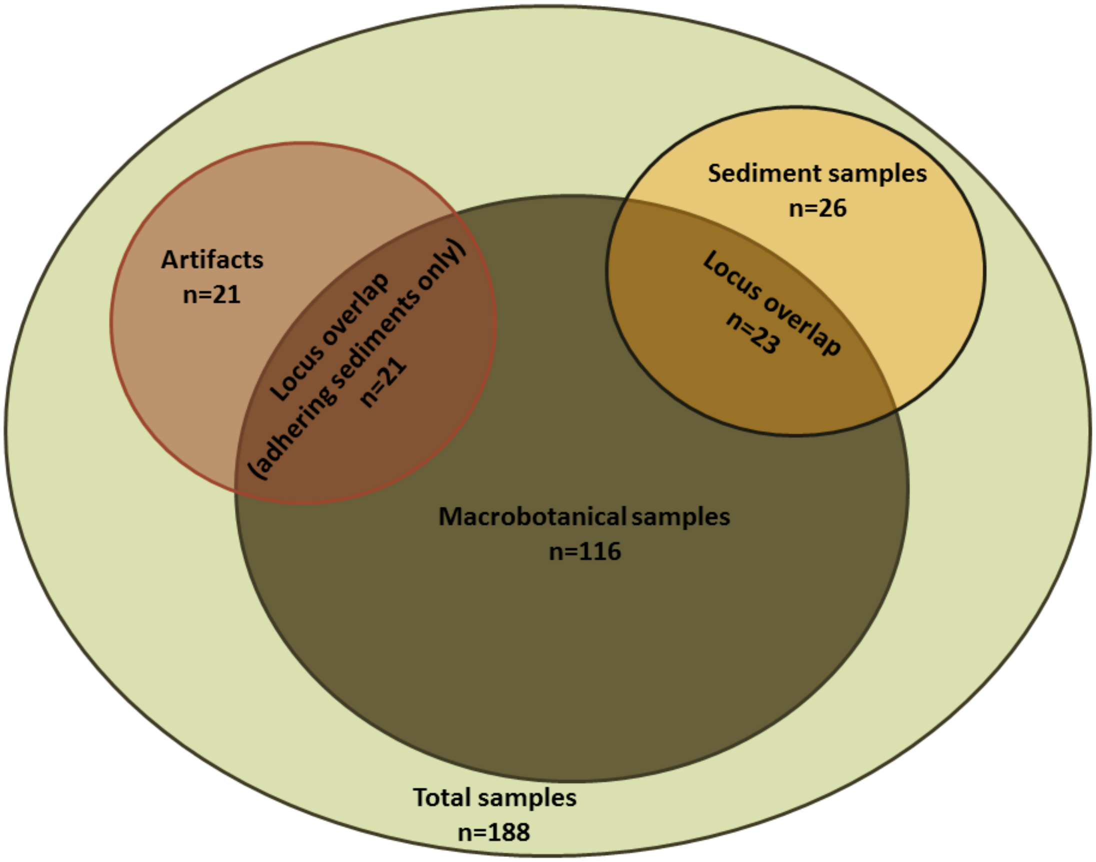


Figure 9.1. Overlap in loci between sample types.

Resolving the clade overlap problem

Plants which were likely to be identifiable at the taxon level as one type of botanical data that were also identifiable as another type of botanical data, but in a higher node of the clade, were not doubly counted. So, for example, *Dactyloctinium*, recovered as a seed, may also have been recovered as a (*Poaceae*) *Chloridoid* phytolith, but would not have been diagnostic to the genus level, *Dactyloctinium*. However, the *Chloridoid* grasses producing phytoliths should have been recoverable as a species of this subfamily. For that reason, where the species were recovered that corresponded to this subfamily, those numbers were added to the actual ubiquities. It is not certain that the *Chloridoid* phytoliths were recovered from *Dactyloctinium*, nor that the *Dactyloctinium* seeds corresponded with the same plants that produced the *Chloridoid* phytoliths, so I provide a *maximum* count of the possible number of places where *Dactyloctinium* and *Chloridoid* species were recovered.

In spite of these precautions, there is still the danger (and, in fact, likelihood) of some overlap. The cocoyol palm genus *Acrocomia,* for example, does not overlap 100% with its broader palm family, *Arecaceae*, in terms of what remains will be recovered, but does produce some phytoliths similar to those of other *Arecaceae* spp. So, although I've incorporated all unknown *Arecaceae* spinulose spheres when calculating the maximum possible ubiquity of *Acrocomia*, as I've done the same thing for the *Attalea* genus, these two genera essentially "share" a set of phytoliths. This is the same situation as with the *Panicoideae* subfamily, where not all phytoliths likely correspond with the genus *Setaria*, but are included to maximize the possible ubiquity of this genus. So, there is necessarily some overlap, as phytoliths may be doing "double duty" in two taxonomic designations (*Attalea* and *Acrocomia*, *Setaria* and *Eleusine*, etc.).

I pursued a different tactic with seeds and phytoliths that I could not identify to even the family level. In the process of combining categories, unknown (UNKN) phytoliths were calculated completely separately from unknown (UNKN) seeds, and vice versa, as it was impossible for me to correlate these in any way. For this reason, some overlap is possible between, as a hypothetical example, Unknown Seed #1 and Unknown Phytolith #4. For the moment, however, these will have to remain completely discrete categories.

Broadly, I calculated families to incorporate all taxa from within that family that had been diagnostic at the level of a smaller clade. However, I have only included those families that were *not* attached to a single taxon. So, although *Carica papaya* belongs to the *Caricaceae* family, as it was the only member of this family recovered, I have not calculated *Caricaceae* ubiquity separately. For *Poaceae*, when calculating the ubiquity of this family, I calculated subfamilies such as *Bambusoideae* separately, but grouped all genera within this subfamily, then calculated all genera within *Poaceae*. I have only done this in the case of the grasses, as they are the only phytoliths I was able to differentiate at the subfamily level but not the genus level. In terms of genera and species, I incorporated all *undifferentiated* unknown macro and microremains within a genus or species.

Broad ubiquities of taxa

Following all of these delineated parameters, I outline the maximum possible ubiquity across loci, for each taxon, in **Table 9.2**. This maximum possible ubiquity, again, is calculated as a percentage ratio of maximum number of possible loci where the taxon was actually recovered, out of total *potential* instances where that taxon *could* have been recovered. I also include, in this table, the associated sites, artifacts, contexts, and spaces for each of these taxa.

Table 9.2: Plant taxa ubiquities, by sites, artifacts, contexts, and spaces.

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces

Taxon:	**Maximum possible number of loci where taxon recovered**	**Potential number of instances where taxon recoverable**	**Maximum possible ubiquity across loci**	**Assoc. sites**	**Assoc. artifacts**	**Assoc. contexts**	**Assoc. spaces**
Acrocomia sp.	33	126	26.2%	CURR	ceramic sherd interior, obsidian biface, obsidian blade, obsidian flake, retouched obsidian flake, small retouched flake	architect fill, external surface, high - density midden, interior str surface, lined pit fill, low-density midden, matrix between, special deposit, UNKN	adjacent, interior ground str, interior mound str, outside, patio
Amaranthus sp.	2	116	1.7%	LNAR, PESC	__	lined pit fill, matrix between	adjacent, between
cf. Annona sp.	7	126	5.6%	CURR, LNAR	__	architect fill, low-density midden, matrix between	adjacent, interior ground str, patio
Annonaceae spp.	7	126	5.6%	CURR, LNAR	__	architect fill, low-density midden, matrix between	adjacent, interior ground str, patio
cf. Apiaceae sp.	1	116	0.9%	CURR	__	low-density midden	adjacent
Arecaceae spp.	35	126	27.8%	ALL	ceramic sherd interior, obsidian biface, obsidian blade fragment, retouched obsidian blade fragment, small retouched flake	architect fill, external surface, interior str surface, kiln, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
Artemisia sp.	2	126	1.6%	PESC	__	__	__

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
Arundinoideae spp.	16	126	12.7%	ALL	__	architect fill, external surface, high-density midden, kiln, lined pit fill, low-density midden, matrix between	adjacent, between, outside, patio
Asteraceae spp.	15	126	11.9%	CPAL, CURR, LNAR	__	external surface, high-density midden, kiln, low-density midden, matrix between	adjacent, interior ground str, outside, patio
Attalea cohune	34	126	27.0%	ALL	ceramic sherd interior, obsidian blade fragment, retouched obsidian flake, obsidian biface, obsidian flake fragment	architect fill, external surface, interior str surface, kiln, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
Bambusoideae spp.	37	126	29.4%	ALL	__	architect fill, external surface, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between	adjacent, between, interior ground str, outside, patio
Boraginaceae sp.	1	116	0.9%	CPAL	__	high-density midden	outside
Bromeliaceae spp.	1	126	0.8%	CURR, LNAR, PESC	obsidian blade fragment	lined pit fill, matrix between, UNKN	adjacent, between, outside

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
Burseraceae spp.	5	126	4.0%	CURR	__	architect fill, interior str surface, matrix between	adjacent, interior ground str, patio
Butia capitata	32	126	25.4%	ALL	ceramic sherd interior, obsidian blade fragment, retouched obsidian flake, obsidian biface, obsidian flake fragment	architect fill, external surface, interior str surface, kiln, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
Byrsonima crassifolia	4	116	3.4%	CURR	__	external surface, low-density midden, matrix between	adjacent, outside, patio
Cactaceae sp.	6	116	5.2%	CPAL, CURR	__	high-density midden, low-density midden, matrix between	adjacent, outside, patio
Calathea sp.	10	126	7.9%	CURR, LNAR, PESC	obsidian blade fragment	architect fill, external surface, interior str surface, low-density midden, matrix between	adjacent, interior ground str, outside, patio
Canna sp.	1	126	0.8%	CURR	__	matrix between	patio
cf. Carex sp.	1	126	0.8%	CURR	__	matrix between	patio
Carica papaya	1	116	0.9%	CURR	__	matrix between	adjacent
cf. Cecropia peltata	1	116	0.9%	CURR	__	low-density midden	patio
Celtis sp.	4	126	3.2%	CURR, PESC	__	external surface, matrix between	adjacent, outside
Chenopodiaceae sp.	2	116	1.7%	CPAL, PESC	__	high-density midden, lined pit fill	adjacent, outside
Chenopodium sp.	1	116	0.9%	PESC	__	lined pit fill	adjacent

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
Chloridoideae spp.	36	126	28.6%	ALL	obsidian blade fragment, small retouched flake, obsidian flake fragment	architect fill, external surface, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between	adjacent, between, interior ground str, interior mound str, outside, patio
Chrysobalanaceae sp.	13	116	11.2%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
Crotalaria sp.	1	116	0.9%	CURR	__	low-density midden	outside
Cucurbita spp.	14	126	11.1%	CPAL, CURR, PESC	obsidian blade fragment, ceramic sherd interior	architect fill, external surface, interior str surface, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
Cucurbita andreana	4	126	3.2%	CURR	__	matrix between	adjacent, interior ground str, outside, patio
Cucurbita maxima	4	126	3.2%	CURR	__	low-density midden, matrix between	adjacent, patio
Cucurbita moschata	3	126	2.4%	CURR	__	architect fill, external surface, matrix between	adjacent, interior mound str, outside
Cyperaceae spp.	12	126	9.5%	ALL	__	external surface, kiln, low-density midden, matrix between	adjacent, outside, patio
Cyperus sp.	7	126	5.6%	CURR, PESC	__	external surface, low-density midden, matrix between	adjacent, outside, patio

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
Dactyloctenium sp.	24	126	19.0%	ALL	obsidian blade fragment, small retouched flake, obsidian flake fragment	architect fill, external surface, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between	adjacent, between, interior ground str, interior mound str, outside, patio
Eleusine sp.	24	126	19.0%	ALL	obsidian blade fragment, small retouched flake, obsidian flake fragment	architect fill, external surface, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between	adjacent, between, interior ground str, interior mound str, outside, patio
Euphorbiaceae spp.	4	126	3.2%	PESC, CURR	obsidian blade fragment	matrix between	adjacent
Fabaceae spp.	14	126	11.1%	ALL	__	burial matrix, hearth, high-density midden, kiln, low-density midden, matrix betwteen	adjacent, between, interior ground str, outside, patio
Fabaceae sp. 2	1	116	0.9%	CPAL	__	kiln	patio
Fabaceae sp. 3	1	116	0.9%	CPAL	__	high-density midden	outside
Galphilma glauca	1	116	0.9%	CURR	__	interior floor surface	interior mound str
Hedeoma sp.	5	116	4.3%	CURR	__	low-density midden, matrix between	adjacent, outside, patio
cf. Hedyosmum sp.	1	126	0.8%	CURR	__	low-density midden	adjacent
Heliconia sp.	2	126	1.6%	CURR	__	low-density midden, matrix between	patio
Hirtella sp.	13	126	10.3%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
cf. Indigofera sp.	1	116	0.9%	LNAR	__	matrix	between

Taxon:	**Maximum possible number of loci where taxon recovered**	**Potential number of instances where taxon recoverable**	**Maximum possible ubiquity across loci**	**Assoc. sites**	**Assoc. artifacts**	**Assoc. contexts**	**Assoc. spaces**
						between	
Ipomoea sp.	0	126	0.0%	LNAR	__	[artifact adhering sediment only, x3]	[artifact adhering sediment only, x3]
Lagenaria sp.	1	126	0.8%	CURR	__	external surface	adjacent
Lamiaceae sp.	12	116	10.3%	CURR, LNAR, PESC	__	collapse matrix, high-density midden, low-density midden, matrix between	adjacent, between, outside, patio, UNKN
cf. Lepidium sp.	1	116	0.9%	LNAR	__	matrix between	between
Lozanella sp.	6	126	4.8%	CURR	__	matrix between	adjacent
Magnoliaceae	7	126	5.6%	CURR	__	interior str surface, matrix between	adjacent, interior ground str, outside, patio
Mammillaria sp.	5	116	4.3%	CPAL, CURR	__	high-density midden, low-density midden, matrix between	outside, patio
Manihot sp.	0	126	0.0%	LNAR	__	[artifact adhering sediment only, x5]	[artifact adhering sediment only, x5]
Maranta sp.	2	126	1.6%	CURR, PESC	obsidian blade fragment	matrix between	adjacent, interior ground str
Marantaceae spp.	21	126	16.7%	CURR, LNAR, PESC	obsidian retouched flake, obsidian blade fragment, obsidian flake fragment	architect fill, external surface, interior str surface, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
cf. Myrsinaceae sp.	1	126	0.8%	CURR	__	low-density midden	adjacent
Nicotiana sp.	3	116	2.6%	CPAL, LNAR, PESC	__	burial matrix, high-density midden, matrix between	between, interior ground str, outside
Oenothera sp.	1	116	0.9%	LNAR	__	pit fill	adjacent
cf. Oxalis	1	116	0.9%	LNAR	__	matrix	between

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
corniculata						between	
Panicoideae spp.	37	126	29.4%	ALL	ceramic sherd, small retouched flake, obsidian blade fragment, obsidian retouched flake, obsidian flake fragment, obsidian biface	architect fiill, burial matrix, burned deposit, external surface, hearth, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between,	adjacent, between, interior ground str, interior mound str, outside, patio
cf. Panicum sp.	26	126	20.6%	ALL	ceramic sherd interior, obsidian blade fragment, obsidian biface, small retouched flake, obsidian flake fragment	architect fill, external surface, interior str sufrace, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
Parmentiera aculeata	1	116	0.9%	LNAR	__	matrix between	between
cf. Persea americana	1	116	0.9%	CURR	__	low-density midden	outside
cf. Phaseolus sp.	1	126	0.8%	LNAR, PESC	__	interior str surface, lined pit fill, matrix between	adjacent, interior ground str, outside
Pinaceae sp.	2	126	1.6%	CURR	__	matrix between	patio
Poaceae spp.	53	126	42.1%	ALL	ALL	ALL	ALL
Poaceae sp. 1	36	126	28.6%	ALL	ALL	ALL	ALL
Poaceae sp. 2	41	126	32.5%	ALL	ALL	ALL	ALL
cf. Poaceae sp. 3	38	126	30.2%	ALL	ALL	ALL	ALL
Poaceae sp. 4	38	126	30.2%	ALL	ALL	ALL	ALL
Poaceae sp. 5	38	126	30.2%	ALL	ALL	ALL	ALL
Pooideae spp.	31	126	24.6%	ALL	obsidian blade fragment	architect fill, external surface, high-density midden, kiln, lined pit fill, low-density midden, matrix	adjacent, between, interior ground str, interior mound str, outside, patio

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
						between	
Potentilla sp.	10	116	8.6%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
Protium sp.	1	126	0.8%	CURR	__	matrix between	adjacent
Rosaceae sp.	11	116	9.5%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
cf. Salvia hispanica	1	116	0.9%	LNAR	__	matrix between	between
Salvia sp.	4	116	3.4%	CURR, LNAR	__	low-density midden, matrix between	adjacent, between, outside
cf. Scirpus sp.	4	126	3.2%	LNAR	__	matrix between	adjacent
Setaria sp.	38	126	30.2%	ALL	ceramic sherd, small retouched flake, obsidian blade fragment, obsidian retouched flake, obsidian flake fragment, obsidian biface	architect fiill, burial matrix, burned deposit, external surface, hearth, high-density midden, interior str surface, kiln, lined pit fill, low-density midden, matrix between,	adjacent, between, interior ground str, interior mound str, outside, patio
Sisyrinchium sp.	1	116	0.9%	LNAR	__	matrix between	between
cf. Smilacaceae sp.	1	116	0.9%	CURR	__	matrix between	outside
Smilax sp.	1	116	0.9%	CURR	__	matrix between	interior mound str

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
Trichomanes sp.	13	126	10.3%	CURR	__	external surface, interior str surface, low-density midden, matrix between	adjacent, interior ground str, outside, patio
cf. Verbena sp.	1	116	0.9%	LNAR	__	matrix between	between
cf. Veronica sp.	1	116	0.9%	LNAR	__	matrix between	between
Zea mays	33	126	26.2%	ALL	obsidian blade fragment, small retouched flake, ceramic sherd interior, obsidian retouched flake	architect fill, burial matrix, burned deposit, external surface, hearth, high-density midden, lined pit fill, low-density midden, matrix between	adjacent, interior ground str, interior mound str, outside, patio
UNKN seed 1	22	116	19.0%	CPAL, CURR, LNAR	__	architect fill, external surface, high-density midden, interior floor surface, kiln, low-density midden, matrix between, matrix with carbon	adjacent, interior mound str, outside, paptio, UNKN
UNKN seed 3	7	116	6.0%	CPAL, LNAR	__	high-density midden, interior floor surface, kiln, matrix between	adjacent, between, interior mound str, patio, outside
UNKN seed 5	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 6	1	116	0.9%	CPAL	__	kiln	outside
UNKN seed 7	4	116	3.4%	CPAL, CURR, LNAR	__	high-density midden, interior floor surface, matrix between	adjacent, interior mound str, outside
UNKN seed 8	1	116	0.9%	CPAL	__	special deposit	patio

Taxon:	**Maximum possible number of loci where taxon recovered**	**Potential number of instances where taxon recoverable**	**Maximum possible ubiquity across loci**	**Assoc. sites**	**Assoc. artifacts**	**Assoc. contexts**	**Assoc. spaces**
UNKN seed 9	2	116	1.7%	CPAL, CURR	__	high-density midden, interior floor surface	interior mound str, outside
UNKN seed 10	1	116	0.9%	CPAL	__	kiln	patio
UNKN seed 11	3	116	2.6%	CPAL, LNAR	__	kiln, matrix between	between, outside, patio
UNKN seed 15	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 16	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 18	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 19	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 20	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 21	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 22	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 23	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 24	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 25	1	116	0.9%	CPAL	__	high-density midden	outside
UNKN seed 26	1	116	0.9%	LNAR	__	matrix between	adjacent
UNKN seed 28	3	116	2.6%	CURR, LNAR	__	architect fill, matrix between	adjacent, interior ground str, outside
UNKN seed 29	2	116	1.7%	CURR, LNAR	__	matrix between	between, outside
UNKN seed 30	2	116	1.7%	CURR	__	low-density midden, matrix between	adjacent, outside
UNKN seed 31	1	116	0.9%	CURR	__	low-density midden	adjacent
UNKN phytolith 1	5	26	19.2%	CURR, LNAR, PESC	obsidian retouched flake, obsidian blade fragment, obsidian flake fragment	interior str surface, lined pit fill, matrix between, UNKN	interior ground str, outside, patio

Taxon:	**Maximum possible number of loci where taxon recovered**	**Potential number of instances where taxon recoverable**	**Maximum possible ubiquity across loci**	**Assoc. sites**	**Assoc. artifacts**	**Assoc. contexts**	**Assoc. spaces**
UNKN phytolith 2	2	26	7.7%	ALl	obsidian retouched flake, obsidian flake fragment, ceramic sherd interior, obsidian blade fragment	matrix between	outside, patio
UNKN phytolith 3	11	26	42.3%	ALL	obsidian retouched flake, obsidan blade fragment, obsidian biface, retouched obsidian flake	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
UNKN phytolith 4	1	26	3.8%	CURR	__	matrix between	patio
UNKN phytolith 5	5	26	19.2%	CURR	__	architect fill, low-density midden, matrix between	interior mound str, outside, patio
UNKN phytolith 7	5	26	19.2%	CURR	__	low-density midden, matrix between	interior ground str, outside
UNKN phytolith 8	4	26	15.4%	CURR	__	matrix between	adjacent, outside
UNKN phytolith 9	12	26	46.2%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior mound str, outside, patio
UNKN phytolith 10	8	26	30.8%	CURR	__	architect fill, external surface, low-density midden, matrix between	adjacent, interior ground str, outside
UNKN phytolith 11	2	26	7.7%	CURR, LNAR	obsidian blade fragment	matrix between	patio
UNKN phytolith 12	3	26	11.5%	CURR, PESC	obsidian blade fragment	external surface, matrix between	adjacent, outside
UNKN phytolith 13	4	26	15.4%	CURR	__	external surface, interior str surface, matrix between	adjacent, interior ground str, outside

Taxon:	Maximum possible number of loci where taxon recovered	Potential number of instances where taxon recoverable	Maximum possible ubiquity across loci	Assoc. sites	Assoc. artifacts	Assoc. contexts	Assoc. spaces
UNKN phytolith 14	5	26	19.2%	CURR, PESC	small retouched flake	external surface, low-density midden, matrix between	adjacent, outside
UNKN phytolith 15	2	26	7.7%	CURR	__	architect fill, matrix between	interior mound str, outside
UNKN phytolith 16	2	26	7.7%	CURR, PESC	obsidian blade fragment	matrix between	outside
UNKN phytolith 17	1	26	3.8%	CURR	__	matrix between	outside
UNKN phytolith 18	1	26	3.8%	CURR	__	architect fill	interior mound str
UNKN wood spp.	100	126	79.4%	ALL	ALL	ALL	ALL

Broad interpretations of ubiquities

In **Figures 9.2, 9.3, and 9.4**, I present the maximum possible ubiquities of taxa. I have arbitrarily divided these into three charts, by ubiquity value, as roughly one-third have a ubiquity of 0%-1%, one-third have a ubiquity of 1%-10%, and one-third have a ubiquity of 10%-80%. There are many Unknowns scattered throughout these three graphs, as either phytoliths or macroremains. Unfortunately, although I can note the ubiquities of these items, their identities and associated practices remain opaque for the time being.

In terms of taxa with ubiquities over 10%, overall, it is apparent that wood, whether represented as phytoliths or charred macroremains, comprises the most prevalent element across loci, times, artifacts, contexts, and spaces. This is likely the result of several factors. First, wooden implements and articles were commonly used for a wide variety of purposes, from the quotidian to the sacred. Importantly, however, in terms of fuel, wood was almost exclusively used in this region, and wood torches were also often used for lighting interiors. It should come as no surprise, then, that remains of charred wood are found scattered throughout sites and time periods, and found in a wide variety of milieus.

Species in the *Poaceae* family are other commonly identified taxa. This, as in the case of wood, is no surprise. Members of the grass family include maize (*Zea mays)*, and multiple grass species potentially used in thatching, bedding, tinder, and potentially for medicinal purposes. Moreover, many of these species may have become incorporated into the archaeological record as components (intentional or otherwise) of clays and sediments used as daub and flooring materials. This is not to presume that every instance of a grass species is due to contemplative action. Grasses grow wild everywhere throughout this region, and may have sprung up in nooks throughout the site. Grass seeds can also find their way naturally into the archaeological record, as travelers clinging to clothing and feet, or due to the activities of rodents. And all this is aside from the potential movement of grass remains due to wind and water. Ubiquities of specific *Poaceae* family species (even where identified only to the family level) are combined with identified subfamilies *(Bambusoideae, Panicoideae, Chloridoideae, Pooideae,* and *Arundinoideae)* and identified species *(Setaria* sp., *Zea mays*, cf. *Panicum* sp., *Dactyloctenium* sp., and *Eleusine* sp.), leading to an overall high ubiquity for this family (42.1%).

Various palm *(Arecaceae)* species also demonstrated high ubiquity across samples. As previously discussed, the durability of the microremains and macroremains of palm species make them highly likely to remain visible once incorporated into the archaeological record. Moreover, the popularity of various palm species as snacks and ingredients, and as thatching, matting, and bedding, adds to these species being extremely likely to be recovered. This accounts for the high possible maximum ubiquity of *Acrocomia*, *Butia capitata*, and *Attalea cohune*, which are in turn contributors to the broader *Arecaceae* family ubiquity, along with unidentified *Arecaceae* macroremains and phytoliths.

The *Marantaceae* family incorporates the edible *Calathea* and *Maranta*, two genera with underground storage tissues sometimes used as foodstuffs. Some plants in this family are also grown for ornamental purposes. It is therefore not surprising that this family is ubiquitous across the loci.

Sunflower family (*Asteraceae)* species were recovered both as microremains and macroremains. Similar to grass species, these may have been used for medicinal purposes, and in some cases as foodstuffs, but overall, as with grasses, grow wild quite easily in various places and have the tendency to spread quickly throughout areas, growing without the intervention of people.

The *Chrysobalanaceae* family incorporates the genus *Hirtella*, which was fairly ubiquitous (of its own accord). Species of this genus are used in tanning leather, for bee-keeping (nectar), and as snacks (edible fruit). The relatively high ubiquity of the bristle fern genus (*Trichomanes),* however, is something of a surprise. I can find no reported uses for species in this genus anywhere in the literature of Southeastern Mesoamerica. Phytoliths from this genus, as with some of the grasses, may have become incorporated through the clay and sediment materials used in construction, and might index the ecology surrounding sources of earthen products.

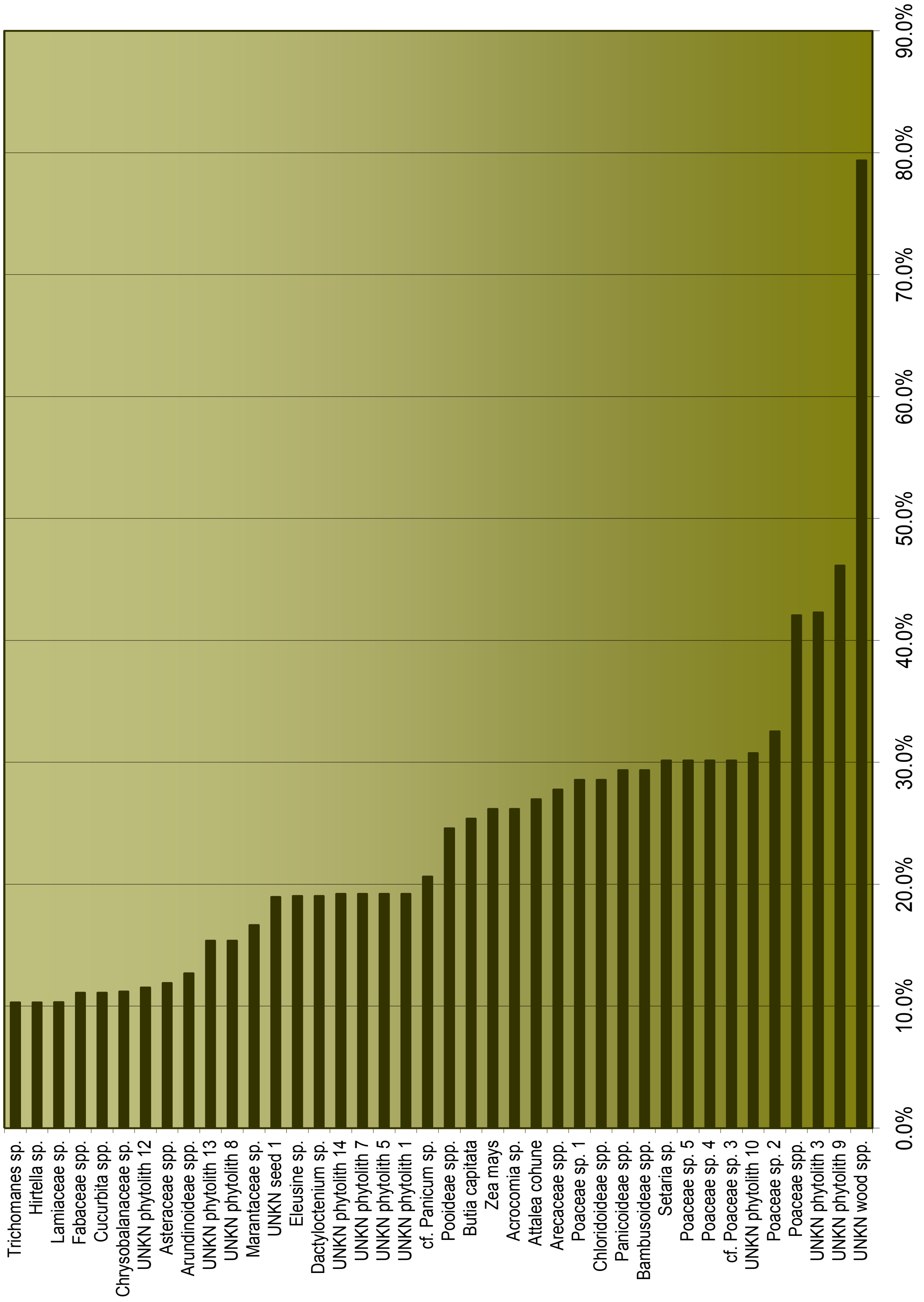


Figure 9.2. Maximum possible ubiquity of each taxon where ubiquity equals 10-80%.

Finally, there are three taxa that closely fit ethnographic and archaeological expectations of recoverable food species. *Cucurbita* (squash) species are highly anticipated in foodways paradigms of Southeastern Mesoamerica. The primary economic use of species in this genus is the consumption of the edible flesh and seeds of the squash fruits. Several species of squashes were recovered, primarily as phytolith remains. *Fabaceae* (bean family) species are used in a variety of ways, beyond simple consumption of the common bean (*Phaseolus*), which, incidentally, has very low ubiquity. Various *Fabaceae* tree, shrub, and herbaceous species are used in every way imaginable, from construction to food to medicine. *Lamiaceae* (mint family) species are also unsurprisingly ubiquitous. Herbs in this family are commonly used as condiments, medicines, and scents.

In terms of species with ubiquities of less than 10%, there are similar expectations met and similar surprises revealed, as well as a continued abundance of Unknown macro- and microremains. In terms of expected taxa, at roughly the expected ubiquity, we have common fruit species, such as custard apple *(Annona/Annonaceae)*, cactus *(Mammillaria/Cactaceae)*, nance *(Byrsonima)*, and hackberry *(Celtis).* We also find common herb and condiment species, such as chia *(Salvia)*, taxa in the epazote/goosefoot family *(Chenopodiaceae)*, and the mint family's *Artemisia*. We also find evidence for amaranth grain *(Amaranthus)*, though not at a high frequency that would infer staple-levels. There is the expected tobacco *(Nicotiana)* and a variety of squashes *(Cucurbita maxima, moschata,* and *andreana)*. All of these are species normally not identified (individually, in the case of the squashes) as staples for this area, but would be expected to be commonly occurring as supplements to the diet or in other regular activities.

Less expected were the ubiquities of the *Heliconia*, *Scirpus/Cyperaceae* and *Magnoliaceae* species, although these plants frequently occur naturally in local ecologies. *Heliconia* species have been used medicinally and ornamentally, although the relatively high ubiquity at these Honduran sites is somewhat curious. Species of rushes (*Scirpus)* are sometimes used in bedding or matting, and some medicinal uses have been reported. I have not found descriptions of uses of *Magonliaceae* species in this area, although they are currently used as ornamental and shade trees in the U.S. The unexpected appearance of *Calathea* was of particular interest, as this is a genus more commonly recovered further south, in Panama and Ecuador, where it is found on occasion as the root crop *lirén* (Piperno 2009; Ezell 2006).

Very unexpected was the relatively high ubiquity of the genera *Potentilla, Lozanella*, and false pennyroyal *(Hedeoma).* These species may have been used for medicinal purposes, as are reported in other regions of the world, but do not have specific recorded economic aspects in Southeastern Mesoamerica. Also unexpected were the relatively high recovery rates of rose family *(Roseaceae)* species. These species are not commonly recorded in the literature of this area, whether as culturally-used or naturally-occurring.

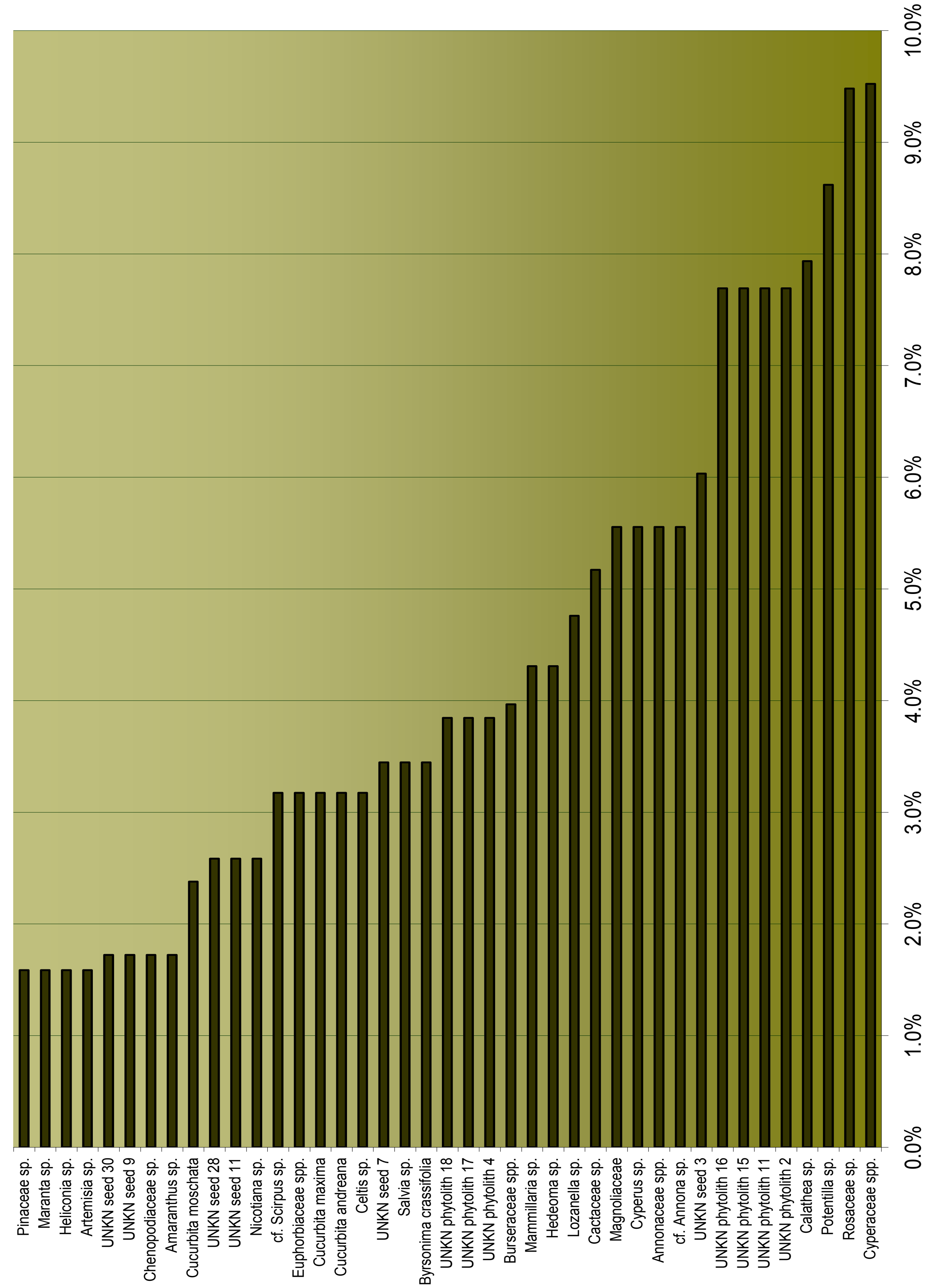


Figure 9.3. Maximum possible ubiquity of each taxon where ubiquity equals 1%-10%.

A large number of herbaceous taxa had, expectedly, very low recovery rates, including those of *Apiaceae, Boraginaceae, Crotalaria, Galphimia glauca, Lepidium, Oenothera, Oxalis, Parmentiera, Sisyrinchium, Smilacaceae, Verbena, Veronica, Carex, Hedyosmum,* and *Myrsinaceae*. Perhaps, like the lone indigo plant *(Indigofera)* recovered, some of these were used for dyeing purposes. Some may have had edible fruits or seeds that were occasionally consumed (*Boraginaceae, Parmentiera).* Like many other herbaceous plants, some of them likely had medicinal or condiment uses as is recorded for these taxa elsewhere (*Boraginaceae, Lepidium, Oxalis, Smilacaceae, Verbena)*. Some may have been used as ornamentals or home garden privacy screens *(Galphimia, Myrsinaceae, Oenothera)*. Some may have had a role in thatching or matting *(Carex, Myrsinaceae).* Many, however, were probably opportunistic plants growing in disturbed areas.

In terms of taxa with lower-than-expected recovery rates, these included species in the *Burseraceae*, *Euphorbiaceae*, and pine *(Pinaceae)* families, as well as the root crops manioc *(Manihot),* arrowroot *(Maranta)* and achira *(Canna)*, and avocado *(Persea).* These species have all been recovered archaeobotanically at higher rates in other regions, or are more regularly noted in ethnographic and ethnohistoric accounts. Copal *(Protium)* was recovered only once, which is not entirely surprising considering its primary use as an odiferous resin. The common bean *(Phaseolus)* was also recovered only once. Considering its designation as one of the "trinity" of staple species (including squash and maize), and the fact that it has diagnostic starch grains, phytoliths, and macroremains, the fact of its low recovery is curious. Papaya *(Carica papaya)* was also recovered only once, although this is a commonly seen item in traditional Southeastern Mesoamerica foodways.

The trumpet tree *(Cecropia peltata)* though not commonly employed, is frequently found in this area, and has medicinal uses. *Lagenaria*, the bottle gourd, was recovered only once, and considering the complete absence of calabash *(Crescentia cujete)* remains, this begs the question of what sort of containers were being used at these four sites. Although basketry, ceramics, and wooden vessels are obvious alternate choices, the high frequency of rinds used as containers, in modern times and at archaeological sites, makes the absence of these taxa significant in this area.

Common genera found today in the region that were completely missing included those of agaves *(Agava),* chile peppers *(Capsicum),* cacao (*Theobroma)*, hogplum *(Spondius)*, annatto *(Bixa),* piñuela *(Bromelia)*, nopal cacti *(Opuntia)*, cotton *(Gossypium)*, guava *(Psidium)*, guaya *(Talisia)*, sapote *(*various *Sapotaceae* genera) and wild grape *(Vitis)*. Cacao has been recovered through chemical means from ceramic vessels at Puerto Escondido and historic documents record this as a species grown intensively in the area (Henderson and Joyce 2006; Joyce and Henderson 2010; McNeil 2006), so the lack of macroremains is somewhat surprising. Additional species that would have been incredibly difficult to recover are those of the chaya *(Cnidoscolus)* genus, as it has no diagnostic microremains, is usually propagated vegetatively, and its economically-valuable parts (the leaves) are harvested before the plant goes to seed.

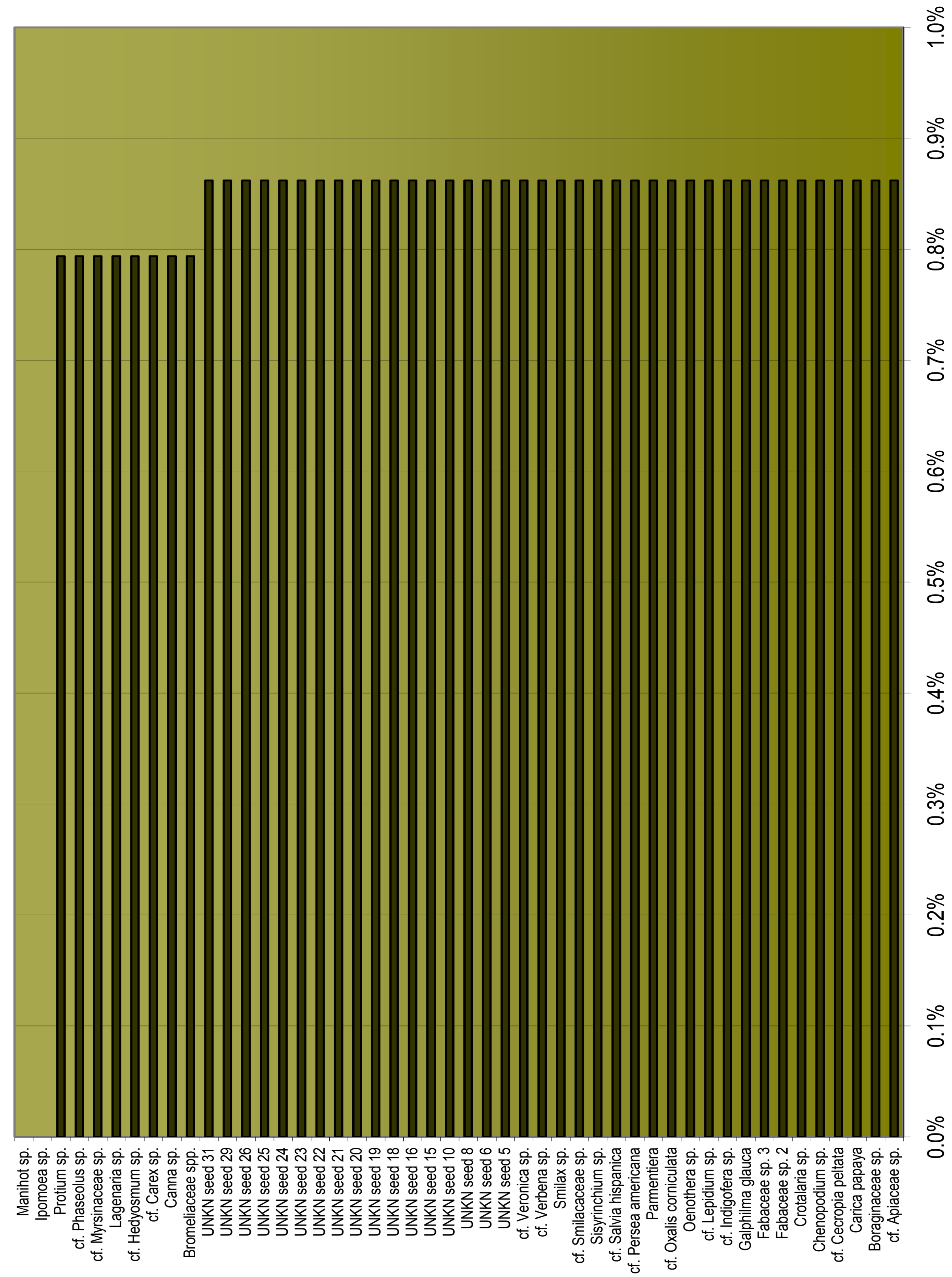


Figure 9.4. Maximum possible ubiquity of each taxon where ubiquity equals <1%.

Spectra of practices

In the course of the interpretive process, Gary Martin (1995) notes that ethnobotanists necessarily utilize etic views (that of the archaeologist "outsider") or rely on analogy for the emic (the subjects' "insider's view"). Ethnographic and ethnohistoric analogs are often central to interpretation of paleoethnobotanical data; indeed, often these are the only way in which such data are interpreted. However, some authors have indicated the utility of judicious use of ethnographic models in identifying plant-related practices (Hastorf, 1988; Jones 1984, 1989). For this reason, there are other examples of paleoethnobotanists linking practices to paleoethnobotanical remains. In one case, Glynis Jones (1987) makes use of statistical applications to discern even different stages of crop processing, using their products as proxy.

As we've seen, a wide variety of plants are represented across these four Honduran sites, representing an even wider variety of uses and associated practices. In thinking through plant practices, the sometimes sparse botanical samples develop interesting implications. By focusing on activities, essentially I can make more interpretations. Instead of dividing according to taxonomy, I can divide, overlap, and intersect, based on the idea of practice. I can have sets of plants associated with "tending", and sets of plants associated with "medicinal uses". Moreover, these categories are not mutually exclusive, and include a fair amount of overlap, which allows me more analytical leeway instead of awkward "lumping". Even splitting practices into those associated with consumption and those associated with production can have interesting implications. In this scenario, cultivated plants are not necessarily consumed plants (tobacco, for example); and wild plants are not necessarily economically less valued (palms used in thatching, for example).

It is difficult, however, to thrust different plant taxa into specific categories, even when they are not mutually-exclusive. Are botanical remains domesticates, cultigens, wild, or something in between? Seasonally cultivated or harvested? Restricted to certain regions? In terms of broad practices, the various taxa recovered index aspects of production, procurement, processing, preservation, consumption, cleaning, and scheduling. Some of these practices can be implied from the biological properties of the plant (e.g. maize is a human-reliant domesticate) while others, from the models set up by the ethnographic and archaeological records (e.g. the use of tobacco as medicine). I focus more on these practices in subsequent chapters, where I relate them to contexts, spaces, and artifacts.

Exchange is one area of practice where a few plants might be highlighted. Exchanging plant goods has been commonplace throughout human history, whether as foodstuffs, medicine, implements, or for other purposes. Beyond being used strictly as items of trade, however, plant foodstuffs can be used to clinch an agreement into which they do not factor as actual trade goods. Plant foodstuffs may be used in feasting, given as gifts, and exchanged for goods or services. In terms of such modes of exchange, I must note that that at the moment, there is no evidence of distant trade as indicated solely by "foreign" plant species. However, the recovery of cacao, a trade item frequently noted in ethnohistoric documents, through chemical residues, supports the paradigm of cacao production and exchange in this region (Joyce 2010). Overall, given the ethnohistoric data, various plant goods were likely to have circulated along with other materials. Local barter, within a single community, was also likely commonplace, with neighbors swapping fruits from their trees for those of their neighbors (following Hanks 1990).

In terms of ingredients that may link residents to certain ideals or identities, there is one plant in particular that I should draw attention to. The potential *lirén (Calathea)* tuberous root, much more common to the south of the Ulúa Valley, is something neither commonly used nor commonly recorded in the Maya area. This fact, dovetailing with other studies related to ceramics and stone tools, carves out these Northwestern Honduras sites from those defined as the Maya area. Not to read too much into a few small instances, peoples of this region may have partially defined themselves through such foods. This may be an example of communities setting themselves as distinct from their neighbors in multiple aspects from tools to food, thus defining themselves vis-à-vis the "other" as has happened with groups from historic Papua New Guinea to ancient Europe (Sutton 2001:5, Kahn 1986; Janik 2003, Hesse 1990; Fischler 1988). Or, this may rather be a foodstuff meant to connect people to their heritage, through the practice of cooking recipes of grandparents who came from distant regions (similarly to Sutton 2001). Perhaps it is a simple matter of taste-- a foodstuff that at one point was prized for certain flavors it possessed (Fischler 1988). Or, perhaps this was a food occasionally utilized as a substitute for something else, when the ideal ingredient was not available (Adolph 2009).

Whatever the practices that allow certain taxa to be revealed through paleoethnobotanical analysis, it is evident that multiple practices overlap within a single taxon. When narrowing ethnobotanical practices to those associated with foodways, the picture is still quite complex. People engage in a wide variety of practices when participating in specific foodways activities, beyond simple preparations and consumptions of food. Based on several years of working in a commercial kitchen, in addition to many more years of cooking in domestic contexts, I can attest to the long list of concomitant activities that take place, from gossip to power plays to flirtations. As anyone can witness, on a daily basis, social practices inform and mediate foodways in every aspect, in the same way that foodways inform and mediate other lifeways in every aspect.

Summary

What can ubiquities tell us? How much of the past do they inform us about, and how much of our interpretation is a reflection of taphonomic bias in the archaeological record? Although, overall, the recovery rates for macroremains were less than impressive, a data set emerged that would have been unrecoverable by any other means. The microbotanical data, though fairly robust, did not reveal certain species recoverable through macroremains, but did enable the recovery of other taxa not found through macroremains. The strengths and weaknesses of each kind of data were discussed in the previous chapter. However, I would like to highlight the fact that both data sets failed to reveal certain anticipated species.

Broadly, how do paradigms of past plant practices compare to the paleoethnobotanical data? In drawing comparisons between paradigmatic models and actual taxa recovered from bulk flotation samples, there are curious results and striking absences. First, there is the set of taxa anticipated by the model, as drawn from ethnographic and ethnohistoric resources (as detailed in Chapter 4): squashes, tobacco, chia, maize, nance, palm fruits, beans, papaya, avocado, and several species of known economic families. There is the set of taxa *not* anticipated by the model: coyotillo, chipilin, pennyroyal, crowfoot, and other species that are traditionally identified as "weeds". And there is the set of taxa anticipated by the model, but *not* thus far recovered: cotton, chile, nopal, calabash, guava, sapote, and annatto, among others.

By reviewing the evidence in this way, we are able to compare these various taxa to the broad paradigms of expected plants. However, the combination of items recovered also reflects syntagmatic relations of foodways– the residues of daily residential practices. These practices include likely procurement from milpas (subsequent to a large set of crop-production practices), weeding and/or expedient use of plants as fuel, home gardening, the disposal of hearth materials near to residential structures, and the potential ritual or medicinal activity. These practical combinations of plants and foodstuffs are analogous to a set of continuous "speech acts", subject to ecological diversity and historically contextualized in the long durée of Ulúa Valley activities. Such "speech acts", though granting us insight into the daily lives of pre-Hispanic peoples, require further community-level comparisons and short-term plant use histories, in order to better socially and historically contextualize the two axes of foodways. For this reason, in the following chapters, I approach practical associations by looking at the data from the perspective of artifacts, spaces, contexts, and time periods, using the methodological tools of density analysis, diversity analysis, and relative presence analysis. I start, in the next section, with artifacts.

10. Artifacts and Plants, Paradigms and Syntagms

Further complicating the simple availability of plants and their integration into daily life is the set of practices surrounding the implements with which they interact-- the gardening tools and culinary equipment used by pre-Hispanic peoples. In previous chapters, I have addressed the recovery of various plant remains, and their broad distributions at the four Honduran sites. I have also set up the expectations and analogs used in considering various plants and their practices. In this chapter, I make use of the theoretical tools explored in the second and third chapters, to consider the syntagms and paradigms of ethnobotanical practice, in relation to artifacts.

In this section, I consider several broader questions. Are some taxa associated with particular types of artifacts (squash with cutting tools, maize with ceramic vessels)? Are some taxa more ubiquitous across some types of artifacts than others (maize found more than wood in serving vessels)? Are there changes in certain taxa over time in terms of ubiquity (decreases in wild foods; increases in maize)? Generally, what are the associations and disassociations between specific artifacts and ethnobotanical practices? In this comparison, I make use of taxa recovered from four kinds of obsidian artifacts, and ceramic vessels. I look at twenty-one artifacts in total: sherds from four ceramic vessels, one obsidian biface tool, two obsidian flake fragments, four obsidian retouched flakes, and fragments of ten obsidian blades **(Table 10.1)**. These vessels and implements were recovered from three of the four sites in my study, the exception being Currusté, where I did not have access to artifacts.

Artifact category	**Number of samples**
Obsidian biface tool	1
Obsidian flake fragments	2
Obsidian retouched flakes	4
Obsidian blade fragments	10
Ceramic vessel sherds	4

Table 10.1. Artifact categories and number of analyzed samples associated with each.

Here, I make use of three types of analysis: ubiquity (the number times particular taxa are present/absent across artifacts), taxa richness (the number of taxa represented per artifact), and relative abundance (the percentages of taxa relative to each other on each artifact). I do not employ any type of density analysis (the quantity of all materials per artifact). This is due to the difficulty in standardizing or quantifying volumes at those sizes, where a tenth of a droplet can contain tens of phytoliths, and the difficulty in quantifying weights of phytoliths, as they cannot be completely separated from other material and removed from the mounting medium.

I begin by looking individually at each taxon recovered from artifacts, considering associated artifact types, and relative abundances. I then explore the relative abundances of taxa, as related to each individual artifact. Turning to broader artifact classes, I discuss the differences and similarities between artifact classes and then within artifact classes, comparing ceramic vessels to obsidian implements, and then comparing different types of obsidian implements with each other. In each case, I look at the diversity index and relative abundances of taxa associated with each artifact class or artifact type. Finally, I explore the associations between taxa recovered from artifacts, using ubiquity measures. Overall, I view the results of each of these analyses in terms of how they match and do not match previous expectations and analogies, and how they shed light on possible paradigmatic substitutions and syntagmatic associations of Southeastern Mesoamerican foodways.

What artifacts are associated with each particular taxon?

To follow each plant taxon across the five artifact types, I first record the artifacts associated with each taxon, by calculating the number of each type of artifact where microremains of each taxon were recovered (**Figure 10.1**). As previously mentioned, the data from this study was not included as part of the taxon's broad ubiquity. This is because the artifacts were recovered from secondary or tertiary contexts, and thus the ubiquities of taxa are not likely associated with the locations where the artifacts were found. Moreover, relative abundances (of artifact types to each taxon) are difficult to calculate, as the species found across artifacts correspond most frequently with artifacts that were more in number to begin with. In fact, the number of artifact types, per taxon, follows a regular distribution based on the uneven numbers of sampled artifact types. Below, I highlight the taxa richness of artifact types per taxon, and ubiquities of each taxon as related to various artifact types.

As with recovery across sediments and bulk flotation samples, palm family *(Arecaceae)* species were recovered across a wide variety of artifacts. This likely has to do with the preparation of palm fronds for a variety of uses, likely including, as previously mentioned, thatching, matting, bedding, and basketry, among others. Several practices which were likely commonplace-- cutting palm fronds and fitting them together into thatching panels, slicing palm leaves to an appropriate length for weaving together with other palm leaves— are potentially the reason behind the recovery of species in this family across multiple obsidian artifacts. Small palm frond ties are sometimes used to secure tamale wrappings, which may account for the presence of this family on the interior of a ceramic sherd, although in this case, contamination from surrounding sediment is also possible. Regardless, the regular recovery of palm microremains likely indexes the commonplace nature of palm species in daily life, across time periods and artifact types, from expedient tools to expensive (traded) blades.

Bromeliaceae phytoliths were recovered from three artifacts, all obsidian blade fragments. Species in this family are most often used for fiber and/or fruit. The very fibrous nature of *Bromeliaceae* plants may account for the need to use a long sharp blade, in place of a smaller flake or other tool. However, this reasoning for the low diversity of artifact types with *Bromeliaceae* remains very speculative. Ritual practice may also be implicated, as in more recent times Chapman (1985) has documented the construction of perishable altars decked with *Tillandsia*, a genus in *Bromeliaceae*.

Three subfamilies of grass species were recovered, from all artifact types. *Chloridoideae* grass species were recovered from two obsidian blades, and *Pooideae* species from one obsidian blade, while *Panicoideae* species were recovered twelve times, from all artifact types. The few instances of *Chloridoideae* and *Pooideae* recovery leave me hesitant to attribute a strong association between obsidian blades and these two grass subfamilies. However, the recovery of *Panicoideae* species across all artifact types is unsurprising, as it likely had a set of practices very similar to those attributed to the palm family. Moreover, grass phytoliths can also be indices of meat consumption. In the case of grass-consuming animals which are stewed and served, if the undigested bits in the intestines of the animal are still available (as noted in Reinhard and Danielson 2005), grass phytoliths (and others) are recoverable. Comparing these results with proteins would help to answer this question.

Marantaceae species were recovered twice, once on an obsidian blade and once from an obsidian retouched flake. As mentioned in previous chapters, this family is associated with multiple practices, from the culinary to the ornamental. For this reason, the presence of these taxa on two artifact types may reflect a more broad use of different artifacts, from the difficult-to-acquire to the expediently-crafted.

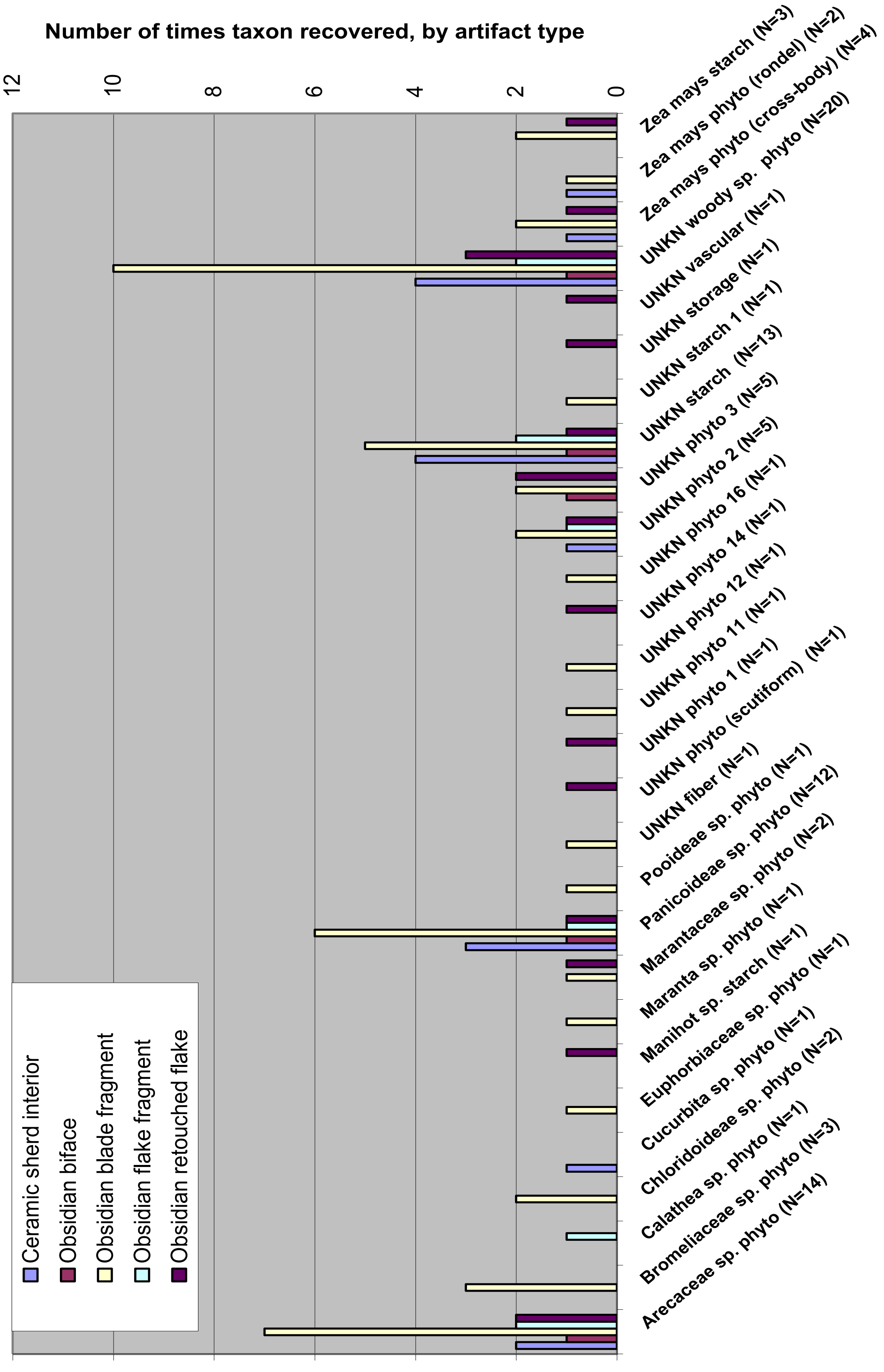


Figure 10.1: Artifact types where each taxon is recovered.

Unknown phytoliths 2 and 3 were each recovered five times, Unknown 2 from every artifact type except the obsidian biface, and Unknown 3 from the biface, the blade fragment, and the retouched flake. Although it is (clearly) unknown to which plants these phytoliths correspond, their relatively high ubiquity and multiple associated artifact types would indicate taxa fairly commonplace in daily life. Unknown, non-diagnostic starches were recovered 13 times. These starch grains likely index a variety of taxa, so I do not attempt categorical interpretations of them here.

Unknown woody species phytoliths were recovered 20 times, from every artifact type, but were not recovered from one of the blades at Los Naranjos—an interesting case that I address further on. Like the non-diagnostic starch grains, the non-diagnostic arboreal spheres likely index a variety of taxa. However, like the grass species, and as discussed in previous chapters, the ubiquity of wood across artifact types is unsurprising, given the enormous number of practices associated with woody taxa and its wide incorporation into daily life.

Maize was recovered nine times, as leaf phytoliths (cross-bodies), cob phytoliths (rondels), and starch grains. Maize starches were recovered from obsidian blades, and one of the retouched flakes. The leaf phytoliths were found as residues on the interior of a ceramic vessel sherd, as well as obsidian blade fragments and a retouched flake. The cob phytoliths were also recovered from a ceramic vessel and an obsidian blade, but not any flakes. Interestingly, this plant was not found in association with the obsidian biface or obsidian flake fragments. It is also interesting that maize starch was not recovered from any of the ceramic vessels, as other, non-diagnostic starch grains were recovered from these. It is possible, however, that some of these non-diagnostic grains correspond with maize.

The recovery of maize leaf phytoliths from blades and the retouched flake may be related to the slicing of husks to access the cob, or the slicing of leaves for unknown use, or the slicing of leaves in the course of clearing maize husks in a field or home garden. The recovery of maize leaf phytoliths from the ceramic sherd interior may have to do with the practice of wrapping tamale masa in maize husks and leaves. The presence of the cob phytoliths in the ceramic sherd may correspond with sections of corn-on-the-cob stewed with other ingredients, while the recovery of cob phytoliths from the blade may have to do with the stripping of fresh green corn for tamales or other dishes. Moreover, in contemporary times, maize leaves and cobs have been seen utilized to clean implements (Lucia Gudiel and Stephanie Simms, personal communication), which is a likely explanation for the remains of these materials in the past, as well. *Zea mays* starch grains, associated with the maize kernels, were recovered from blade fragments and a retouched flake. This may correspond with the slicing of fresh green maize, or perhaps tamales.

Taxa recovered only from a single artifact include *Calathea* sp., *Cucurbita* sp., *Euphorbiaceae* sp., *Manihot* sp., *Maranta* sp., *Pooideae* sp., an UNKN scutiform phytolith, UNKN phytoliths 1, 11, 12 , 14, and 16 , UNKN starch 1 , UNKN storage tissue, UNKN vascular tissue, and an UNKN fiber. The lirén *(Calathea)* was recovered from an obsidian flake fragment **(Figure 10.2)**, the squash *(Cucurbita)* from a ceramic vessel, the manioc *(Manihot)* from a retouched flake, and the arrowroot *(Maranta)* from an obsidian blade. It is curious that none of these key food species overlap in a single artifact. Moreover, with the exception of one obsidian blade, the evidence thus far does not indicate the exclusive use of certain tools for food species and certain tools for non-food species.

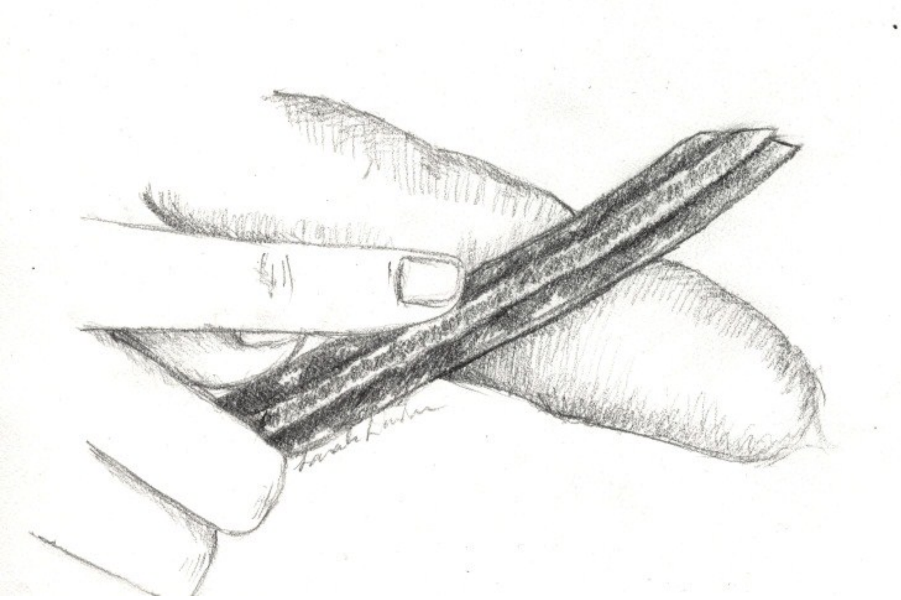


Figure 10.2. One posited use of an obsidian blade for slicing into the tuberous root of lirén. (Drawing by Sarah Davidson.)

In terms of ethnographic and historic expectations, it is perhaps unsurprising that maize starch was not more ubiquitous. Aside from the stripping of green corn from the cob, most ethnographic and ethnohistoric descriptions indicate that maize is normally dried on the cob before processing. Kernels are removed through applying physical pressure, oftentimes by using another maize cob. Unlike other plants which are often sliced fresh, the dried maize would be extremely difficult to cut, and would have been an inefficient (and likely ineffective) use of obsidian tools. The dearth of maize starch in ceramic vessels may have to do with the damage of starch in the course of cooking, rendering grains unrecognizable. Or, as previously mentioned, some non-diagnostic starch grains may actually correspond with maize.

It is somewhat surprising that squash (*Cucurbita* spp.) were not more ubiquitous, but this may have to do with practices that involve, for example, roasting whole squashes in the fire or in pits **(Figure 10.3)**, rather than cutting them in preparation beforehand. The few root crops represented do adequately reflect a propensity toward maize use, but these taxa may have oftentimes been roasted whole. Moreover, as with maize, non-diagnostic starch grains may sometimes correspond with these taxa.

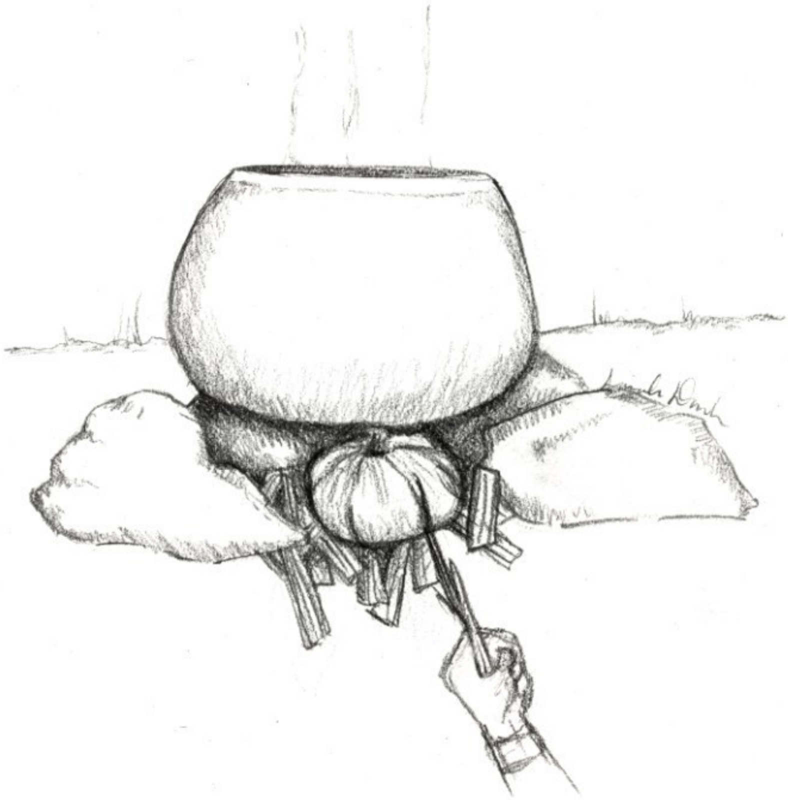


Figure 10.3. One posited method of roasting squash *(Cucurbita)*. (Drawing by Sarah Davidson.)

In terms of what expected taxa may have been completely absent, it is difficult to assess, considering how many anticipated species (such as amaranth) do not leave diagnostic microremains, or would not have had slicing or cutting of commonly-used anatomical parts. Many Unknown phytoliths likely correspond with less commonly used economic species for which we do not yet have adequate comparative data, and even, potentially, species that no longer exist. Moreover, the many Unknown starch grains are for the most part non-diagnostic, and thus may correspond with known economic species. There are a few noteworthy absences, however: chile peppers, yams, and sweet potatoes were not recovered from any tools, and yams and chile peppers were not recovered at all. Due to the aforementioned limitations and formation process issues, however, most expectations are still met.

What taxa are associated with particular artifacts?

In **Figures 10.4-10.24**, I present a series of figures that display the relative abundance of taxa on each artifact. There was no standard number of microremains recovered, as recovery rates were highly variable, depending on the size of the artifact sonicated and, of course, initial use patterns.

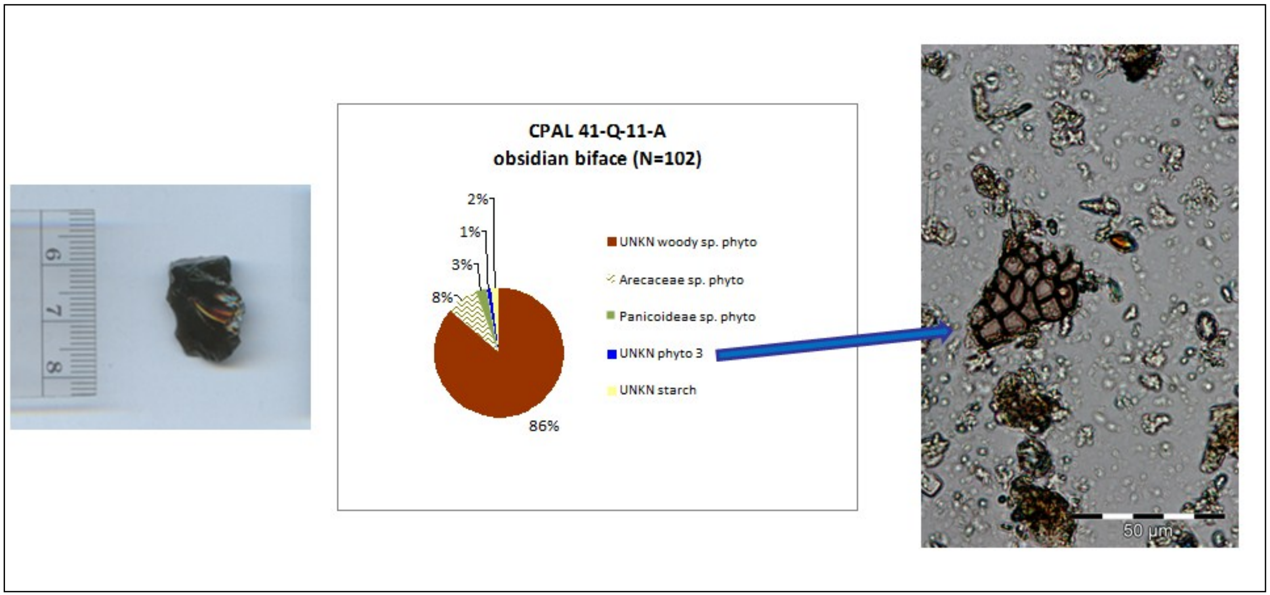


Figure 10.4. Obsidian bifacial implement, relative abundance of associated taxa, and Unknown phytolith 3.

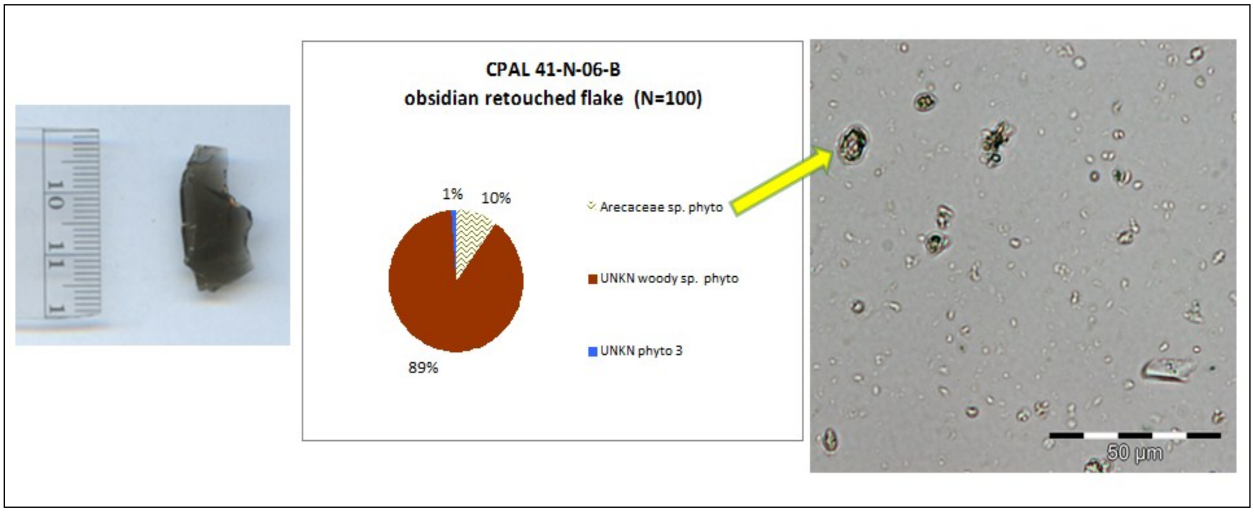


Figure 10.5. Obsidian retouched flake, relative abundance of associated taxa, and *Arecaceae* sp. phytolith.

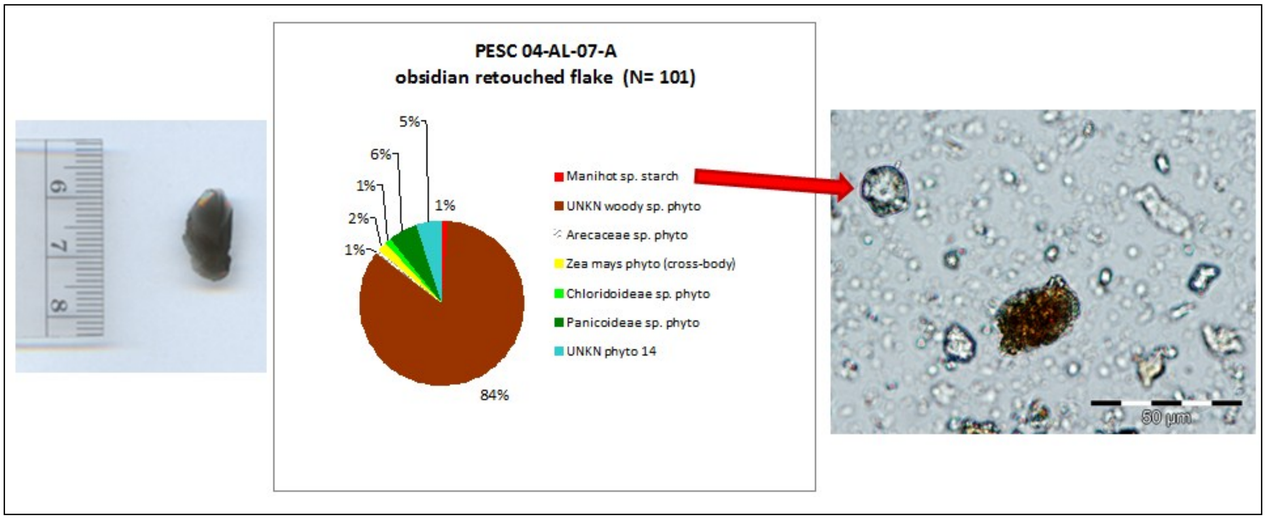


Figure 10.6. Obsidian retouched flake, relative abundance of associated taxa, and *Manihot* sp. starch grain.

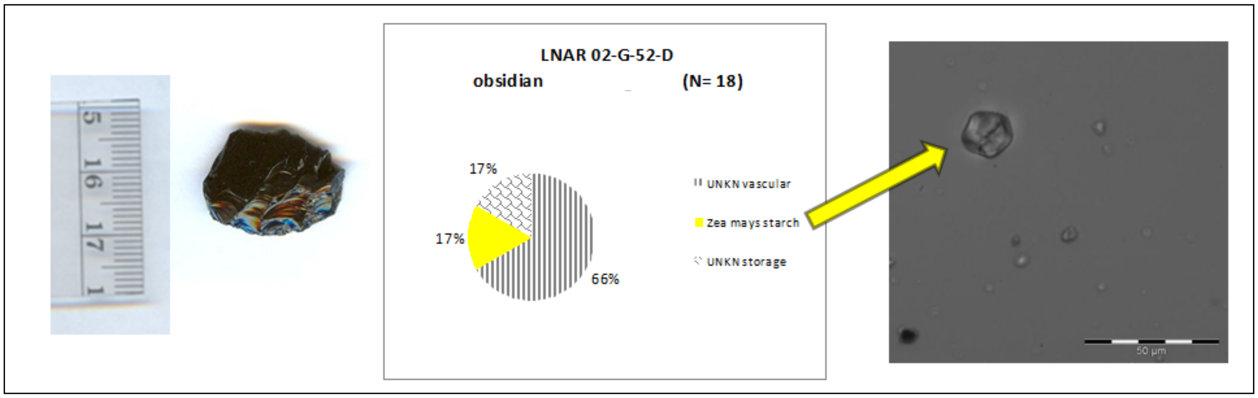


Figure 10.7. Obsidian retouched flake, relative abundance of associated taxa, and *Zea mays* starch grain.

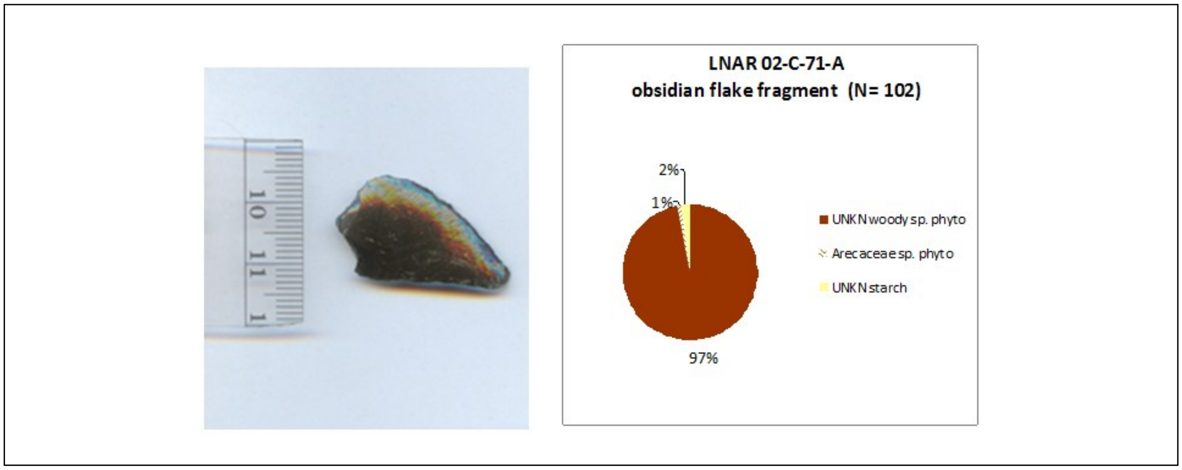


Figure 10.8. Obsidian flake fragment and relative abundance of associated taxa.

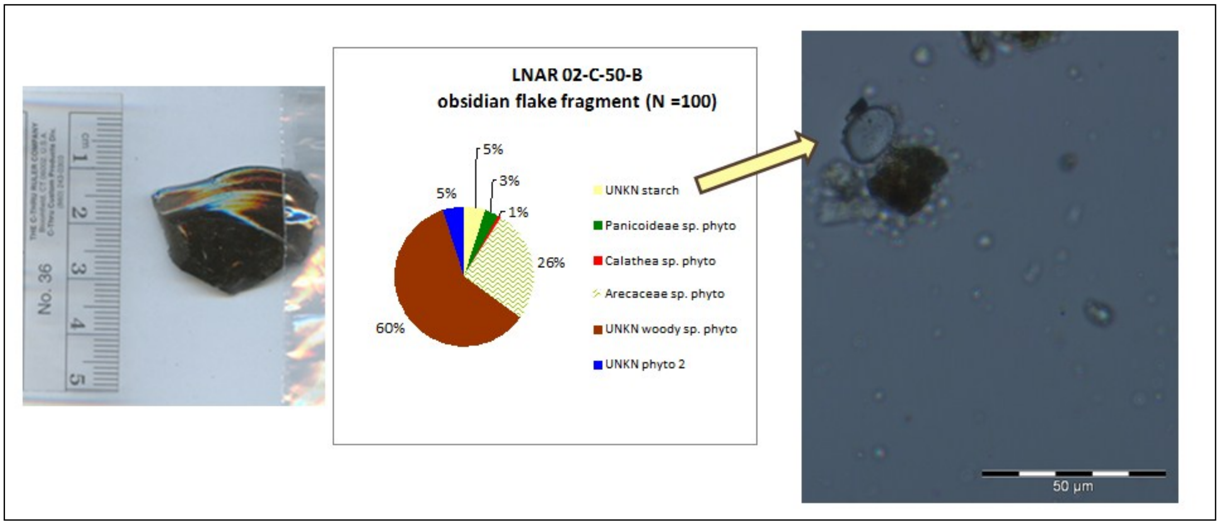


Figure 10.9. Obsidian flake fragment, relative abundance of associated taxa, and unknown starch grain.

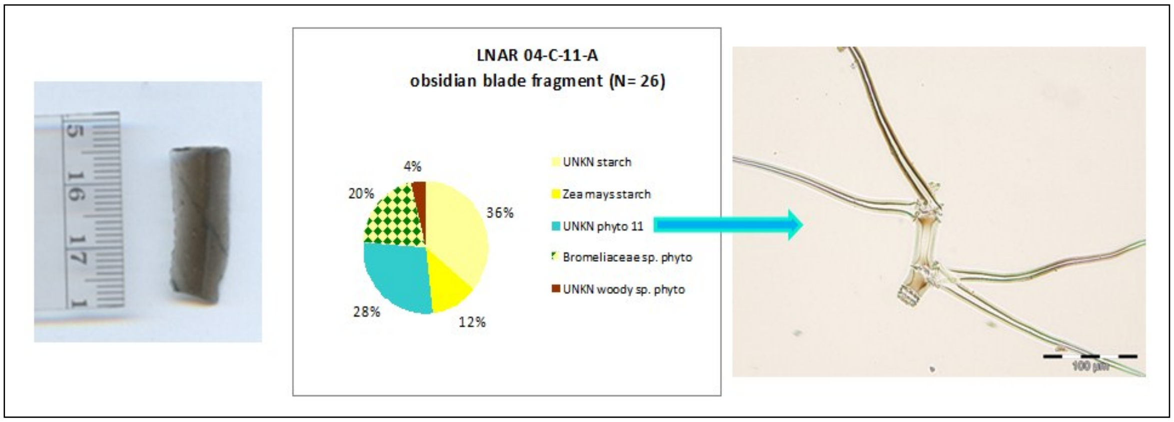


Figure 10.10. Obsidian blade fragment, relative abundance of associated taxa, and Unknown phytolith 11.

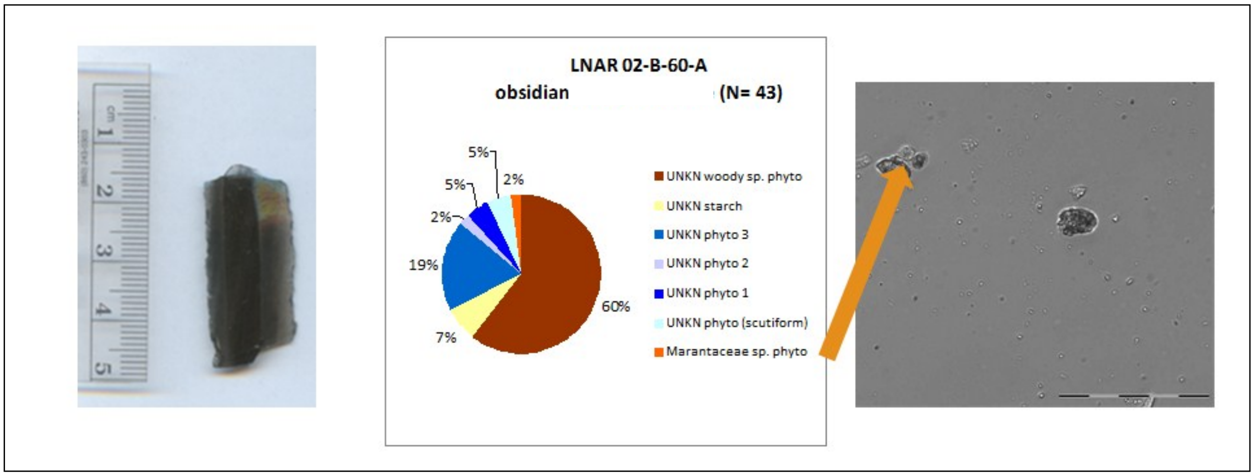


Figure 10.11. Obsidian blade fragment, relative abundance of associated taxa, and *Marantaceae* sp. phytolith.

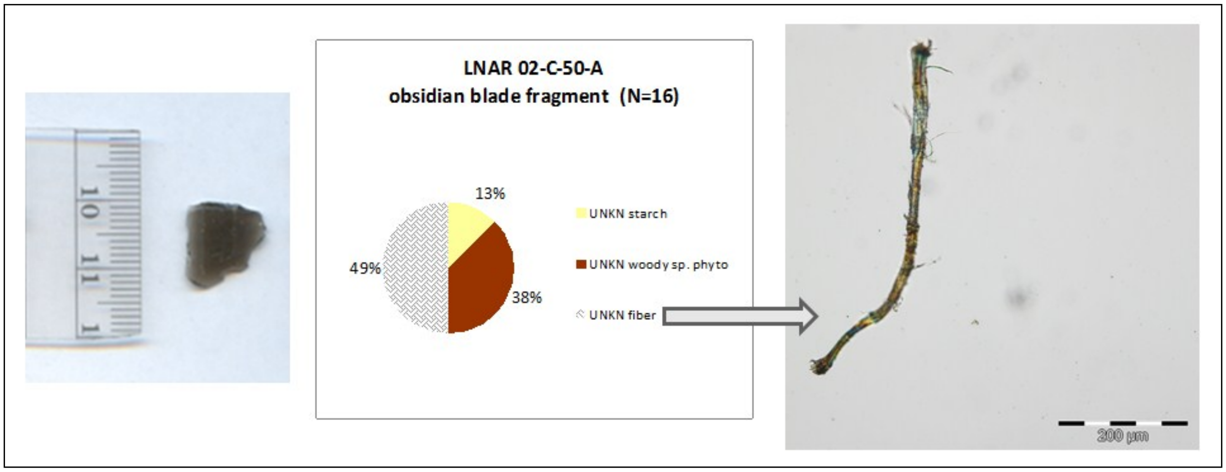


Figure 10.12. Obsidian blade fragment, relative abundance of associated taxa, and unknown fiber.

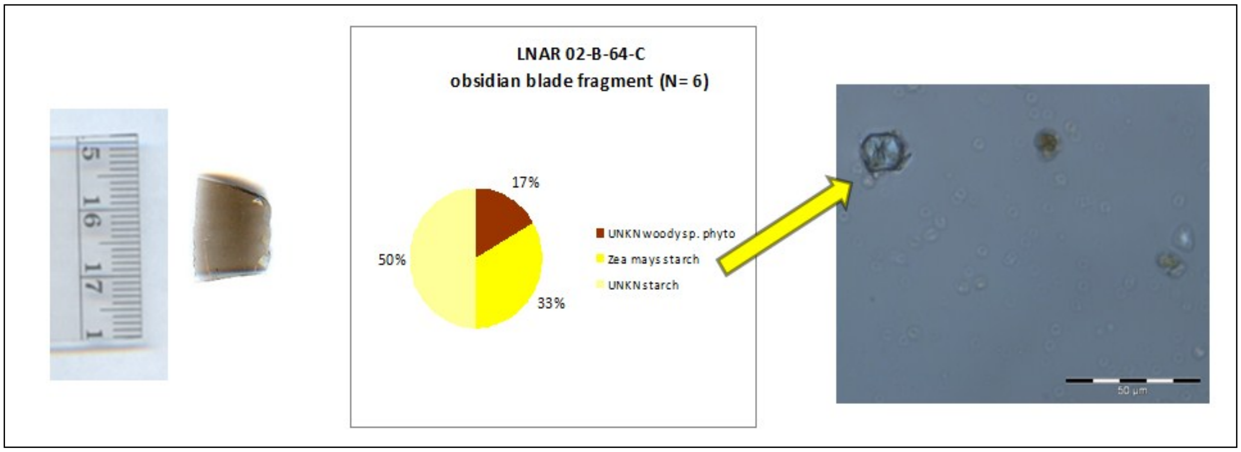


Figure 10.13. Obsidian blade fragment, relative abundance of associated taxa, and *Zea mays* starch grain.

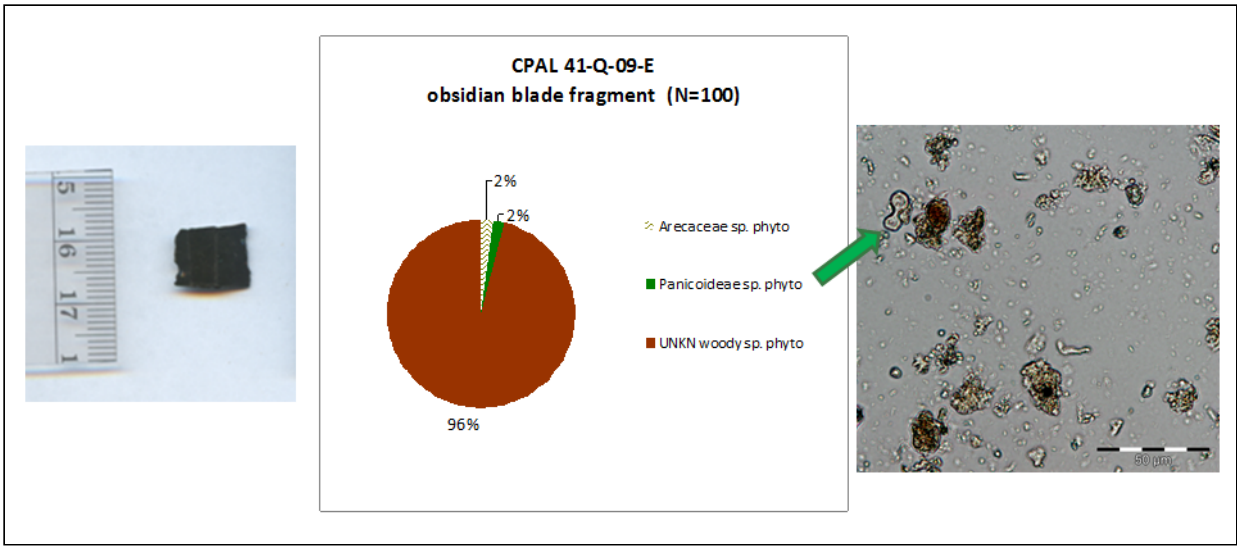


Figure 10.14. Obsidian blade fragment, relative abundance of associated taxa, and *Panicoideae* sp. phytolith.

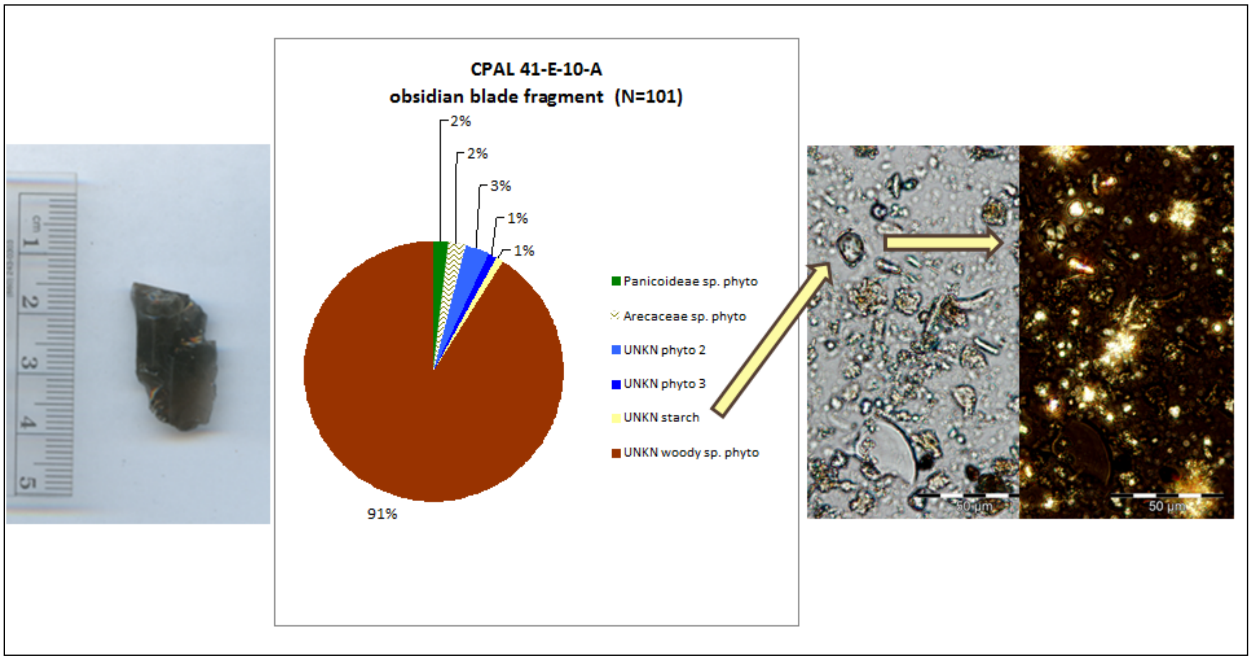


Figure 10.15. Obsidian blade fragment, relative abundance of associated taxa, and unknown starch grain under transmitted and polarized light.

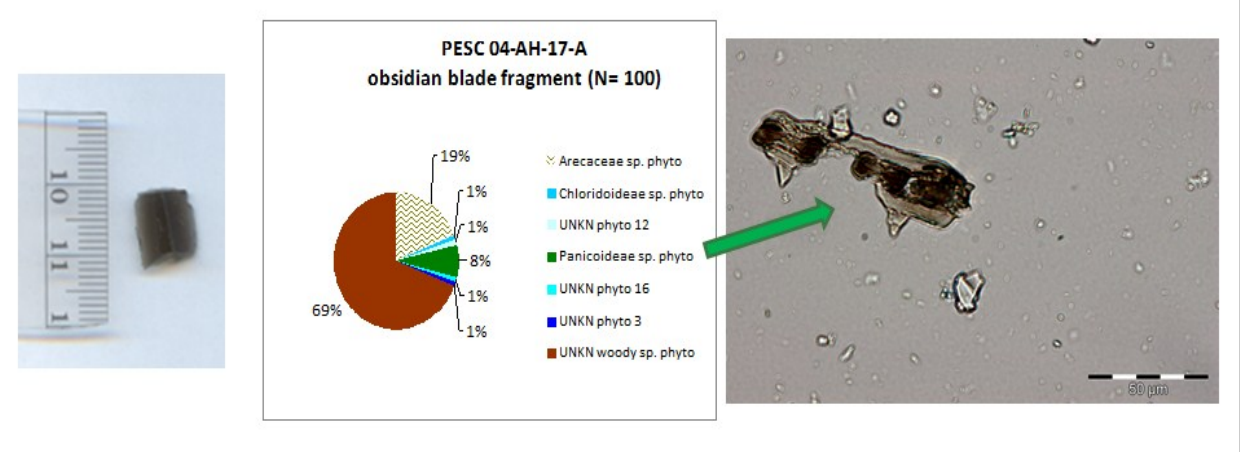


Figure 10.16. Obsidian blade fragment, relative abundance of associated taxa, and *Panicoideae* sp. phytoliths.

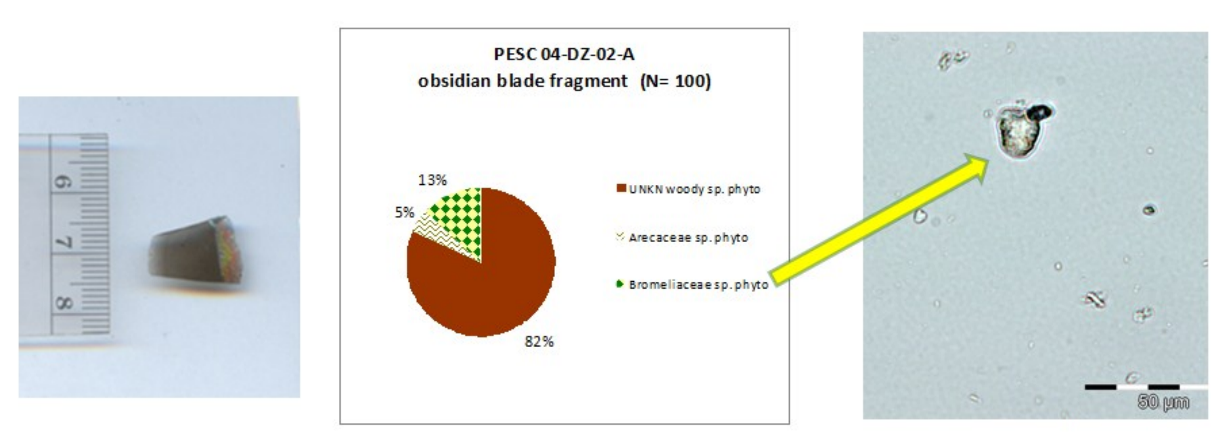


Figure 10.17. Obsidian blade fragment, relative abundance of associated taxa, and *Bromeliaceae* sp. phytolith.

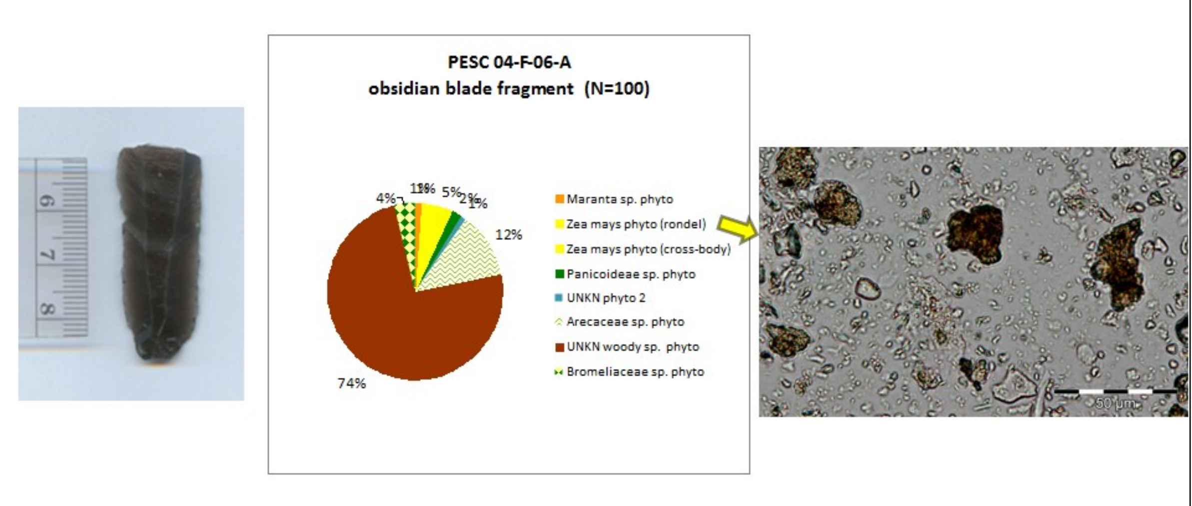


Figure 10.18. Obsidian blade fragment, relative abundance of associated taxa, and *Zea mays* cob phytolith.

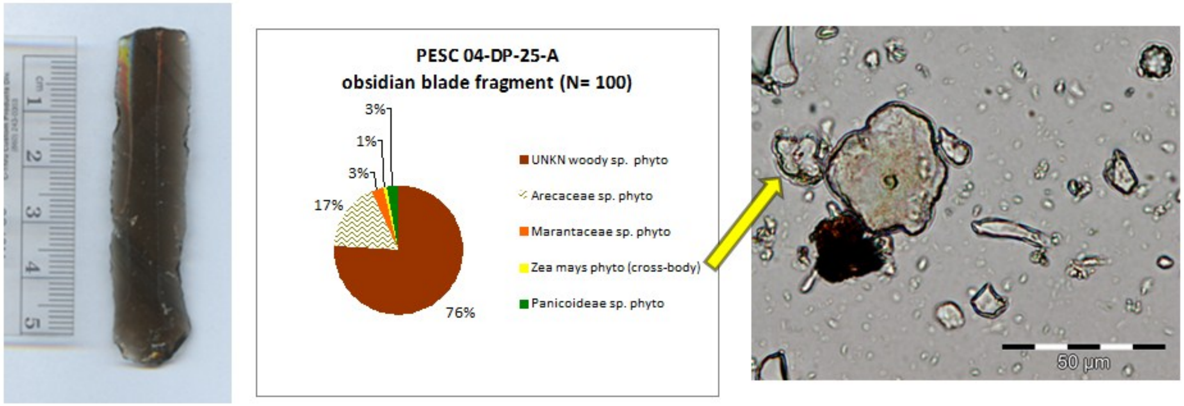


Figure 10.19. Obsidian blade fragment, relative abundance of associated taxa, and *Zea mays* leaf phytolith.

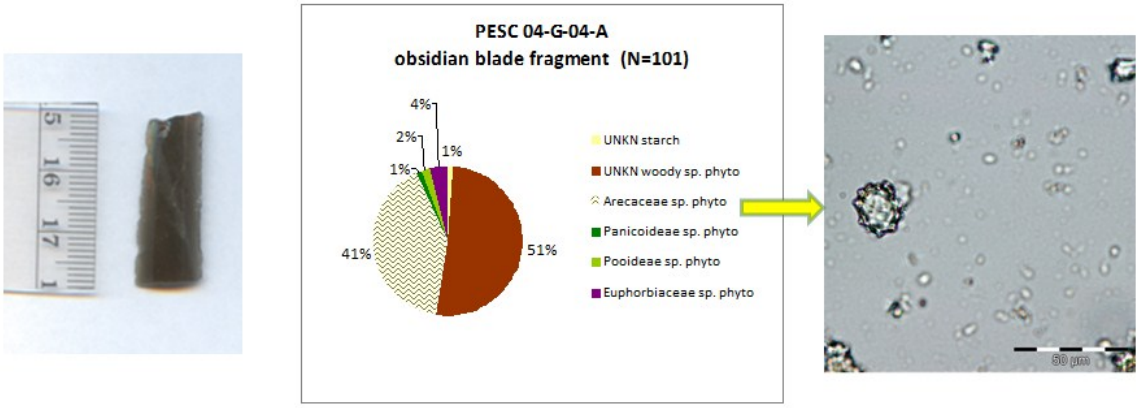


Figure 10.20. Obsidian blade fragment, relative abundance of associated taxa, and *Arecaceae* sp. phytolith.

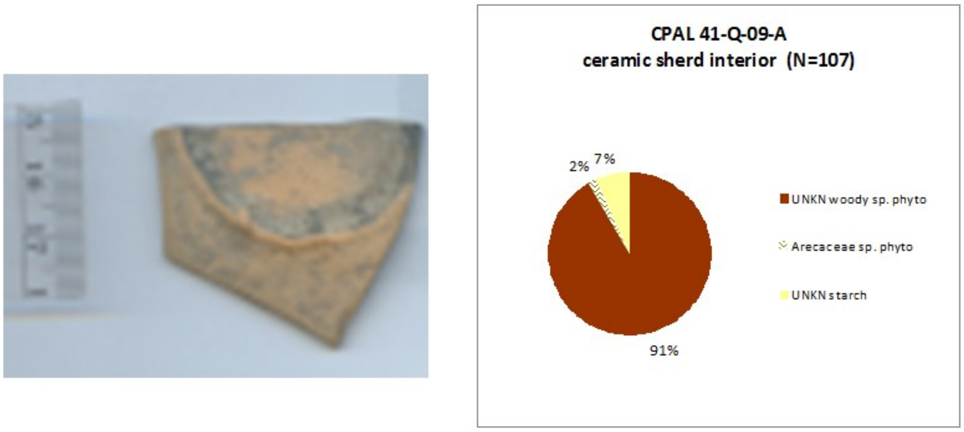


Figure 10.21. Ceramic basal sherd and relative abundance of associated taxa.

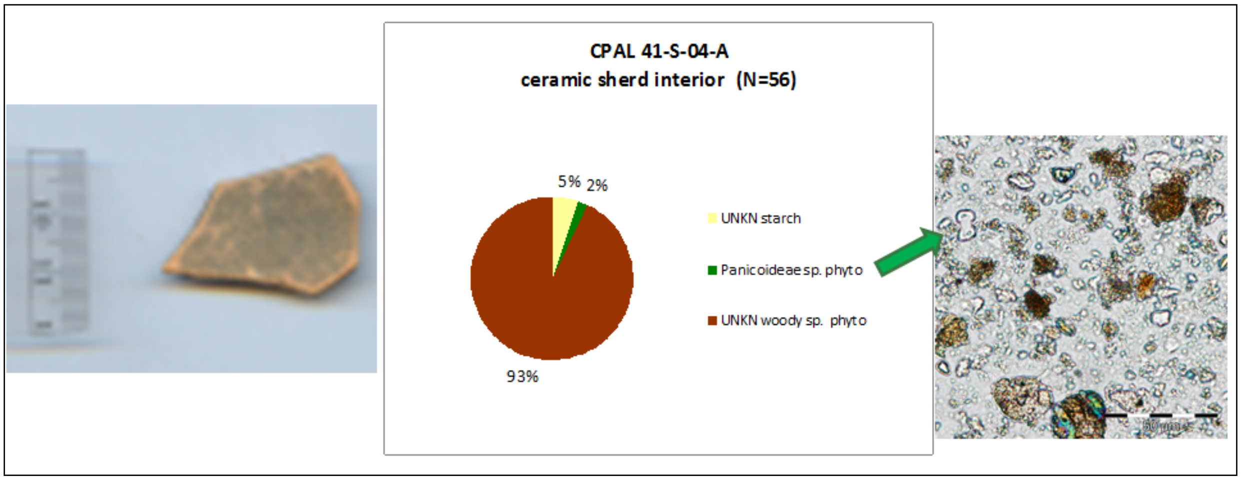


Figure 10.22. Ceramic body sherd, relative abundance of associated taxa, and *Panicoideae* sp. phytolith.

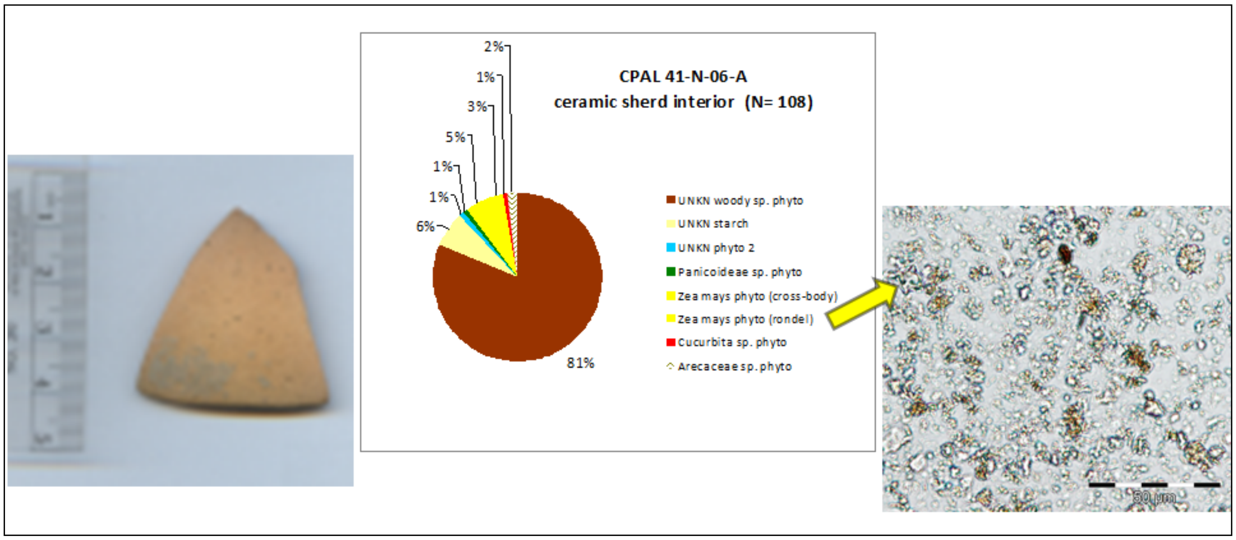


Figure 10.23. Ceramic body sherd, relative abundance of associated taxa, and *Zea mays* cob phytolith.

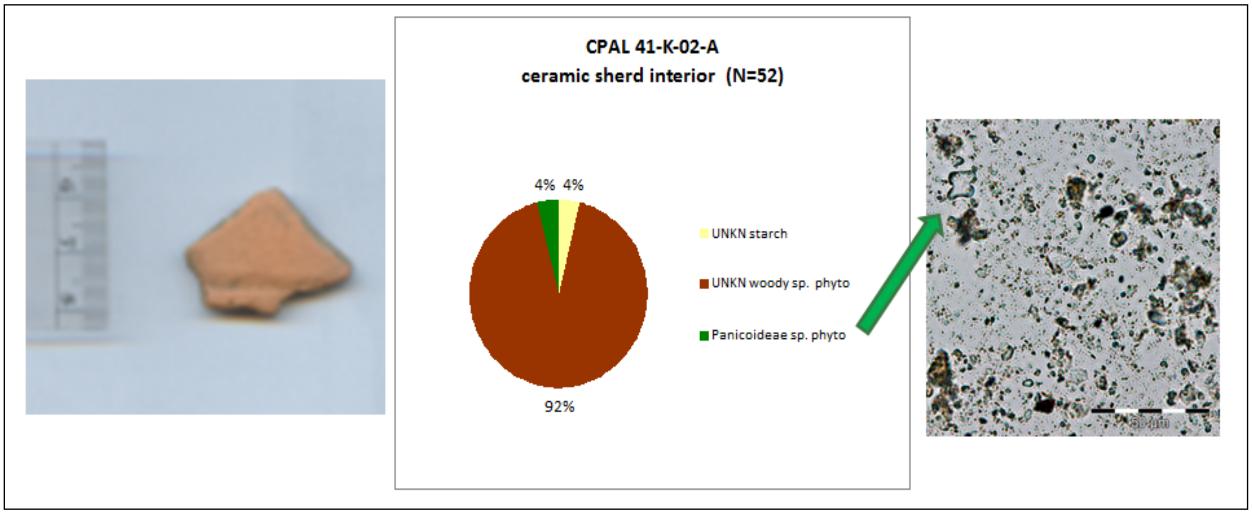


Figure 10.24. Ceramic sherd, relative abundance of associated taxa, and *Panicoideae* sp. phytolith.

I summarize the results by artifact class further on, and further discuss aspects of these findings when investigating transformation and continuity over time in Chapter 13. However, I will note that, overall, species richness was generally either low (three) or high (seven) in terms of discrete identifiable taxa per artifact, with the average being roughly five taxa per artifact. Only three artifacts matched the average—the obsidian biface tool, and two of the blades. Although, overall, implement and vessel use seems bimodal, when considering the many potential species associated with the Unknown woody species and Unknown starch grains, the actual taxa diversity index for each artifact is likely much higher.

What differences and similarities exist between broad artifact classes?

In terms of differentiation and affiliation based on artifact class (obsidian tool vs. ceramic vessel), thus far, the evidence at these four Honduran sites suggests multiple uses for all tools and vessels (similar to Perry 2001:262). However, there are some differences between artifact classes in terms of the suites of taxa represented by each, and their relative frequencies.

In terms of ceramic vessels, it is often presumed that the surface slip or paints helps to index the whole vessel form, which in turn indexes vessel. Julia Hendon, in her study of form classes and general surface treatment classes (1987, 1991) demonstrated a correlation between function and distribution at the site of Copán. The four sherds of this study come from Cerro Palenque, and are from red-slipped bowls or dishes. Bowls like these are understood to be used in warming and serving food, based both on form and surface treatment, and on distributions described for Cerro Palenque (Joyce 1991) and Copán (Hendon 1987, 1991).

At least eight different taxa were recovered from ceramic sherds, with an average richness of approximately four taxa per ceramic vessel. Unknown starches were recovered from all of the vessels, as well as unknown arboreal phytoliths. Unfortunately, there was very little remaining slip on the interior of each of the ceramic sherds that I studied, which makes it possible that contamination of the sonicated sample occurred through the dissolution of the clays from the vessel itself. However, I can note that only damaged starch grains were recovered from ceramic samples, likely indicating that only cooked foods were being served in these vessels, versus preparation of uncooked starchy foods. Starch grains would not have survived the high temperatures of the ceramic firing process, so it is unlikely that the clays, in the case of starches, are the source of the microremains. It was also from the ceramic sherds that the lone squash *(Cucurbita)* phytolith was recovered. As phytoliths survive even extremely high temperatures, this could have been from either a cooked or an uncooked bit of squash.

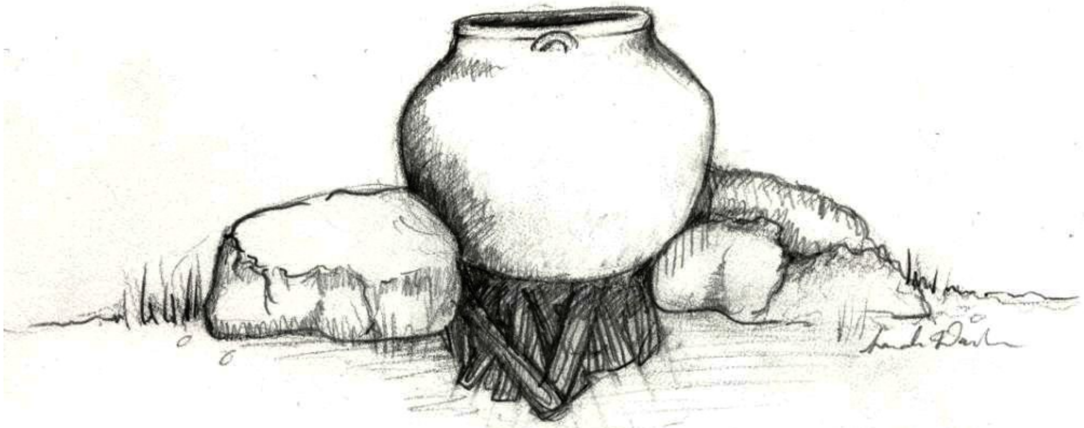


Figure 10.25. Posited cooking of atole or stew in a ceramic vessel. (Illustration by Sarah Davidson.)

The obsidian artifacts, like the ceramics, appear to have been multi-use. At least twenty-six different taxa were recovered from obsidian artifacts, with an average diversity of approximately 4.8 taxa per implement. Every taxon recovered at the four sites, with the exception of squash *(Cucurbita),* was recovered from the obsidian implements. It appears as though, almost across the board, obsidian artifacts were used for cutting and slicing woody, fiberous things, including grasses, bromeliads, palm leaves, and wood.

In considering several aspects of obsidian artifacts, fortunately we have a set of analogs from the site of Joya de Cerén. Unfortunately for my comparison, the analyses carried out on these obsidian tools were primarily of usewear and animal proteins. What was clear from these studies, however, was that none of the obsidian tools had been wrapped or bound for use. No discarded blades, stored blades, or blades in use showed evidence of any sort of "handle". It is partly attributed to this lack of wrapping that the presence of human proteins was found on one of the blades (likely accidental injury), in addition to the duck, deer, and dog proteins found on other tools (Sheets 1998). Regardless, the presence of woody and grassy species is thus not likely related to binding of any sort.

Overall, I suspect that much of the viewable diversity of foods on ceramic vessels would have been lost through the heating of starch grains, whereas the high number of taxa recovered from obsidian tools is at least partially attributable to the lack of heating. Moreover, it appears that cutting implements were used for food and gardening purposes, whereas serving implements would be more restricted to culinary uses.

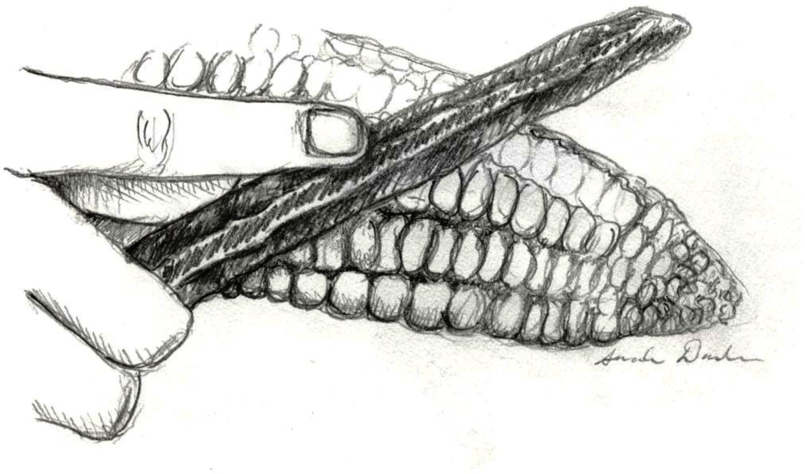


Figure 10.26. Posited stripping of green maize kernels from cob. (Illustration by Sarah Davidson.)

Aside from taxa richness and ubiquity, it appears as though relative abundances of taxa were roughly similar, in the sense that they were quite diverse from artifact to artifact. Woody species dominated most assemblages, whether ceramic or obsidian, with the exception of four blades from Los Naranjos. *Panicoid* grasses and palm species were also frequently represented, regardless of artifact class, though much less abundant than the woody phytoliths. This is likely partially a function of the better preservation and identification of these species, and may or may not reflect percentages of actual uses.

Overall, in terms of prior expectations, although I felt personal disappointment at the lack of recoverable and diagnostic starch grains, I was pleasantly surprised by the high diversity and abundance of recovered microremains including starches and phytoliths. This diversity was anticipated by ethnographic and historic narratives, in addition to prior work at other sites in Southeastern Mesoamerica. The high abundance and ubiquity of wood, though surprising, should perhaps have been anticipated by these same narratives. As relative abundances occur within a closed array, the woody materials were bound to dominate each artifact's assemblage. For this reason, although some root crops and maize microremains were recovered, their abundance seemed relatively slim as compared to prior expectations. Microremains recovered from adhering sediments, as well, exhibited similar patterns of high wood and grass species recovery, although these microremains cannot be fully attributable to the artifacts themselves nor to surrounding sediment matrix. Samples from adhering sediments are likely a mixture of both, and thus are not calculated here, but are rather incorporated into the broader site and time period assemblage.

What differences and similarities exist within artifact categories?

Due to the fact that all of the ceramic sherds belonged to a single vessel type, I do not view patterns in microremains for this artifact class. The diverse types of obsidian implements, however, did reflect some diversity in the microremains recovered from them. In a pilot study, I had analyzed three obsidian tools. In this limited analysis, I posited a basic sketch of both paradigmatic and syntagmatic relationships. One paradigm appeared to be "food tools" versus "garden tools", while possible syntagms appeared to include the use of obsidian blades for multiple purposes and the use of modified obsidian flakes for expedient uses. However, this hypothesis was not entirely borne out in the course of analyzing all seventeen obsidian tools, which may have to do with complicating factors I have mentioned elsewhere (butchering practices, wooden cutting boards and tables, etc.)

In terms of taxa richness for each kind of obsidian artifact, the hypothesis was partially supported. From the obsidian biface, as the lone representative of its type, at least four taxa were recovered. The obsidian flakes (N=2) exhibited a richness of at least 4.5 taxa per artifact. Retouched flakes (N=3), by comparison, had a richness of at least 5.7 taxa per artifact. Curiously, two of the retouched flakes had very high number of taxa (7) while one had very low number of taxa (3). Obsidian blades (N=11) fell within the range of the bifaces and the flakes, exhibiting a richness of 4.6 taxa per artifact. Within this type, however, the distribution was fairly bimodal (as with the retouched flakes), with artifacts tending toward either 3 or 7 taxa recovered per artifact. Thus, contrary to my hypothesis formed during the pilot study, it appears as though, for a given type of obsidian artifact, there are no broad associations that may be made in terms of diversity of use.

However, within each of these types, there is some differentiation, seen through comparisons of individual tools. Some behave like multipurpose pocketknives, while others appear to be part of a sort of elaborate "knife set" where individual implements have more specialized uses (i.e. bread knife vs. cleaver vs. garden shears). For this reason, although it is difficult to form associations between a specific artifact type and its use, individual artifacts do appear to be differentiated through their associated plant practices. Most seem to have flexible uses, much like a modern pocketknife.

When looking at relative abundances of taxa, by type of obsidian artifact, there are some patterns. Wood is generally most abundant, generally ranging between 60% and 90% of each microremain assemblage, with the exception of the obsidian blade fragments from Los Naranjos. Palm (*Arecaceae)* phytoliths are also common, ranging between 5% and 30% of each array. *Panicoid* grasses often factor into the arrays, but never top more than 3% of the assemblage. Relative abundances of all other taxa generally ran between 1% and 5%, the exception, again, being the four obsidian blade fragments from Los Naranjos. As palm, grass, and woody species produce prodigious numbers of very small phytoliths throughout most of the plant, their high relative abundance cannot be directly correlated to frequency of use. However, it is clear that there are similar trends between obsidian artifacts, regardless of type, with the exception of the Los Naranjos blades.

When examining the Los Naranjos blades alone, differences are thrown into high relief. These four artifacts had much smaller recovery rates (N between 6 and 26, total), which may mean an inadequate view of the overall picture. Regardless, on three of these four obsidian blades, there appears to be a much higher relative abundance of maize (12% to 33%), and much less wood. By comparison, one of the blades had unknown fibers and high quantity of wood, in addition to unknown starches, but no evidence of maize. This blade may represent an exclusive industrial or workbench "wood and fiber" tool. Another blade had only maize, vascular tissue, and unknown storage tissue, with no wood phytoliths present. This blade may represent an exclusive "food" tool. Another blade had a higher diversity of taxa (N=5) and thus may have been more multipurpose. Overall, in the way they diverge from each other and other obsidian artifacts, even blades, these four Los Naranjos blades emerge distinct from overall patterns of obsidian tool use.

It is somewhat surprising that there were not more differentiated uses for particular obsidian artifacts, considering the diversity of forms. In terms of syntagmatic associations, then, with the exception of the Los Naranjos blades, there are no broad patterns of use associated with a particular obsidian artifact type. In terms of paradigmatic substitutions, however, there may be some patterns. Although palm, wood, and grass microremains are most common and abundant across obsidian artifact types, at the level of individual artifacts, the remaining taxa or taxon are much more constrained, and "substituted" with other taxa, depending on the artifact.

Bromeliaceae, Chloridoideae, Euphorbiaceae, arrowroot, and *Pooideae* species are associated only with obsidian blade fragments, while lirén was associated only with an obsidian flake fragment, and manioc only with a retouched flake. The remaining various Unknown phytoliths were found in association with only one or two artifact types. Interestingly, it appears as though potential food species are, in a sense, "swapped out" for each other, depending on the tool. These paradigmatic substitutions are explored more thoroughly in the next section, and, although there are slight differences between time periods, I save this topic for the chapter on temporal transformation and continuity.

What are the associations between taxa recovered from artifacts?

Finally, I wanted to find out associations between taxa, across artifacts. **Table 10.2** displays the list of associations between taxa. It is grouped by the first taxon (A), and then arranged according to percentage ubiquity with each associated taxon (B), highest to lowest. I also list the raw number of times that taxon A is associated with taxon B, and the total number of times that taxon A is found, across artifacts.

Table 10.2: Co-occurring taxa recovered from artifacts.

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
Arecaceae sp. Phyto	UNKN woody sp. phyto	14	20	70%
Arecaceae sp. Phyto	Panicoideae sp. phyto	10	20	50%
Arecaceae sp. Phyto	UNKN starch	7	20	35%
Arecaceae sp. Phyto	UNKN phyto 2	4	20	20%
Arecaceae sp. Phyto	UNKN phyto 3	4	20	20%
Arecaceae sp. Phyto	Zea mays phyto (cross-body)	4	20	20%
Arecaceae sp. Phyto	Chloridoideae sp. Phyto	2	20	10%
Arecaceae sp. Phyto	Bromeliaceae sp. phyto	2	20	10%
Arecaceae sp. Phyto	Zea mays phyto (rondel)	2	20	10%
Arecaceae sp. Phyto	Calathea sp. phyto	1	20	5%
Arecaceae sp. Phyto	UNKN phyto 12	1	20	5%
Arecaceae sp. Phyto	UNKN phyto 16	1	20	5%
Arecaceae sp. Phyto	Manihot sp. starch	1	20	5%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
Arecaceae sp. Phyto	UNKN phyto 14	1	20	5%
Arecaceae sp. Phyto	Marantaceae sp. phyto	1	20	5%
Arecaceae sp. Phyto	Maranta sp. phyto	1	20	5%
Arecaceae sp. Phyto	Pooideae sp. phyto	1	20	5%
Arecaceae sp. Phyto	Euphorbiaceae sp. phyto	1	20	5%
Arecaceae sp. Phyto	Cucurbita sp. phyto	1	20	5%
Bromeliaceae sp. Phyto	UNKN woody sp. phyto	3	3	100%
Bromeliaceae sp. Phyto	Arecaceae sp. phyto	2	3	67%
Bromeliaceae sp. Phyto	UNKN starch	1	3	33%
Bromeliaceae sp. Phyto	Zea mays starch	1	3	33%
Bromeliaceae sp. Phyto	UNKN phyto 11	1	3	33%
Bromeliaceae sp. Phyto	UNKN starch 1	1	3	33%
Bromeliaceae sp. Phyto	Maranta sp. phyto	1	3	33%
Bromeliaceae sp. Phyto	Zea mays phyto (rondel)	1	3	33%
Bromeliaceae sp. Phyto	Zea mays phyto (cross-body)	1	3	33%
Bromeliaceae sp. Phyto	Panicoideae sp. phyto	1	3	33%
Bromeliaceae sp. Phyto	UNKN phyto 2	1	3	33%
Calathea sp. Phyto	UNKN starch	1	1	100%
Calathea sp. Phyto	Panicoideae sp. phyto	1	1	100%
Calathea sp. Phyto	Arecaceae sp. phyto	1	1	100%
Calathea sp. Phyto	UNKN woody sp. phyto	1	1	100%
Calathea sp. Phyto	UNKN phyto 2	1	1	100%
Chloridoideae sp. Phyto	Arecaceae sp. phyto	2	2	100%
Chloridoideae sp. Phyto	Panicoideae sp. phyto	2	2	100%
Chloridoideae sp. Phyto	UNKN woody sp. phyto	2	2	100%
Chloridoideae sp. Phyto	UNKN phyto 12	1	2	50%
Chloridoideae sp. Phyto	UNKN phyto 16	1	2	50%
Chloridoideae sp. Phyto	UNKN phyto 3	1	2	50%
Chloridoideae sp. Phyto	Manihot sp. starch	1	2	50%
Chloridoideae sp. Phyto	Zea mays phyto (cross-body)	**1**	2	50%
Chloridoideae sp. Phyto	UNKN phyto 14	**1**	2	50%
Cucurbita sp. Phyto	UNKN woody sp. phyto	1	1	100%
Cucurbita sp. Phyto	UNKN starch	1	1	100%
Cucurbita sp. Phyto	UNKN phyto 2	1	1	100%
Cucurbita sp. Phyto	Panicoideae sp. phyto	1	1	100%
Cucurbita sp. Phyto	Zea mays phyto (cross-body)	1	1	100%
Cucurbita sp. Phyto	Zea mays phyto (rondel)	1	1	100%
Cucurbita sp. Phyto	Arecaceae sp. phyto	1	1	100%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
Euphorbiaceae sp. Phyto	Arecaceae sp. phyto	1	1	100%
Euphorbiaceae sp. Phyto	UNKN starch	1	1	100%
Euphorbiaceae sp. Phyto	UNKN woody sp. phyto	1	1	100%
Euphorbiaceae sp. Phyto	Panicoideae sp. phyto	1	1	100%
Euphorbiaceae sp. Phyto	Pooideae sp. phyto	1	1	100%
Manihot sp. Starch	UNKN woody sp. phyto	1	1	100%
Manihot sp. Starch	Arecaceae sp. phyto	1	1	100%
Manihot sp. Starch	Zea mays phyto (cross-body)	1	1	100%
Manihot sp. Starch	Chloridoideae sp. phyto	1	1	100%
Manihot sp. Starch	Panicoideae sp. phyto	1	1	100%
Manihot sp. Starch	UNKN phyto 14	1	1	100%
Maranta sp. Phyto	Zea mays phyto (rondel)	1	1	100%
Maranta sp. Phyto	Zea mays phyto (cross-body)	1	1	100%
Maranta sp. Phyto	Panicoideae sp. phyto	1	1	100%
Maranta sp. Phyto	UNKN phyto 2	1	1	100%
Maranta sp. Phyto	Arecaceae sp. phyto	1	1	100%
Maranta sp. Phyto	UNKN woody sp. phyto	1	1	100%
Maranta sp. Phyto	Bromeliaceae sp. phyto	1	1	100%
Marantaceae sp. Phyto	UNKN woody sp. phyto	2	2	100%
Marantaceae sp. Phyto	UNKN starch	1	2	50%
Marantaceae sp. Phyto	UNKN phyto 3	1	2	50%
Marantaceae sp. Phyto	UNKN phyto 2	1	2	50%
Marantaceae sp. Phyto	UNKN phyto 1	1	2	50%
Marantaceae sp. Phyto	UNKN phyto (scutiform)	1	2	50%
Marantaceae sp. Phyto	Arecaceae sp. phyto	1	2	50%
Marantaceae sp. Phyto	Zea mays phyto (cross-body)	1	2	50%
Marantaceae sp. Phyto	Panicoideae sp. phyto	1	2	50%
Panicoideae sp. Phyto	UNKN woody sp. phyto	12	12	100%
Panicoideae sp. Phyto	Arecaceae sp. phyto	10	12	83%
Panicoideae sp. Phyto	UNKN starch	7	12	58%
Panicoideae sp. Phyto	UNKN phyto 2	4	12	33%
Panicoideae sp. Phyto	Zea mays phyto (cross-body)	4	12	33%
Panicoideae sp. Phyto	UNKN phyto 3	3	12	25%
Panicoideae sp. Phyto	Chloridoideae sp. phyto	2	12	17%
Panicoideae sp. Phyto	Zea mays phyto (rondel)	2	12	17%
Panicoideae sp. Phyto	Calathea sp. phyto	1	12	8%
Panicoideae sp. Phyto	UNKN phyto 12	1	12	8%
Panicoideae sp. Phyto	UNKN phyto 16	1	12	8%
Panicoideae sp. Phyto	Manihot sp. starch	1	12	8%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
Panicoideae sp. Phyto	UNKN phyto 14	1	12	8%
Panicoideae sp. Phyto	Marantaceae sp. phyto	1	12	8%
Panicoideae sp. Phyto	Maranta sp. phyto	1	12	8%
Panicoideae sp. Phyto	Bromeliaceae sp. phyto	1	12	8%
Panicoideae sp. Phyto	Pooideae sp. phyto	1	12	8%
Panicoideae sp. Phyto	Euphorbiaceae sp. phyto	1	12	8%
Panicoideae sp. Phyto	Cucurbita sp. phyto	1	12	8%
Pooideae sp. Phyto	Arecaceae sp. phyto	1	1	100%
Pooideae sp. Phyto	UNKN starch	1	1	100%
Pooideae sp. Phyto	UNKN woody sp. phyto	1	1	100%
Pooideae sp. Phyto	Panicoideae sp. phyto	1	1	100%
Pooideae sp. Phyto	Euphorbiaceae sp. phyto	1	1	100%
UNKN fiber	UNKN starch	1	1	100%
UNKN fiber	UNKN woody sp. phyto	1	1	100%
UNKN phyto (scutiform)	UNKN woody sp. phyto	1	1	100%
UNKN phyto (scutiform)	UNKN starch	1	1	100%
UNKN phyto (scutiform)	UNKN phyto 3	1	1	100%
UNKN phyto (scutiform)	UNKN phyto 2	1	1	100%
UNKN phyto (scutiform)	UNKN phyto 1	1	1	100%
UNKN phyto (scutiform)	Marantaceae sp. phyto	1	1	100%
UNKN phyto 1	UNKN woody sp. phyto	1	1	100%
UNKN phyto 1	UNKN starch	1	1	100%
UNKN phyto 1	UNKN phyto 3	1	1	100%
UNKN phyto 1	UNKN phyto 2	1	1	100%
UNKN phyto 1	UNKN phyto (scutiform)	1	1	100%
UNKN phyto 1	Marantaceae sp. phyto	1	1	100%
UNKN phyto 11	UNKN starch	1	1	100%
UNKN phyto 11	Zea mays starch	1	1	100%
UNKN phyto 11	Bromeliaceae sp. phyto	1	1	100%
UNKN phyto 11	UNKN woody sp. phyto	1	1	100%
UNKN phyto 11	UNKN starch 1	1	1	100%
UNKN phyto 12	Arecaceae sp. phyto	1	1	100%
UNKN phyto 12	Chloridoideae sp. phyto	1	1	100%
UNKN phyto 12	Panicoideae sp. phyto	1	1	100%
UNKN phyto 12	UNKN phyto 16	1	1	100%
UNKN phyto 12	UNKN phyto 3	1	1	100%
UNKN phyto 12	UNKN woody sp. phyto	1	1	100%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
UNKN phyto 14	Manihot sp. starch	1	1	100%
UNKN phyto 14	UNKN woody sp. phyto	1	1	100%
UNKN phyto 14	Arecaceae sp. phyto	1	1	100%
UNKN phyto 14	Zea mays phyto (cross-body)	1	1	100%
UNKN phyto 14	Chloridoideae sp. phyto	1	1	100%
UNKN phyto 14	Panicoideae sp. phyto	1	1	100%
UNKN phyto 16	Arecaceae sp. phyto	1	1	100%
UNKN phyto 16	Chloridoideae sp. phyto	1	1	100%
UNKN phyto 16	UNKN phyto 12	1	1	100%
UNKN phyto 16	Panicoideae sp. phyto	1	1	100%
UNKN phyto 16	UNKN phyto 3	1	1	100%
UNKN phyto 16	UNKN woody sp. phyto	1	1	100%
UNKN phyto 2	UNKN woody sp. phyto	5	5	100%
UNKN phyto 2	UNKN starch	4	5	80%
UNKN phyto 2	Panicoideae sp. phyto	4	5	80%
UNKN phyto 2	Arecaceae sp. phyto	4	5	80%
UNKN phyto 2	UNKN phyto 3	2	5	40%
UNKN phyto 2	Zea mays phyto (rondel)	2	5	40%
UNKN phyto 2	Zea mays phyto (cross-body)	2	5	40%
UNKN phyto 2	UNKN phyto 1	1	5	20%
UNKN phyto 2	UNKN phyto (scutiform)	1	5	20%
UNKN phyto 2	Marantaceae sp. phyto	1	5	20%
UNKN phyto 2	Calathea sp. phyto	1	5	20%
UNKN phyto 2	Maranta sp. phyto	1	5	20%
UNKN phyto 2	Bromeliaceae sp. phyto	1	5	20%
UNKN phyto 2	Cucurbita sp. phyto	1	5	20%
UNKN phyto 3	UNKN woody sp. phyto	6	6	100%
UNKN phyto 3	Arecaceae sp. phyto	4	6	67%
UNKN phyto 3	UNKN starch	3	6	50%
UNKN phyto 3	Panicoideae sp. phyto	3	6	50%
UNKN phyto 3	UNKN phyto 2	2	6	33%
UNKN phyto 3	UNKN phyto 1	1	6	17%
UNKN phyto 3	UNKN phyto (scutiform)	1	6	17%
UNKN phyto 3	Marantaceae sp. phyto	1	6	17%
UNKN phyto 3	Chloridoideae sp. phyto	1	6	17%
UNKN phyto 3	UNKN phyto 12	1	6	17%
UNKN phyto 3	UNKN phyto 16	1	6	17%
UNKN starch	UNKN woody sp. phyto	13	15	87%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
UNKN starch	Panicoideae sp. phyto	7	15	47%
UNKN starch	Arecaceae sp. phyto	7	15	47%
UNKN starch	UNKN phyto 2	4	15	27%
UNKN starch	UNKN phyto 3	3	15	20%
UNKN starch	Zea mays starch	2	15	13%
UNKN starch	UNKN phyto 1	1	15	7%
UNKN starch	UNKN phyto (scutiform)	1	15	7%
UNKN starch	Marantaceae sp. phyto	1	15	7%
UNKN starch	UNKN fiber	1	15	7%
UNKN starch	Calathea sp. phyto	1	15	7%
UNKN starch	UNKN phyto 11	1	15	7%
UNKN starch	Bromeliaceae sp. phyto	1	15	7%
UNKN starch	UNKN starch 1	1	15	7%
UNKN starch	Pooideae sp. phyto	1	15	7%
UNKN starch	Euphorbiaceae sp. phyto	1	15	7%
UNKN starch	Zea mays phyto (cross-body)	1	15	7%
UNKN starch	Zea mays phyto (rondel)	1	15	7%
UNKN starch	Cucurbita sp. phyto	1	15	7%
UNKN starch 1	UNKN starch	1	1	100%
UNKN starch 1	Zea mays starch	1	1	100%
UNKN starch 1	UNKN phyto 11	1	1	100%
UNKN starch 1	Bromeliaceae sp. phyto	1	1	100%
UNKN starch 1	UNKN woody sp. phyto	1	1	100%
UNKN storage	UNKN vascular	1	1	100%
UNKN storage	Zea mays starch	1	1	100%
UNKN vascular	Zea mays starch	1	1	100%
UNKN vascular	UNKN storage	1	1	100%
UNKN woody sp. phyto	Arecaceae sp. phyto	14	20	70%
UNKN woody sp. phyto	UNKN starch	13	20	65%
UNKN woody sp. phyto	Panicoideae sp. phyto	12	20	60%
UNKN woody sp. phyto	UNKN phyto 3	6	20	30%
UNKN woody sp. phyto	UNKN phyto 2	5	20	25%
UNKN woody sp. phyto	Zea mays phyto (cross-body)	4	20	20%
UNKN woody sp. phyto	Bromeliaceae sp. phyto	3	20	15%
UNKN woody sp. phyto	Marantaceae sp. phyto	2	20	10%
UNKN woody sp. phyto	Zea mays starch	2	20	10%
UNKN woody sp. phyto	Chloridoideae sp. phyto	2	20	10%
UNKN woody sp. phyto	Zea mays phyto (rondel)	2	20	10%
UNKN woody sp. phyto	UNKN phyto 1	1	20	5%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
UNKN woody sp. phyto	UNKN phyto (scutiform)	1	20	5%
UNKN woody sp. phyto	UNKN fiber	1	20	5%
UNKN woody sp. phyto	Calathea sp. phyto	1	20	5%
UNKN woody sp. phyto	UNKN phyto 12	1	20	5%
UNKN woody sp. phyto	UNKN phyto 16	1	20	5%
UNKN woody sp. phyto	Manihot sp. starch	1	20	5%
UNKN woody sp. phyto	UNKN phyto 14	1	20	5%
UNKN woody sp. phyto	UNKN phyto 11	1	20	5%
UNKN woody sp. phyto	UNKN starch 1	1	20	5%
UNKN woody sp. phyto	Maranta sp. phyto	1	20	5%
UNKN woody sp. phyto	Pooideae sp. phyto	1	20	5%
UNKN woody sp. phyto	Euphorbiaceae sp. phyto	1	20	5%
UNKN woody sp. phyto	Cucurbita sp. phyto	1	20	5%
Zea mays phyto (cross-body)	UNKN woody sp. phyto	4	4	100%
Zea mays phyto (cross-body)	Arecaceae sp. phyto	4	4	100%
Zea mays phyto (cross-body)	Panicoideae sp. phyto	4	4	100%
Zea mays phyto (cross-body)	Zea mays phyto (rondel)	2	4	50%
Zea mays phyto (cross-body)	UNKN phyto 2	2	4	50%
Zea mays phyto (cross-body)	Manihot sp. starch	1	4	25%
Zea mays phyto (cross-body)	Chloridoideae sp. phyto	1	4	25%
Zea mays phyto (cross-body)	UNKN phyto 14	1	4	25%
Zea mays phyto (cross-body)	Marantaceae sp. phyto	1	4	25%
Zea mays phyto (cross-body)	Maranta sp. phyto	1	4	25%
Zea mays phyto (cross-body)	Bromeliaceae sp. phyto	1	4	25%
Zea mays phyto (cross-body)	UNKN starch	1	4	25%
Zea mays phyto (cross-body)	Cucurbita sp. phyto	1	4	25%
Zea mays phyto (rondel)	Zea mays phyto (cross-body)	2	2	100%
Zea mays phyto (rondel)	Panicoideae sp. phyto	2	2	100%
Zea mays phyto (rondel)	UNKN phyto 2	2	2	100%
Zea mays phyto (rondel)	Arecaceae sp. phyto	2	2	100%
Zea mays phyto (rondel)	UNKN woody sp. phyto	2	2	100%
Zea mays phyto (rondel)	Maranta sp. phyto	1	2	50%
Zea mays phyto (rondel)	Bromeliaceae sp. phyto	1	2	50%
Zea mays phyto (rondel)	UNKN starch	1	2	50%
Zea mays phyto (rondel)	Cucurbita sp. phyto	1	2	50%
Zea mays starch	UNKN woody sp. phyto	2	4	50%
Zea mays starch	UNKN starch	2	4	50%
Zea mays starch	UNKN vascular	1	4	25%
Zea mays starch	UNKN storage	1	4	25%
Zea mays starch	UNKN phyto 11	1	4	25%

Taxon (A)	**Associated taxon (B)**	**# times A associated with B**	**total # times taxon A found**	**% of time taxon B is associated**
Zea mays starch	Bromeliaceae sp. phyto	1	4	25%
Zea mays starch	UNKN starch 1	1	4	25%

In terms of relationships between plant taxa, there are some syntagmatic associations that I would like to highlight. I only explore instances where a taxon is associated with another taxon more than once. I must emphasize that it is not an A:B::B:A associative relationship in every case. Woody species are found in a multitude of instances, and therefore, although *Marantaceae* species may be associated with wood 100% of the time, as there were 20 cases of wood recovery and only two cases of *Marantaceae* recovery, wood is not associated with this taxon 100% of the time.

I should first make note, however, of the large set of plants I do not discuss in terms of associations with other taxa, as their recovery with these other taxa occurred less than twice. *Calathea, Cucurbita* (squash)*, Euphorbiaceae* (the manioc family, along with edible leafy species)*, Manihot* (manioc)*, Maranta* (arrowroot)*,* and the large Unknown starch 1. Most of these are likely food species. However, none of these potential food species was recovered with any of the others, including maize starch. In terms of not-likely food species, *Pooideae* grasses, Unknown fibers, Unknown scutiform phytoliths, Unknown phytoliths 11, 12, 14, 16, and Unknown storage and vascular tissue were not strongly associated with any other taxon.

Palm species *(Arecaceae)* are most often associated with wood, in 70% of instances. Half of those times, Panicoid grass species are also present. Also associated with palms are Unknown starch grains, Unknown phytoliths 2 and 3, and maize leaves. To a much lesser degree, palm species are associated with Chloridoid grasses, bromeliads, and maize cobs. Palm phytoliths are recovered from both obsidian implements and ceramics, and the same diagnostic palm phytolith types are found in various parts of the plant, from leaves to fruits. I postulate that the obsidian implements may have been used in cutting the palm fronds for various purposes, from matting to basketry, or in cutting exocarps of large palm fruits (as in the case of *Acrocomia)*. The presence of palm phytoliths in ceramic vessels may correspond with strips of palm used as ties in binding and wrapping foods (tamales, for example) or the presence of palm fruits in various foods.

Every time *Bromeliaceae* species were recovered, wood was recovered. 67% of those times, palm species and Unknown starch 1 were also recovered. These three are the only taxa associated with Bromeliad plants more than once. This may correspond with a use of the associated tool type (obsidian blades), for cutting bromeliad species in home gardens and/or forests. In two cases, potential food species were also recovered (arrowroot, maize, and Unknown starch 1).

Every time *Marantaceae* species phytoliths were recovered, woody species were recovered. Perhaps this has to do with these tools (obsidian blade and retouched flake) used more for trimming or gardening purposes, or the cutting of *Marantaceae* species for food purposes. These species were not recovered in association with other likely food species, however.

Each time Chloridoid grass species were recovered, palm, Panicoid grass, and wood species were recovered (100%). This may have to do with these items (obsidian blades) used primarily for fibrous plant and wood cutting practices. Panicoid grass species were highly ubiquitous, and so associated with a multitude of other taxa, to varying degrees. They are most closely associated with wood phytoliths, at 100% of the time. In over 3/4 of those cases, palm phytoliths were also associated with this species. This, as in the case with palm phytoliths, may indicate a strong correlation between these three elements—wood, palm species, and Panicoid grasses. This may index a use for these tools (obsidian blades, flakes, and biface) that has to do with fibrous plant and wood cutting activities. Panicoid grasses may also be common taxa in clays used in ceramic vessels, the other artifact type where these grasses were recovered. To a lesser degree, Panicoid grasses are associated with Unknown starch grain species, Unknown phytoliths 2 and 3, and maize leaf phytoliths. To a much lesser degree, Panicoid species are associated with Chloridoid grass and maize cob phytoliths.

Unknown phytolith 2 is uniformly ubiquitous with woody species, at 100% of the time. This taxon is also strongly associated with Unknown starches, Panicoid grasses, and palm species. To a lesser degree, it is associated with Unknown phytolith 3, and maize leaves and cobs. Aside from the maize cob association, this may indicate a non-food designation for this unidentified species, recovered from obsidian blades and flakes, and a ceramic vessel.

Unknown phytolith 3 is also strongly associated with wood, at 100% of the time. Like the Unknown phytolith 2, this taxon is also highly associated with palm species, Unknown starch grains, and Panicoid grass species. It is also associated with Unknown phytolith 3 (twice). This taxon, like the Unknown phytolith 3, may indicate woody or fibrous species cutting or trimming activities, unconnected from food use, as this taxon is not recovered from the interiors of ceramic vessels and only once in association with any potential food taxa *(Marantaceae)*.

I hesitate to engage in too much speculation surrounding the Unknown starch taxa, as this category represents a wide variety of non-diagnostic starches that could potentially belong to literally hundreds of different species of plants. However, in association with these various starches, I recovered wood, Panicoid grasses, palms, and Unknown phytoliths 2 and 3. In several cases, unknown starches were recovered in association with identified maize and *Calathea* starches and *Marantaceae* species phytoliths. However, on these obsidian blades, obsidian biface, and ceramic vessels, some of the unknown starches may actually belong to known taxa, as not every starch grain produced by a plant is diagnostic (unfortunately).

Wood phytoliths, like Panicoid grasses, were highly ubiquitous and also associated with a multitude of taxa. The most commonly correlated taxa include palm species, unknown starches, Panicoid grass species. To a lesser degree, Unknown phytoliths 2 and 3 were recovered, followed by maize leaves, Bromeliads, *Marantaceae* species, and Chloridoid grasses. In two cases (an obsidian blade and a ceramic vessel), woody species were recovered with maize cobs. In another two cases (obsidian blades) wood was recovered with maize starch grains. In some of these cases, the recovery of wood phytoliths may have to do with a wooden chopping surface—such as a low table, dish, or cutting board. Or, in the case of recovery from ceramic vessels, these phytoliths may correspond with the use of wooden implements in stirring, mixing, scraping the sides of a bowl, etc. These phytoliths could also have been incorporated into clays used in crafting ceramics, as I have also posited for the presence of Panicoid grasses.

Finally, *Zea mays* showed up in a variety of locations, as a variety of represented anatomical parts. The cross-body phytoliths associated with maize leaves were strongly correlated with woody species, palms, and grasses, at 100% of the time in each case (retouched flake, and blade, and ceramic vessel). As the cutting of maize leaves, in gardening and farming practices, may not have had to do with actual meal preparation, this is unsurprising. To a lesser degree, maize leaves were also associated with the presence of maize cobs (obsidian blade and ceramic vessel) and the Unknown phytolith 2. Maize cobs were strongly associated with maize leaves, Panicoid grasses, Unknown phytolith 2, palm species, and woody species. This could have to do with its presence (as a cob portion) in stewed foods in ceramics, or in the use of cutting tools on maize as well as garden, milpa, and/or forest plants. Maize starches were only semi-associated with woody species and unknown starches. This could be, again, the appearance of wood through implements in ceramics vessels or in the course of chopping maize cobs on a wood surface, in the case of obsidian blades.

In terms of multi-taxa associations, it appears as though there are clusters of wood and fibrous species, and clusters of maize cobs, Unknown phytolith 2, wood, and maize leaves. Broadly, paradigmatic substitutions seem to occur between food species, as presumed "food taxa" are replaced by each other on a single artifact. Food and nonfood taxa are syntagmatically associated, perhaps linked through food preparation practices previously outlined, or through the lack of association between artifacts and particular uses.

Summary

Deetz (1996) states that what equipment is actually placed on the dinner table varies directly associated with foodways themselves, which are historically contextualized and contemporaneously contingent. In his discussion of servingware in early America, he notes the presence of variable types of artifacts in the archaeological record, as related to four factors: "availability, need, function, and social status" (1996:73). In this study, however, availability, need, function, and social status do not leave direct traces. Syntagmatic relationships occur between one taxon and others, and one artifact and particular taxa (e.g. **Figure 10.27**). However, few syntagmatic associations are noted between artifact types, or even artifact classes. Many artifacts appear to have been multi-use, incorporating both food and non-food elements, although all these elements may be incorporated in the course of normal culinary practice.

We see the linked fates of practices, artifacts, and taxa in their object biographies. Although not an ideal analogy, people may use a single pocketknife for a whole variety of things, from cutting into a motor oil container to slicing an apple. These ‘pocket knives’ of the past, however, seem to have been more freely shared between people, as they were less durable and tended to be stored together (as shown in situ at Cerén), rather than stored individually with a single person. For this reason, the non-discrete uses of various tools may actually be linked to discrete activities carried out by multiple individuals.

Broadly, however, I’ve explored the ways in which particular taxa are linked to particular artifacts, and considered the broad ubiquities of taxa across artifact classes. I’ve considered the relative abundances of taxa across artifacts. I’ve also explored the relationships between artifact classes and taxa, and artifact types and taxa, considering taxa richness, relative abundances, and ubiquities. In terms of syntagmatic associations, I’ve looked at relationships between taxa, when recovered from artifacts. Broadly, I’ve matched all of these findings to the expectations set up by studies of other areas and time periods in Southeastern Mesoamerica.

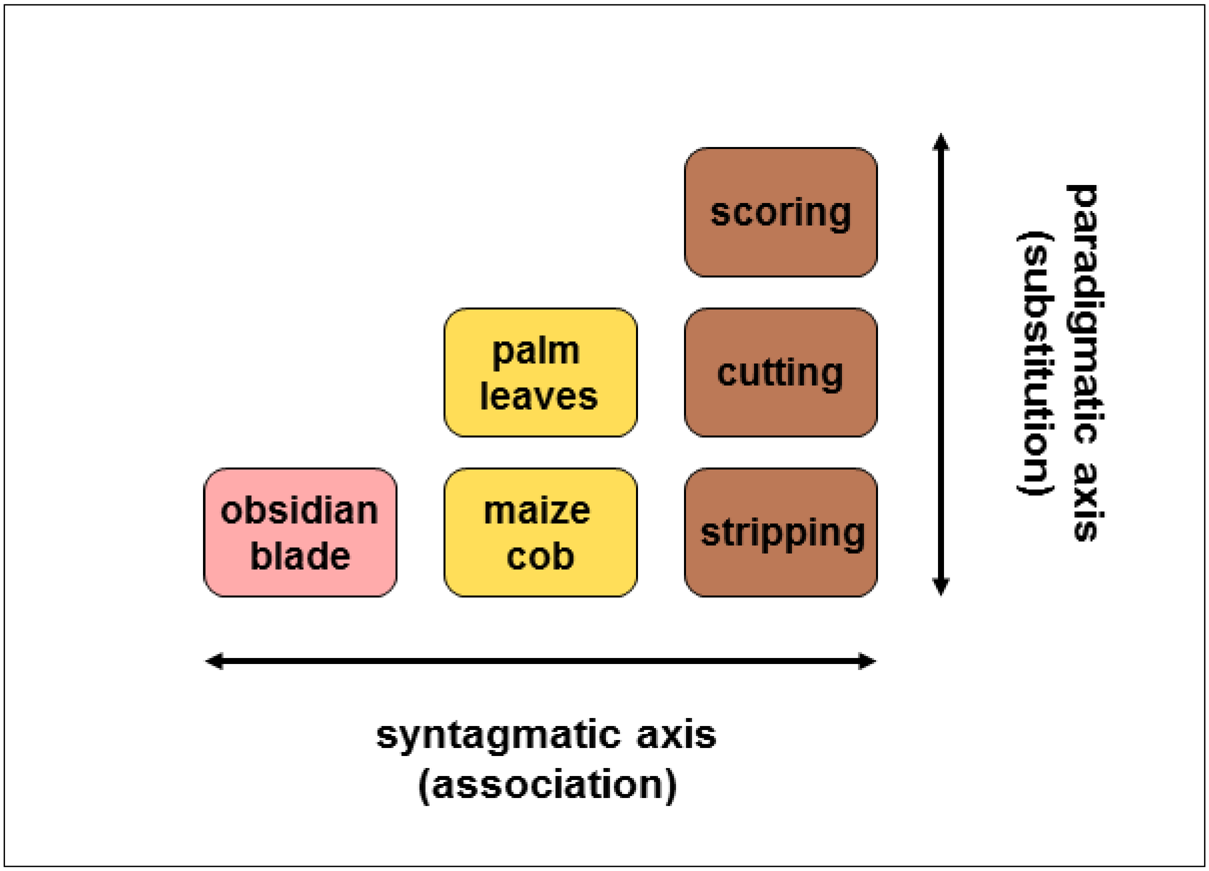


Figure 10.27. Potential syntagmatic associations and paradigmatic substitutions related to obsidian blades.

Additional elements that could be brought to bear on this study include protein residues, as were fruitfully recovered from obsidian tools at the site of Cerén. Exploration of various ceramic types would also help to expand our understanding of relationships between and substitutions of taxa for this artifact class. However, in the following chapter, I explore the different spaces associated with plants and ethnobotanical practices, to understand how different plants are associated with particular practices in certain contexts, and how certain contexts are associated with particular ethnobotanical practices.

11. Paradigms and Syntagms of Space and Ethnobotanical Practice

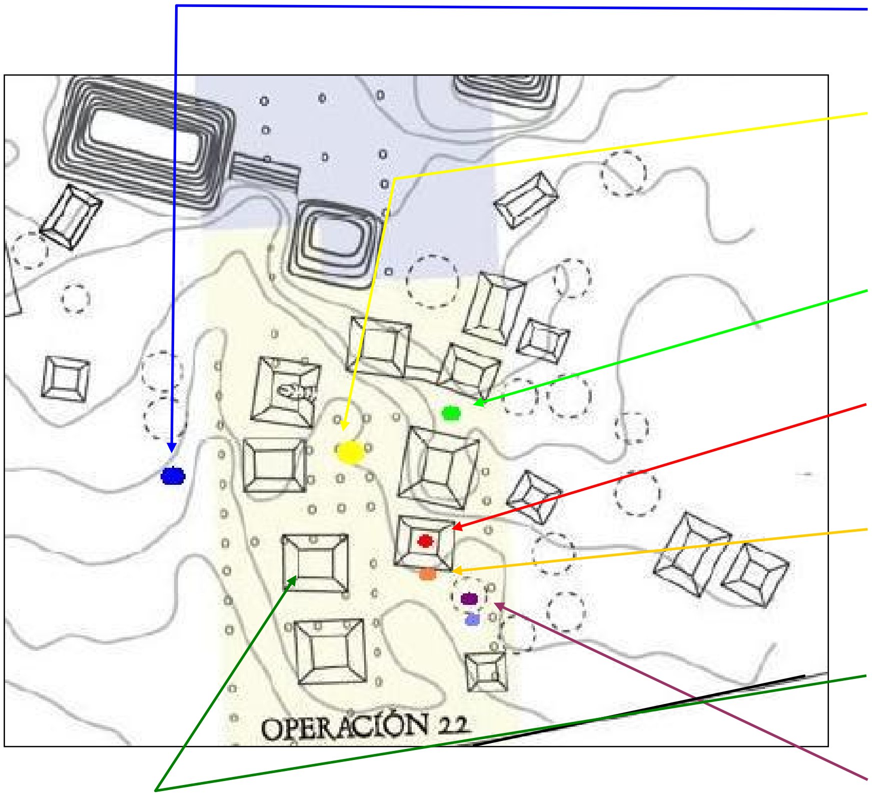
In prior chapters, I have outlined ethnobotanical practices as related to taxa and artifacts. In this chapter, I engage with the spatial patterning of ethnobotanical practices. I approach such questions as: are some taxa associated with particular types of spatial designations (e.g., do the grinding and processing of maize primarily take place in patio areas)? Are some taxa more ubiquitous across certain spaces than others (e.g., is charred wood highly ubiquitous)? Are there changes in certain taxa combinations over the landscape, in terms of associations with spatial types (e.g., are different kinds of foodstuff refuse likely to co-occur outside of patio areas)?

In this chapter, I review data from six kinds of spaces, looking at 148 total botanical samples **(see Table 11.1 and Figure 11.1)**. These spaces represent a variety of contexts, and come from several time periods. They are identified according to location and construction materials (stone, earth, and/or perishable). The bulk of the data comes from macrobotanical analysis, but I do make some use of microbotanical analysis where possible. This microbotanical data has only been recovered from Curresté, the lone site with analyzed sediment samples.

The variety of spaces represents pathways, divisions between public and private areas, areas suitable for disposal, interiors and exteriors of structures, and interiors and exteriors of patio areas. At the site of Curresté, my excavation units were expressly directed toward recovering comparative data from all seven types of spaces. However, due to the lack of access to samples, not all types of spaces are represented in this study. No samples were recovered from atop a platform mound ("platform") where the location was also outside of a superstructure, although I had collected data related to this spatial designation in the course of excavations at Curresté.

Table 11.1: Description of Spatial Units Analyzed.

platform (n=0)	atop a platform mound, but NOT inside of a structure
adjacent (n=33)	immediately (within 1 m) adjacent to a platform mound or structure
interior mound str (n=18)	interior to a structure ALSO ATOP a platform mound
between (n=1)	area between structures and/or platform mounds
patio (n=27)	comprised of area surrounded by cluster of platform mounds and/or structures
outside (n=39)	outside of area comprised by patio group
interior ground str (n=8)	interior to a structure NOT atop a platform mound



Outside	**outside of area comprised by patio group**
Patio	**comprised of area surrounded by cluster of platform mounds and/or structures**
Between	**area between structures and/or platform mounds**
Interior mound str	**interior to a structure ALSO ATOP a platform mound**
Adjacent	**immediately (within 1 m) adjacent to a platform mound or structure**
Mound	**atop a platform mound but NOT inside a structure**
Interior ground str	**interior to a structure NOT atop a platform mound**

Figure 11.1: Types of spaces represented, in relation to built environments.

I begin this chapter with a discussion of my reasons for separating spatial units from contextual designations in my analyses (the analysis of contexts is the topic of Chapter 12). I then turn to the various taxa recovered, exploring spatial nodes of ubiquity of individual plants, and relative abundance of all plants at different spatial locations. When considering various spaces, I examine each type individually, and the ethnobotanical practices associated with it. I then explore the differences and similarities between spatial types, and variability within individual spaces. In pursuit of these goals, I utilize material densities, taxa richness of samples, and relative abundances of various taxa. I also look for associations between taxa, whenever clustered in particular contexts. My broad objective, in comparing combinations of taxa at various spatial nodes, is to address the ways that space contextualizes and is formed through nodes of ethnobotanical activities, among other modes of practice. However, exploring the distinction between "contexts" and "spaces" is a first step in examining the ways that these two categories of locales dynamically impact and/or reinforce practice.

What is the relationship between a context and a space?

Place and space are the juncture of the typological, the topological, and the temporal (following Giddens 1979:54; Soja 1985). Just as practical knowledge can only ever be partially and imperfectly expressed in discourse (Giddens 1979:40), material expression in space is only partially representative of the "place" it indexes. That is, there is a perpetual disjuncture between the "object" and "concept" aspects of the signified "place". This renders our limited view of the past yet more partial, as place is often conceived as a parcel of both assumed function and ascribed meaning. Moreover, in the case of built and modified landscape, places and spaces of the past may have been 1) enunciated only partially, 2) apprehended only partially, 3) comprehended only partially, and/or 4) relational to time, space, and "speaker" (following de Certeau 1984:33).

Perceived as interplay between the cultural and the natural, landscape, for many archaeologists, is metaphorically (at its simplest) a combination of "text" and "context" (Ashmore and Wilk 1988; Knapp and Ashmore 1999). Similarly to views of language, views of landscape have included landscape as a system (Flannery 1976) to landscape as activity (Killion 1992) to landscape as ideation (Tilley 1994). Practice, in this case, does not exist outside of "system", "activity", and "ideation", nor is it an alternative to these concepts. Rather, practice both encompasses and is encompassed by these concepts in a dynamic relationship of "doing". Following this premise, landscape is continuously subject to a dynamic and diachronic process of both producing and being produced (Bender 1993; de Certeau 1984; Soja 1985).

"Places" are clusters of attributes which are fluid and dynamic, as they emerge in relation to their spatio-temporal and social context. Problematically, the experience of place is also individuated (de Certeau 1984). Even if archaeological materials are conceived of simply as "text", documents are non-literal. That is, there is no overriding, determinative power of place itself, as the power of place is dependent on the effectiveness of its dialogue with "memory, emotion, and belief" (Levi 2002:3). Thus, the view of place as "text" yields multiple possible readings or interpretations, when juxtaposed with place as "bodily position" (de Certeau 1984). In this way, place is rendered not only multi-dimensional, but multi-multidimensional, as it can index multiple meanings simultaneously over multiple spatio-temporal contexts (Bender 1993; Tilley 1994; Giddens 1979; de Certeau 1984).

Concomitant with studies of place, studies of "space" have evolved from the idea that space is 'generated and inert' to the idea that space is 'generative and dynamic'. Gupta and Ferguson state that space is a neutral grid upon which "cultural difference, historical memory, and societal organization are inscribed" (1992:7). This view can be contrasted with that of de Certeau (1984) and Giddens (1979), where space *itself* is dynamic. (It must be here noted, however, that the translator of de Certeau employs the terms "space" and "place" in a direct inverse of almost all geographers, architects, and archaeologists.) Society is a function, reflection, and producer of "the space forged jointly by particular institutions possessed of variable goals and characterized by variable degrees and kinds of organizational power" (Levi 2002:24). Built space, in this schema, is comprised dually of "enduring structure" and "organizational medium" (following Levi 2002).

Figure 11.2. Patios, areas adjacent to structures, and areas between structures. Place-making and ethnobotanical practices are hypothesized. (Illustration by Sarah Davidson.)

Spaces, like places, can be viewed in terms of linguistic practice, as a language subject to variation in translation and interpretation. As our discourse with space emerges relationally with our unique sets of experience, our *"langue"*– the realm of possible spatial expressions – both constrains and is constrained by our *"parole"*-- the spatial expressions produced, which further influences the *langue*, ad infinitum. Space-making, like place-making, occurs in the course of daily practice, and as such is mutable. As Emanuel Schegloff notes (1972), the way people describe places may seem semantic, but descriptions of place are actually indexically sensitive, and respond to the speaker's frame of reference for utterance. Categorization of the landscape depends on location (of the beholder relative to other elements of landscape), membership (as tied to memory and recognizability), and topic (as linked to activities and transitional natures) (Schegloff 1972; similarly to Giddens 1979:190). Similarly, the spaces defined in Table 11.1 are relational. That is, each is defined vis-à-vis surrounding built spaces.

A single defined space can index many different practices and places, just as a single defined practice or place can occur over many spaces. For example, Alexander (1999:80) defines three spatial correlates of co-residential units in Mesoamerica: the house lot, the house compound, and the dwelling. These are combined with other categories, including "patios, gardens, and refuse areas" (1999:79) which are not defined to the mutual exclusion of other sorts of places and spaces. But what defines a "structure"? A "site"? An "activity area"? And do the designations of the archaeologist bear any resemblance to past conceptions of the same?

Considering the complexity of spaces and places individually, and their dynamic relationship, it seems Sisyphean to try to extricate each from the other. These two elements cannot be cleaved apart in a clean way, as some spaces (such as kitchen structures) are constructed with specific places (such as cooking areas) in mind, and some established places (such as cooking areas) can direct construction (of a roof over an outdoor cooking fire). However, as a first step in understanding social interactions with built spaces, and ethnobotanical activities as enacted within landscapes, teasing these two elements apart seemed a fruitful way of isolating some aspects of practice. I hoped to find ethnobotanical associations with certain spaces that may or may not have been expressed in the places engendered within them. Although much more complicated than the picture I sketch here, I define spatial categories in terms of built spaces, vis-à-vis structures of various sorts and configurations. I define categories of place in terms of various contexts, vis-à-vis features of various morphologies and contents. I begin with spaces, and explore contexts separately, in the next chapter.

Taxon to spaces: What spaces are associated with each taxon?

In order to consider the practices associated with each plant across the six represented spatial types, I first recorded the spaces associated with each taxon, as elaborated in Chapter 9 **(see Table 9.2)**. Here, I focus my discussion only on those taxa which appear multiple times, and those which have broader implications in terms of practice. I highlight the taxa richness for each spatial type, and the ubiquities of each taxon as related to various spaces. I plot, however, only those taxa which appear more than once in a particular space. In **Figures 11.3 and 11.4**, I display the types of spaces associated with each taxon. I do not plot unknown woody species or storage tissue fragments ("lumps"), due to their incredibly high ubiquity across spaces, although I do discuss these botanical elements further on.

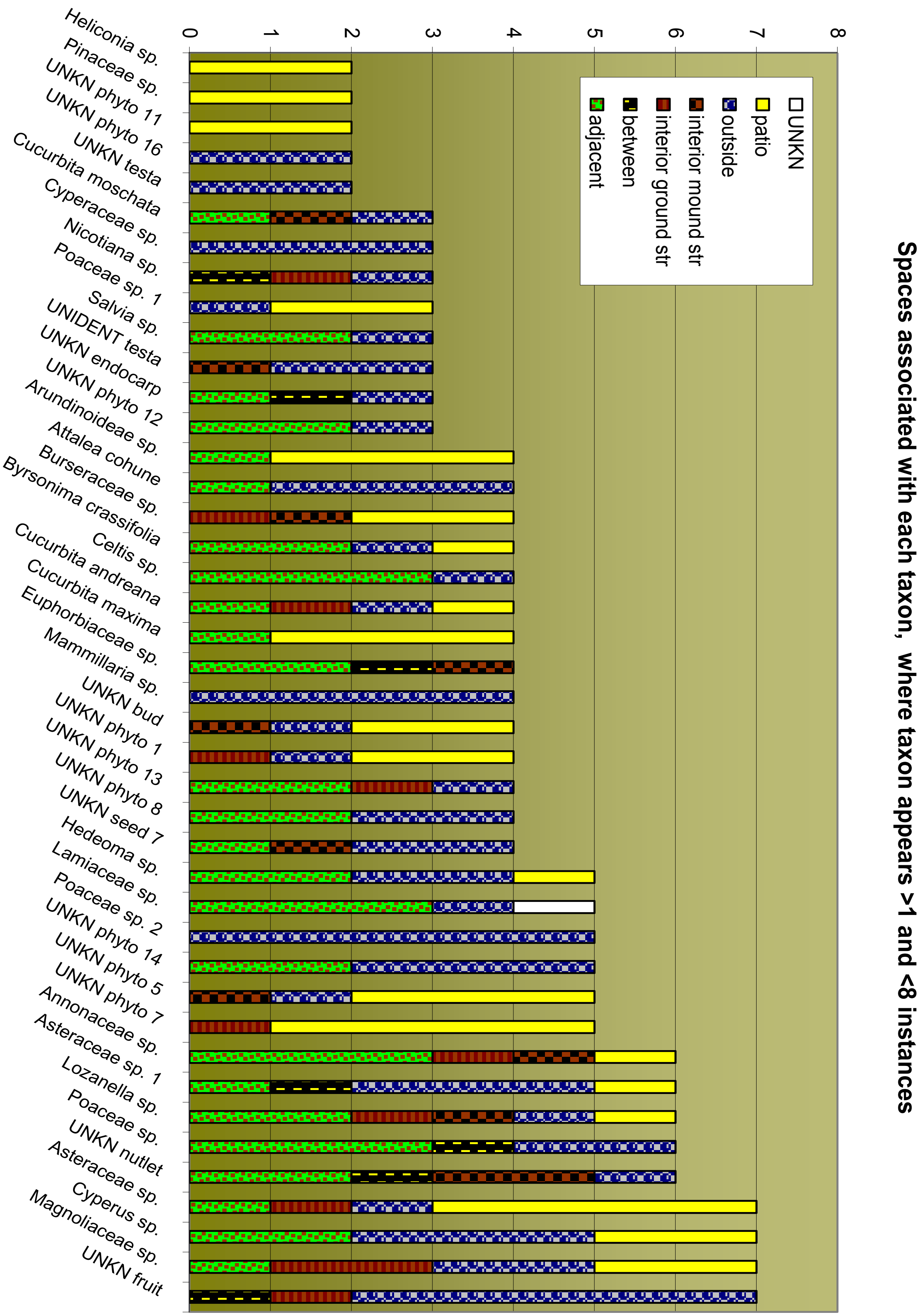


Figure 11.3: Spaces associated with each taxon, where taxon appears >1 and <7 instances.

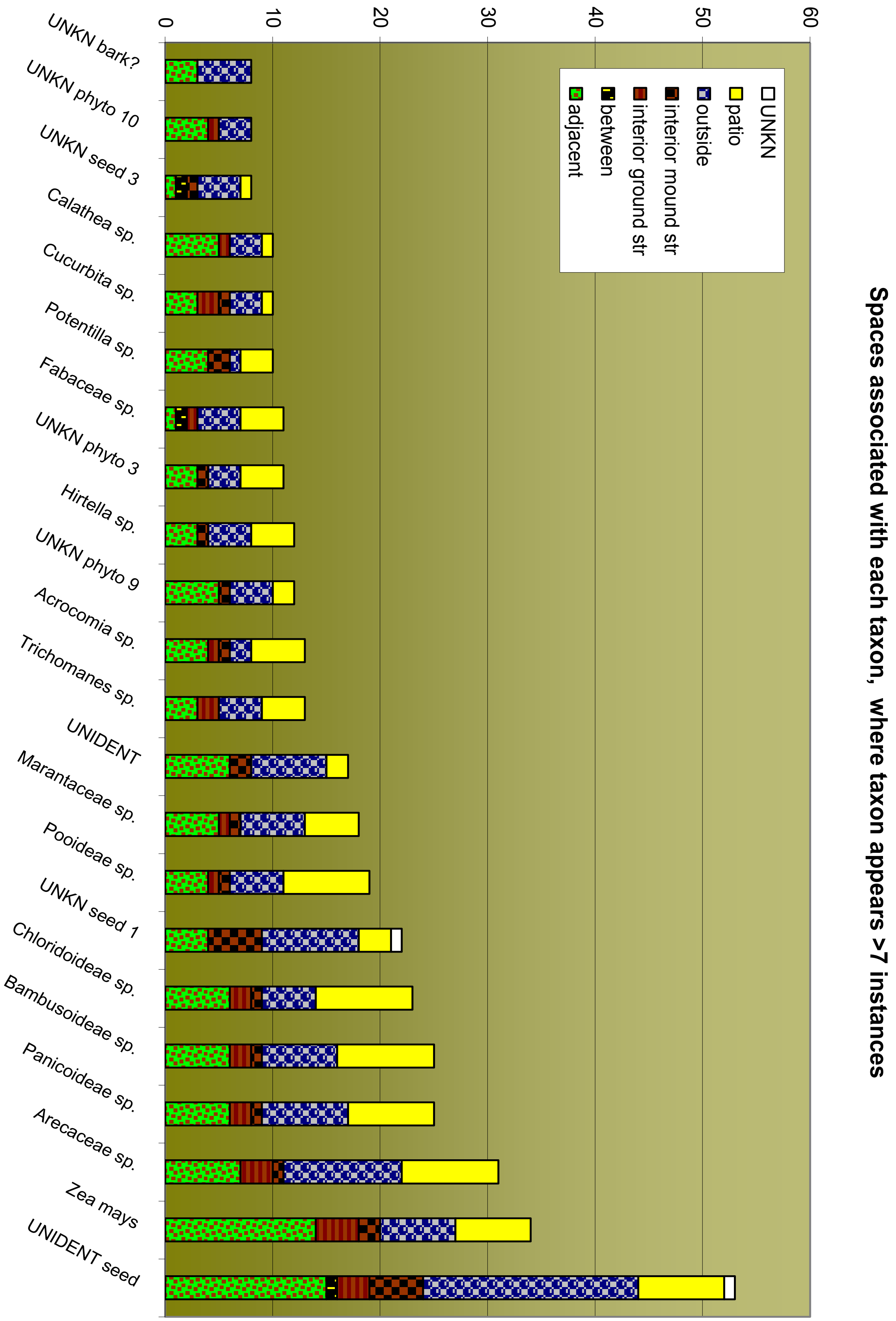


Figure 11.4: Spaces associated with each taxon, where taxon appears >7 instances.

Out of those plants recovered more than once in a single spatial category, there are several taxa found only in one type of space. This includes *Heliconia*, pine (*Pinaceae* sp.), *Cyperaceae* spp., and several unknown species represented by both seeds and phytoliths. Heliconias, pine, and Unknown phytolith 11 were recovered from patio areas every time they were recovered. Heliconias, as common shade and decorative plants in modern times, may have had similar roles in ancient times, or been used in ritual. The remains of pine are unlikely to correspond with shade trees in this area, as pine does not thrive in this area. The pine may have corresponded with fuel, torchwood, or construction materials, or may have been incorporated into ritual activities, as posited by Morehart and Butler (2010) and Lentz et al. (2005).

The unidentified *Cyperaceae* species, recovered only from outside patio groups, may indicate a more "weedy" categorization for these plants. However, *Cyperus* sp., a genus belonging to this family, was recovered from adjacent and patio areas. This may implicate differential practices associated with different species of this family, or may simply indicate that the unknown *Cyperaceae* species were too few in number to associate strongly with any particular space. Other plants with seemingly strong associations with a particular space include many Unknown species, for which I cannot hazard interpretations.

Various grass species were recovered across every spatial category. Grass species subfamilies *(Arundinoideae* spp., *Panicoideae* spp., *Pooideae* spp., *Chloridoideae spp., Bambusoideae* spp.) and several unknown subfamilies (*Poaceae* spp., including *Poaceae* sp. 1 and *Poaceae* sp.2.) were recovered in the form of both macrobotanical remains (seeds) and microbotanical remains (leaf phytoliths). Arundinoid species, the least ubiquitous, were found in only two types of exterior spaces: adjacent to structures and within patios. Bambusoid, Chloridoid, and Pooid species were found everywhere outside of structures, except between two adjoining structures, and were recovered most often in the patio and adjacent to structures. Panicoid species were similarly patterned, but recovered from between structures, as well, and quite frequently from outside the patio group.

The highly ubiquitous nature of grass species, also evident in the data recovered from across artifacts and contexts, references a wide spectrum of deliberate practice, including roofing, bedding, fuel, matting, and even medicine-concocting. It also references the many sorts of inadvertent incorporation of various grasses, through sediments used in construction, and "travelers" moved through human and natural activities. The fact that so few grasses were recovered from between structures is mostly to do with the low number (n=1) of this spatial type. However, it may also have to do with well-traveled paths between structures, that are kept more clear of grass detritus than patio areas, more clear of grass construction materials than areas immediately surrounding homes, and more clear of grass weeds than areas outside of patio groups.

The multitude of palm species, so well represented at these four Honduran sites, comes from a wide array of spaces. Cohune palm *(Attalea)* was recovered only from adjacent and outside areas. Coyol palm *(Acrocomia)* was recovered from everywhere except between structures, and most frequently from adjacent and patio areas. Unknown palm (*Arecaceae*) species were recovered from everywhere except between structures, but most frequently from exterior outside and patio areas, and often from areas adjacent to structures. *Butia capitata* palm was recovered only from outside the patio group. This may indicate that palm trees commonly grew just outside of patio groups. As discussed in previous chapters, the high preservation rates of palm species, both at the macrobotanical and microbotanical level, make them highly likely to remain archaeologically visible, even after suffering the effects of formation processes. Palm species are noted ethnographically and ethnohistorically as popular foodstuffs, so it fits with expectations that they appear in contexts where disposal of other food garbage has taken place. Moreover, as the fronds of various palm species are frequent components of thatching, matting, and bedding, the appearance of these species in architectural fill and across surfaces and in general occupational material also fits expectations. Overall, it is no surprise that palm species were recovered as common representatives of daily activity across various contexts.

Various species often consumed for grains (and sometimes greens) were recovered from only four locations. Chia (*Salvia* spp.) seeds were recovered from between adjoining structures and outside patio groups, but most frequently from areas adjacent to structures or mounds. Amaranth *(Amaranthus* sp.) seeds were recovered only twice, once each from adjacent to and between structures. Goosefoot *(Chenopodium* sp.) was also recovered just twice, once each from adjacent and outside patio groups. Overall, it seems as though the small charred seeds of these similar ruderal species are found mostly in what would likely be nodes of dumping and sweeping activity.

The many various squash species were recovered from the entire suite of spaces analyzed, with the exception of areas between structures. In every case, squash taxa are represented by rind phytoliths only. Various *Cucurbita* species, including *andreana, moschata,* and *maxima*, were most frequently recovered from areas immediately adjacent to buildings, inside the patio, and outside of the patio group. However, they were also found within the interiors of structures, whether atop a mound or at ground level. It is interesting that no squash rinds were recovered from between structures. These areas, as likely pathways, may have been kept clear of larger detritus such as fragments of squash rinds. However, squash remains are present in interiors of structures, which would also have been kept somewhat clear. It's possible that preparation may have taken place inside of structures, leaving some remains, but ultimately detritus was deposited in adjacent, patio, and outside areas. It is also possible that the remains recovered from inside of structures mark the "scooping" and deposit of friable material during construction episodes.

As with other grass species, maize *(Zea mays)* is recoverable through several types of microremains and macroremains. Maize macroremains includecob fragments, cupules, and kernels, while microremains included several types of phytoliths. Maize, like the various squashes, was recovered from all spaces except areas between structures, and most frequently from adjacent, outside, and patio areas. As with the squash species, maize was also recovered from the interiors of buildings, but only once each from a ground level structure and a structure atop a mound. In these cases, maize was indexed only by phytoliths, which may correspond with food preparation but not disposal, or the use of previously-deposited material in construction. As with the squash, it is curious that no maize was recovered from between structures, which may have to do with nodes of deposit or construction. Overall, however, maize is most common, as leaf and cob phytoliths, and as charred kernels and cupules, in areas associated most often with disposal of detritus, through sweeping or dumping.

In terms of various commonly eaten fruits, there were some similarities between hackberries *(Celtis),* cactus fruits *(Mammillaria),* custard apple family taxa *(Annonaceae),* papaya *(Carica papaya),* avocado *(Persea americana),* and nance fruits *(Byrsonima crassifolia)*. Hackberry, papaya, nance, and custard apple family taxa were recovered most frequently from areas adjacent to structures. Hackberry and nance were also found once each outside of patio groups, along with avocado and cactus fruits. Custard apple was found in the interior of structures and in patio areas, where it may have been grown, as it is here represented by uncharred phytoliths. As all of these taxa were likely fairly common foodstuffs, it is unsurprising to find their remains scattered in common disposal and preparation areas, as well as occasionally re-deposited in construction fill.

Bean family *(Fabaceae)* species were found in almost every kind of space, although the lone edible bean *(Phaseolus)* was recovered only from an area adjacent to a structure, which is consistent with what seems to be a locus for food disposal. The spatial locations of other bean species may correspond with medicinal uses, tinder, or other unknown uses. It is also possible that these species in some cases are simply adventitiously-growing taxa which came in close proximity to high temperatures.

Those taxa associated with root and tuber crops were consistent with the refuse-disposal and reuse-as-fill patterns already hypothesized. Arrowroot (*Maranta* sp.) was recovered only in phytolith form, once from the interior of a structure and once adjacent. Achira *(Canna sp.)* was recovered just once, from a patio. Arrowroot family (*Marantaceae)* species, in phytolith form, were recovered most frequently from adjacent structures, outside, and inside of patios, and once each from a structure atop a mound and a structure at ground level. Lirén (*Calathea* sp.) phytoliths were recovered primarily from adjacent contexts, with some frequency outside the patio group and once each from the patio and the interior of a structure at ground level. Adjacent, outside, and patio recovery may represent disposal of refuse, while the presence of these taxa in interiors of structures in several places may correspond with areas of processing or construction episodes.

Several herbs associated with medicinal and condiment purposes were scattered across a variety of spaces. The lone trumpet tree (cf. *Cecropia peltata)* seed was recovered from a patio area. Pennyroyal *(Hedeoma* sp.), *Hirtella,* and *Potentilla* were recovered from disposal and sweeping areas (adjacent, outside, and patio), consistent with the majority of food refuse. Potentilla seeds and *Hirtella* phytoliths were also recovered from structures atop mounds. Sunflower family *(Asteraceae)* species, were recovered from all contexts, as phytoliths and seeds, most frequently from adjacent, outside, and patio areas. Mint family *(Lamiaceae)* seeds were recovered most frequently from areas adjacent to structures, and once outside of a patio group. The wider variety of spaces encompassed by these species may reference adventitious growth in homegarden and disposal areas, in addition to deliberate use and disposal.

In terms of species often associated with homegarden or patio areas ethnographically, in the *Burseraceae* and *Magnoliaceae* families, there was some recovery from patio areas, which was anticipated. Phytoliths corresponding to both families were also recovered from the interiors of a few structures, and in the case of magnolia family species, adjacent to structures and outside the patio group. Aside from the occasional interior recovery, such patterns are consistent with the growth of various species among houses and mounds. Recovery from interiors likely corresponds with decomposed implements, furnishings, or earlier construction fill.

Cyperaceae family phytoliths were recovered primarily from outside patio groups, with some appearing adjacent to structures and in patio areas. The frequent appearance of these seeds and phytoliths may be related to their use as tinder, baskets, or their proximity as common adventitious weeds.

A few species found infrequently, but with high economic value, were recovered from across an array of spaces. Bottle gourd (*Lagenaria* sp.) phytoliths were recovered only once from a surface immediately adjacent to a structure. It is likely that decomposed bits of a serving or storage vessel, swept or thrown to the side of the structure, are responsible for its presence at this location. Copal *(Protium sp.*) was also recovered only once, in phytolith form, from adjacent to a structure. As this species is more commonly found in forested areas than in homegardens, it is not surprising to find it rarely represented. Tobacco (*Nicotiana* sp.) was recovered from three places, each unique (between, outside, and interior of a structure at ground level). These tobacco seeds were likely dispersed as elements of fill, swept into disposal areas, and/or distributed as a result of fruits falling from plants left hanging to dry.

In general, the spaces where various flora were recovered fit expected patterns of disposal, growing, processing, and incorporation into architectural fill. Through following these various plants, we can see glimpses of associations between particular plant practices and particular spaces. In the following sections, I turn to the plant profiles of these spaces, to track the syntagmatic associations between elements.

Space to taxa: What differences and similarities exist between spatial types?

In this section, as with the artifacts in Chapter 10 and the contexts in Chapter 12, I begin with a comparison of spatial types, looking at the "average" profile for each space. I compare spaces in terms of taxa richness broadly and relative abundances of various taxa more specifically. I also briefly discuss taxa associated with only a single spatial category. Finally, I explore standardized densities of charred botanical remains by count and weight.

In calculating richness for each kind of space, I do not include Unknown or Unidentifiable botanical parts (wood, parenchyma lumps, seeds, etc.), unless these are the only items available. I also expand taxa diversity in cases where unknown woody species are combined with herbaceous grass species, as in the cases where only *Zea mays* and wood are found. I calculate the maximum frequency of unknown phytoliths OR unknown seeds, whichever is greater, to prevent possible overlap between a taxon which produces both recoverable seeds and phytoliths. Ultimately, what I calculate is a minimum number of taxa recovered, per spatial type. I follow many of the same parameters as those I have outlined in Chapter 9. (For example, I did not overlap *Poaceae* family seeds with *Poaceae* subfamily phytoliths.)

In **Figure 11.5**, I order the spaces from those with the fewest samples analyzed to those with the most, and plot species richness along this same axis. The expectation is that, following a normal population distribution, the richness of the sample will increase as the number of samples increases, until the number of species plateaus at maximum possible population (similar to Lennstrom and Hastorf 1992). This plot is somewhat complicated by the different volumes of sediment taken (varying between 2L and 10L), however, the chart does reveal a few surprising points.

Overall, following a normal distribution of plant remains, the expected taxa richness holds true for most spaces. In general, the number of species recovered does rise as the number of samples increases. However, two spaces have greater richness than what is anticipated by the model. The single locus from the area between two adjacent structures was markedly diverse in terms of botanical remains, while the interior spaces of structures located at ground level had only slightly more taxa than anticipated.

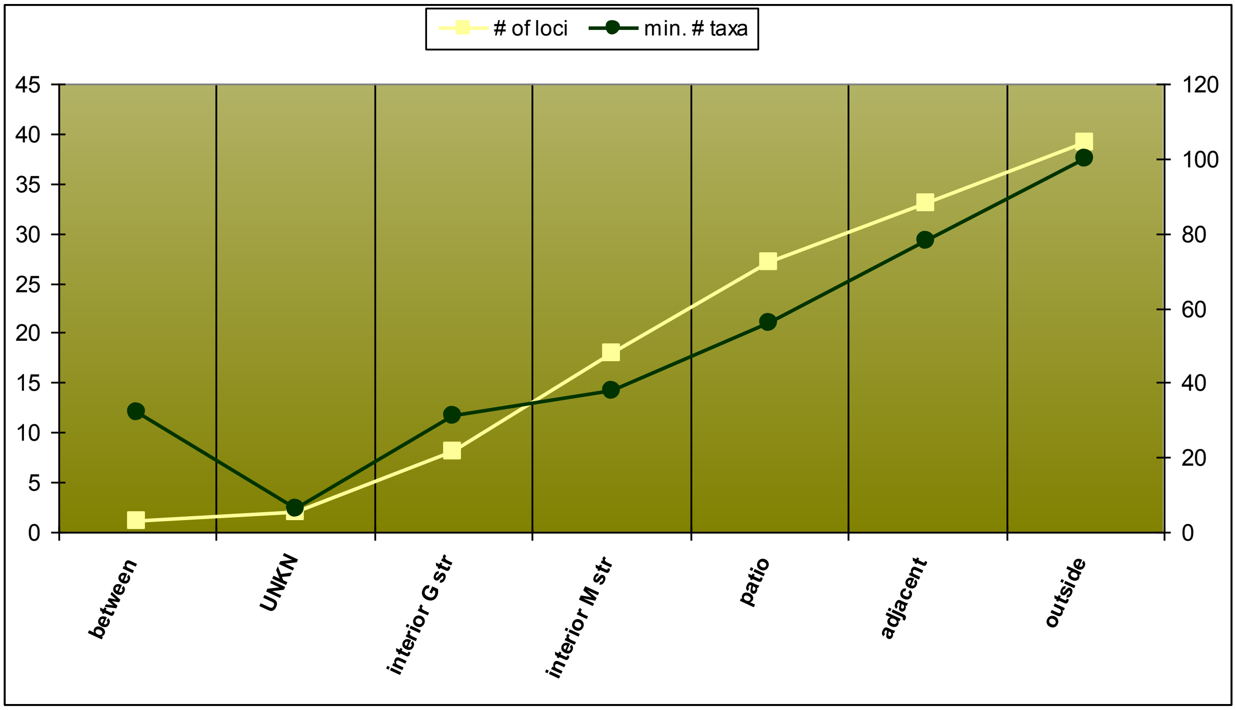


Figure 11.5: Comparison of number of samples collected and taxa richness. Darker line indicates taxa richness (n = 6-100 species) and lighter line indicates total number of samples collected (n = 1-39 samples).

In the case of the lone "between" space, as there was a surprisingly wide variety of taxa present (12 in total). Unfortunately, as there was only one sample from a space of this type, there is no basis for comparison with similar samples. It is possible that various materials were deposited here indiscriminately, as is the case for midden contexts. However, the space does not seem to have been designated as a formal midden, as evidenced by the lack of significant numbers of ceramic sherds and other refuse. It is possible that, at least in this case, charred organic materials were left in place, whereas harder and more durable materials were shifted elsewhere. This practice would be consistent with the potential use of the area as an occasional pathway.

There were slightly more taxa represented in the floors of interior spaces of structures located at ground level than were anticipated. This may indicate that food preparation, and related detritus (including scraps of matting, basketry, etc.), often occurred in structures at ground level. Such is anticipated by ethnographic models and archaeological evidence from the site of Joya de Cerén (Sheets 1992, 2002).

In looking at individual spaces, there is patterning, with variation in the frequencies of taxa across different spatial categories. I calculated the number of times that a taxon was recovered from a particular space, and presented this figure as a percentage relative to the number of times other taxa were recovered from the same type of space. Highest frequencies of recovered taxa are represented by larger pie slices, while less frequently recovered taxa have much thinner slices. I here group the data in terms of recoveries of materials in close proximity to structures, materials inside of structures, and materials from areas inside and outside of the patios.

It is difficult to calculate the differences between areas between and immediately adjacent to structures **(Figure 11.6 and Figure 11.7)**, as only one sample was analyzed from the "between" category. However, both of these spatial types, located in closest proximity to structures (though not inside them), demonstrate a high number of species recovered. As discussed further on, it is very surprising that the "between" sample is so diverse, considering the small sample size.

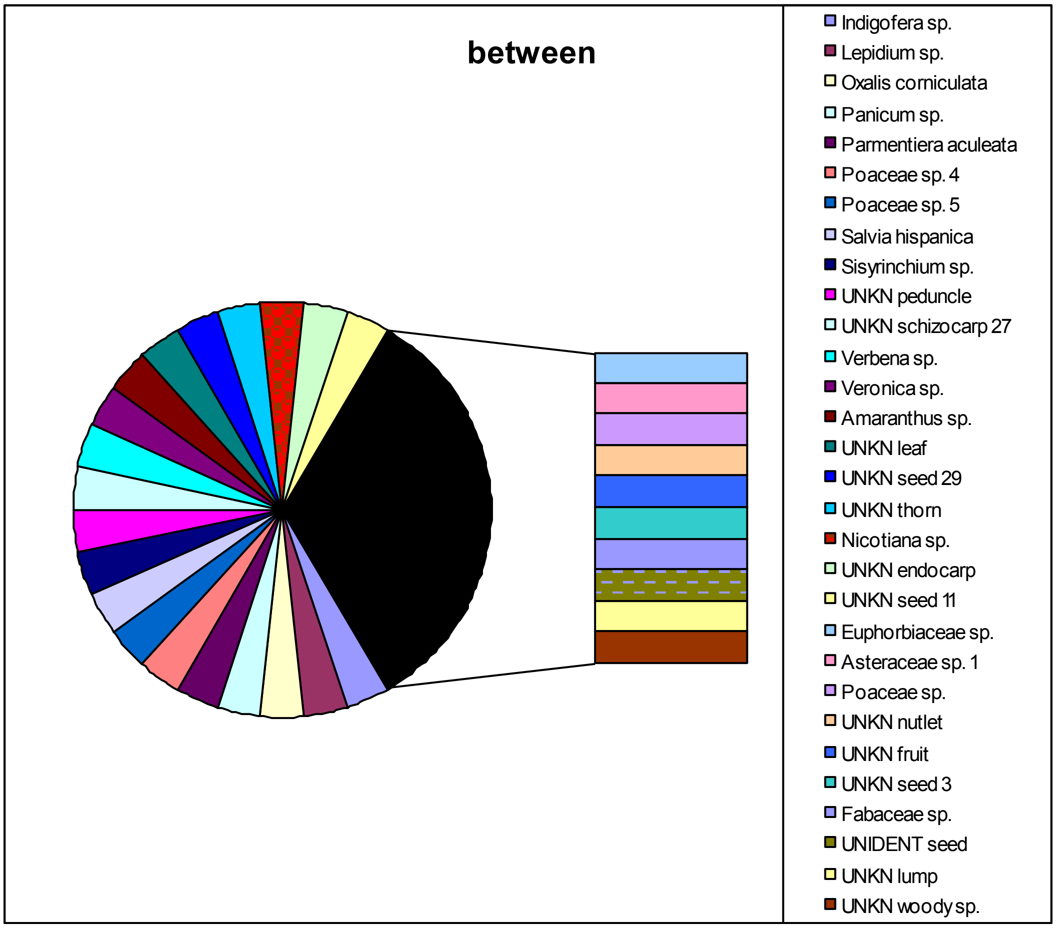


Figure 11.6. Relative frequencies of taxa recovered from sample of area between structures (n=1).

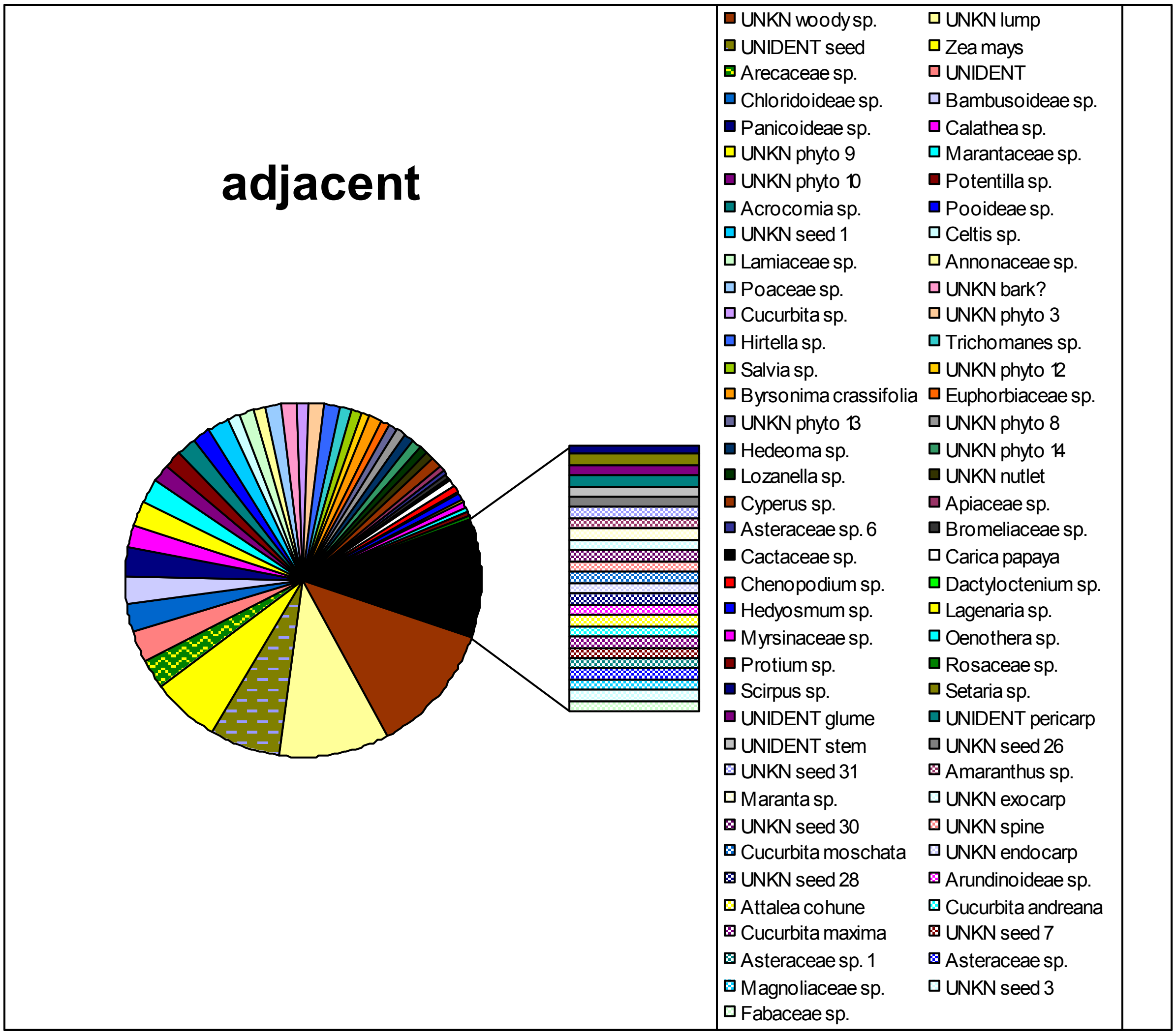


Figure 11.7. Relative frequencies of taxa recovered from samples of areas immediately adjacent to structures (n=33).

As with areas inside and outside the patio area, areas adjacent to structures demonstrated a high frequency of unknown lumps, wood species, and unidentifiable seeds. Maize and the detritus of various foodstuffs were also frequently present. This would appear to corroborate the hypothesis that areas immediately adjacent to structures were frequently used as "dumping" zones, as already suggested by comparisons of broad richness between these three areas.

In comparing structures at ground level **(Figure 11.8)** to those atop mounds **(Figure 11.9)**, there are some striking similarities. Unknown storage tissue lumps and woody species accounted for a high relative percentage of recovery, making these items highly ubiquitous inside both types of structures. A large number of unknown species were recovered from the interiors of each, but were found most often in the interiors of structures at ground level. The relative ubiquity of foodstuffs was roughly similar in each, in terms of squashes *(Cucurbita* spp.) and cocoyol palm *(Acrocomia* sp.). Various grasses *(Poaceae* spp.) were also similar between the interiors of different structures, which may correspond with matting, thatching, and other uses as described above.

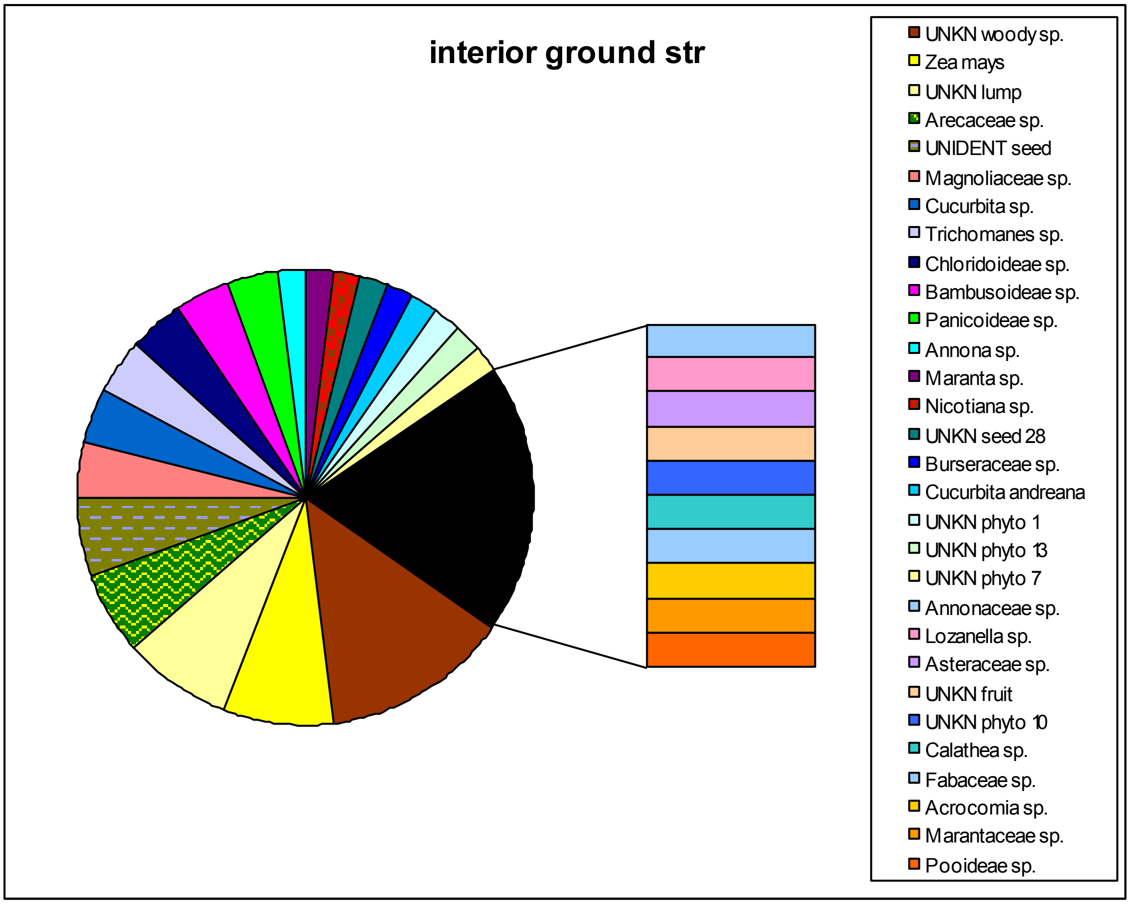


Figure 11.8. Relative frequencies of taxa recovered from samples of areas inside perishable structures at ground level (n=8).

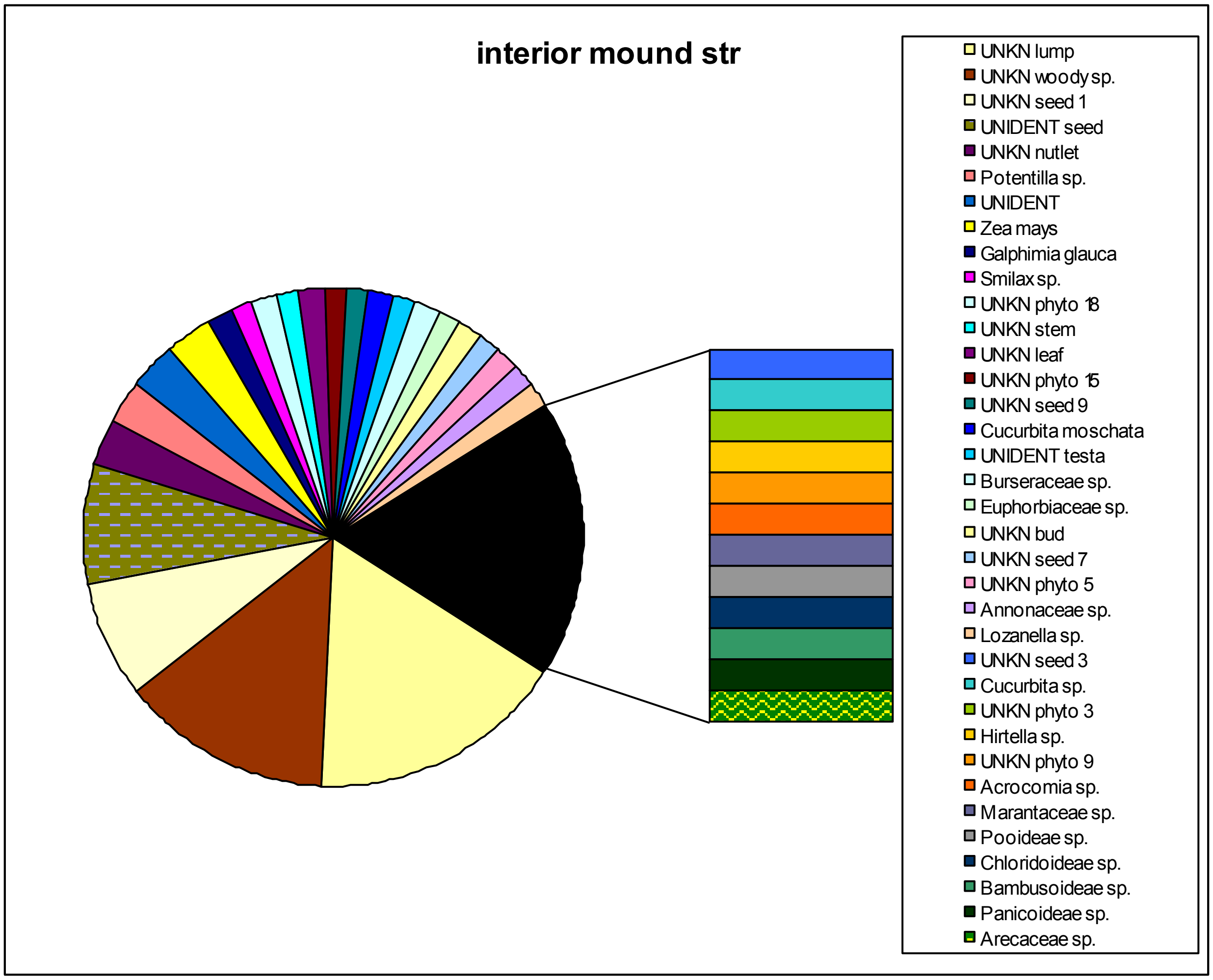


Figure 11.9. Relative frequencies of taxa recovered from samples of areas inside structures atop mounds (n=18).

Most strongly differentiating these two spatial types are the relative frequencies of palm species and maize. Maize and palm species were found most often in the interiors of ground-level structures. The palm frequencies are likely also related to similar uses as those of grasses, as described above, in house construction. If we use maize as an index, foodstuff preparation appears to occur most often in structures at ground level. The high relative frequency at this spatial type of annona (*Annona* sp.*)* fruits, as well as root crops such as *Maranta* and *Calathea*, appear to corroborate such an index. However, the relatively similar frequency of other foodstuff types (cocoyol, squashes, and potentially rootcrops from *Marantaceae* and fruits from *Annonaceae*), in these two spaces, demonstrates that there is no clear distinction between them. Some structures atop mounds appear to have been loci of food preparation, as were some structures at ground level, but foodstuffs are not uniformly ubiquitous across either of these structure types.

Looking at the differences and similarities between structures inside **(Figure 11.10)** and outside patio groups **(Figure 11.12)**, there is similarity in terms of the broad richness of taxa recovered, although each spatial category corresponds with a very high number of samples taken, which would tend to increase the number of taxa recovered. Woody species, in both cases, occupied the position of most-frequent item recovered. Unknown lumps, palm species, and unidentified species were also frequently present in both types of samples. Various types of foodstuffs and ruderal species were also recovered equally frequently, relative to other types of taxa, although in the types differed slightly from location to location.

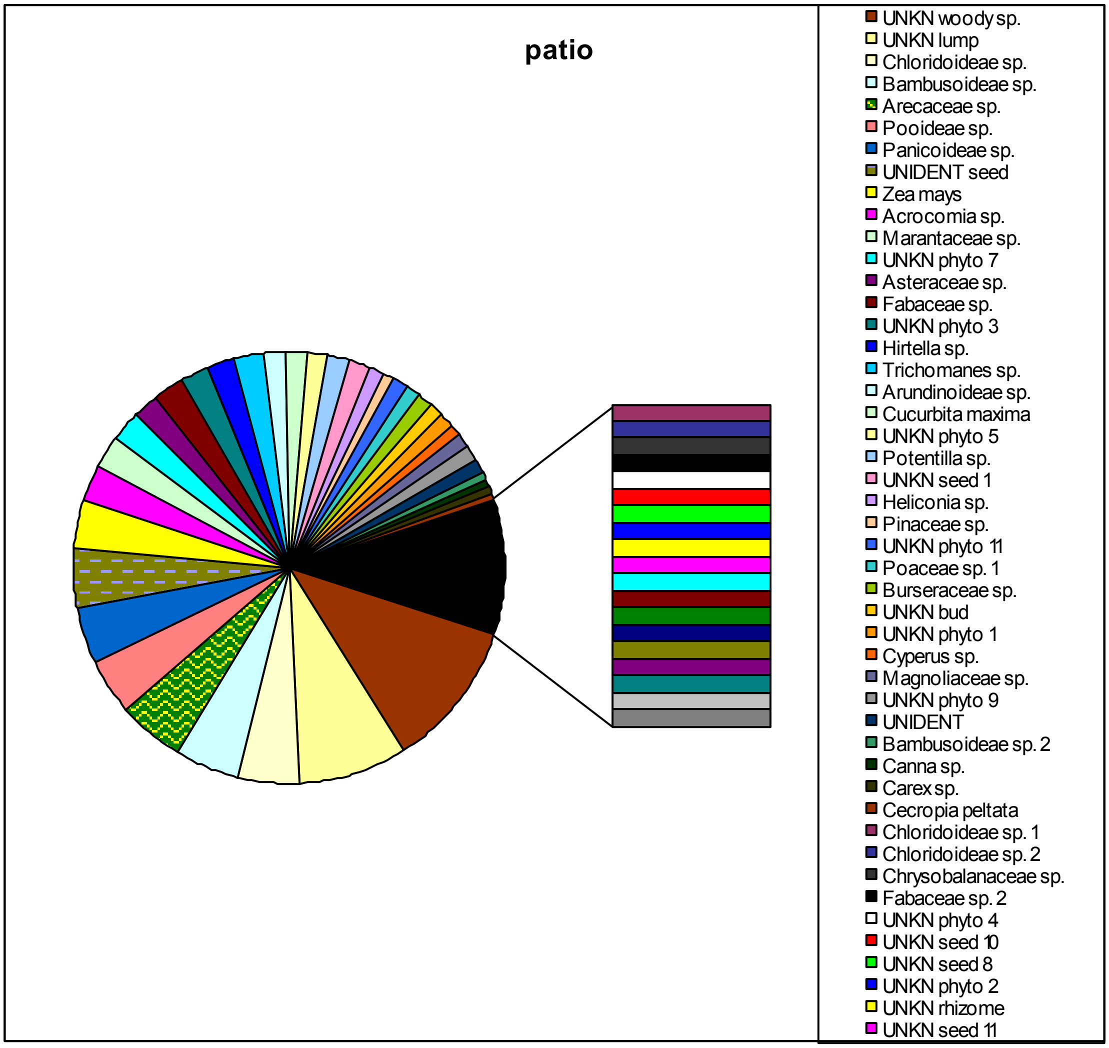


Figure 11.10. Relative frequencies of taxa recovered from samples of patio areas (n=27).

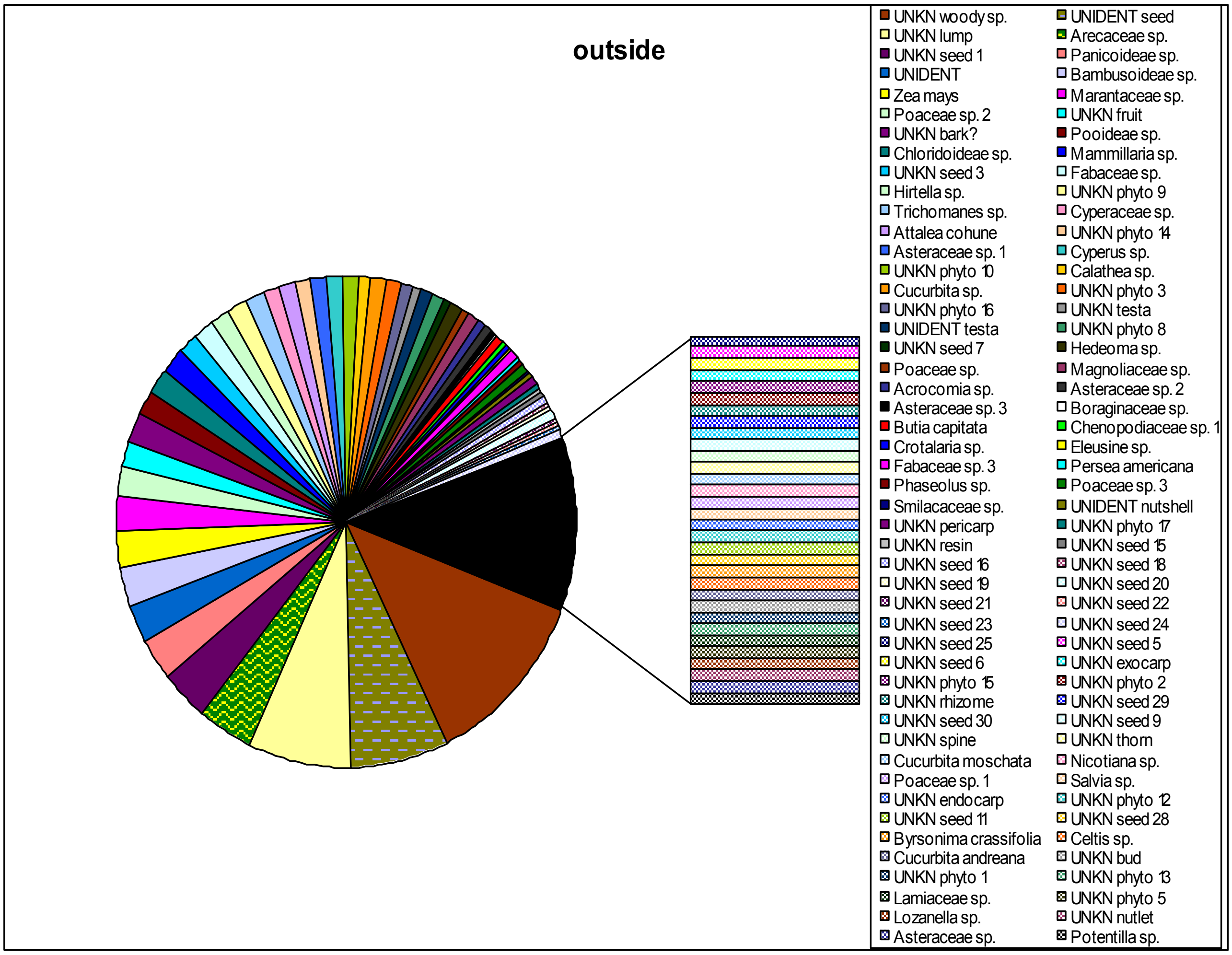


Figure 11.11. Relative frequencies of taxa recovered from samples of areas outside of patio groupings (n=39).

Patio areas, however, were more frequently marked with grass species, especially the Chloridoid and Bambusoid subfamilies. This may correspond with these types of grasses used in thatching, matting, and other similar activities that correspond with architecture or perishable implements. It is curious that grass species are found less frequently in areas outside of the patio group, where they would be expected to grow wild. Overall, however, in terms of taxa recovered, the relative frequencies of various types of plants, and the practices suggested by them, do not seem to have varied dramatically between areas inside and outside of patios, although the densities tell a slightly different story.

When calculating the density of materials per spatial category, I was only able to utilize macrobotanical remains, for reasons stated earlier. When comparing macrobotanical samples, I standardized densities by the volume of sediment floated. I have plotted the charred material density per space in **Figure 11.12** by both weight (in grams) per Liter and counts per liter, in order of counts (lowest to highest).

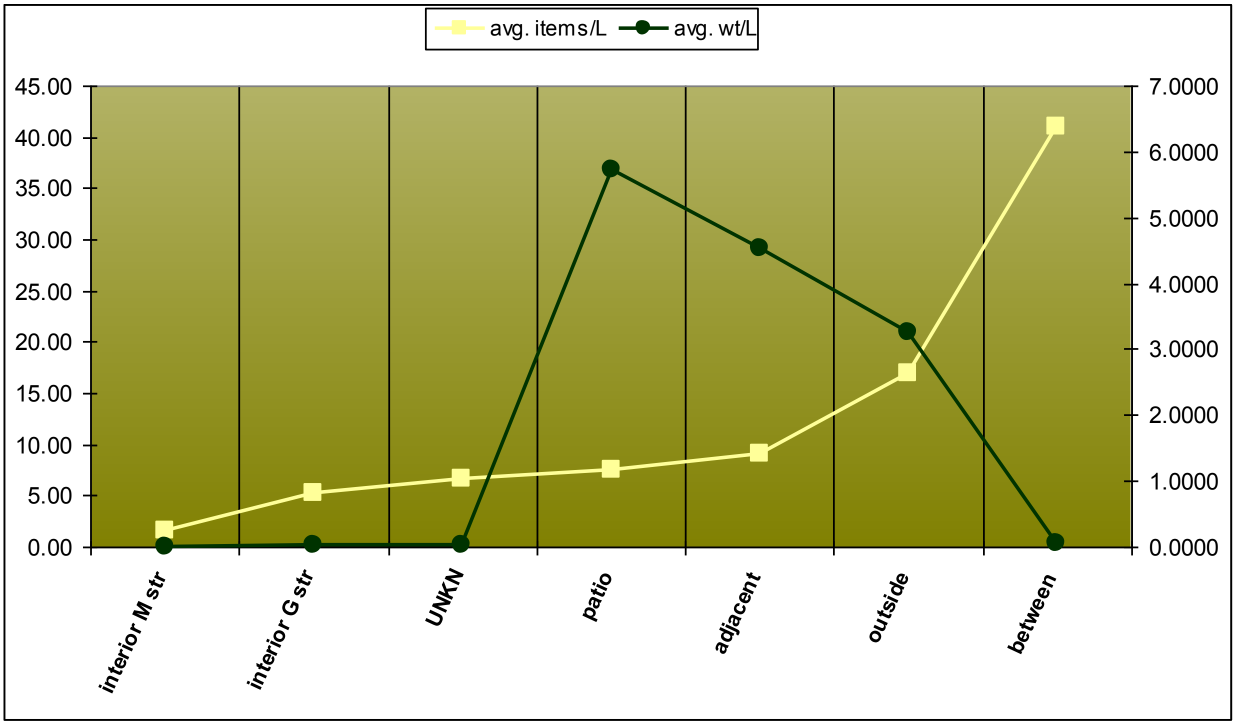


Figure 11.12: Comparison of average counts and weights of charred materials, by spatial type.

Only a few spaces had concordance between increases in per-liter counts and increases in per-Liter weights of materials. That is, if size and weight both had a normal distribution, we would expect the total weight of items per liter to increase as the total count of items per liter increases. In this chart, however, dramatic spikes and drops are noted, in terms of standardized densities. The most striking example, that of patio spaces, demonstrates a marked heaviness of charred plant remains, relative to the average counts. This indicates the deposit of very large items and/or little fragmentation through various formation processes over time. The accumulations of larger charred plant remains may have to do with the presence of typical homegarden vegetation, such as fruit trees and shrubs, where pockets of larger remains represent the disposal of hearth materials and food waste around the base of plants. Ethnographically, such activities are geared not only toward disposal of refuse, but also toward deliberate mulching-- a practice with many benefits to plants.

Areas immediately adjacent to structures also show surprisingly little disintegration of remains. This may be related to the practice of dumping off the sides of structures and/or the presence of "sweep zones", where materials accumulate but are less subject to fragmentation than they are in more open and heavily-trafficked areas. Conversely, the lone sampled area between structures had incredibly high amounts of fragmentation. This augments the earlier evidence regarding taxa richness at such spaces. The combined findings support the hypothesis that this space between structures may have been a pathway, where organic remains were deposited indiscriminately (and subsequently crushed under foot traffic), while larger and more durable objects were kept fairly clear.

Figure 11.13. Potential "sweep zones" adjacent to structures. (Illustration by Sarah Davidson.)

Overall, the interiors of structures (whether ground level or atop a mound) appear to have been kept relatively clear of plant detritus. Patios and areas immediately adjacent to structures appear to have a normal level of everyday scatter, deposit, and re-deposit of materials. Areas outside the patio group tend to have the densest accumulation of materials, which is consistent with where we would expect to find midden contexts. The lone representative of areas between structures has a high number of remains, but they are also highly fragmented, likely indicating the physical breakdown of what would have otherwise been represented as a normal level of scatter and deposit.

In considering taxa richness, relative frequency profiles, and densities of charred plant remains, some expectations were met and others were not. It does appear as though disposal was heaviest and most frequent in areas outside of patio groups, as represented by both concentrations of remains (standardized densities) and kinds of taxa represented **(see Figures 11.14, 11.15, and 11.16)**. The interiors of structures were toward the lower end of the scale, in terms of densities and richness of plant remains, whether at ground level or atop a mound. Patios and areas adjacent to houses are toward the higher end of the scale, in terms of densities and richness of plant remains. The single sample analyzed from between structures is unexpectedly diverse and contains a relatively high density of remains, but upon further reflection does not fall entirely outside the parameters of ethnographic and archaeological analogs. It seems as though charred remains were ubiquitous across surfaces, but densities varied, according to potential areas of deposit as structured by built space. Interior spaces were generally cleaner. Spaces exterior to structures but inside the patio area, such as a potential pathway between structures, areas adjacent to structures, and patio activity areas, had more materials. Areas exterior to the patio group had the most materials, and seem to be the locations of heaviest deposit.

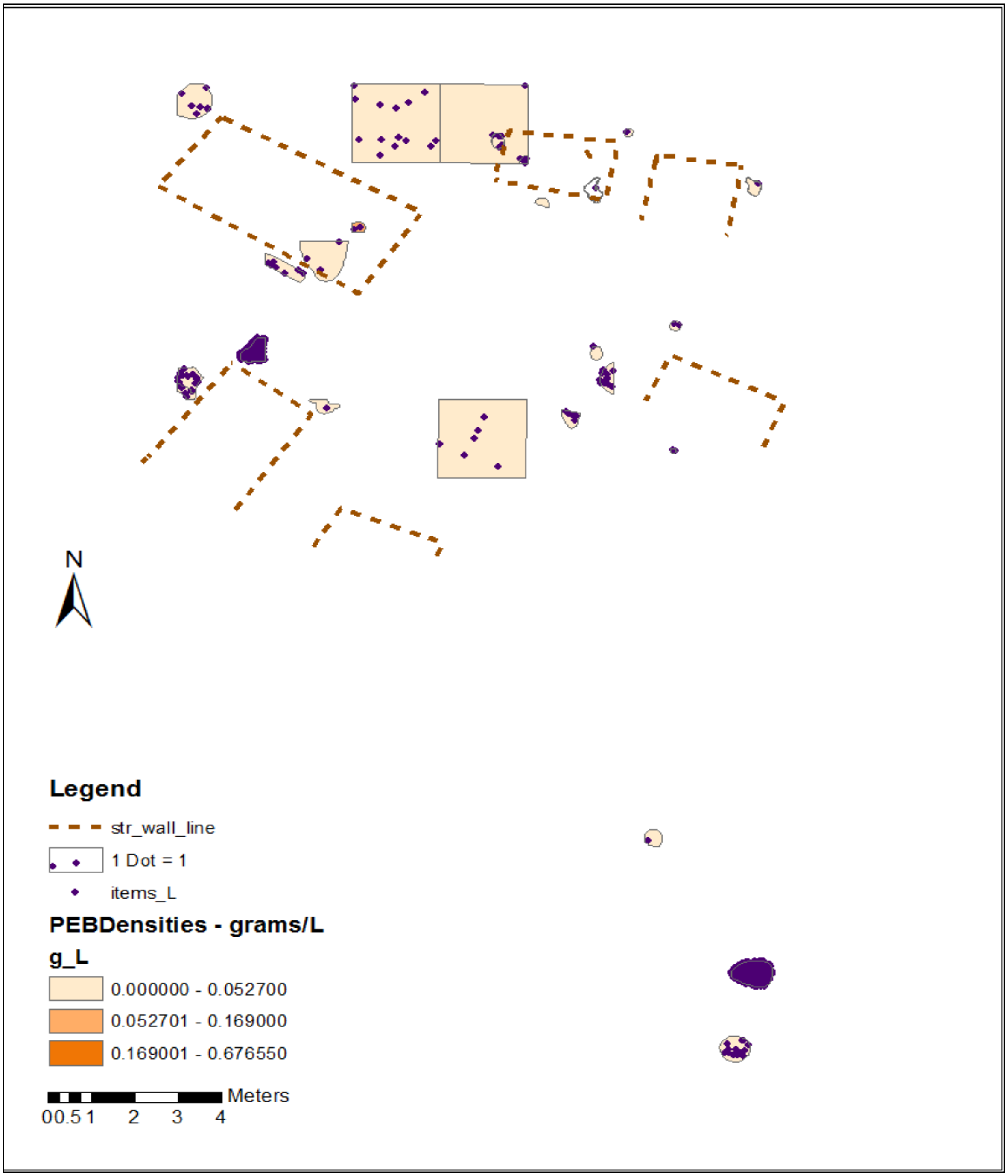


Figure 11.14. Puerto Escondido: Standardized densities of charred macrobotanical remains in excavated locations, by items/L (represented by dots) and grams/L (represented by orange shading).

Figure 11.15. Los Naranjos: Standardized densities of charred macrobotanical remains in excavated Formative-period locations, by items/L (represented by dots) and grams/L.

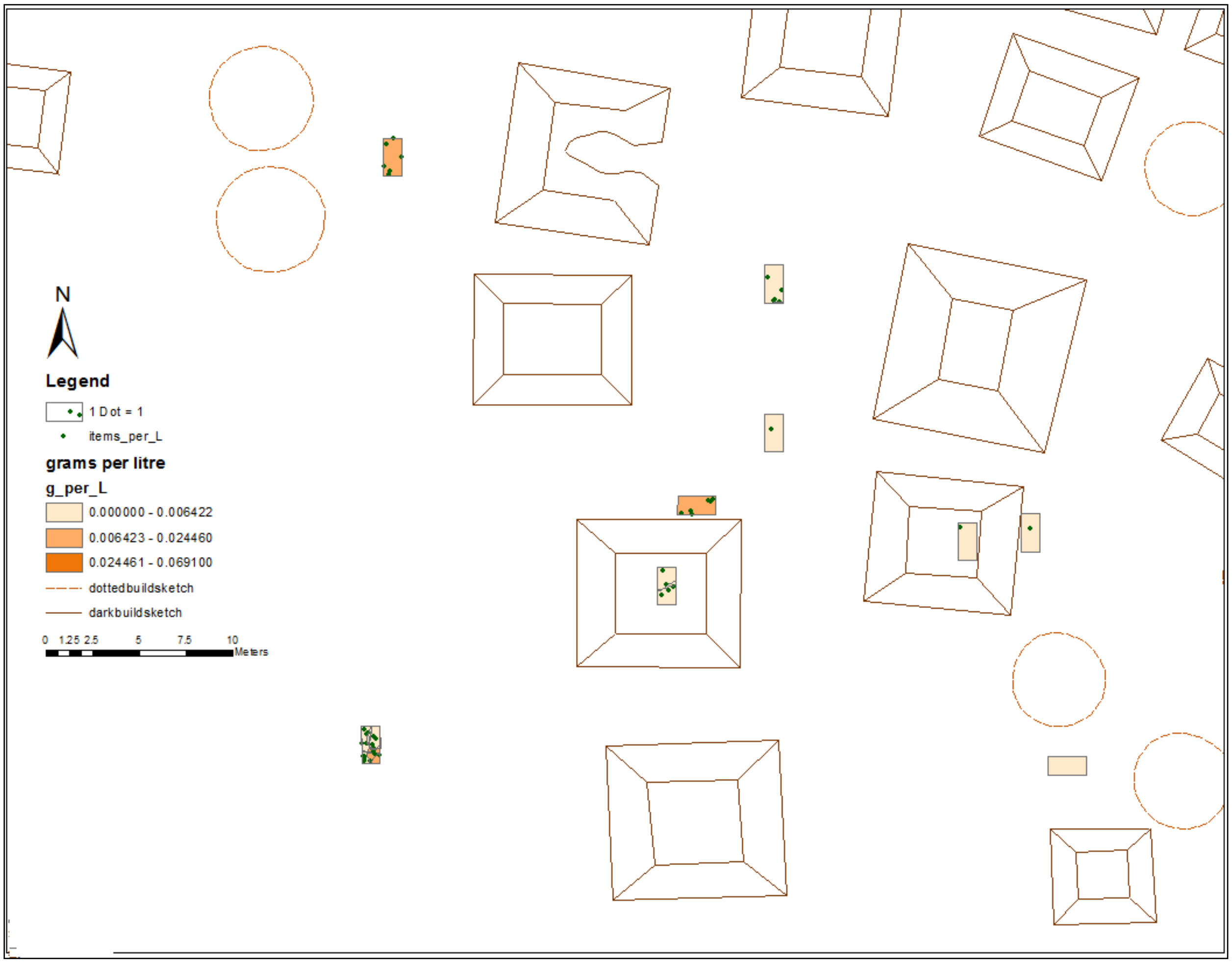


Figure 11.16. Currusté: Standardized densities of charred macrobotanical remains in excavated locations, by item/L (represented by dots) and g/L (represented by orange shading).

Moreover, taxa we would expect to find in homegardens, such as heliconias and *Burseraceae* trees, emerge as uncharred phytolith remains and may have been growing in patios. Such plants may have been fostered through mulching practices, as evidenced by larger deposits of remains in patio areas. Various grasses and palms are spread across all areas, likely representing ruderals, thatching materials, and mats, among others. Taxa representing food remains are found as refuse scattered cross-site, with slightly higher frequencies in areas adjacent to structures, in patios, and outside of patio groupings.

Summary

When discussing foodways and ethnobotanical practice, issues of settlement, space, and place come to the foreground. In a general sense, studies of such practices get at similar things–social organization and daily practice dynamics. In Southeastern Mesoamerica, however, foodways are often directly tied into socio-spatial models, whether explicitly or implicitly.

Social dynamics (or perceived lack thereof) are often considered to be directly linked to settlement and space, and foodways often piggyback on such models, especially when considering the diversity and quantity of foods available to a society or household. Foodways have to do with decision-making and where it is nested, from the individual to the governmental, and ties between these decisions and the ecological, from the microenvironment to the ecological zone. Often, however, discussions of "land use" are tied into hidden algorithms of "production per acre" and "product per person." Such algorithms are usually left unstated, even in formulations of demographic size. However, ethnobotanical practices and socio-spatial relations are two entities with related but often very differing dynamics.

As here demonstrated through analyses of different spatial categories and the varying taxa found within them, there are both patterns and anomalies in the dynamics between spatial and ethnobotanical practice. In some cases, spatiality appears to have little impact on ethnobotanical practice, as indexed, for example, by the high frequency of unknown wood species across the entire array of spaces. In other cases, particular types of spaces are tied to varying aspects of practice. Divisions between public and private areas appear to be marked by slight increases in diversity and density of plant refuse, with disposal more indiscriminate outside of structures, even when abutting them. Structure interiors are differentiated from structure exteriors by amounts and kinds of refuse, as well as a much more limited diversity of taxa. Areas often used for disposal appear to be mostly outside of structures, concentrated primarily adjacent to structures and in the exteriors of patio groups, with a high amount of disposal taking place inside patio areas, as well. Patio areas are similar to the areas outside of them, in terms of the high diversity and quantities of taxa deposited, but differ in terms of average density of remains and types of plants likely growing *in situ*.

It is also evident that space both contextualizes and is formed through ethnobotanical activities, along with other kinds of practices. Areas used primarily for disposal, homegardens, and/or daily ethnobotanical activities are left clear of architecture. Moreover, some structures appear to have been designated for uses more associated with food preparation and/or storage. Finally, (and to state the obvious), many plants are utilized in the actual construction of spaces and their furnishings, whether as posts, thatch, mats, or fencing.

Spaces, places, and foodways lie in nested relationships within the cultural and natural environment, from viewsheds to water sources (Bender 1993; Fedick 1996; Tilley 1994). As previously noted, "social activity is always constituted in three intersecting moments of difference: temporally, paradigmatically (invoking structure which is present only in its instantiation) and spatially" (Giddens 1979:54). It is in such intersects that paradigmatic and syntagmatic axes of foodways become manifest. In the following chapter, I address “place”, specifically, through the study of various types of contexts.

12. Paradigms and Syntagms of Ethnobotanical Practices and Place-making

Arguments employing direct-historical approaches are implicit in literature addressing everything from demographics to daily life. These arguments are our "taken-for-granteds" when we talk about food options available in the past, and how they were selected. As paleoethnobotanical studies are particularly scant in Southeastern Mesoamerica, such approaches have traditionally provided the framework from which archaeologists' paradigms of foodways have emerged. Moreover, in considering the ways that people distribute themselves and enact practices, across and within landscapes, ethnohistory and ethnography have often provided starting points for comparison. Places, often cast as activity-areas, are frequently subject to this trajectory of research.

In the previous chapter, I explored the practices carried out across various spaces. I also detailed why I have divided "space" and "context" into two separate aspects of analysis. In this chapter, I explore place-making, as related to ethnobotanical practice. I endeavor to answer such questions as: are some taxa associated with particular types of contexts (e.g., that grinding and processing of maize takes place on compacted surfaces)? Are some taxa more ubiquitous across contexts than others (e.g., that maize is highly ubiquitous)? Are there changes in certain taxa combinations over the landscape, in terms of associations with context types (e.g., that maize and other foodstuffs are likely to co-occur)?

In the course of this discussion, I view 148 botanical elements over 16 types of contexts **(see Table 12.1).** These contexts are located across a variety of spaces and time periods. The information gleaned comes primarily from comparisons of macrobotanical remains, but I make use of microbotanical analysis where possible. Unfortunately, microbotanical analysis of sediments could only be carried out at the site of Currusté.

I begin this chapter with a short review of landscape, contexts, and nodes of practice. I then turn to the ways that an individual taxon plays out across different contexts, making use of ubiquity and relative abundance analyses. Changing perspective, I then view individual contexts, and the ways that different ethnobotanical practices play out across them. I look first at differences and similarities between context types, and explore some of the variability within individual contexts. In both of these cases, I evaluate taxa richness, relative abundances, and material densities. As in previous chapters, I also turn to associations between taxa, as recovered from the disparate contexts. Broadly, in comparing contexts and the combinations of taxa therein, I make interpretations regarding the semiotics and activities of place.

Layout of the landscape and domains of practice

Following the ethnographic and ethnohistoric literature of broader Southeastern Mesoamerica, the layout of the landscape is quite deliberate, incorporating "an enormous stock of knowledge regarding the local ecology, the distribution of soil and vegetation types, the conformation of the land, and the location of specific natural features in the area" (Hanks 1990:308,322; also in Redfield and Villa Rojas 1962 [1934]:43, and similar to Balée and Erickson 2006). Broadly, there are several domains that have been defined as intensively food-related: the *milpa*, the home garden, the kitchen, and the market.

Milpas are agricultural areas used for "maize intercropped with beans, squash, and often other plants, with numerous islands of trees" (Anderson 1995:142). They may be adjacent to residences, or even up to 30 kilometers away (Hanks 1990:355). Hanks identifies several main crops of the milpa: "big old" maize, "big white beans", "big squash", and "big black beans" (Hanks 1990:355). Camotes (sweet potatoes) and yuca (manioc) were, during the colonial period, grown in the fields between corn "hills", and dug out with a pointed stick (Tozzer 1907:53). Although maize currently provides the bulk of calories, Anderson notes the important use of "chiles, fruit, squash, and perhaps wild plants for vitamins and minerals [and variety!] lacking in the grain crop" (1995:145).

Gillespie et al. (1993:157) detail the use of what they term "forest covered home gardens," and their role in supplying food and other products for direct family consumption or marketing. Hanks notes, "The residential *soolar* is cultivated with as much productive plant life as possible: trees, corn, or garden, depending on the quality of the soil and availability of water" (Hanks 1990:316). Residences are often completely surrounded with trees (1990:320). In the immediate vicinity of the solar, people water the domestic garden, sweep, weed, grow flowers, and maintain the domestic cooking fire (Hanks1990:112).

Hanks claims a symbolic link between women and the kitchens in which they work (1990:107), and that the kitchen is sometimes termed a sort of *nah* [residence] which corresponds to the woman's sphere of activity (1990:322). Daughter-in-laws and mother-in-laws generally cook together and/or share a single kitchen (1990:102), although "while one resident daughter-in-law may share the kitchen of the senior woman, relatively independent wives usually have their own kitchens, and this is the center of their personal domains" (Hanks 1990:106). However, on occasion, sisters-in-law may cook for or with one another (Hanks 1990:109). The fire may be made "on the dirt floor of the house or of an adjacent thatched separate kitchen" (Redfield on 1940's Chan Kom, 1950:44).

Meal times are socially dynamic affairs, and as Hanks reveals, "Eating together is an important form of sociality in Maya culture" (Hanks 1990:108). In the sixteenth century, Landa noted that men and women would not eat together, but rather ate separately, on the ground, sometimes with a mat for a "table". Similarly, Hanks describes how, at mealtimes, "women serve men but do not typically join them in eating. Men eat at a table, usually removed from the heat of the kitchen fire, while women remain within reach of the fire" (Hanks 1990:111).

If food is not grown by an individual or a household, it may be obtained through markets, where locals sell produce, among other goods. Regarding staples, Redfield and Villa Rojas (1962 [1934]:56) noted, "From time to time [the farmer] uses small quantities of maize for purposes of barter at the local store or in buying goods or services from his neighbors; and moreover... he sells some of his accumulated harvest in the town." Supplies were also purchased from or sold to neighbors (Redfield and Villa Rojas 1962 [1934]:52), or obtained through gifts and informal exchanges. Morley (in Sullivan 1991:94) discussed gifts of food given to his party during a 1935 visit in Xcacal Guardia that included tortillas, eggs, and fruits. On a more daily level, Villa Rojas remarked (in Sullivan 1991:124) that he was often given reciprocal gifts of food, usually near mealtime, including fruits in season, fresh corn on the cob, corn-based gruel beverages, and occasionally a full meal.

Intensively food-related areas are defined partially through built space, partially through portable materials, and partially through social context, in the same way that any of these elements is defined by the others. However, given these conditions, there are many other contexts that might be accounted for, such as forested areas, storage areas, and burials, among others. Moreover, transformations in elements over time lead to more nuanced places or complete transformations in dominant context. Hanks describes how Maya farmers "approach agricultural space from a diachronic perspective" (Hanks 1990:360), in the sense that areas are defined differently over time, depending on the length that they have lain fallow, the vegetation growing in them, and the amount of soil nutrient depletion (Hanks 1990:360; Redfield 1950:55). This year's cultivated milpa is next year's fallow fields-- a place where deer browse, honey bees pursue nectar, medicinal herbs are gathered, and children play.

In **Table 12.1**, I define the set of contexts I have used to categorize the different places at the four Honduran communities of my study. I did not take part in excavations at three of these sites, and rely entirely on the excavation forms and notes to formulate these categories. In many cases, the designations are my own, and represent an effort to standardize locales for comparison across sites.

Table 12.1: Description of contexts analyzed.

low-density midden (n=25)	disposal area with low density of material. may contain ash or carbon.
high-density midden (n=5)	disposal area with high density of material. may contain ash or carbon.
special deposit (n=3)	matrix with special deposit of ceramic (in-situ smashing or placing) or other items (such as human bone, non-burial)
burned deposit (n=2)	primary burning context that is not a hearth, but related to special activity
kiln (n=5)	matrix interior to kiln feature
hearth (n=7)	material from hearth (primary burning context)
ashy deposit (n=1)	ashy deposit, though not primary burning context. mostly ash, few artifacts.
matrix with carbon (n=3)	matrix containing large quantity of carbon, though not primary burning context
matrix between (n=38)	amorphous occupational deposit between identified surfaces
collapse matrix (n=2)	matrix surrounding stones that includes wall fall/collapse-- sometimes combined with deliberately added additional matrix
architect fill (n=8)	structural or platform fill—separate from collapse
burial matrix (n=4)	matrix within burial context
lined pit fill (n=12)	fill from interior of clay-lined pit, not ashy
pit fill (n=3)	fill from interior of a pit, -not- clay lined, not ashy
external surface (n=2)	discrete use compacted surface, exterior to structure & platform mound
platform surface (n=0)	surface atop a platform mound but OUTSIDE structure
interior str surface (n=7)	floor interior to structure (whether structure is atop or off-platform mound)

It is through this expanded set of contexts that I view ethnobotanical practices in different places. All of these contexts are restricted to on-site locations, so there is no "milpa" area represented, although home garden areas are likely to overlap with some of the contexts. Moreover, one context— platform surface— was not part of the analysis. Although this context was recovered in the course of excavations at Currusté, none of the materials analyzed came from this type of location.

What contexts are associated with each taxon?

To look at each plant and its associated practices across the fifteen represented context types, I first recorded the contexts associated with each taxon **(see table 9.2).** However, I center my discussion only on those taxa that have multiple appearances, and those taxa that have broader implications in terms of practice. I highlight the taxa richness of each context type per taxon, and the ubiquities of each taxon as related to various contexts. I focus, however, on only those taxa which appear more than once in a context. In **Figures 12.1 and 12.2**, I plot the associated contexts for each taxon. (I do not plot unknown woody species or unknown storage tissue lumps, due to their incredibly high ubiquity across contexts, but do discuss them.)

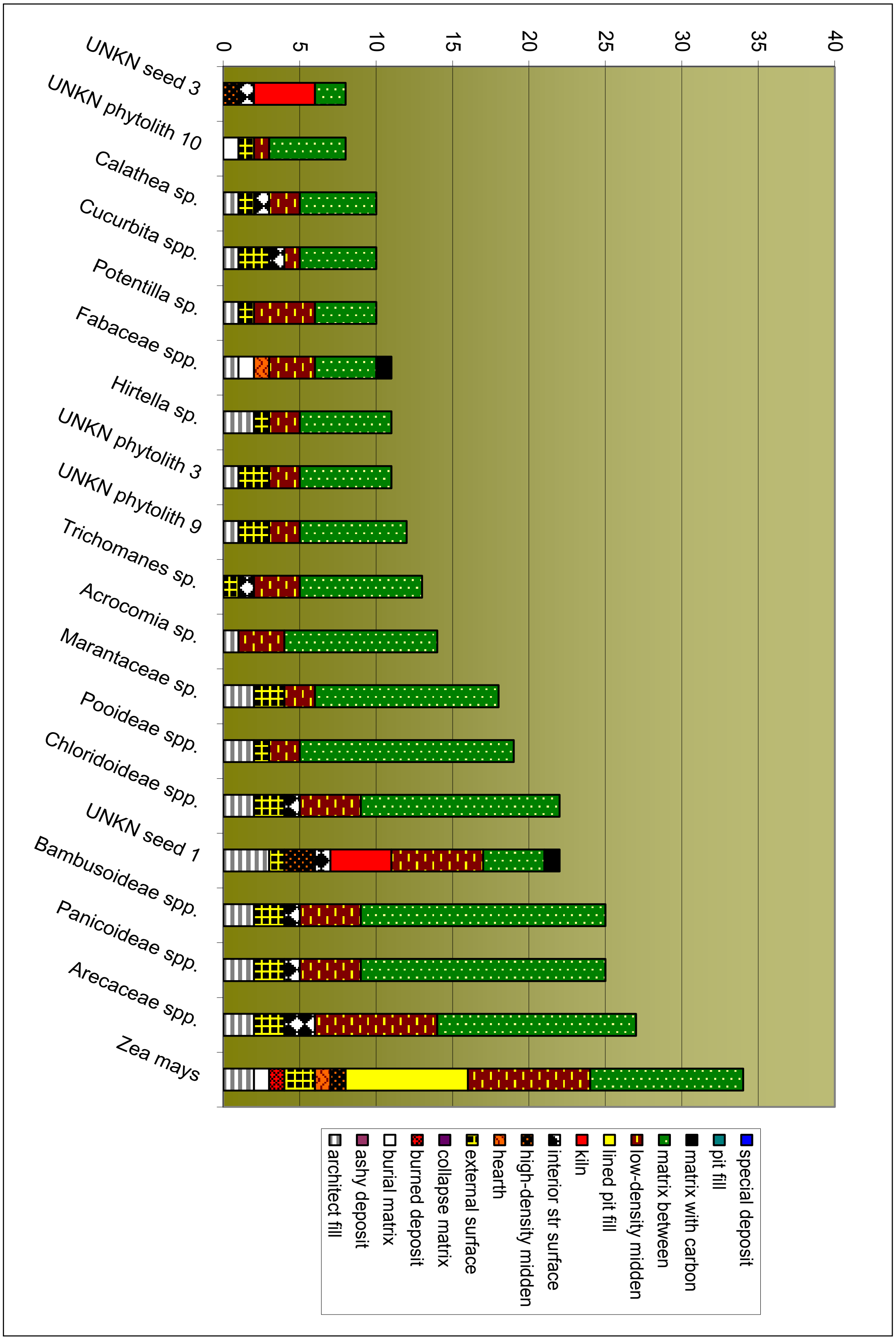


Figure 12.1. Contexts associated with each taxon, where taxon appears >8 instances.

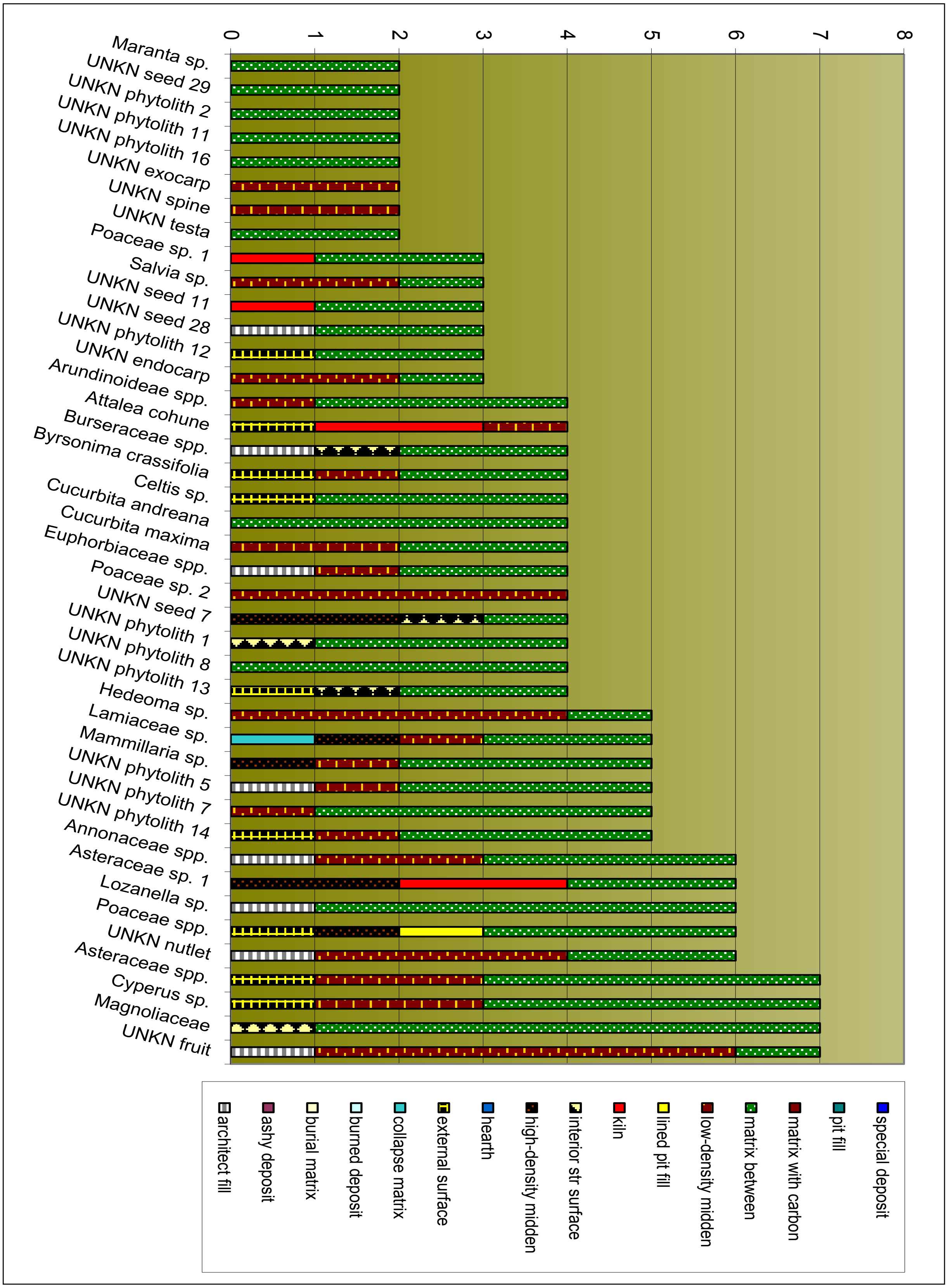


Figure 12.2. Contexts associated with each taxon, where taxon appears >1 and <8 instances.

Several species are associated with a single context-- occupational detritus (coded "matrix between") -- 100% of the time. These taxa are arrowroot *(Maranta sp.)*, one squash species *(Cucurbita andreana)* and several unknown species represented by seeds and phytoliths. This is likely due to the increased chances of more rarely-used plants falling into the material of everyday activity, since a large share of the samples came from "matrix between" contexts (description in **Table 12.1)**. Likewise, two other items, unknown spines and seed coats, are associated with low-density middens 100% of the time. As these are completely unknown taxa, I do not hazard any interpretation here. For the remaining taxa, I focus only on those that are not unknowns.

Chia *(Salvia sp.)* seeds were recovered from only two kinds of contexts: low density middens and occupational detritus. Amaranth seeds were also recovered from occupational detritus, as well as fill from a clay-lined pit. Chenopodium seeds, like amaranthus, were recovered from lined pit fill, as well as a high-density midden. As these are all likely foodstuffs and/or medicinal herbs, it is no surprise that both these species, well documented in historic time periods and commonly recovered from other sites, were found associated with probable food preparation and disposal areas, as well as tertiary-deposit fill.

Representatives of various grass species subfamilies *(Arundinoideae* spp., *Panicoideae* spp., *Pooideae* spp., *Chloridoideae spp., Bambusoideae* spp.) and several unknown subfamilies (*Poaceae* spp., including *Poaceae* sp. 1 and *Poaceae* sp.2.) were recovered in the form of both macrobotanical remains (seeds) and microbotanical remains (leaf phytoliths), across a multitude of contexts. Arundinoid species, the least ubiquitous, were found in only two contexts: occupational detritus ("matrix between") and a low-density midden. Bambusoid, Panicoid, Chloridoid, and Pooid species, the most ubiquitous, were all recovered from architectural fill, external surfaces, and low-density middens, but primarily from occupational detritus. Bambusoid, Chloridoid and Panicoid species were also recovered from an interior surface.

As with their appearance across various spaces and artifacts, the high ubiquity of these grass species likely indexes a variety of practices, as described in previous chapters, including thatching, bedding, tinder, animal feed, and potentially for medicinal purposes. Other means of incorporation into these contexts may have to do with components (intentional or otherwise) of clays and sediments used as daub and flooring materials, wild grasses clinging to clothing and feet, and/or through rodent and wind activity. When viewed in terms of their particular associated contexts, it seems as though grasses appear in the course of everyday activity (matrix between, low density middens, external surfaces), and in the course of construction (architectural fill, interior surface). Moreover, as they are found across surfaces, interior and exterior, it is likely these abundant phytoliths are, underfoot, making their way into compacted paths and floors.

The pattern for macrobotanical recovery of grass seeds, however, somewhat varies from that of other parts of grasses. Various Poaceae grass species (including unknowns, *Setaria* sp., cf. *Panicum* sp., *Dactyloctenium* sp., *Eleusine* sp., and *Poaceae* sp. 1-5), were recovered as seeds several times from low-density middens and occupational detritus, but just once each from a high-density midden and a kiln. Seeds, to preserve, would need to be charred, whereas the phytoliths can be charred or uncharred. This may account for the preservation of seeds at a kiln context. These seeds may have been grasses used as tinder, when preparing the kiln. However, the lack of grass seeds found in hearth contexts makes it unlikely that this was a common use for grass species. The contexts which correspond with everyday activity and deposition—low-density middens and occupational detritus—are expected locations to find various grass seeds (here recovered as phytoliths, as well). The lack of grass phytoliths in the high-density midden and kiln contexts is likely entirely due to the fact that no microbotanical samples were taken from either of these contexts.

Botanical remains of various palm species *(Attalea* sp., *Acrocomia* sp., *Butia capitata,* and unknown *Arecaceae* spp.) were also recovered from a wide variety of contexts. Cohune *(Attalea)* and coyol *(Acrocomia)* palms, along with unknown Arecaceae species, were recovered from low-density middens. Coyol and unknown palm species were recovered from architectural fill and occupational detritus, while cohune and unknown palm species were recovered from external surfaces. A cohune palm endocarp was found at a kiln context, perhaps marking the snacking of someone firing ceramics. Cohune and coyol palms were each recovered from three contexts, unknown *Arecaceae* from five contexts, and the *Butia capitata* only from occupational detritus.

As discussed in previous chapters, the high preservation rates of palm species, both at the macrobotanical and microbotanical level, make them highly likely to remain archaeologically visible, even after the effects of many formation processes. Added to this, palm species are noted ethnographically and ethnohistorically as popular foodstuffs, so it fits with expectations that they appear in contexts where disposal of other food garbage has taken place. Moreover, as the fronds of various palm species are frequent components of thatching, matting, and bedding, the appearance of these species in architectural fill and across surfaces and in general occupational material also fits expectations. Overall, it is no surprise that palm species were recovered as common representatives of daily activity across various contexts.

The many recovered squash species were represented across various contexts, by rind phytoliths. Unknown *Cucurbita* species and *C. moschata* were recovered from architectural fill and an external surface, and unknown squash species were recovered from an interior surface, as well. Unknown *Cucurbita* and *C. maxima* were associated with low-density middens. All squash species (including *C. andreana)* were recovered from occupational detritus. It is somewhat surprising that squash remains were not present in more locales, given that this genus is recoverable both through macrobotanical and microbotanical remains and is an anticipated mainstay of the Southeastern Mesoamerican culinary spectrum. The presence of squashes in low-density middens and occupational detritus fits expectations, as potential food preparation and disposal areas. The recovery from architectural fill, as a secondary or tertiary deposit, is also unsurprising. However, it is curious that *Cucurbita* were found relatively frequently on surfaces, both exterior and interior, as rinds are less "mobile" than leaves from grasses and palms.

Maize *(Zea mays)* was the most ubiquitous item recovered (aside from unknown storage tissue lumps and wood). This taxon was recovered from nine of the fifteen possible contexts, including all contexts likely associated with food preparation or disposal. As with other grass species, maize is recoverable through several types of microremains and macroremains. Maize macroremains included cob fragments, cupules, and kernels, while microremains included several types of phytoliths. Maize is not fully ubiquitous, as it was not recovered from any contexts *not* potentially containing food remains, such as kilns and ashy deposits. Curiously, no maize remains were recovered from the interior surface of any structure, suggesting (more so than any other plant) discrete food activity areas.

Maize kernels were recovered from low-density middens, architectural fill, and occupational detritus. As no phytoliths are associated with maize kernels, and kernels comprise the consumed part of the maize plant, it is unsurprising to find a lower ubiquity for this element.

In terms of inedible parts, maize cob fragments, cupules, and cob phytoliths were recovered from low-density middens, the fill of lined pits, occupational detritus, burned deposits, burial matrix, hearths, high-density middens, external surfaces, and architectural fill. These were the most ubiquitous parts of the maize plant, which likely has to do with several factors. Ethnographic and historic sources record the common practice of leaving the majority of the corn stalk in place, and retrieving the ears only for processing **(Figure 12.3)**. As the inedible portion of the plant also directly attached to the edible portion, it is no surprise to see cob bits appear in common disposal and food preparation areas.

Secondary and tertiary deposits such as fill from lined pits, burial matrix, and architectural construction were likely comprised of sediment drawn from areas already containing cob fragments. Some maize leaves were incorporated into daily activity, as evidenced by leaf phytoliths recovered from external surfaces, occupational detritus, low-density middens, external surfaces, and architectural fill. These may represent maize leaves used for unknown purposes, or entered with retrieved ears of corn. In general, the ubiquity of maize leaf phytoliths is lower than that of other parts, probably due to the low likelihood that they would survive charring and thus preserve as macroremains.

Figure 12.3. Bending ears of corn for drying and later harvest. (Illustration by Sarah Davidson.)

In terms of species commonly eaten as fruits, there were depositional similarities between hackberries *(Celtis),* cactus fruits *(Mammillaria),* custard apple family taxa *(Annonaceae),* papaya *(Carica papaya),* avocado *(Persea americana),* and nance fruits *(Byrsonima crassifolia)*. All of these taxa but the avocado were recovered from occupational detritus, and all but the hackberry and papaya recovered from low-density middens. Nance fruit pits and hackberry were also recovered from external surfaces, and cactus fruit seeds from a high-density midden. *Annonaceae* phytoliths and a custard apple *(Annona* sp.) seed were found in architectural fill. Again, as all of these were likely fairly common foodstuffs, it is unsurprising to find their remains scattered in common food disposal and preparation areas, as well as re-deposited architectural fill.

Only one edible bean *(Phaseolus sp.)* was recovered, from occupational detritus. As mentioned in previous chapters, it is extremely curious that one of the attributed staple species should be recovered so few times. Various other bean family *(Fabaceae*) species were recovered as seeds and a pod. None of these, however, were consistent with known edible taxa, and appear to be mostly wild-growing species. They were recovered from middens, architectural fill, burial matrix, hearths, occupational detritus, matrix with carbon, and kilns. The charred seed remains of these various species may be associated with medicinal uses, tinder, or other unknown uses. The recovery from middens and hearths would perhaps point toward medicinal qualities and/or tinder, while the remains from kilns likely index tinder in those cases, or the simple proximity of adventitiously-growing plants to very high temperatures.

The various taxa potentially associated with root crops came from a wide variety of contexts. All were found in occupational detritus, which was the only type of context from which arrowroot (*Maranta* sp.) and achira *(Canna sp.)* were recovered. Arrowroot family (*Marantaceae)* species and lirén (*Calathea* sp.) were also recovered from architectural fill, external surfaces, and low-density middens, but lirén (*Calathea* sp.) was the only species found in association with interior surfaces. The recovery from likely food-preparation and disposal areas fits expectations for root crops, as does the likely secondary deposits of materials in architectural fill.

In terms of species cited most often for herb, condiment, and/or medicinal purposes, a large variety of contexts was found in association with these plants. All species were recovered from low-density middens and occupational detritus, with the exception of the lone trumpet tree (cf. *Cecropia peltata)* seed recovered only from a low-density midden. Pennyroyal *(Hedeoma* sp.) was recovered only from these two contexts. *Potentilla* and *hirtella* were additionally recovered from architectural fill, and along with sunflower family *(Asteraceae)* species, from external surfaces. Mint family *(Lamiaceae)* and sunflower family species were also found in high-density middens, while *Asteraceae* species were further recovered from a kiln.

Interestingly, mint family species were recovered from architectural collapse, which may reference these plants hanging as herbs. For the most part, however, these plants are associated with food-preparation and disposal areas, as well as secondary deposits as fill, and in the case of one mint family species, potential food-storage. The unknown sunflower family species recovered from the kiln context may, as in the case of the unknown bean family species, reference the proximity of wild plants.

Species cited most often for ornamental, shade, or fencing purposes include those of the magnolia family (*Magnoliaceae)* and *Burseraceae* family. Taxa from both of these families were recovered from occupational detritus, and strangely, from interior structure surfaces. *Burseraceae* was also recovered from architectural fill. *Cyperaceae* and *Cyperus* sp. seeds and phytoliths were recovered from occupational detritus, kilns, external surfaces, and low-density middens, and may, like many grass and palm species, be associated with matting or bedding at these locations, tinder, or close-growing weeds. Species from the *Euphorbiaceae* family have a wide variety of uses, from construction to medicine to foodstuff, so it is no surprise that unknown species of this family were recovered from architectural fill, low-density middens, and occupational detritus.

The few taxa with completely unknown associated practices were recovered from a wide range of contexts. *Lozanella* came from architectural fill only once, but multiple times was recovered from occupational detritus. *Trichomanes* was recovered from external surfaces, interior structure surfaces, low-density middens, and occupational detritus. There are no known uses for this species, however, it does not appear to be accidentally incorporated, considering the wide variety of contexts where it is found, especially the interior structure surface.

Expected remaining species were found associated with diverse contexts. Bottle gourd (*Lagenaria* sp.) phytoliths were recovered only once from an external surface. This species is surprisingly scarce, considering ethnographic accounts (and personal experience) of its ubiquitous use. Its rarity could indicate a heavier reliance on calabash tree (*Crescentia cujete)* fruit rinds for containers, or wood and/or palm leaves. However, calabash was not recovered as a seed or rind, and does not produce identifiable phytoliths. Copal *(Protium sp.*) was recovered only once, in phytolith form, from occupational detritus. This is not very surprising, considering this is a species normally only harvested for resin, and rarely grown in home gardens. As far as tobacco (*Nicotiana* sp.) goes, there were no patterns as to where this species was found. It is the leaves that are smoked, there are no known practices associated with its fruits, which is unfortunate as the fruits contain literally hundreds of seeds. Moreover, the plant is most commonly hung **(Figure 12.4)**, to "cure" before use. For these reasons, it is easy to see how tobacco seeds might be dispersed across site, even in the fill of the burial context.

Figure 12.4. One posited method of curing tobacco. (Illustration by Sarah Davidson.)

Unknown species, recovered as charred wood fragments, woody species phytoliths, and storage tissue "lumps", were found in every context on-site, with few exceptions. No wood or storage tissue lumps were recovered from any special deposit, and, ironically, wood was not recovered from any ashy deposit. Aside from the lack of wood in the ashy deposit, these distributions fit expectations. The likely general scatter of charred wood fragments from cooking fires, kilns, and clearing, dispersed through sweeping and wind, explains their recovery in so many contexts. Parenchymous tissues from a variety of plants, including woody ones, could have been incorporated in a variety of methods, and many of these lumps could be related to root crops.

Overall, the recovery of most plants fits prior expectations, with some divergence. In tracking various plants, we see certain patterns-- a sort of "context" profile for each taxon-- that outline syntagmatic associations. In the following sections, I turn to the plant profiles of some specific contexts, to see how the proposed syntagmatic associations hold.

Context to taxa: what differences and similarities exist between context types?

In exploring paleoethnobotanical characteristics of various contexts, I first draw comparisons between broad types of contexts, that is, I look at the "average" profile for each context. I begin with comparisons of taxa richness, then relative abundances of taxa at each type of context, briefly discussing plants which are found only in particular contexts. I then explore densities of paleoethnobotanical remains, by weight and count.

In terms of the taxa richness for each kind of context, I do not include unknown or unidentifiable botanical parts (wood, lumps, seeds, etc.), unless these are the only items available, as in the case of storage tissue lumps recovered from the lone ashy deposit. I also expand taxa richness in cases where unknown woody species are combined with herbaceous grass species, as in the cases where only *Zea mays* and wood are found. I calculate the maximum number of unknown phytoliths or unknown seeds, whichever is greater, to prevent possible overlap between a taxon which produces both recoverable seeds and phytoliths. Ultimately, what I calculate is a minimum number of taxa recovered, per context type. Moreover, I follow many of the same parameters as those I have outlined in Chapter 9. (For example, I did not overlap *Poaceae* family seeds with *Poaceae* subfamily phytoliths.)

In **Figure 12.5**, I arrange the contexts from those with the fewest samples to those with the most, and plot species richness along this same axis. The expectation is that, following a normal population distribution, the overall taxa richness will increase as the number of samples increases, until the number of species plateaus at maximum possible (similar to Lennstrom and Hastorf 1992). This plot is somewhat complicated by the fact that different volumes of sediment taken (varying between 2L and 10L), however, the chart reveals some surprising points. Overall, following a normal distribution of plant remains, the expectations hold true for most contexts. In general, the number of species recovered rises as the number of samples increases. However, several contexts have greater taxa diversity than what is anticipated by the model. External surfaces, high density middens, and architectural fill have numbers higher than what are expected by the model, whereas fills from lined pits have numbers much lower than expected.

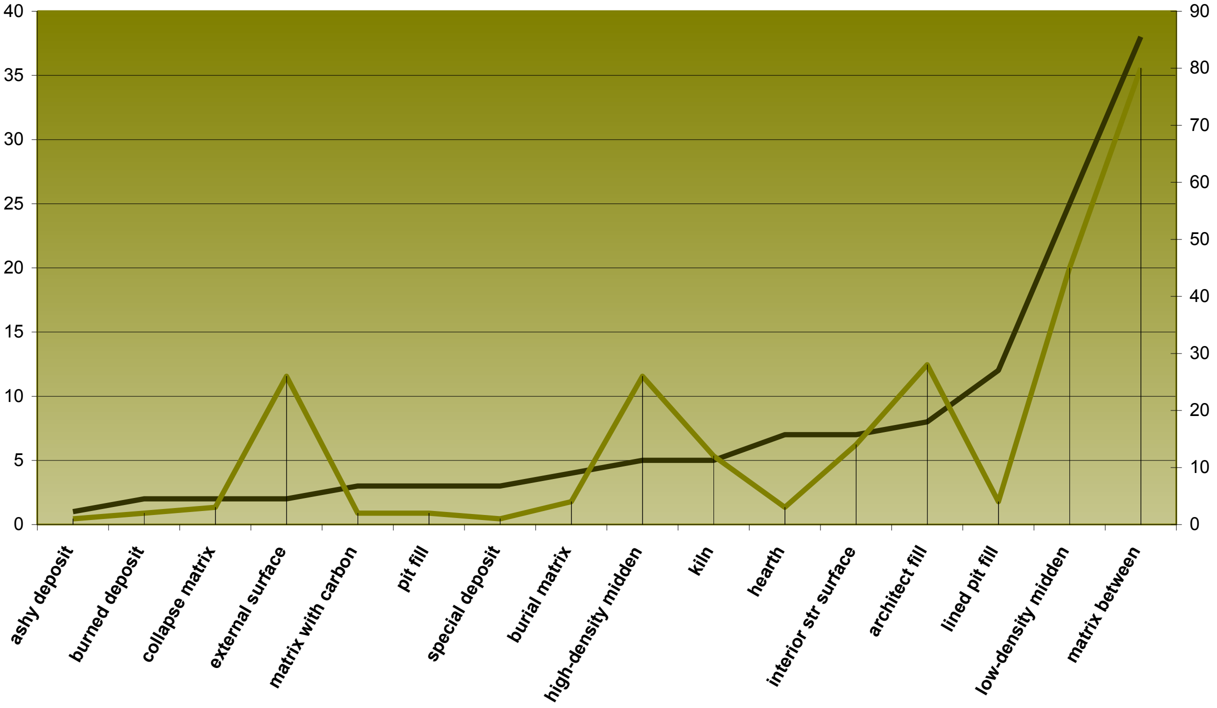


Figure 12.5: Comparison of number of samples collected and taxa richness. Lighter line indicates taxa richness (n = 1-36 species) and darker line indicates total number of samples collected (n = 1-85 samples).

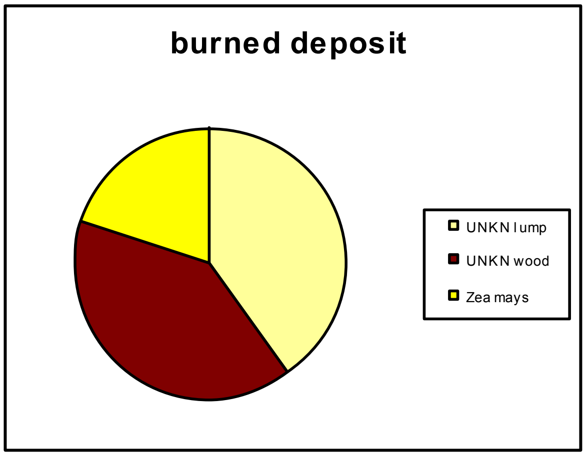
There are several possible interpretations for these discrepancies. In terms of the high-density midden, it is not unforeseen that this context would have greater taxa richness than others, considering it is a primary location of disposal. However, the high number of diverse taxa in the other two contexts is somewhat puzzling. It could be that external surfaces are not kept especially clean— a wide spectrum of things is swept there, scattered, walked on. Or perhaps external surfaces are where highly diverse activities take place, as is suggested in some accounts. The high diversity of taxa in architectural fill could have to do with the removal of fill dirt from nearby areas with loose accumulations of material. In this scenario, middens would be prime candidates for plentiful and friable sediments. The fill, therefore, would share a profile similar to that of midden contexts.

The fill from various lined pits, at the other end of the richness spectrum, may be indicative of the use of these contexts as storage pits. Such pits would likely have been kept relatively clean of detritus from surrounding areas, perhaps even covered, and thus charred remains would be scarce. Unfortunately, as no phytolith samples were recovered from any lined-pit contexts, potential additional microbotanical clues remain momentarily out of reach. However, the lined pits are also curious in terms of their high densities, a point to which I will return below.

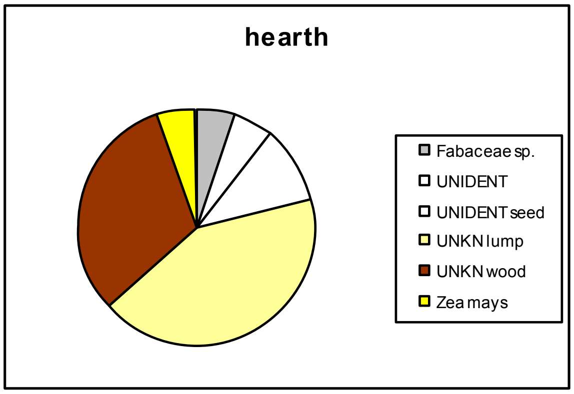
When looking at the frequency of taxa across contexts, there was great variation in the types and ranges of taxa recovered. Below, I present the relative ubiquities of the species recovered from each context, as a series of pie charts. I must emphasize that, again, the number of samples per context is highly variable, so the "average" paleoethnobotanical profile assembled for each context is sometimes based on only a single locus.

In looking at all deposits that involved more frequent instances of burnt materials, unknown storage tissue lumps were recovered at least a third of the time. In the case of the lone ashy deposit **(Figure 12.6d)**, unknown storage tissue lumps comprised the entirety of the context. For the other three contexts, charred wood appeared in the assemblage in 25-33% of the samples. Maize was recovered from both burnt deposits **(Figure 12.6a)** and hearth contexts **(Figure 12.6b)**. Unknown non-domesticate *Fabaceae* (bean family) seeds are in both hearth deposits and matrix with carbon **(Figure 12.6c)**. It is interesting that maize was recovered more often from burned deposits than hearths, and that hearths have such low taxa richness, in general. It may be that hearths were kept fairly clean, with burnt material removed and deposited in other areas, such as middens. The low densities of hearths (discussed below) further support this hypothesis.

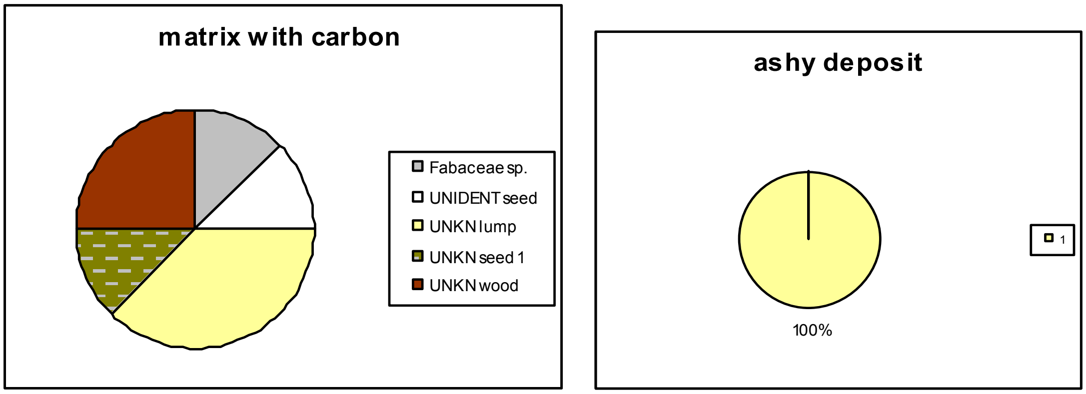
Ashy deposits may just contain highly charred materials, to the extent that most are rendered unrecognizable, a hypothesis also supported by low densities of recovered charred materials. The two burned deposits, locales not utilized in the same way as hearths, may have involved burning materials in ritualized practices only obliquely related to food, encompassing both ceramic figurine and maize cupule fragments. The matrices with carbon mottling, further described below, may be areas in close proximity to fires, leaving frequently present wood and accounting for the distributed scatter of the few other types of remains such as seeds. All four of these contexts, in terms of practices involving the depositing of materials, exhibit a low diversity of remains, likely related to varying types and properties of charred materials, formation processes such as re-deposition, and the number of samples collected for analysis.



12.6a



12.6b

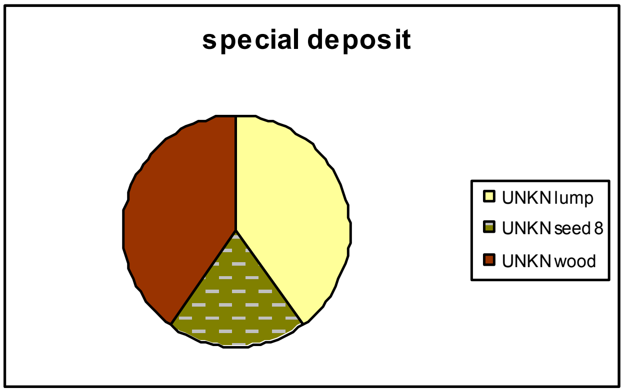


12.6c **12.6d**

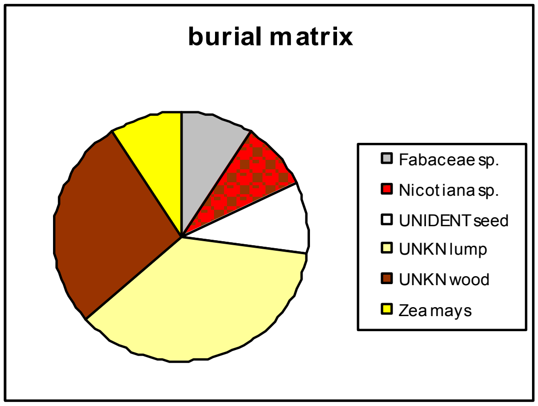
Figures 12.6a-d. Relative ubiquities of taxa in areas with visible evidence of burning.

In terms of special deposits **(Figure 12.7a)**-- matrices without significant presence of carbon and sediment from burials-- unknown wood taxa and storage tissue lumps appear frequently. The assemblages from special deposits included Unknown seed 8, and those from burial matrices included unknown bean family *(Fabaceae)* species, maize, and a tobacco seed. Interpreted as ritual deposits, including deliberately placed ceramic vessels, the three special deposits demonstrate a density of botanical materials similar to that of other "general scatter" contexts (discussed below), but with much less diversity. These likely indicate a more constrained set of practices, but the incorporation of some fill materials, as none of these loci was indicated to have been a primary burning locus (as juxtaposed with burned deposits).

The burial matrices **(Figure 12.7b)** likely have a similar story. Although highly ritualized contexts, the fills from these locations appear to have incorporated re-deposited materials from other locations, as discussed previously. In both of these cases, food offerings may have formed a component of ritualized practices. However, uncharred remains were not recoverable, and it is unlikely that small, previously-charred bits would have been incorporated as offerings.



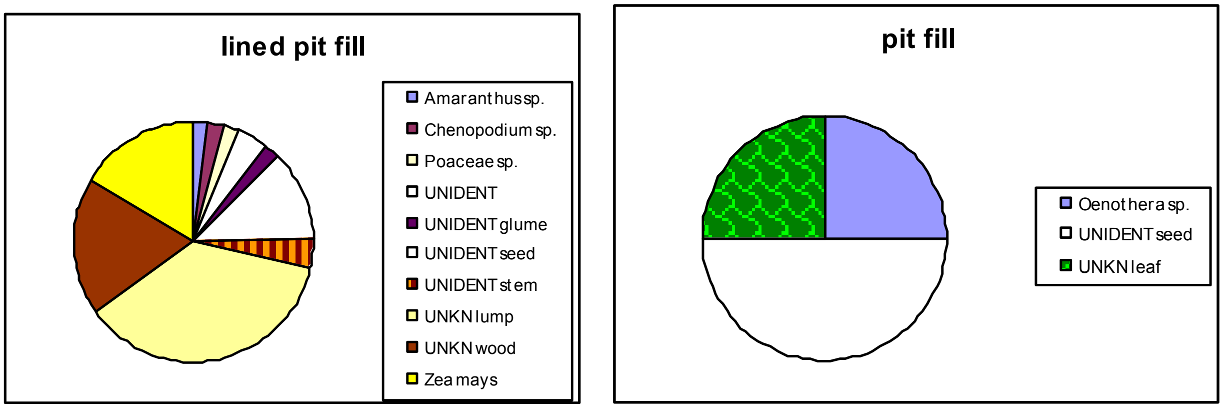
12.7a



12.7b

Figures 12.7 a & b. Relative ubiquities of taxa in areas marked by ritualized activity.

Fills from pits varied, based on context type. Lined pit fills **(Figure 12.8a)** were marked by relatively high taxa richness, and unlined pit fills **(Figure 12.8b)** by relatively low taxa richness. The only 'overlap' between taxa is from unidentified seeds. The three unlined pit fills contained extremely little diversity in taxa. These unlined pit fills, strangely, contained no charred wood or lumps, only one *Oenothera* seed, and bits of unknown leaves and seeds. The fills from clay-lined pits, in contrast, had an overall greater taxa richness, including amaranth, goosefoot, and maize grains, other grass seeds, and a glume. The clay-lined pit fills also contained unknown wood and lumps. I explore possible interpretations of these two assemblage types, in my discussion of densities.



12.8a **12.8b**

Figures 12.8 a & b. Relative ubiquities of taxa in fills from pits, both lined and unlined.

The matrices from architectural collapse **(Figure 12.9)** are marked primarily by wood, but also contain, with equal frequency, mint family *(Lamiaceae)* seeds, unidentified seeds, and unknown lumps. This is a marked difference from the deliberately-deposited architectural fill **(Figure 12.10)**, which has a much higher number of taxa represented. Both of these contexts, however, may be contrasted with interior structure surfaces **(Figure 12.11)**, which have greater combined taxa richness. If architectural fill is placed below structures and prepared interior floors, and construction episodes are followed by collapse of constructions at later times, this leads us to certain expectations. We would anticipate the most diverse materials in the secondary and tertiary-deposited architectural fill, some diversity in terms of recovery from clean-kept interior floors, and least diversity in terms of architectural collapse, containing mostly construction materials. These expectations were borne out by the findings. A wide spectrum of materials was recovered from the architectural fill, which contained an enormous variety of taxa, a narrower range of materials from the interior floor surfaces, which have fewer taxa, and a small range of materials from the collapse matrix, which contained mostly unknown storage tissue lumps, wood, and seeds.

Aside from many unknown species, as well as palm and grass species likely related to matting, the interior surfaces contained several foodstuffs of note, including squash and lirén, though not at great frequencies. The architectural fill contained diverse materials, encompassing these same plants, as well as many other unknown and known species in smaller frequencies, including custard apple, cocoyol palm, and various squash species. Also of interest, as previously mentioned, the mint family seeds recovered from collapse matrix may index a bundle of herbs suspended from roofing, similar to suspended materials recovered at Joya de Cerén (Sheets 1998).

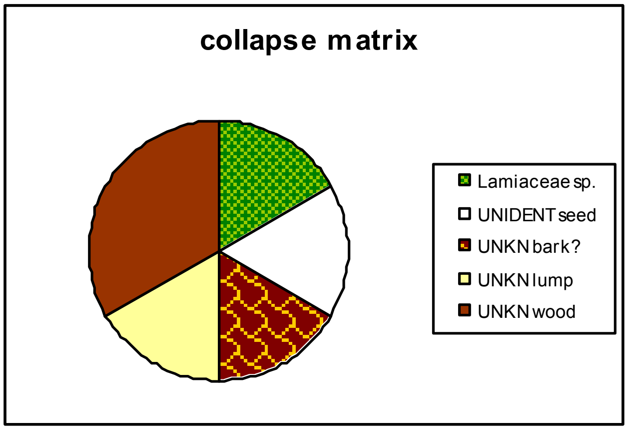


Figure 12.9. Relative ubiquities of taxa in materials corresponding with collapsed construction.

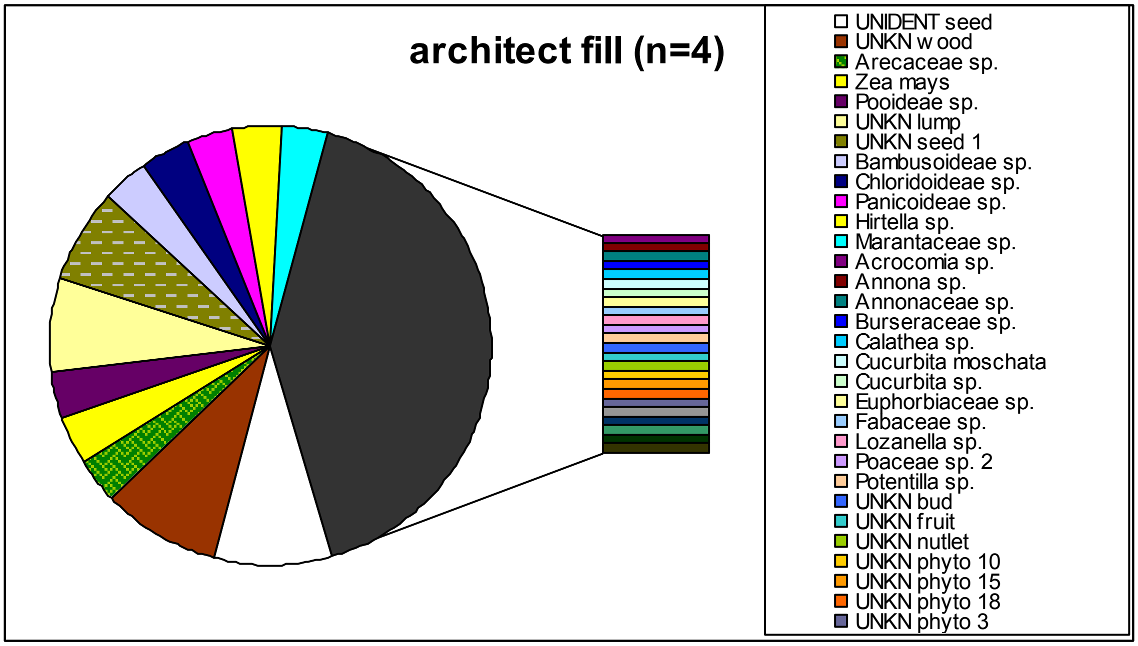


Figure 12.10. Relative ubiquities of taxa in materials corresponding with materials used in construction fill.

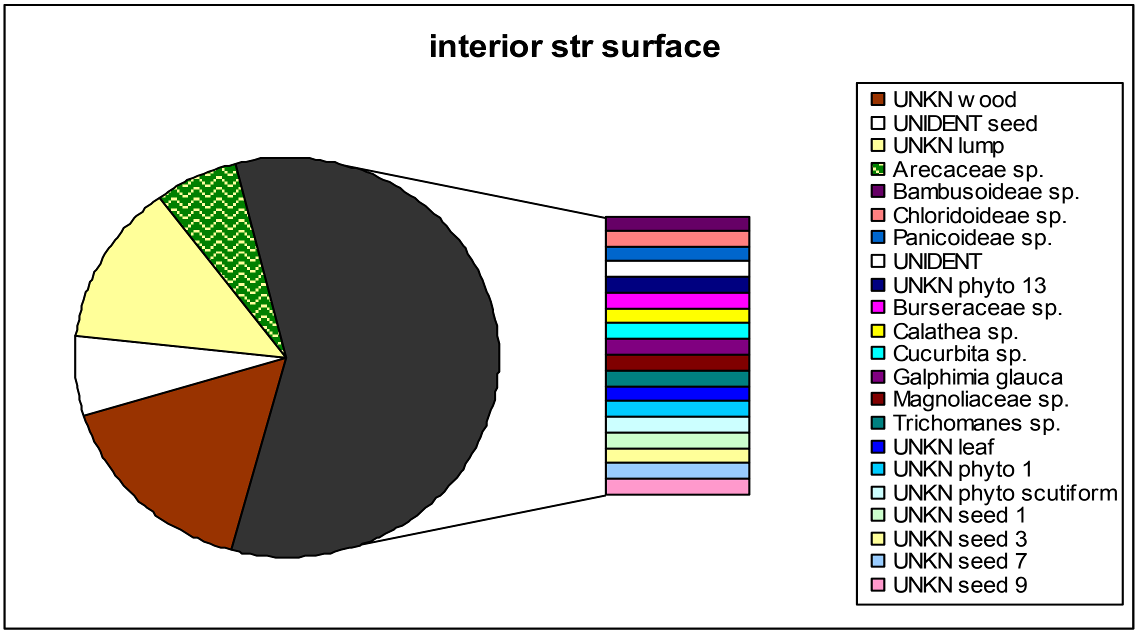


Figure 12.11. Relative ubiquities of taxa in interior surfaces of structures.

The two external surfaces, when contrasted with interior structure surfaces, demonstrate greater combined taxa richness **(Figure 12.12)**. Wood is recovered as frequently from these contexts as eleven other taxa types. Lirén and various squashes were among the recovered foodstuffs, as well as various grasses and palm species, in a profile partially mirroring that of interior surfaces. Significantly, however, external surface scatters include edible fruit remains such as nance and hackberry, cohune palm, and maize. External surfaces also included bottle gourd, as well as many additional unknown species, in the form of both macro- and microremains. Overall, external surfaces exhibited a level of taxa richness more similar to that of low-density middens and occupational detritus, although there are differences in densities that I explore further, below.

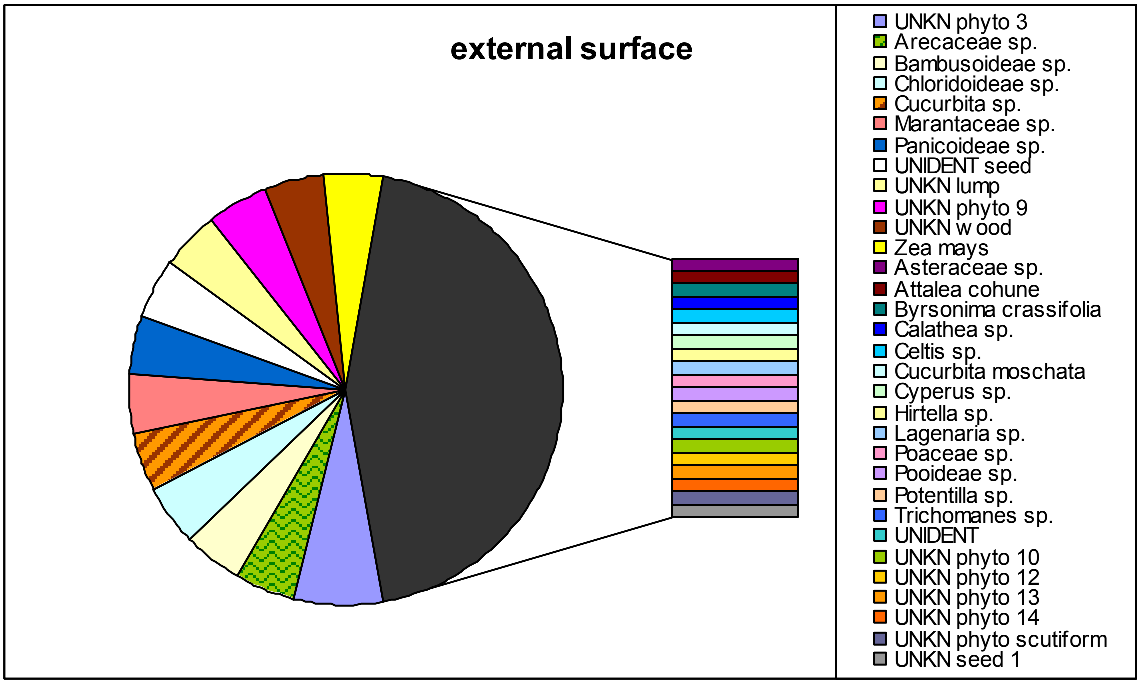


Figure 12.12. Relative ubiquities of taxa in external surfaces of structures.

Kiln contexts contained a surprisingly diverse assortment of taxa **(Figure 12.13)**, considering they are supposed to be loci primarily associated with the firing of ceramics. Most frequently recovered remains were those of wood, grass species, and various unknown species reflecting fuel. The inclusion of the cohune palm may, as previously mentioned, have to do with snacking near the kiln. The various other unknown, sunflower family *(Asteraceae)*, *Cyperaceae* and bean family *(Fabaceae)* species may reflect the use of tinder, or the scorching of adjacent growing species.

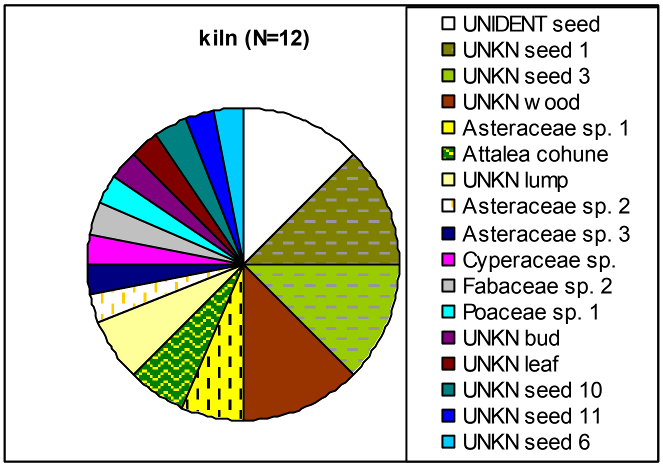


Figure 12.13. Relative ubiquities of taxa recovered from kiln contexts.

The high-density **(Figure 12.14)** and low-density middens **(Figure 12.15)** are expectedly similar, in terms of macrobotanical taxa present. However, low-density middens have a much wider array of taxa represented across loci, due to the fact that no samples of microbotanical remains were obtained from high-density middens, thus eliminating a large potential number of taxa from analysis. In terms of macrobotanical remains, both types of contexts are similar regarding frequencies of maize, nutshell, mint and grass family species, cactus fruit species *(Mammillaria),* and non-domesticated bean family species, as well as multiple unknown wood, storage tissue lump, and seed species. High-density middens are also marked by the recovery of tobacco.

Low-density middens, however, have a multitude of taxa recovered only in phytolith form, including species from multiple grass subfamilies, palms, and foodstuffs such as maize, lirén, squash. Also represented, in macrobotanical form, are food and medicinal species such as chia, cohune and coyol palms, avocado, potential medicinal or condiment species such as pennyroyal *(Hedeoma* sp.) and trumpet tree *(Cecropia peltata)*, and various potential ornamental and shade species such as heliconias. Densities of charred materials were also divergent between these two midden types, as discussed below. Overall, however, both types of middens appear to represent the deposit of a wide assortment of refuse.

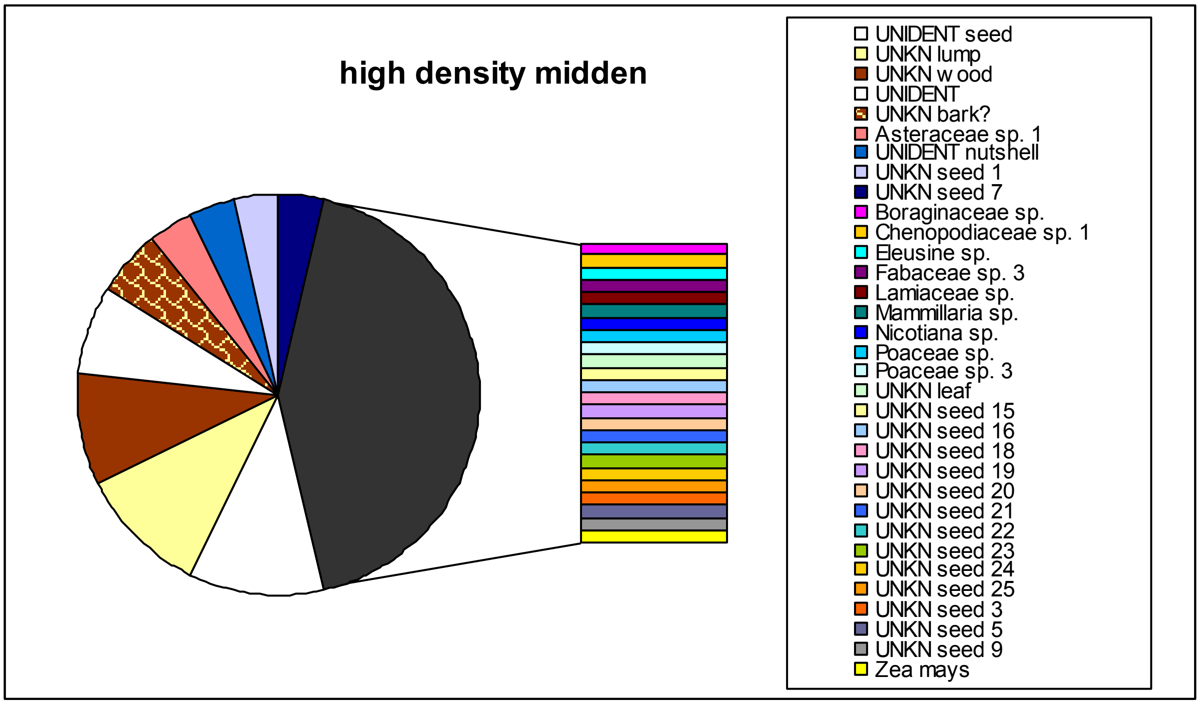


Figure 12.14. Relative ubiquities of taxa recovered from high density middens.

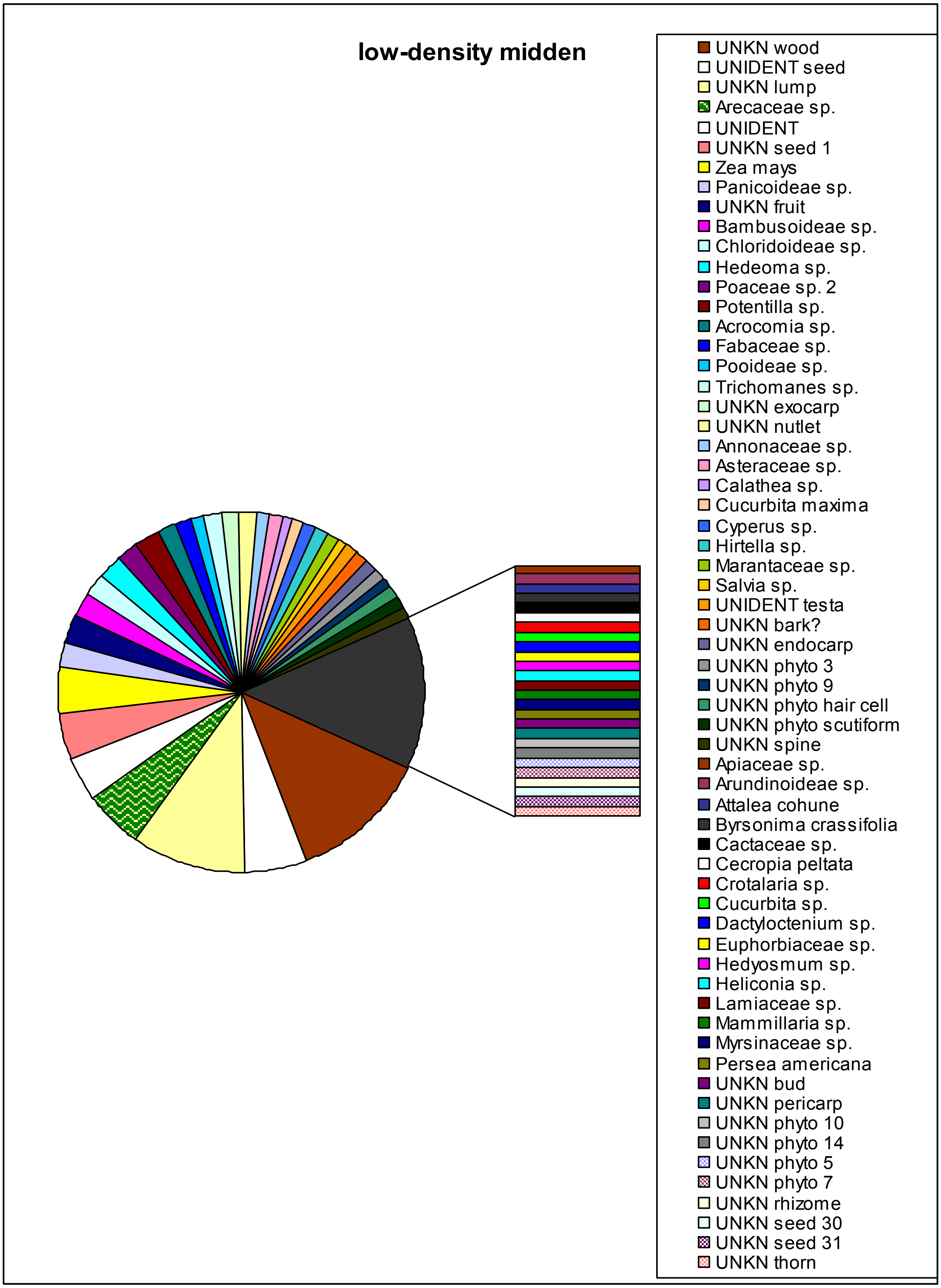


Figure 12.15. Relative ubiquities of taxa recovered from low-density middens.

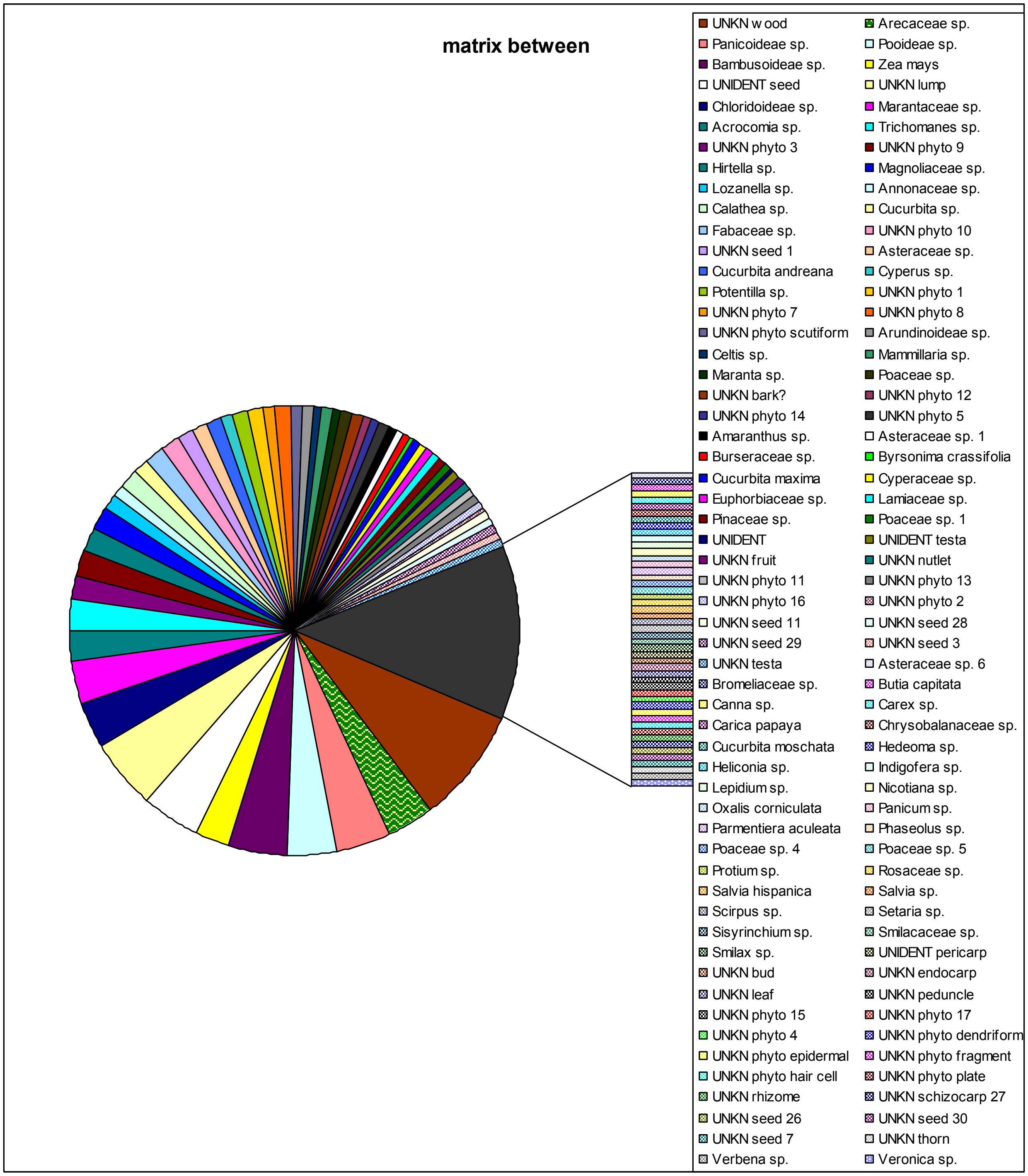


Figure 12.16. Relative ubiquities of taxa recovered from amorphous occupational detritus.

Occupational detritus **(Figure 12.16)**, the matrix between various identified occupational surfaces, represents the context type with the greatest taxa richness. Every taxon recovered, with only a few exceptions, is represented across samples from this context type. The notable nonpresent taxa include cohune palm, bottle gourd, hackberry, goosefoot, and several grass and bean family species. Many examples of unknown phytoliths and seeds were also not found in these contexts. Taxa only recovered from "matrix between" include achira, indigo (cf. *Indigofera* sp.), bromeliads, *Butia capitata*, papaya, *Oxalis corniculata*, verbena, cf. *Veronica* sp., and arrowroot.

When calculating the density of materials per context, I was only able to utilize macrobotanical remains, for reasons stated in previous chapters. In drawing comparisons between macrobotanical samples, I standardized densities by the volume of sediment floated. I have plotted the charred material density per context in **Figure 12.17** by both weight (in grams) and counts. I do not include the kiln contexts, due to their extremely high density of materials, both in terms of counts and weights.

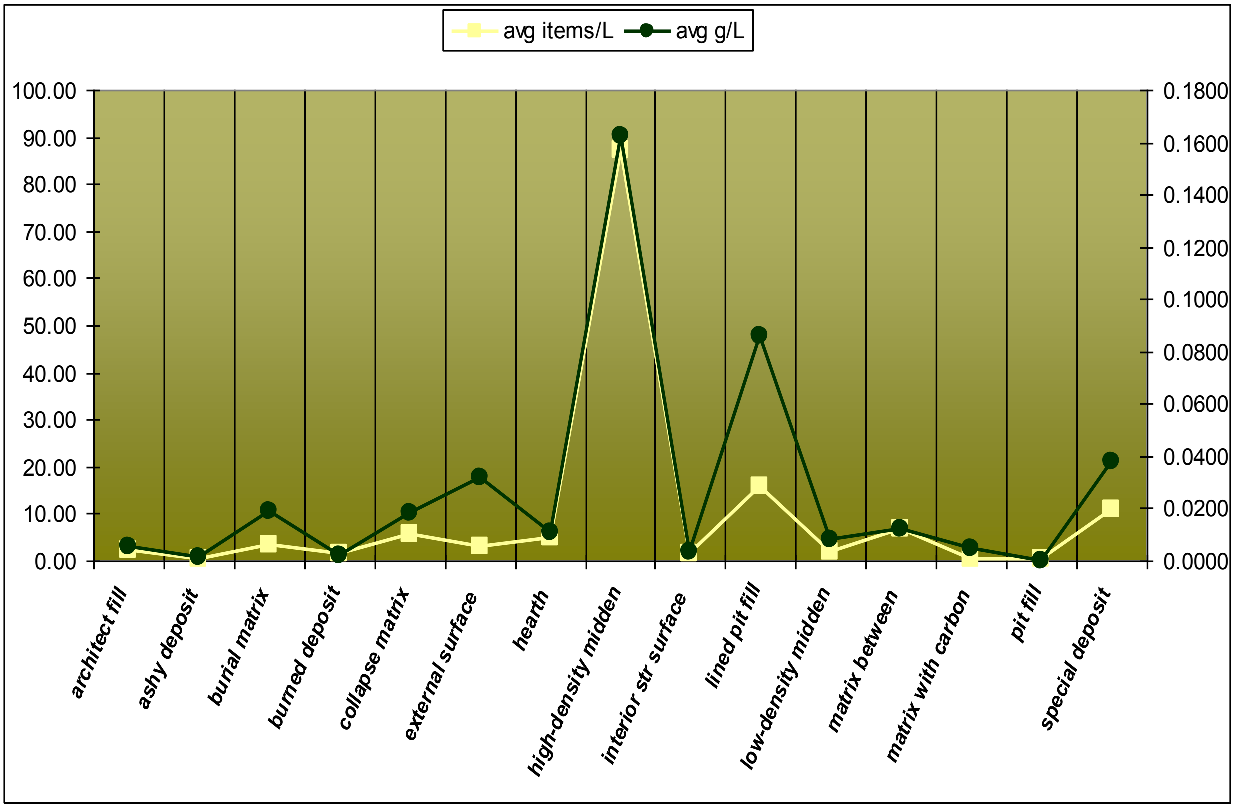


Figure 12.17: Comparison of average counts and weights of charred materials, by context type.

Most contexts had concordance between increases in per-liter counts and weights of charred materials. However, there was some notable divergence in several contexts. Burial matrices had lower count densities than anticipated, considering relative increases in weight densities as compared to other contexts. This was also the case with external surfaces, lined pit fills, and special deposits. This divergence indicates that, in each of these cases, there are larger "chunks" of materials than at other locations. This may index fewer disturbances after primary deposition, and/or fewer subsequent depositions, both being transformations that would break up charred materials into smaller fragments. In terms of burial matrices **(Figure 12.18)** and special deposits, these results fit expectations. Intentional deposits such as these, although likely making use of fill material from external sediments already containing charred materials, were less likely to have been re-dug or re-deposited after placement.

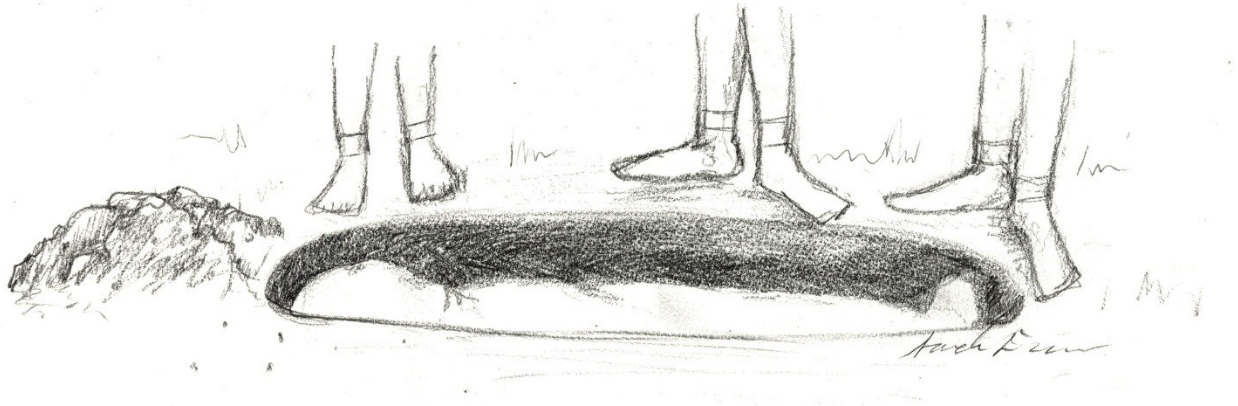


Figure 12.18. Posited incorporation of plant taxa, through mixed fills, into burial contexts. (Illustration by Sarah Davidson.)

The discrepancy in terms of external surfaces and lined pit fills is more puzzling. The lined pits, as previously mentioned, may have been kept cleaner for food storage purposes, explaining the relatively low diversity of materials found within. Similar grain and bean storage patterns have been noted at Cerén (Sheets 1998) where maize and beans were stored on the floor, above layers of leaves (in place of clay). The charring of the few remaining grains in the Puerto Escondido pits may have occurred in the course of fiery termination of these buildings, rather than in the course of cooking. This may also explain why the fills have larger chunks of wood materials than other contexts—they may represent primary deposits of materials from the collapsed overhead and/or adjacent architecture. This is juxtaposed with architectural fill that is drawn from surrounding areas, thus containing secondary or tertiary deposited materials.

In the case of the external surface contexts, as there were only two examples analyzed, the relatively large charred fragments may have to do with a strong "pull" from the one locus (22-AM-03) that had a very high weight-to-count ratio. It is unclear why this one locus, in a presumed high-traffic area (due to the compaction of the sediment), would have larger, less fragmented chunks of materials.

Kilns, overall, had the highest density of charred materials, followed by high-density middens and lined pit fill (previously discussed). The charred plant remains produced in the course of firing ceramic materials may have been left in-situ, more so than in other contexts. High-density middens also fit this profile, as locations where large amounts of charred (and uncharred) materials were disposed **(Figure 12.19)**. Ironically, ashy deposits and matrix containing carbon, along with pit fill, had the lowest densities of charred materials. In the case of ashy pits, this may have to do with the formation of small-particle ash from very high temperature fires, or the type of material burned. The matrix containing carbon may have been formed through proximity to fire, leading to visible flecks of carbon that were too small to be recovered for identification purposes. It seems as though unlined pit fills did not contain any secondary or tertiary deposits, as the densities and taxa do not match other contexts in this regard. Combined with the extremely low taxa richness in these contexts, and the complete lack of charred wood and storage tissue lumps, the practices associated with these unlined pits remain unclear, aside from the fact that they appear to have been kept very clean.

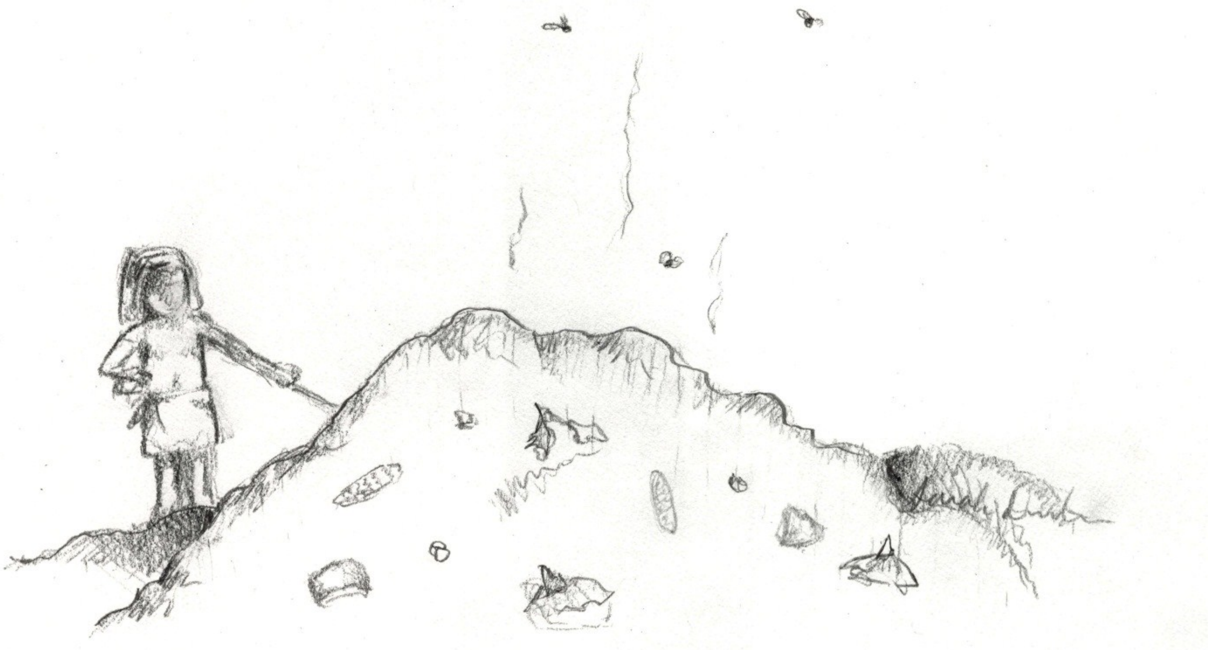


Figure 12.19. Posited high-density midden area. (Illustration by Sarah Davidson).

Overall, it seems as though the remaining contexts represent everyday scattering, depositing, and re-depositing of materials across surfaces and locations. In some areas these appear to be more concentrated, and in others, less so, indexing a sliding scale of more- to less- "clean" without discrete areas of plant refuse disposal. Even in the case of low-density middens, it appears as though these may be primarily accumulations of *inorganic* materials, rather than nodes of organic material disposal. Interpreting discrete areas of activity outside of structures is further complicated by the probability that homegardening was taking place, meaning organic materials-- including nightsoil, hearth ashes, food scraps-- were scattered everywhere.

Considering taxa richness, relative frequency profiles, and densities of charred remains, some expectations were met and others were not. The combination of data types and analyses reveal interesting patterns, and in some cases the curious lack thereof, in ethnobotanical practices. Charred items may have come from the normal cast of hearth fires, the spreading of hearth materials in home gardens, and the sweeping away of hearth materials. They may also have come from termination practices where structures which are commonly burned to the ground, providing fill for the next structural iteration. Similarly, in terms of surfaces and daily occupational detritus, bits of uncharred materials may indicate the activities of people carried out at that context, or swept in from other locations. Middens, primary disposal areas, index the removal of materials from other contexts such as hearths and processing areas. We find some things in likely secondary or tertiary contexts—various species, for example, showing up in fill from architectural construction, lined pits, unlined pits, and burial matrices. Unfortunately, very few materials were recovered from hearths, kilns and other burned and ashy primary deposits, and we have only three examples of other special deposits.

Summary

"Feature bias" (Lennstrom and Hastorf 1995) references the misconception that identified features are the most productive areas to sample for archaeobotanical materials. However, a focus on expected "productive" features would have obscured a great many findings recovered from anticipated unremarkable contexts (following Lennstrom and Hastorf 1995). Overall, middens and general occupational detritus were contexts found in association with many taxa, but general occupational detritus contained as wide an array of plants as the middens, and had a greater density of remains than low-density middens. This likely has to do with the nature of these two contexts (each is an area of disposal and/or accumulation), as well as the sheer number of samples recovered from each of these contexts (25 from "low-density middens" and 38 from "matrix between").

Indeed, some of my results may suffer from the distorted effects of too few examples (as in the case of ashy deposits, where n=1) and/or only one type of botanical sample (as in the case of high-density middens, which have only macrobotanical samples). It appears as though the presence of both types of botanical remains can double or triple the number of taxa recovered. In sampling archaeological sites, then, the importance is shifted to having similar numbers of samples for contexts, and matched microbotanical and macrobotanical samples, rather than pursuing presumed "productive" areas.

Overall, I have difficulty in making broad generalizations about the various sampled contexts, considering that the numbers of these contexts are highly variable, and only a portion of them have both microbotanical and macrobotanical remains available for analysis. However, we find sediments that are probably mixed in terms of primary and secondary deposition, especially regarding surfaces, both interior and exterior-- some charred items are mixed with uncharred phytoliths. The scattering of various plant species across contexts indicates a good deal of secondary and tertiary deposition of materials, which appear to have often ended as fill in the array of pits and architectural features. Food remains, in particular, seem to have been dispersed everywhere. Middens and accumulated detritus are associated with smaller and more fragmented chunks of disposed remains (as well as ceramics and lithics), and often exhibit higher density of charred materials.

However, bits of plant remains have a wide scattering, cross-contexts. This indicates that disposal areas may not have been bounded or discrete, fitting what has been observed ethnographically. Essentially, it seems as though a lot of sediment and refuse were moved around, scattered across areas that may have been home gardens, and used as fill in architecture and other contexts. All of these practices would have served as deliberate and inadvertent transport of plant remains.

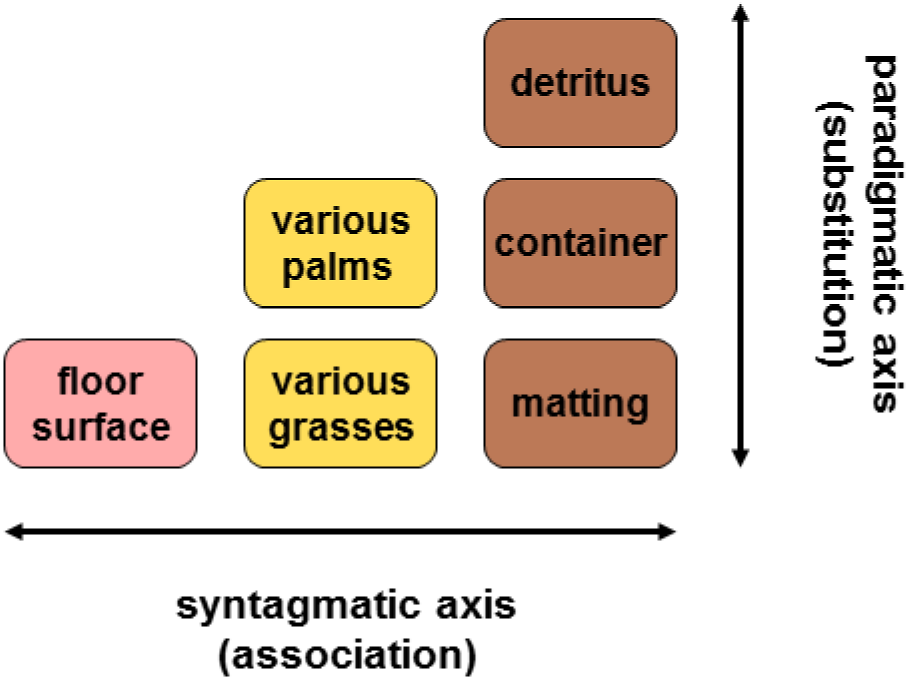


Figure 12.20. Potential syntagmatic associations and paradigmatic substitutions related to floor surfaces.

Broadly, we see people cleaning areas, constructing buildings with palm and grass thatch, tucking herbs into roof thatching, spreading mats of different palms and grasses, snacking next to kilns, spreading refuse in homegardens or depositing it on trash heaps, and using undifferentiated fill materials from these areas to construct homes, bury their dead, and overlay special deposits. We see syntagmatic associations between some plants and contexts (e.g. **Figure 12.20)**, but not between others. We see few paradigmatic differentiations between "clean" dirt and "contaminated" dirt. In the final chapter of data analysis, I look at these practices, over time, in order to understand some of the paradigmatic substitutions that may have taken place, and the syntagmatic associations that unfolded within them.

13. Transformation and Continuity over Time

In previous chapters, I have explored aspects of ethnobotanical practice along various axes. To gain some sense of the "average" and range of plants and practices, I have, until this point, somewhat collapsed the temporal dimension. In this chapter, I take the broad "grammar" of plant-related activities in Northwestern Honduras, and re-examine the data between non-contemporaneous periods along the axis of time.

Here, I try to account for change and continuity in plant practices, by examining ethnobotanical practices as analogous to "speech acts", subject to shifts in language over time with the loss and gain of botanical elements and modes of articulation. I incorporate the excavated locations (artifacts, contexts, and spaces) as a sort of immediate context ("footing"), environmental and social aspects as broader context, and the historical trajectories of plant practice as the prior set of paradigms. In this way, I hope to detail syntagmatic associations between elements of ethnobotanical practice, and shifts in paradigmatic substitutions over time and space.

In the course of this analysis, I make use of many of the same methods as in previous chapters, focusing on ubiquity (number of loci where a particular taxon is present/absent across time), taxa richness (number of taxa represented in a study unit), and density (quantity of materials per unit volume). I assess two broad time periods: the Formative and the Classic. However, I acknowledge that these time periods are not only punctuated by breaks in occupation, but may also be divided into much smaller temporal increments. In my samples, these time frames consist of two Middle Formative episodes with estimated dates of ca. 1000-800 BCE and 700-500 BCE; and three episodes in the Classic period with firm radiocarbon dates of 450-650 CE (early Late Classic), 750-1000 CE (Late Classic to Terminal Classic), and 850-1000 CE (Terminal Classic).

There are two reasons for lumping these samples: first, sample sizes would make it difficult to assess changes over time if I subdivided these samples further. Second, there is major culture historical discontinuity between the Formative period and Classic period, which has often been associated with changes in economy, and should be reflected in human plant use. With these caveats in mind, I begin by tracking changes in paradigm, as seen through taxa richness over time.

How did the spectrum of economic plants and their loci of practice change over time?

To assess changes in the range of plants used and their associated practices, I first made various calculations of taxa richness, as outlined in **Table 13.1** below. There are some broad differences between the recovery rates of diverse taxa for each time period, as indicated in these first-look measurements.

Table 13.1. Formative period and Classic period calculations of richness.

Formative period and Classic period calculations of richness	Formative	Classic	Both periods
Total number of taxa (including artifact data)	45	101	122
Total number of samples (including artifact data)	30	158	188
Average plant richness across samples (combined total M/m taxa by total # of samples, including artifact data)	1.5	0.64	0.65
Average per- sample richness (min. # taxa per sample, averaged)	3.97	4.76	4.63
Total number of taxa represented (without artifact data)	34	98	116
Total number of loci represented (without artifact locations)	16	111	154
Average plant richness across loci (combined total M/m taxa by total # of loci, without artifact data)	2.13	0.88	0.75
Average per-locus richness (min. # taxa per locus, averaged)	3.63	5.3	4.02

I make use of four kinds of calculations in this table. I incorporate data from excavated loci (without artifact data) and data from samples (including artifact data). I average plant richness *across* samples and *across* loci, as well as average plant richness *per-* sample and *per-*locus. The cross-sample and cross-loci average give us a sense of the broad range of plant practices encompassed within each time period, taking into account the overlap between the plants represented at each location. In these calculations, the total number of taxa (removing redundant taxa) is divided by the total number of samples or loci. In contrast, the per-sample and per-locus averages give us a sense of the average richness of plant activities at each given location. In these calculations, redundant taxa are left in place, to highlight the average number of plants associated with each location, throughout the time period.

In averaging these figures, there is a remove from the per-volume or per-count standardization of samples and loci, the methods used in other analyses presented in this thesis. However, I here standardize my calculations by using them *only* as relative to each other. That is, instead of comparing the Formative to the Classic period using non-standardized numbers, I compare the *differences* between calculations of richness for each time period, so that the fluctuations in numbers of samples and sample sizes are accounted for as a comparison between *juxtapositions* of sample and locus data, rather than comparisons between simple non-standardized measurements. For this reason, I plot two measurements simultaneously, to assess the relative gaps between them. In this way, the number and size of the samples remains consistent within each time category, but the *gaps* become comparable between time categories.

In the following series of graphs, I make use of these calculations to understand transformations and continuities in the language of plant use between the Formative and Classic periods. Essentially, I look for the ways that the broad paradigms of ethnobotanical practice change over time.

The greatest taxa diversity is seen in the Classic period, when viewing all of the microbotanical and macrobotanical samples **(Figure 13.2)**. This corresponds with the higher number of samples analyzed from this time period. However, the Formative period emerges as relatively richer, as there is slightly higher diversity than expected given the smaller number of samples. In comparison, for the Classic period there is slightly lower diversity than expected, given the higher number of samples. There were also taxa unique to each time period, as evidenced by the larger combined total of taxa.

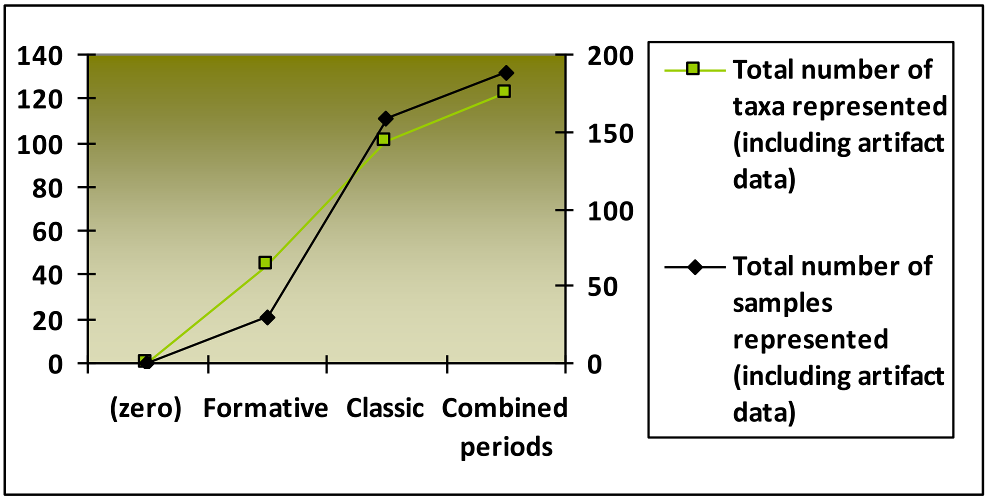


Figure 13.2. Total number of samples analyzed, as compared to taxa represented, by time period.

The combined number of microbotanical and macrobotanical taxa, averaged *per sample*, is highest in the Formative period **(Figure 13.3)**. In this average sample richness, I calculated the minimum number of taxa recovered from each sample, then combined and averaged these figures for each of the two time periods, arriving at the average number of taxa recovered from *each* sample. For comparison, I have also charted the broad average richness, per sample. That is, I calculated the total number of taxa represented in each of the two time periods, removing redundant taxa from the data set, and divided this overall richness figure by the total number of samples for each time period. Overall, **Figure 13.3** displays more total richness *per sample* in Formative period sites, as compared to the difference between per-sample and broad richness in the Classic period, as was anticipated in **Figure 13.2,** but here better detailed and clarified.

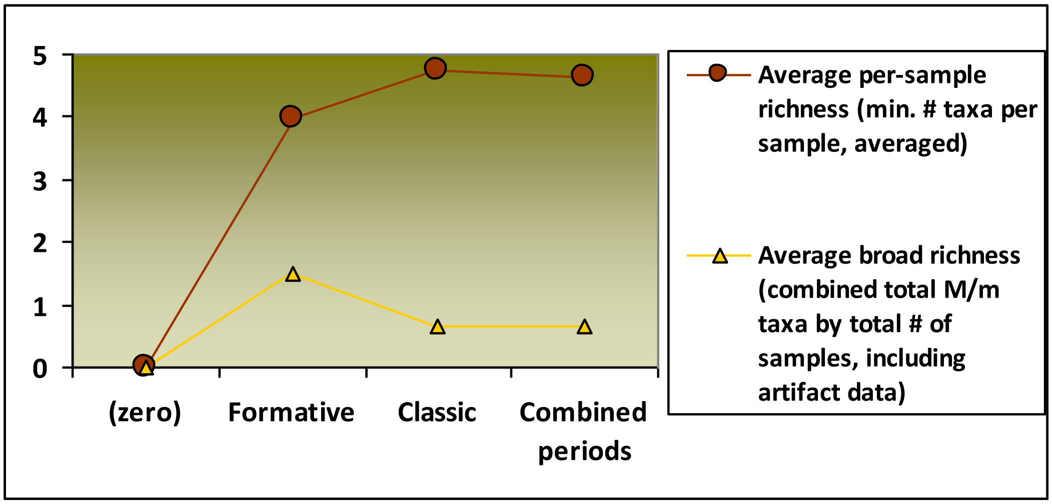


Figure 13.3. Average number of taxa recovered per sample by time period, first in terms of broad richness for each time period, then as calculated individually per-sample.

There are several possibilities for this discrepancy. First, this may have to do with the law of diminishing returns. That is, given the limited number of taxa available in a region, and the uneven distribution of these taxa on-site, analyzing more samples will not necessarily maintain the rate at which we find diverse taxa. This may also be due to, second, potential ontological differences. The data are subject to different sampling strategies at each site (e.g. more of some contexts rather than others), in combination with selected data origins (e.g. more sediment samples than flotation samples), in combination with the more limited population of microbotanical data (e.g. fewer diagnostic starch grains and phytoliths to be potentially recovered from the overall population of taxa than other botanical parts).

Broadly, however, there is more redundancy between taxa assemblages in the Classic period, and less redundancy in the Formative period. It would appear as though there are fewer activities being carried out in more discrete locations in the Formative period, and more activities being carried out in more overlapping locations in the Classic period. That is, although there may be slightly less diversity of plant deposition in the Formative period, ethnobotanical practice takes place in locations more strictly categorized, paradigmatically, but with fewer plants in syntagmatic association. Someone in the Formative period might have fewer plants in their daily repertoire, but the nodes of plant activities are more formally defined. For example, in the Formative period, a person living at Los Naranjos may have dumped trash in more discrete areas, and deposited more specific plants therein. This can be juxtaposed with the Classic period, where a person living at Puerto Escondido may have dumped or swept trash more diffusely, and deposited a wider variety of plants across their living spaces.

These broad trends are borne out at the level of the artifact samples, but with some significant differences. In **Figure 13.4,** I have mapped per-sample and average sample richness for each artifact category, divided by time period. In these calculations, the counts are standardized across artifacts.

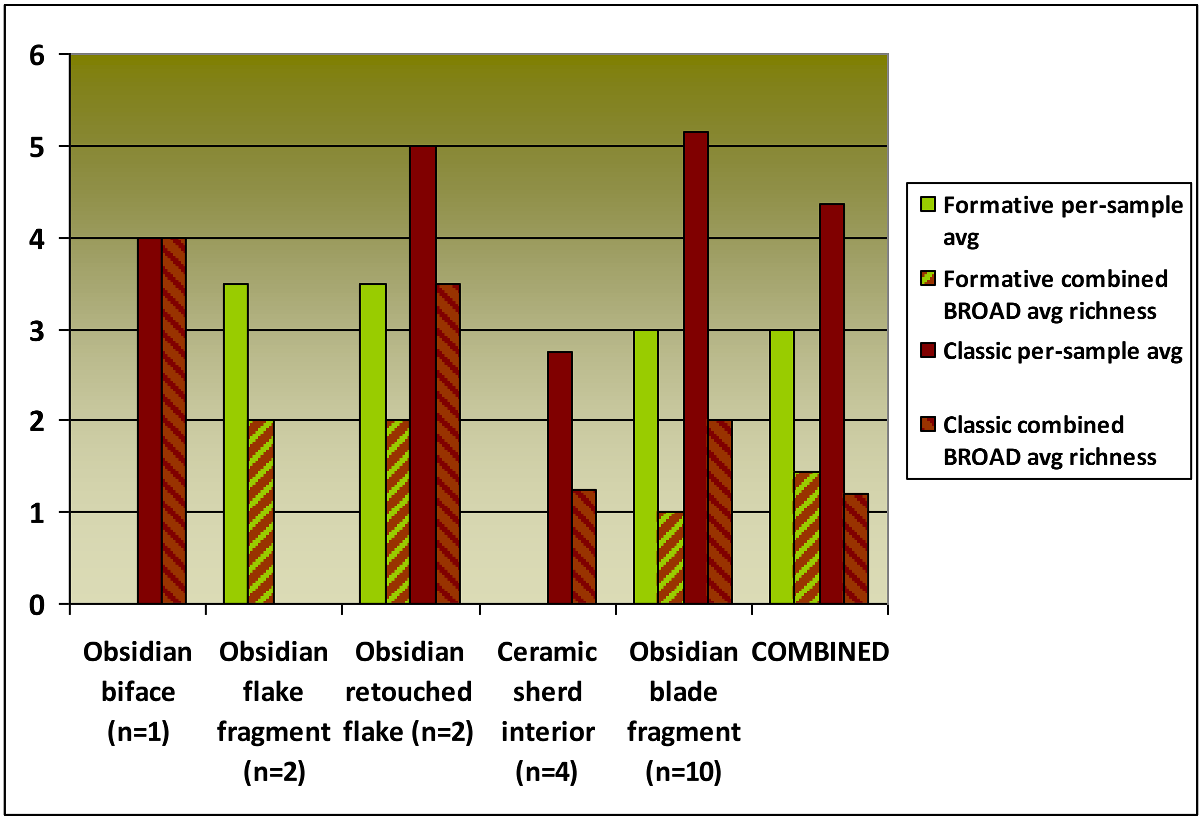


Figure 13.4 Average number of taxa recovered from artifacts, by time period and artifact type. (Per-sample: calculated individually per-sample, then averaged for whole category. Broad: calculated for combined category, then averaged per sample.)

Samples from the Classic period artifacts exhibit greater richness than those of the Formative period, both broadly and as calculated on a per-artifact basis. When looking across artifacts (within the "COMBINED" category), unlike the previous general trends demonstrated in the Classic and Formative periods, the average broad sample richness of artifacts is lower than the per-sample average richness. This indicates more redundancy between categories in terms of taxa assemblages, although *individual* artifact types may have had multiple uses. That is, there is some similarity between uses for different artifact types within each of the two time periods. For example, an obsidian blade OR retouched flake OR biface OR flake fragment could have been utilized for a single given practice, such as cutting palm fronds. This cross-category overlap would point toward fewer discrete paradigms of uses for artifact types, and more expediency when using tools.

Looking within artifact categories, the pattern is similar, although obsidian blades seem to have slightly more discrepancy between broad and per-sample calculations, indicating greater redundancy of activities than for other artifact classes. This appears consistent across both Formative and Classic periods. Such a pattern would indicate that, over time, obsidian blades could be swapped with each other for similar tasks, but each blade was responsible for a wider range of plant-related activities than other artifact types. That is, obsidian blades were more multi-purpose than other artifacts, and used with more kinds of plants.

The various spaces exhibited similar broad patterns over time. In **Figure 13.5,** I have graphed average sample richness for each artifact category, per-sample and cross-sample, according to time period. (The "between" category is not displayed, as there is only one large sample, which dominates and distorts the overall representation of the results. "Unknown" plant specimens are also removed for lack of ability to form comparisons with them.)

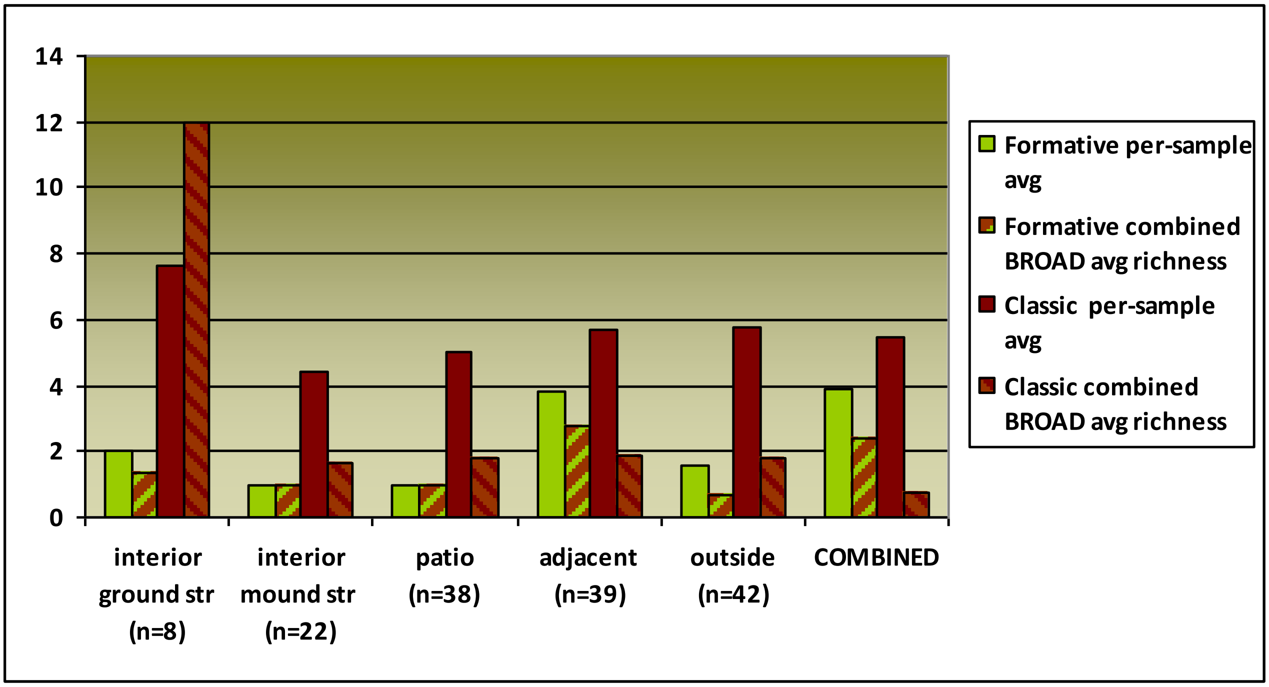


Figure 13.5 Average number of taxa recovered from spaces, per sample, by time period and spatial category. (Per-sample: calculated individually per-sample, then averaged for whole category. Broad: calculated for combined category, then averaged per sample.)

Samples from the Classic period floors exhibit greater richness than those of the Formative period, both broadly and as calculated on a per-sample basis. This is a function of the larger sample sizes for the Classic than the Formative. When looking across spaces (within the "COMBINED" category), as was seen in artifacts, the average sample richness is lower than the per-sample average richness. This indicates more redundancy between categories in terms of taxa assemblages than discrete uses of particular areas, although *individual* types of spaces evidenced multiple kinds of use. That is, there is some similarity between practices across spatial types, for each of the two time periods. For example, the interior of a mound atop a structure OR a patio area OR an area adjacent to a structure could have been utilized for a single given practice, such as the deposit of charred remains. However, the frequency and intensity of such practices varied, as discussed below in terms of standardized densities.

Overall, the high cross-spatial redundancy would point toward fewer discrete associations between particular ethnobotanical practices and particular spaces, and much more spatial overlap of activity in various areas, indicating their paradigmatic substitutability. However, in some cases, particular types of space contained and conditioned many more syntagmatic associations with various plant taxa than other types of space, as noted with samples from the interiors of ground-level structures versus other spatial types in the Classic period.

When assessing the data within spatial categories, the pattern is similar, with a few notable exceptions. During the Formative period, it appears as though areas immediately adjacent to structures had a higher combined set of activities, averaged broadly, than analogous spaces in the Classic period. This is unusual, in that there are more analyzed samples for the Classic period (n=34) than the Formative (n=5), which generally leads to greater combined richness. However, there is more richness, per *sample*, in the Classic period than in the Formative. It may be that in the Formative period, areas adjacent to structures were used categorically for a broader set of practices, with less overlap in activities between adjacent spaces, than in the Classic period, when they were used categorically for a more limited set of practices, with more overlap in activities between adjacent spaces.

Samples taken from the interiors of structures at ground level also exhibited interesting dynamics. During the Classic period, the combined set of botanical activities, averaged per sample, is far greater than the average per-sample set of activities. This indicates less redundancy in taxa between samples taken from the interiors of ground-level structures during the Classic. This might index more discrete uses for such spaces, or more paradigmatic substitution of one space for another when carrying out a particular activity.

Similarly, in looking at Formative period samples from patio areas and the interiors of structures atop mounds, the broad average richness is exactly equivalent to the per-sample average richness. I will discount the patio sample, as there is only one analyzed for the Formative period, and thus the numbers are necessarily equivalent. However, for samples taken from inside of structures atop mounds, this would indicate that, as with ground-level structures in the Classic, such spaces were used for more discrete purposes. In comparing the interiors of these two types of structures over time, during the Formative period, the interiors of structures atop mounds were more unique in their uses for various botanical practices, whereas during the Classic period, the structures at ground level were more unique in theirs.

Contexts exhibited similar trends as those of other axes of analysis in the Formative and Classic periods **(Figure 13.6).**

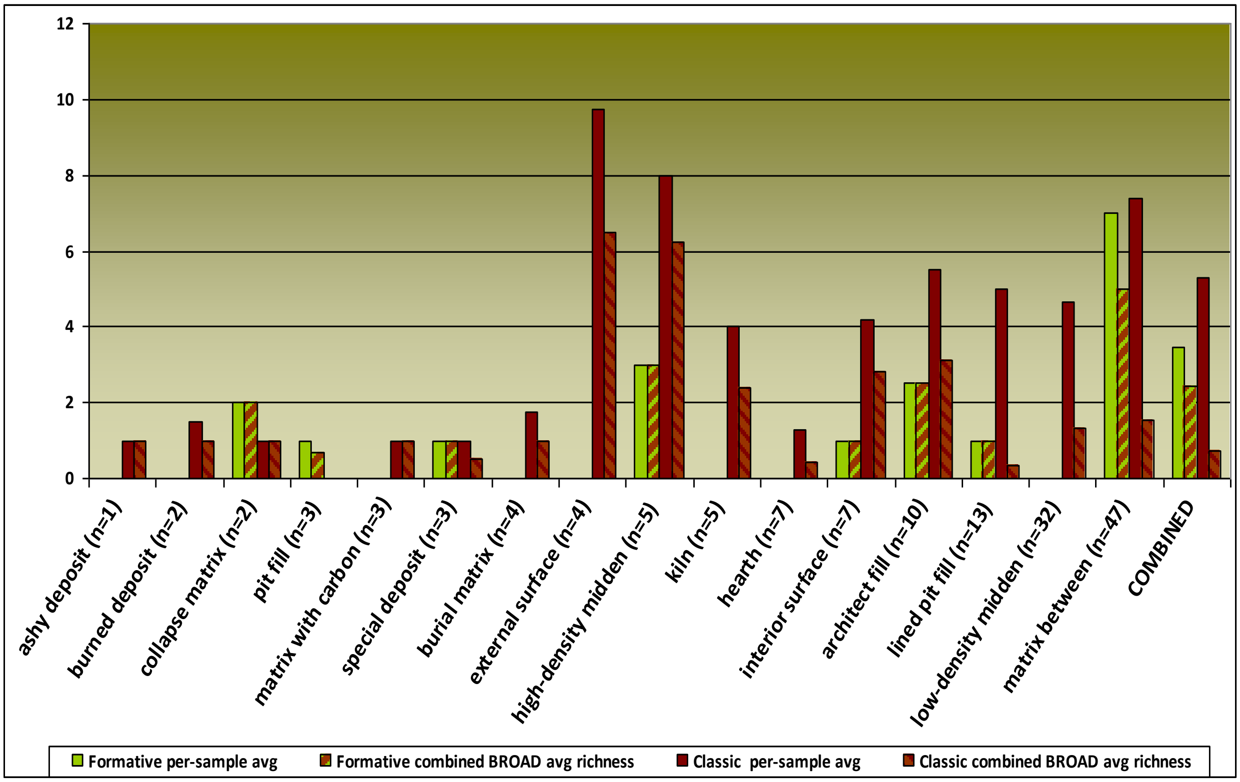


Figure 13.6 Average number of taxa recovered from contexts, per sample, by time period and context category. (Per-sample: calculated individually per-sample, then averaged for whole category. Broad: calculated for combined category, then averaged per sample.)

Overall, as with the spatial data, per-sample average numbers of taxa recovered were greater than the average number of non-redundant taxa per sample. That is, there was always some redundancy within context categories, and some overlap of botanical activity between contexts of the same type. Moreover, as with artifact and spatial data, the combined set of plants represented in the Classic period is more diverse than the set of plants represented in the Formative period, likely due to the higher number of samples analyzed. However, there is a much larger discrepancy between the per-sample average numbers of taxa and the broad average number of taxa recovered per sample in the Classic period than in the Formative. Similar to what has been previously noted, this likely represents less redundancy between context types in the Formative than in the Classic. For a given plant practice, there was less substitution of certain contexts for others, and less overlap between contexts, as particular ethnobotanical activities were more strongly associated with more formally differentiated locations.

In looking within particular categories, there were some anomalies to these broad Formative and Classic period tendencies. Multiple contextual categories (the ashy deposit and collapse matrix in the Classic, the collapse matrix, special deposit, high density midden, and lined pit fill in the Formative) had only one sample available for a particular time period, leading to *de facto* equivalent measures for both the broad combined and per-sample measures. In the Formative period, architectural fills and interior surfaces had equivalent per-sample and broad-average measures, likely indicating very discrete uses for areas within each of these two context types. That is, distinct activities were carried out from interior surface to interior surface, and distinct activities contributed to different architectural fills, leading to less overlap in composition. The Classic period exhibited no such differentiation between activities within architectural fill samples or interior surface samples. Conversely, during the Classic period, general occupational detritus ("matrix between") and lined pit fills were similar, in that they each exhibited a high diversity of plant activities per context, and high overlap in these activities between contexts of the same type. However, Formative and Classic period samples were almost equivalent in terms of per-sample plant diversity in "matrix between" contexts, indicating, in each case, a moderate diversity of plant activities associated with occupational detritus, regardless of time period.

Between broad trends for each time period, and micro trends exhibited between artifact, context, and spatial data, we see some overlap between loci of plant activities, indicating high substitutability along the paradigmatic axis, and fewer discrete paradigms associated with particular artifact, context, or spatial types. However, there are a few anomalous nodes of ethnobotanical practice, where discrete domains of activity are carved out, indicating more formalized paradigms of plant practice. We also see some variations in broad richness between different kinds of assemblages, as already discussed in previous chapters. I add another dimension to these interpretations, by now turning to the frequency and/or intensity of plant disposal practices, as indexed by standardized densities of charred plant remains.

How did spaces and contexts change over time?

Although different types of locations can be clustered or differentiated according to *kinds* of practices, I here attend to the density of practice at various spatial and contextual loci. Artifact data is not here addressed, as they have no associated macrobotanical remains that can be counted per liter of sediment. I turn first to context types, graphing two metrics of density in **Figure 13.7.**

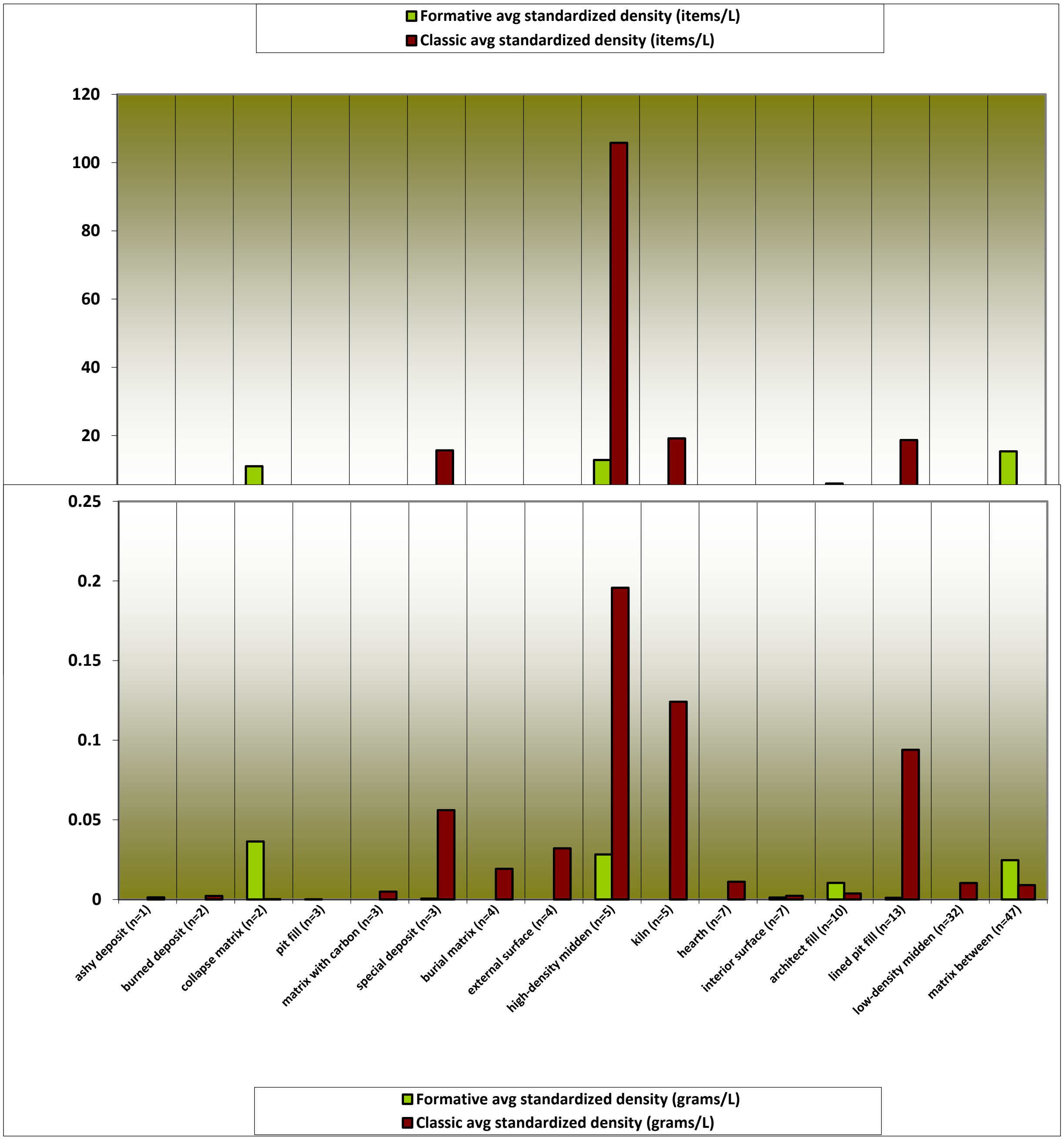


Figure 13.7. Standardized counts and weights, per liter, of each context, during the Formative and Classic periods. Top part of graph displays standardized density as counts per liter, lower part of graph displays standardized densities as grams per liter.

In this representation of the data, different trends are observable over time, as dependent on context type in terms of count and weight densities. As Chapters 8 and 12 drew together a broad potential "grammar", in terms of averages and ranges of plant practices, I here focus on *differences* in densities between Formative and Classic period contexts, to mark the changes and continuity in plant disposal practices over time.

Generally, the density of remains was much higher in the Classic period than in the Formative period. This could have to do with methods of recovery, and/or more scattered plant dispersal occurring in the Formative than in the Classic. The scatter model seems less viable, considering the more discrete patterns of context uses, as discussed in the previous section in terms of richness. However, when taking charred wood, as well as storage tissue lumps and other unidentifiable remains into account, such a model becomes more likely. It appears that charred wood and storage tissue lump fragments may have been denser in the Classic time period. That is, the discrepancies between time periods in numbers and counts of charred remains may be due to the "unidentified taxa" and "wood" elements in the samples. Heavier and more fragmented wood and storage tissue lumps, along with other unidentifiable remains, account for the greater weights and numbers of charred remains overall in the Classic period.

It is evident that certain contexts received more quantities of remains in the Classic than in the Formative, as charred remains were more frequently dumped, swept, or discarded in particular locations, and/or less likely to be removed from these nodes of deposit afterwards. Four contexts in particular, special deposits, high-density middens, kilns, and lined pit fills, show a much higher density of charred macrobotanical materials than in the Formative period. This would indicate higher dumping rates, quantities, and/or sizes of charred items at these contexts.

As high-density middens and kilns are often categorized according to such high rates of charred materials, this is somewhat self-selecting. Moreover, no kiln samples were analyzed for the Formative period, so there is a *de facto* higher density of charred remains for kilns in the Classic period. In terms of special deposits, as this is an internally heterogeneous category, it is unsurprising that different deposits exhibit different densities of remains. Lined-pit fills, however, appear to have different uses over time, and are associated with more disposal activities in the Classic than in the Formative.

It may also be that, in the Formative period, charred remains were more frequently dumped off-site than in those four particular contexts, or concentrated in other locations. One such hint is given by the analyzed "matrix between" samples. This is the lone type of context with a higher density of remains in the Formative period than the Classic. Given that this context is associated with general occupational detritus, the measurements of charred remains bolster the "scatter" depositional model discussed above. It is likely that charred materials, during the Formative period, were scattered and incorporated into occupational detritus, rather than disposed in other types of contexts. Whereas during the Classic period, charred remains were likely dumped or left in particular locations such as kilns, lined pits, special deposits, and high-density middens, rather than scattered more broadly with other detritus.

When looking at spaces, somewhat less clear patterning emerges. In **Figure 13.8,** I display quantities of charred materials in the categories of space over time, by standardized counts and weights. Within-space differences between count and weight density were addressed in Chapter 11. I here focus on differences in densities between these same spatial categories over time.

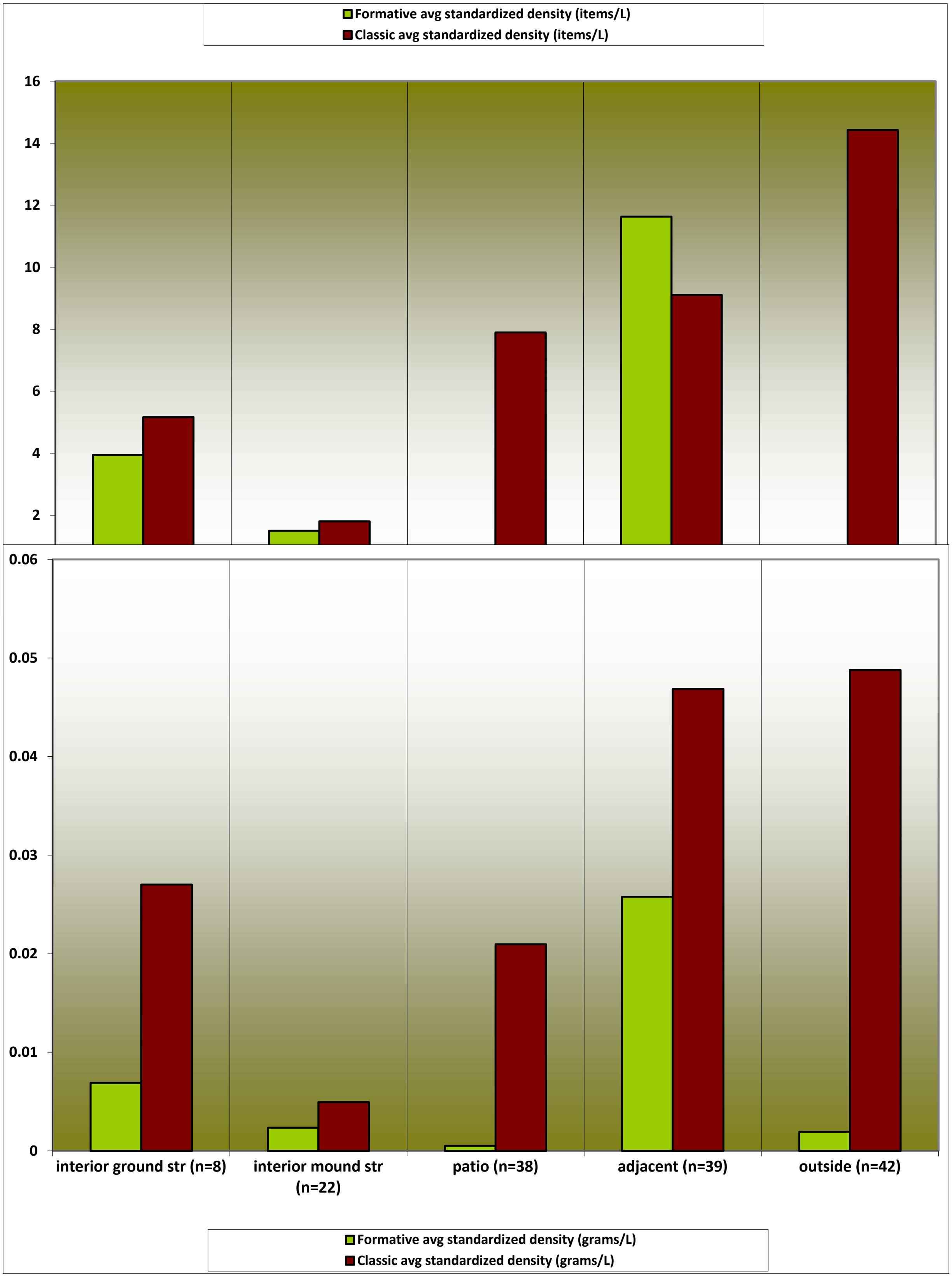


Figure 13.8. Standardized counts and weights, per Liter, of each space, during the Formative and Classic periods. Top part of graph displays standardized density as counts per liter, lower part of graph displays standardized densities as grams per liter.

During the Formative period, the average standardized weight of materials in spaces immediately adjacent to architecture is relatively low, as compared to the average standardized count of materials in this type of space, which are higher than those of the Classic period. This indicates fragmented materials of lower weight, in this case, predominately wood fragments. These many small fragments may represent sweepings from hearths, dumping of hearth ashes, and/or detritus from razed and burned structures. Such materials are potentially more commonly associated with areas adjacent to structures in the Formative period, although the higher degree of fragmentation would point more toward materials of a sweeping size, than a dumping-size particle or burned construction timbers.

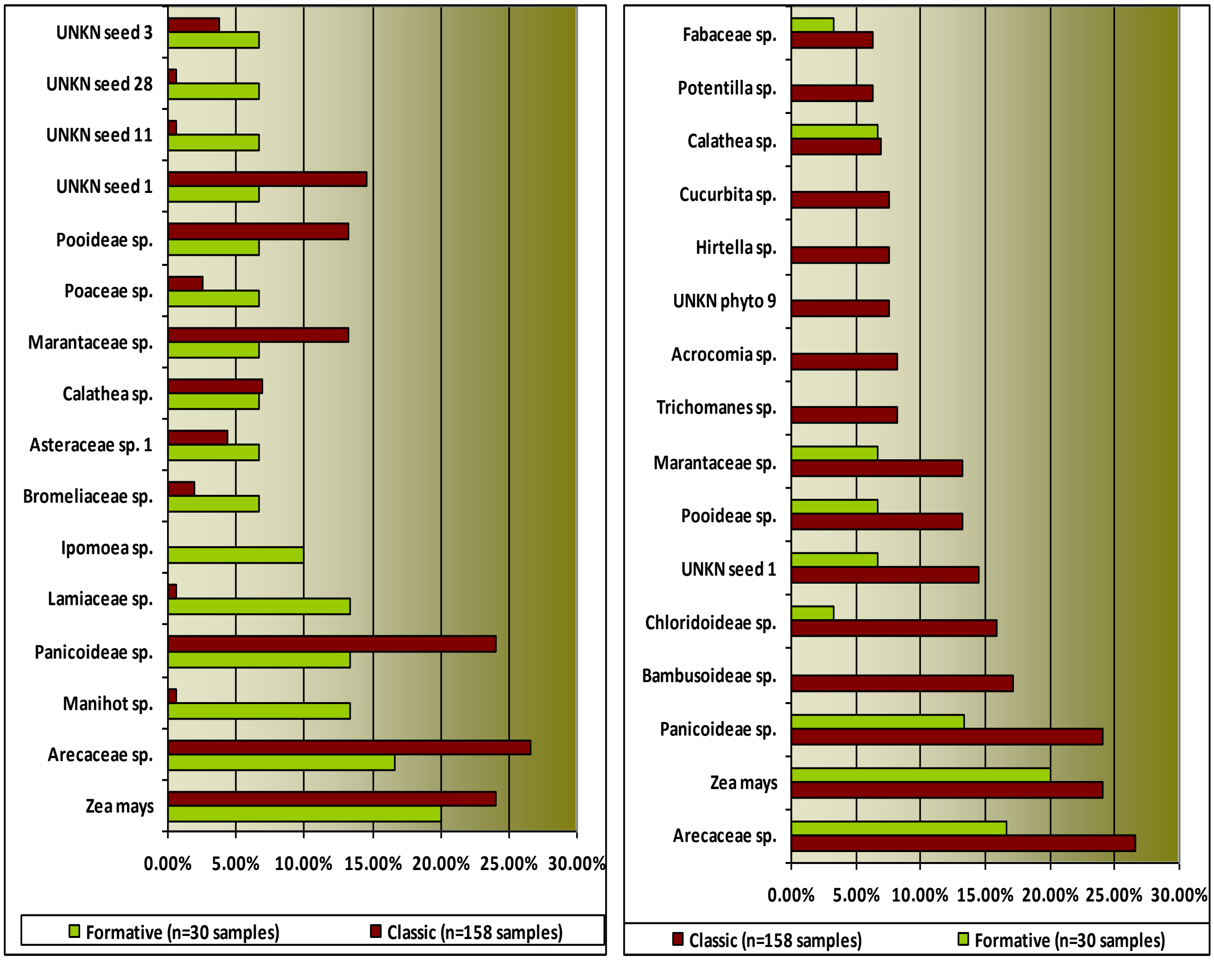
There is also a greater discrepancy during the Classic period between weights and counts of charred remains taken from the interiors of ground-level structures. The slightly higher weight to count ratio may have to do with Classic Period interiors of structures having larger charred remains than those of the Formative period. Such materials are less likely to be sweepings (into the structures) or disposals of materials (inside the structures), and more likely to be associated with burned structural materials from the termination of architectural use.

Overall, the average standardized densities of charred macrobotanical remains were much higher in the Classic period than in the Formative period. Unfortunately, more fine-grained distinctions are difficult to make between Formative and Classic period spatial categories. The context data, in contrast, shows more striking distinctions between categories over time. This is unsurprising, considering the more fine-grained approach to the data set resulting from the larger number of contextual categories to analyze.

Appearances and disappearances of taxa and practices: ubiquities

In turning toward individual taxa, we see distinctions between presences of various taxa over time. I listed each taxon and charted locations of recovery, among other related data (see Table 8.1 in Chapter 8). Here, I track a subset of these plants in the Formative and the Classic, identifying patterns in frequencies and highlighting the appearance and disappearance of these key taxa between these two time periods.

I begin with the sixteen most ubiquitous taxa in the Formative period, comparing percentage ubiquities of these taxa in the Classic period, and the sixteen most ubiquitous taxa in the Classic period, comparing percentage ubiquities of these taxa in the Formative period. Each percent ubiquity is calculated by the total number of times a taxon was found, divided by the total number of samples where the taxon could potentially be recovered. **Figures 13.9a** and **13.9b** chart these comparisons.



Figures 13.9a and 13.9b. Comparisons of the sixteen most ubiquitous taxa in each time period, by percentage ubiquities. a) Formative period (as compared with Classic). b) Classic period (as compared with Formative).

We see maize dominant in both periods. Palm *(Arecaceae)* products are also highly ubiquitous in both periods. However, no cocoyol *(Acrocomia* sp.) palm was found in the Formative period, whereas it is highly ubiquitous in Classic period. This palm was well known in other Classic period sites in Southeastern Mesoamerica, and persists as a popular snack food even today. Moreover, its remains are highly durable and diagnostic, which allows for a more confident conclusion that this species was not utilized in Formative period sites in this area. It may have been introduced to the region by the Classic period.

In terms of crops grown for edible underground storage tissues (roots and tubers), some species are more prominent than others. Manioc *(Manihot* sp.) is much more ubiquitous in the Formative period, whereas sweet potato *(Ipomoea* sp.) has *only* been recovered from Formative samples. Lirén (*Calathea* sp.) is roughly equivalently present in both time periods, whereas broad arrowroot family *(Marantaceae* spp.*)* botanical remains are roughly twice as ubiquitous in the Classic samples. Underground storage organs commonly grown for food are much more frequently present in the earlier samples.

Herbaceous mint family *(Lamiaceae*) species are very ubiquitous in the Formative period, but close to missing in the Classic period. Sunflower family *(Asteraceae)* species are also slightly more ubiquitous in the Formative samples. This may indicate more frequent economic uses of these plants in earlier times, or more tolerance of this ruderal family.

Bromeliads are twice as ubiquitous in Formative period, which may correspond with the more frequent use of these plants as ornamentals and foodstuffs, although *Tillandsia* species, as discussed in previous chapters, are known to have been used ethnographically by the Lenca in rituals (Meluzín 1997). Various unknown species are also highly ubiquitous in the Formative period. The lack of identification of many of these species is likely due to the limits of my various reference collections, but it is also possible that some of these species are now extinct or extirpated from the region.

Grass family *(Poaceae)* species, and especially those corresponding with the Pooid tribe, are quite frequent in earlier time periods. However, the *Pooideae* and other grass family tribes *(Chloridoideae, Panicoideae* and *Bambusoideae),* are much more frequently represented in the Classic period. This may indicate a shift toward the use of grasses in implements, thatching, bedding, daub, clay surfaces, and matting during the Classic period, potentially substituting for other unknown materials formerly used during the Formative period.

Trichomanes, Potentilla, and *Hirtella* are ubiquitous across Classic period samples, as compared with Formative period samples. These plants, as mentioned in previous chapters, may represent decorative plants in homegardens, among other potential uses, or adventitiously-growing weedy species. Wild bean family *(Fabaceae)* species are similarly patterned, potentially marking their use as shade trees in home gardens or the products of fallowed milpa areas. The presence of these various potentially economic taxa during the Classic period is expected, however, their very high ubiquity is not.

Finally, various squash *(Cucurbita)* species were much more ubiquitous in the Classic period, as there is *no* recovered evidence of squash in the Formative period. This is highly contrary to expectations. Squash is expected during the Classic (and indeed, is one of the model Triumvirate foods), making the lack of evidence from the Formative period assemblage surprising. Considering it is one of the earliest domesticates, represented in early ceramics and recovered even from Archaic period caves in the Tehuacán Valley (Smith 1997) and the El Gigante rockshelter (Scheffler 2009), it is not likely to have been unknown to those living in Northwestern Honduras during the Formative period. The vast majority of Classic period squash remains have come from sediment samples at Currusté, a type of sample unavailable for the other three sites, and the microremains recovered from artifacts were limited to ceramic sherds, a data set unanalyzed for the Formative period. Regardless, the lack of evidence for squash in the Formative period at Los Naranjos complicates traditional views of the widespread high ubiquity of squash for thousands of years.

In focusing on economic taxa commonly grown in milpas and homegardens, several less ubiquitous species become visible. In **Figure13.10,** I highlight domesticates and plant taxa grown for food. I do not include the families of *Marantaceae, Annonaceae, Fabaceae,* and *Arecaceae,* although some of these remains may be related to food taxa refuse.

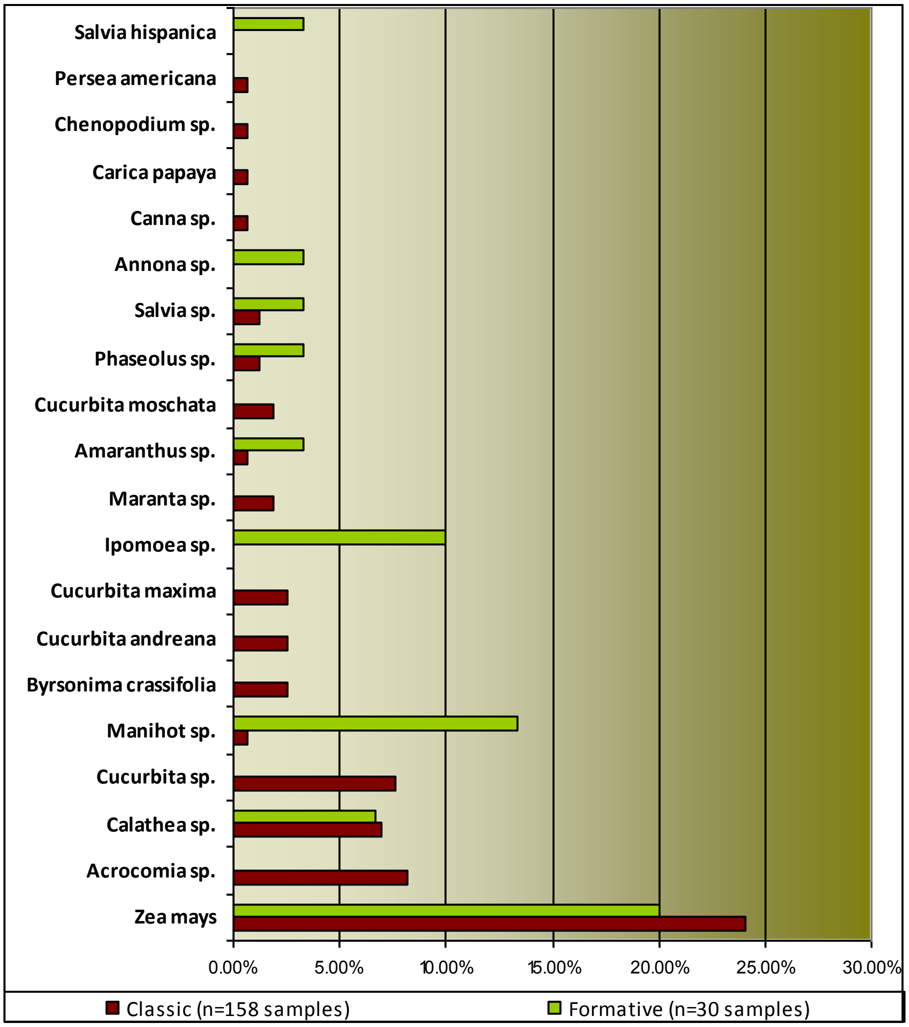


Figure 13.10. Percentage ubiquities of plants commonly grown for food in milpas and homegardens, as anticipated by ethnohistoric, ethnographic, and archaeological models.

In this figure, we see the ubiquities of plants previously discussed (maize, cocoyol, squashes, and various starchy underground crops), as well as several less frequently recovered plants. Seeds from the fruits of nance *(Byrsonima crassifolia),* papaya *(Carica papaya),* and avocado *(Persea americana*) were recovered rarely, whereas custard apple *(Annona* sp.) was recovered only from the Formative period samples. As none of these species is considered a staple crop, their relatively low frequencies (n=1) are unsurprising. However, the presence of these diverse fruit tree species does indicate tree-cropping regimes during both time periods.

Charred grains of chia *(Salvia* spp.), goosefoot *(Chenopodium* sp.) and amaranth *(Amaranthus* sp.) also emerged from macrobotanical samples. Amaranth and chia were more ubiquitous in the Formative, while goosefoot only appeared in the Classic period samples. The combined ubiquities of species used for grains (maize, chia, goosefoot, amaranth) are roughly equivalent in both time periods. However, Classic period samples more frequently contain maize. This may indicate less reliance on maize and greater use of other grain species during the Formative period and/or the increased use of maize during the Classic period. Overall, cereal species were equally frequent between time periods, perhaps indicating the paradigmatic substitution of maize, over time, for other grain species.

Two food species that were surprisingly infrequent in the Formative period are beans *(Phaseolus* sp., n=1) and squashes (nonexistent), as previously discussed. Beans are equally rare in the Classic period, perhaps indicating a continuity of little use through both of these time periods. As beans are found in earlier Archaic period samples (Scheffler 2009) and considered to be a staple food in modern times, it is surprising to find them so infrequently in samples from the time periods in-between, as discussed in Chapter 8 in terms of preservation. Squashes are very frequent and highly diverse in the Classic period, as discussed previously.

Some taxa appeared much less frequently than expected, a few expected taxa were entirely absent. In particular, no chile or cacao paleoethnobotanical remains were recovered. Chile is identifiable through both macrobotanical remains and diagnostic starches, so would have been expected. Cacao can be detected through residue analyses which were not attempted in this dissertation. However, this taxon has been detected in Formative period Puerto Escondido (Joyce and Henderson 2007). Cacao can also be detected from macrobotanical remains, although these are rarely reported in other Mesoamerican sites, so their absence is less surprising than the absence of evidence of chile. Both of these species have previously been recovered from materials corresponding with each of these time periods in Honduras. Their lack of paleoethnobotanical representation in all of the samples signals much less ubiquity than what was anticipated.

When looking specifically at food crops of underground storage organs, there are striking differences between the Formative and Classic periods. In **Figure 13.11,** I focus on five known species of root crops and tubers. Lirén (*Calathea* sp.) tubers were almost equally ubiquitous in both time periods, evidencing some continuity of use. However, all other root and tuber crops were more strongly associated with only one time period. Achira *(Canna* sp.) and arrowroot *(Maranta* sp.) were only recovered from Classic period samples, while manioc *(Manihot* sp.) was recovered from both Classic and Formative samples, though is much less frequent in the Classic period. Sweet potato *(Ipomoea* sp.) was only recovered from Formative period samples. One way to look at these trends is to suggest that there was a substitution of earlier crops (sweet potato and manioc) with later crops (achira and arrowroot), with some continuity in the frequency of lirén tubers.

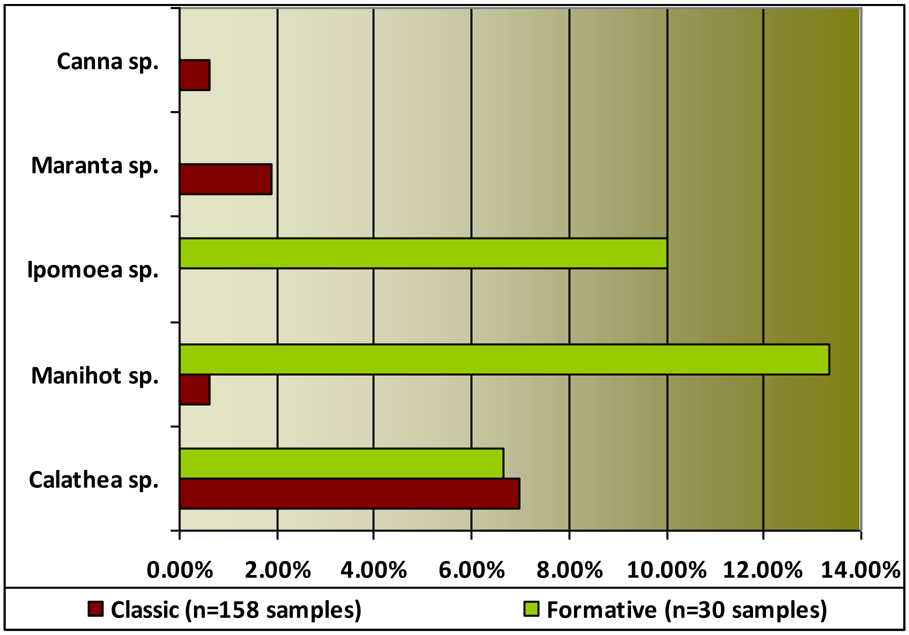


Figure 13.11. Percentage ubiquities of plants commonly grown for edible underground storage organs.

Although I will not fully detail the changes and continuities of frequencies for non-domesticated, uncommon, wild, and/or "weed" species, I do chart them in **Figure 13.12.** Overall, we see the numbers of plant taxa to be roughly equivalent between the two time periods, although actual frequencies of particular taxa are markedly dissimilar. For the most part, grasses dominate this subset in both time periods, with the majority of the other herbaceous species found once in only one of the two time periods.

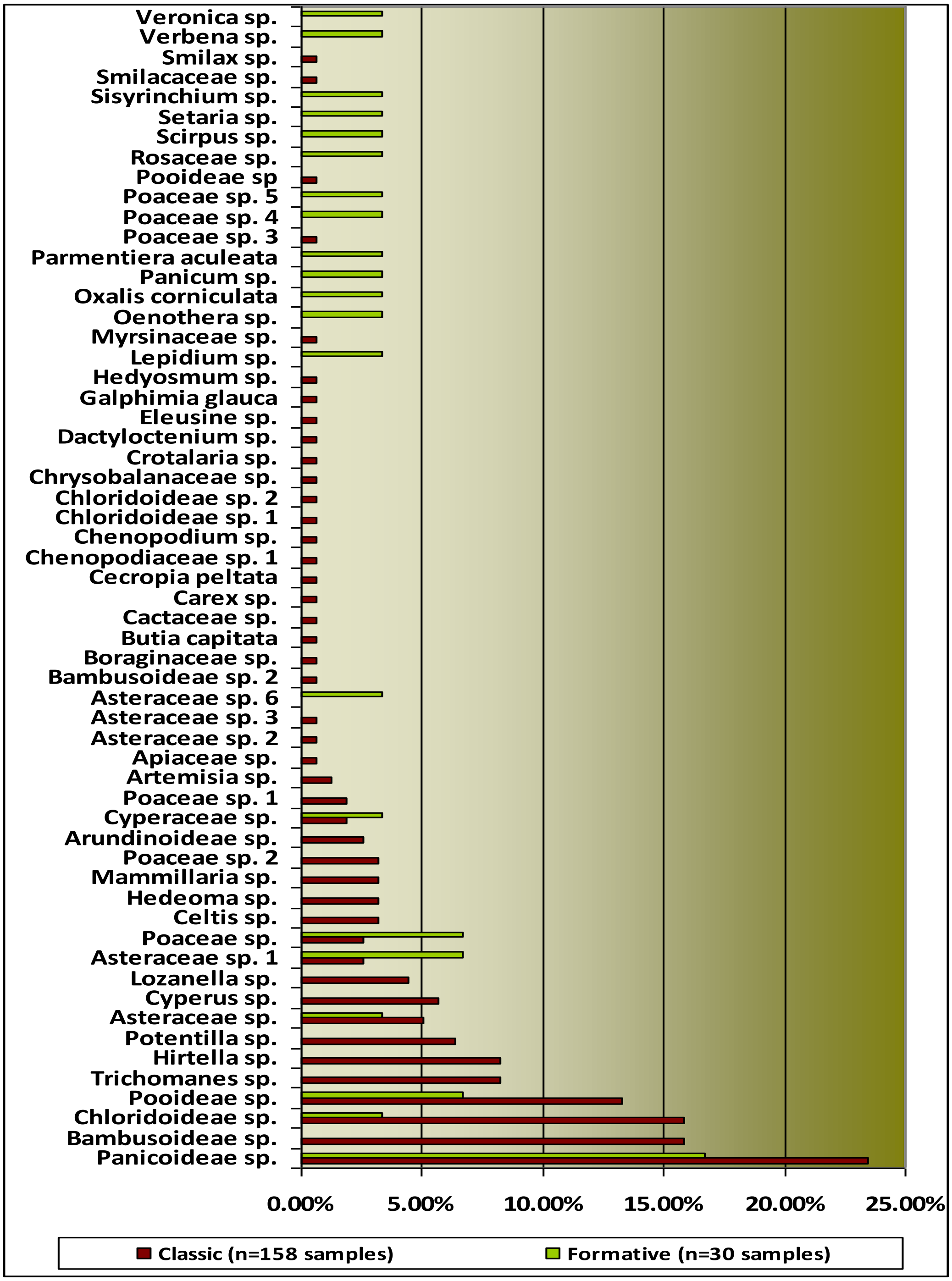


Figure 13.12. Percentage ubiquities of non-domesticated, uncommon, wild, and/or "weed" species traditionally considered to be of little or no economic value, arranged in order of combined overall ubiquity across both time periods.

Economically important taxa commonly grown, but not known to be used as foodstuffs, include bottle gourd *(Lagenaria),* copal *(Protium* sp.), indigo *(Indigofera* sp.), and tobacco *(Nicotiana* sp.). In **Figure 13.13,** I compare the ubiquity of these four species in the two time periods. Bottle gourd was surprisingly infrequent, recovered only once in the Classic period. As this species preserves well, has highly diagnostic macrobotanical and phytolith remains, and is known from other Archaic period samples, it is unclear why it was completely absent in the Formative period samples but present in Classic period samples. Copal was also recovered only from the Classic assemblage, but as it is the resin which is utilized—a material that leaves no macrobotanical or microbotanical remains—it is less surprising to find it so infrequently. A single indigo plant seed was recovered from the Formative period, whereas none were recovered from the Classic period. It is somewhat surprising to find this species at such an early time period, and even more surprising to find it absent from the later Classic timeframe.

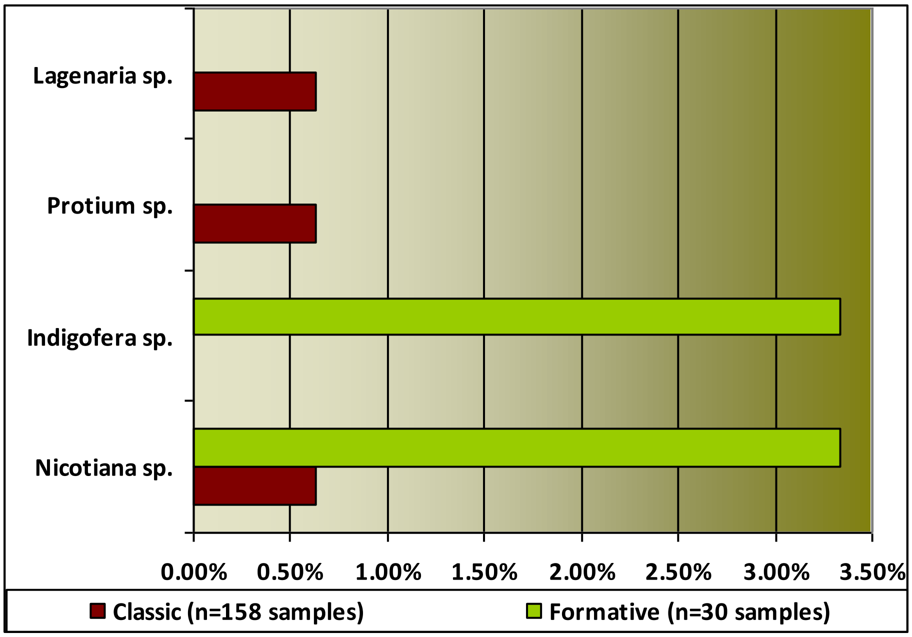


Figure 13.13. Percentage ubiquities of economically important taxa commonly grown in milpas and homegardens, but not known to be used as foodstuffs.

Tobacco was recovered from both time periods, once in the Formative and twice in the Classic, making this taxon roughly six times more ubiquitous in the earlier time period, as the per-sample frequency was not maintained into the Classic period. This may have to do with transformations of use or processing over time.

Figure 13.14. Tobacco growing and curing. Illustrations by Sarah Davidson.

In considering the various plant ubiquities between time periods, it is evident that some began to appear in the Formative period (or earlier) and continued into the Classic period (or later). Others, however, emerge in only one of the two time periods. In some cases, this may have to do with substitutions of certain plants for others over time. In other cases, this may have to do with the introduction of new plant species that develop syntagmatic associations independent of previous paradigms. For those plants present only in Formative samples, there may have been decreased frequency of use in the Classic period, although many of these species are commonly grown today. Regardless, the selective narrowing of the broad available spectrum of plants in each time period indexes the transformation and continuity of ethnobotanical practices over time.

Summary

Just as in studies of portable artifacts, in studies of archaeological places and spaces the temporal aspect is a knotty one. Giddens asserts that time has not been sufficiently incorporated and problematized in social theory and has been treated more as a static environment in which social interactions take place, rather than as integral to their emergence (Giddens1979:202). Indeed, as patterns of social conduct are situated in time, it is only when they are examined *over* time that they form patterns at all (Giddens 1979:202). In referring to the temporal aspect of place, specifically, de Certeau (1984) contrasts speech acts (dialectically articulated with language) with footsteps (dialectically articulated with places). As he terms it, the practice of walking is an act of enunciation. The spatio-temporal trajectory of the walk appropriates the topographical system on the part of the pedestrian, spatially acts-out places, and indexes relations between differentiated positions (de Certeau 1984:98).

Similarly, the biographical trajectories of various plant species shaped cultural practices and were in turn shaped by them, through repeated iteration and paradigmatic substitution. Further investigation of other sites dating to the Formative and Classic time periods would better construct a more complete picture of ethnobotanical practice across contexts, spaces, and artifacts. Extending the current study to other regions and time periods would allow us to more closely approximate paradigms of plant activity over time and across locations. However, given the data set available, some continuities and discontinuities are visible between time periods, likely delineating syntagmatic and paradigmatic axes of ethnobotanical practice.

When considering taxa richness, density, and ubiquity over time and loci, it is apparent that there is more continuity than difference, in terms of plants found at particular locations, and in terms of kinds of locations associated with particular plants. However, the Formative period is marked by more richness per sample as compared to average richness, whereas the Classic period is marked by a broader overall richness as compared to richness per sample. There is more similarity between taxa assemblages in the Classic, while during Formative times ethnobotanical practices took place in locations with more formally-defined and specific activities.

Various artifacts, through both time periods, were redundant across categories, likely indicating fewer discrete paradigms of practice, regardless of time period. Particular artifacts had a range of uses, especially in the case of obsidian blades, and thus were syntagmatically associated with more practices.

For a given plant, there was more general overlap between locations of ethnobotanical practices during the Formative period. Spaces and contexts were similar in the broad overlap between many categories, although several individual categories were anomalous. Structures built at ground level were used for more discrete and formally-defined purposes in the Classic period. Architectural fills and interior surfaces had more discrete deposits in the Formative period, whereas occupational detritus and lined pit fills were more bounded in the Classic period.

Standardized densities of charred remains, in combination with other lines of evidence, indicate more scattered materials in the Formative, with more defined areas of deposit in the Classic period. In earlier times, charred materials were likely scattered and incorporated into occupational detritus, instead of being disposed in specific contexts.

In looking at the ubiquities of four subsets of taxa-- seed plants, underground storage organs grown for food, non-domesticated and/or ruderal plants, and non-food economic plants-- there were surprising omissions, lower frequencies than expected, higher frequencies than expected, and even the potential substitutions of certain grains and root crops for others over time. Such differences in frequencies between certain plants at different time periods reference the fragments of ethnobotanical "speech acts", subject to paradigmatic substitution and syntagmatic association, and influenced by the historical and social contexts of the "speakers".

Ancient practitioners, in the ways they articulated and reformulated plant uses across periods, left behind a glimpse of rich sets of activities, sometimes enunciated very formally. These activities, dependent on both immediate and broad contexts, defined places and artifacts as much as they were proscribed by them. Some practices, continued over time, mark syntagmatic durability, if not duplicate meaning. Transformation in other practices, over time, marks shifts in syntagmatic plant "grammars", although paradigmatic "parts of speech" may have persisted.

14. Conclusions

"Everything is a matrix that you function inside of.... There's about 10 miles of atmosphere at the Equator, and five miles at the poles. That's the matrix we all survive within. You apply your knowledge to that, and figure out how to survive. I'm limited to six ounces of beef that's 95 percent lean every day. That's my matrix. But when I barbecue, I want that flavor to go right down to the bone. Down to the bone!"

--Bobby Seale on his diet at age 75, quoted in the NYT article "My Unhealthy Diet? It Got Me This Far," by Henry Alford, 2/28/11

Foodways are as rich and complicated as barbeque. There is a vast multitude of factors constantly influencing decision-making and practice, and a vast multitude of decisions and practices constantly transforming this set of factors. As Bobby Seale noted, it is a complex and dynamic matrix of ecology, cultural knowledge, nutrition, tastes, and dietary restrictions-- among many other aspects. Furthermore, when looking at the ancient past, foodways appear as *messy* as barbeque. Sampling and preservation issues limit the data we are able to interpret. The combined ethnographic and ethnohistoric records tell us that foodways were not simply enacted at the level of a neatly-defined nuclear family or even extended family household. Foods were shared, distributed, communal, emerged along different axes and at different locations, and were comprised of many activities.

In the case of the four ancient communities in Northwestern Honduras, there are no perfectly discrete disposal areas (they blend into likely homegarden scatters), no striking differences in activities carried out across contexts and spaces, no perfectly discrete tool uses (tools appear to be used for multiple purposes), few single-use plants (some can appear as thatching, matting, tamale ties, and cleaning products), and few sharp divisions over time. We see some practices paradigmatically exchanged for others, dependent upon spatial, contextual, or implement type, while other practices take place across a wide variety of loci and artifacts, indicating weaker paradigms and less boundedness where these activities are concerned.

Over the course of my dissertation project, I have carried out analyses with an emphasis on ethnobotanical activities and foodways, incorporating approaches to linguistics and practice. I have pursued comparisons along the axes of plant taxa, artifacts, spaces, contexts, and time, focusing on three types of paleoethnobotanical data: macrobotanical remains, starch grains, and phytoliths. I believe the various assemblages of these botanical remains comprise something analogous to "speech acts", articulated through artifacts, spaces, and contexts.

In this concluding chapter, I begin with a summary of key findings from each of the analytical chapters. I then return to the pools of questions surrounding the three foci of ethnobotanical practice I had originally pursued: agriculture, underground storage organs, and non-domesticates. I consider a broader approach to foodways, in terms of syntagms and paradigms of plant practice. I also return to previous models of foodways for Southeastern Mesoamerica, and how these models are complicated by the results of this study. I discuss the advantages and complications of my research design and protocols, before turning to various possibilities for future research. In my final thoughts, I re-visit the potential of linguistic models in the analysis of paleoethnobotanical remains and ethnobotanical practice. Broadly, I hope to contribute to the project of complicating previous "taken-for-granteds", and present some new avenues for discourse, in assessing ethnobotanical practice broadly and Southeastern Mesoamerican ethnobotanical practice in particular.

Key findings from each axis of analysis

In Chapters 8-12, I set up a broad average "grammar" of different aspects of foodways at the sites of Puerto Escondido, Currusté, Los Naranjos, and Cerro Palenque. In Chapter 13, I split my results into a comparison between the Formative and Classic periods, to track aspects of ethnobotanical "speech acts" as they play out over time. I here revisit several key findings from each axis of analysis.

In terms of methodological aspects, we see various factors that impact recovery of plant remains and foodways activities (Chapter 8). When comparing macrobotanical and microbotanical data sets, sediment samples yield highest diversity *per sample*, but herbaceous and non-domesticated species have highest recovery rates from bulk flotation samples. Moreover, samples taken from artifacts are the only means of associating particular implements with particular ethnobotanical practices. The three types of analysis together provide the best complementary data, and expand the range of botanical taxa and foodways practices, as well as bolster hypotheses of plant use where plants have more than one diagnostic part.

In looking at the broad spectrum of plants incorporated into the archaeological record and their associated practices (Chapter 9), the ubiquities of various taxa reveal a few key points. Certain taxa appear to co-vary, indicating overlapping nodes of activity and/or intentional combinations of foodstuffs. Other species were anticipated but never found, especially cotton, chile, and annatto. Some species corresponded with foodstuffs recovered more frequently to the south, such as lirén and achira. Yet other species were not anticipated but appeared frequently--coyotillo and false pennyroyal, among others—and may indicate medicinal, dye, and or condiment uses for these herbaceous plants. Through plant species represented and underrepresented, we see articulations of both "Maya" and "Central American" aspects of foodways, as this area of Northwestern Honduras appears to have been at a crossroads of major regional cuisines. With the use of different recovery techniques, we find evidence of root and tuber crops, domesticated and non-domesticated species, and the various activities associated with them **(Table 14.1,** drawing from the set of potential practices outlined in **Table 4.1)**.

Producing	***Procuring***	***Processing***	***Preserving***	***Consuming***	***Cleaning***	***Scheduling***
Organizing (people, things, and spaces), Scheduling	**Digging**	**Peeling, Slicing**, Grinding, **Cutting**, Beating, Extracting	Storing	**Serving**	**Disposing**	**Weather-watching**
Gardening	**Picking**	**Soaking, Treating**, Leaching	Smoking	Presenting	**Sweeping**	**Planning**
Farming	**Gathering**	**Cooking, Toasting**, Baking, **Stewing**, Steaming, **Burning**, Molding, **Roasting**, Brewing	Drying	Exchanging	**Washing**	
Planting, Intercropping	**Harvesting**	**Seasoning**, Salting	Fermenting	Adorning	Fire-banking	
Cutting, Clearing	Exchanging	**Building, Weaving**, Painting, Pressing, **Dyeing**		**Eating, snacking**		
Fallowing (and bee-keeping)	**Cutting**	**Fire-building**		**Treating, Medicating**		
Tending, Weeding, Managing, Pruning		Water-retrieving		**Fueling**		
Shading				**Ritualizing**		
Watering, Channeling, Field ridging						
Burning						
Digging						
Repelling insects and animals						
Fertilizing						
Bolstering						

Table 14.1. Possible ethnobotanical practices (in bold), as indexed by taxa recovered from paleoethnobotanical remains.

Within the broad associations (and disassociations) noted between plants and their practices, one subset relates specifically to gardening tools and culinary equipment (Chapter 10). The variety of taxa recovered from artifacts reference a variety of practices from processing root crops to serving food to carving or trimming wood. Some artifacts appear to have stronger associations with particular taxa than others, in terms of implement uses. There is also some evidence for the use of certain taxa to clean tools. Obsidian artifacts appear to have been used primarily for slicing fibrous and woody things, and there were no strong differentiations between types of obsidian implements. However, particular taxa were "substituted" with other taxa, such as the use of one artifact for sweet potato processing, another for lirén, and another for manioc. Unfortunately, the diversity of species recoverable from ceramic artifacts was limited by the gelatinization of starch grains through cooking, leading to only unidentifiable starch grains in the sonicated samples (similar to that described in Henry et al. 2009). The high preponderance of these damaged starches does at least confirm that these ceramic vessels, as suggested by their morphology, were used mostly to serve cooked foods.

In considering the diverse kinds of spaces within these four ancient communities (Chapter 11), we see differences and similarities between pathways and disposal areas, public and private areas, interiors and exteriors of structures, and interiors and exteriors of patio groupings. Food remains, leftover plant parts from processing, and charcoal from hearth fires are distributed across the settled landscape, although are variably concentrated. Interiors of structures seem to have been kept relatively clear of plant detritus, in terms of charred remain density, and have lower taxa richness. Patios and areas immediately adjacent to structures have a medium level of everyday scatter, deposit, and redeposit, in terms of charred remain density, but a highly rich taxa assemblage. Some taxa we would expect to find in homegardens appear as uncharred phytolith remains, and may represent species growing *in situ* in patio areas. Areas just outside patio groups tend to have the densest accumulations of materials, and the highest taxa richness, likely indicating preferred disposal areas. The high fragmentation of remains in the sample from between two structures may index the use of this area for a pathway.

Patterns of ethnobotanical practice across contexts (Chapter 12) were clearer in some locations than others. We see the movement of plant remains from primary disposal areas to other contexts, especially when incorporated into architectural construction fill. There are associations between certain plants and contexts, and some paradigmatic differentiations between "clean" and "disposal" areas, but to no great degree. Lined pits appear cleaner, with lower densities and fewer kinds of plant remains than other contexts. This perhaps indicates their use as temporary food storage areas during processing (similar to Sheets 1998) or in ceramic production. Unlined pit fills, as well, do not contain a wide variety of plant taxa, and have very few remains in general. Both sorts of pit fills contrast with architectural fills, which have a high diversity of plants, likely indicating regular secondary and tertiary deposits. Kilns, high-density middens, and fills from lined pits have the highest densities of charred plant remains, indicating *in situ* remains as well as common contexts of disposal. Ironically, ashy deposits and matrix containing carbon had the lowest densities of charred materials, perhaps having to do with the temperature of the fires or the types of materials burned. Remaining contexts represent an everyday scatter of materials across contexts, along a sliding scale of concentration. These analyses show that plant remains were incorporated into the archaeological record through nightsoil, hearth ashes, and food scraps, and distributed everywhere in the settled landscape.

By considering similarities and differences between two broad time periods (Chapter 13), we are able to track transformation and continuity of ethnobotanical practice. Broadly, through tracking taxa ubiquities, we see more activities carried out in overlapping locations in the Classic period, as compared to fewer activities carried out in more discrete nodes in the Formative period. Obsidian blades, regardless of time period, were more multi-purpose than other lithic tools, and encompassed a wider spectrum of plants, although a given practice had many potential associated tools (retouched flakes, bifaces, flake fragments). Ground-level structures, when compared to other spatial types in the Classic period, are more strongly associated with particular kinds of plants, although there is great overlap of activity between spatial areas in general. This indicates either strong syntagmatic associations with overlapping activities and/or weak paradigmatic definition of these areas as specialized activity locations.

Underground storage organs commonly grown for food are more common in the earlier samples, whereas maize is less frequent in the Formative and more frequent in the Classic. Several grain species recovered in the Formative period were not recovered in the Classic, possibly indicating the paradigmatic substitution of maize for other cereals over time. Planting cultivars and harvesting trees are evident in both time periods. In terms of quantities of materials, certain contexts were foci of more remains in the Classic than in the Formative. Charred remains were more frequently dumped, swept, or discarded in particular locations such as areas adjacent to structures and outside of patios, likely indicating stronger paradigmatic categories of "disposal areas" for such locations.

In combination, the explorations presented in Chapters 8-13 better expand the element ranges of currently-understood paradigms, elaborate syntagmatic associations between paradigmatic elements, and elucidate phenomenologically distinct "speech acts" particularized to certain nodes and viewed at different scales. With further investigation, patterns of ethnobotanical practices could eventually be established throughout the region, patterns that could be compared with ethnohistoric and ethnographic records to better "seed" pre-Hispanic Southeastern Mesoamerican sites.

How are expectations of foods and foodways in Southern Mesoamerica potentially restructured by this study?

When looking at documentation of various foodways in Southern Mesoamerica (Chapter 4), I presented many potential analogs for understanding the archaeobotanical record of the four ancient communities in Northwestern Honduras. Although I have woven these analogs into the analytical chapters, I here draw together my findings to compare them to what was previously known about foodways in this region. There are three broad pools of questions I had pursued, at the outset, coalesced into categories of agricultural species, non-domesticate species, and root and tuber crops. Below, I elaborate on the key findings that correlate to each of these broader pools.

Common domesticated crops

Products of agricultural practice were recovered from all four sites. Expected domesticated species include maize, beans, and various squashes. Many authors have set up this "trinity" of species as the primary source of sustenance, often drawing from Diego de Landa's ethnohistoric documentation (1978 [1566]). In spite of the variety of ingredients and cooked dishes, Redfield and Villa Rojas (1962 [1934]:38) note that maize was the mainstay. They claimed that even when other foods (such as beans) were abundant they may not have been added to a meal otherwise consisting entirely of maize. Tozzer (1907) detailed the preparation of beans, boiled and eaten with chile, while Redfield and Villa Rojas (1962 [1934]:40) described the toasting of beans and squash seeds for a sort of snack. Broadly, across ethnohistoric and ethnographic sources, maize, beans, and squashes as ubiquitous and dominant in the cuisine of many Southeastern Mesoamerican peoples, even today.

Although this model may be appropriate for the Classic period, there are remarkably few beans and no squashes in the Formative period Honduran sites studied here. Moreover, we see an increased frequency of maize in the Classic time period, but find common grain species such as amaranth and chia present through both time periods. Unlike what has been described for areas to the north (Redfield and Villa Rojas 1962 [1934], de Landa 1978[1566]), we find no chile peppers at any of the four sites of this study, which is consistent with the scant use of chile in present-day Honduras. This may implicate other sorts of condiments and seasonings used in foods-- possibly even several of the herbaceous species in the archaeobotanical record of these sites-- for which we have no recorded uses. Such paradigmatic substitution may help to further our understanding of "flavoring" categories in the region, or define separate paradigms for areas further north.

Underground storage organs: Root and tuber crops

In spite of the root and tuber crops noted in ethnographic and ethnohistoric literature, these types of foodstuffs are not featured prominently, nor are cited as common or staple sustenance for ancient communities. Tozzer (1907) noted that sweet potato and manioc were sometimes eaten in lieu of beans. Tubers were eaten in season, according to other sources, and included manioc (*Manihot* spp.), jicama (*Pachyrhizus erosus*), sweet potatoes (*Ipomoea* sp.), and yams (*Dioscorea* sp.) (Redfield and Villa Rojas 1962 [1934]:38).

At the four ancient communities in Northwestern Honduras, we find evidence of manioc and sweet potatoes, but no evidence of jicama or yams. We also find evidence of lirén *(Calathea* sp.), as well as arrowroot *(Maranta* sp.) and achira *(Canna* sp.). This may mark the difference between northern and southern aspects of foodways, as we see some overlap with southern underground storage organs (as noted in Perry 2001; Piperno 1998, 2009) and some overlap with northern underground storage organs (as seen in the ethnographic literature and Lentz 1996**)**. Manioc, found throughout Southeastern Mesoamerica and through Southern Central America (as noted in the ethnographic literature; Lentz 1996; Piperno and Holst 1998; Pohl et al. 2006), represents an expected element in all of these cuisines, although its importance appears to have varied regionally. The importance of root and tuber crops may have been greater than what has been reflected in archaeological literature, likely as a result of a focus on ethnographic sources and macrobotanical remains. The microbotanical remains have yielded an incredibly rich set of these kinds of food resources, likely indicating more prominence in past foodways.

Non-domesticated plants

Non-domesticates, and/or plants considered to be "wild," were likely important components of daily and ritual life, but until now have largely remained unexamined due to lower recovery rates and/or our sampling strategies. Redfield and Villa Rojas (1962 [1934]:38) noted that leafy greens were used as condiments and not as vegetables. Other sorts of "condiments" they described included tomatoes, cabbage, and onions, and herb seasonings include coriander and mint, and goosefoot (*Chenopodium* sp.). De Landa also noted the use of a sort of 'salad leaf' (1978 [1566]), among other fruits and vegetables. However, as with root and tuber species, such plants have not been characterized as prominent in foodways or daily practice.

Many archaeobotanical reports parse out taxa in terms of first, growing strategies, and second, economic utility. A listed particular "weed", such as pennyroyal (*Hedeoma* sp.), may have had a diversity of uses, including ornamental or medicinal. It may also index a diversity of production or gathering strategies, including tending or simply collecting from fallow fields. However, it grows adventitiously and thus its relationship to human activity is complicated. There are many more such examples of such complications in Southeastern Mesoamerica. For example, the guano palm grows wild, but its leaves are considered a staple for roof thatching, and are collected from the forest and fallow fields.

At the four ancient communities of this study, many herbaceous species were found only once or twice. This rarity may indicate occasional medicinal use, condiments, tinder, or simply incidentally-growing ruderal species. We also find a plethora of grass species. These may come from bajareque (daub) clays, cord, tinder, matting, thatch, brooms, and/or wild-growing taxa. Palms likely represent a similar suite of uses, including basketry and 'plates'. Some of the herbaceous species may have been used as leaf layering on earthen floors where such spaces were used as temporary storage, as detailed by Sheets (1998). Moreover, charred wood remains were almost universally ubiquitous—indoors, outdoors, and across every kind of context. Their presence likely represents a combination of sweepings, interior torches, and charred bits of detritus picked up and moved around on the bottom of peoples' feet or sandals.

All of these plants likely represent a spectrum of cultivation, management, and wild collection. Some may have been purposefully consumed, and others incidentally incorporated. They may also represent overlap in multiple paradigms of activity, including medicines, ritual practices, cuisine, construction, and forestry practices, among others.

How do these sites compare with nearby sites in Southeastern Mesoamerica?

Although it is difficult to define the range of paradigmatic possibilities and syntagmatic associations without systematically-collected regional, site-wide and even area-particularized data, nonetheless a delicate sketch of paradigmatic and syntagmatic relations emerges through studies of macrobotanical and microbotanical remains at these four sites. At each, the range of practices surrounding some of the recovered species is consistent with that of a typical residential area, when compared to ethnographically- and ethnohistorically-described households. However, there are significant differences from what we understand about the paradigm of foodways in Southeastern Mesoamerica. Specifically, we see the low frequency or marked absence of such expected common foodstuffs as beans and chiles.

This absence may indicate different processing or cooking areas, different cooking methods, poor preservation conditions, or a difference in actual paradigmatic elements. Several uncommon and unidentified species present in the assemblages are not currently known to have economic uses, and it is likely that they came to be incorporated in the assemblage as expedient fuel. However, without more data from this area, it is not possible to rule out hitherto-unknown paradigmatic elements and/or paradigms themselves. Moreover, the paradigms of plant use- "medicinal" "food" "ritual" "condiment" etc. overlap in complex ways. Maize, though a common "food" element, also enters syntagmatic relations consistent with ritual activity, medicinal efforts, and even fuel burning, where cobs and husks enter hearth contexts.

In looking at the nearest sites for which we have paleoethnobotanical data, we see differences and similarities between broader languages of paleoethnobotanical practice. As at the site of Copán, Honduras (Lentz 1991), we see the use of many palm *(Arecaceae)* species. Unlike the site of Cerén, El Salvador (Lentz et al. 1996), we find no cotton *(Gossypium* sp.) seeds. This may indicate some sort of paradigmatic substitution of potential oil sources at these different sites. As at Cerén (Lentz et al. 1996), we find evidence of thatching and matting made of grasses *(Poaceae* spp.) and palm leaves, indicating similar associations between these practices and species. We also see similarities between the potential use of floor storage, in lined and unlined pits, whether temporary or long term (Sheets 1998). However, unlike Cerén, we see the potential paradigmatic substitution of clays in place of leaves, or clay in combination with leaves that did not preserve.

In Yarumela, Honduras, as in the four sites of this study, we find unspecified bean family *(Fabaceae)* and grass family species, as well as maize *(Zea mays)* and squash *(Cucurbita* sp.) (Lentz 1997). However, at the four sites of this study we do not see taxa such as cashew *(Anacardium* sp.), ficus *(Ficus* spp.), carpet weed (*Mollugo* sp.), oak *(Quercus* spp.) foxtail millet *(Setaria* sp.), or guanacaste (*Enterolobium cyclocarpum)*. As many of those species were identified by their wood, and remains of charred wood were not analyzed for this study, it is possible that similar patterns could be seen should wood analysis take place. Even without data from wood tissues, in all five sites we see the regular use of non-domesticated forest products, indicating various forestry practices.

Key findings in terms of foodways

Although much of this thesis has focused on broader ethnobotanical practices, I now direct my interpretations specifically toward questions surrounding foodways (first outlined in Chapter 3). I summarize my results, extrapolating particular foodstuffs and incorporating my broader linguistic approach (first outlined in Chapter 2).

How did potential foods become edible or inedible?

Although many potential foods may be available in a particular area, not all of them become incorporated into the diet (Wetterstrom 1978; Farrington and Urry 1985). For this reason, I first sketched a general "grammar" across time periods, in order to get a sense of foods "gained" and "lost" through transformation into edible and inedible. This is somewhat analogous to taking fragments of texts from different time periods to get a sense of broad structural aspects, while acknowledging shifts in vocabulary over time, as words become incorporated into speech acts where contextually appropriate (e.g. "horseshoes" vs. "tires").

What foodstuffs were available in earlier time periods, but only eaten in later ones? What foodstuffs were made use of in earlier time periods, but rejected in later ones? Addressing either of these questions relies on absence of proof, which does not necessarily establish proof of absence. However, my archaeobotanical data (**Table 9.2**; Chapter 13) currently indicate that more types of acknowledged food plants were used in the Classic period (cocoyol palm, nance, achira, papaya, hackberry, various squashes, *Mammillaria* and others in the cactus family, avocado, goosefoot), possibly indicating the slow incorporation of more and more potential food elements over time.

However, some Formative period foodstuffs do not appear in the later Classic period (amaranth, sweet potato, manioc, arrowroot family species, wood sorrel, chia, verbena), possibly indicating their eventual rejection, or the substitution of other foods. In particular, root and tuber crops may have held more favor in earlier time periods, when they are found more frequently, while later time periods were oriented more toward grain crops. Some species, however, are represented across time periods (custard apple, various palms including cohune, lirén, mint family species, beans, maize). Their presence indicates the early incorporation of certain foodstuffs and the continuity of some aspects of diet over time, suggesting the high cultural value or versatility of these taxa.

How were patterns of foodways formed and reformed?

Cultural context is a major part of the dynamic that establishes and transforms foodstuffs into cuisine (Fischler 1988; Weismantel 1988). I posit that the adoption and rejection of certain foodways occurred with the flow of practice through syntagmatic associations and paradigmatic substitutions. Building a more robust data set, by incorporating evidence from more sites, will grant us a better sense of how food associations and substitutions became established in the broader language of cuisine.

Within this dynamic, foods act as both symbols and signs (Weismantel 1988, similar to Peirce 1998:338). In this sense, the various manifestations of foodways across places and through time is analogous to directly translating a colloquial expression into another language--the meaning does not quite come across in the same way even though the words are equivalent. Unfortunately, even in the few contexts evidencing ritualized practice, it is hard to identify symbolic, iconic, or indexical meanings of food elements, much less their variations in expression. Moreover, foodstuffs associated with a particular gender or status are also difficult to recognize, without clear food offerings left in burials or direct iconographic associations from these sites. There are many analogies from the ethnohistoric and iconographic records, especially in terms of food preparation linked to women (Joyce 1993). Thus far, however, there is no solid evidence linking particular foodstuffs with particular individuals at these sites. The materials recovered from burial contexts appear to have been incorporated as part of the fills, and included only charred bits of foodstuffs, more associated with middens and occupational detritus than ritualized practice **(Figures 12.7a and 12.7b)**.

However, when looking at the ways foods are linked to each other and to broader cultural practices, associative bridges and substitutive tradeoffs may be seen at the loci of ethnobotanical activities— artifacts, contexts, and spaces. Across artifacts, there appear to be clusters of wood and fibrous species in some cases, and clusters of maize cobs, unknown phytoliths, wood, and maize leaves in other cases. It also appears as though some food taxa are sometimes "replaced" by each other on a single artifact, where perhaps the artifact had non-specialized general uses yet specialized food uses. In general, food and nonfood remains are associated in syntagmatic ways, either through food preparation activities or through the substitution of artifacts for similar tasks.

There was some degree of substitution in contexts and spaces, as well, as seen in degrees of taxa richness. Many types of spaces and contexts overlapped in food taxa and practices represented, meaning a high level of substitutability, similarly to lithic tools. However, *individually*, some locations appeared slightly more specialized in their uses. The interiors of structures at ground level in the Classic, and architectural fills and the interiors of structures in the Formative, appear to have had stronger categorical definitions. Activities that took place within these categories were swapped out for others, depending on the particular location. That is, in terms of broader cultural practices, certain locational categories (such as the interiors of ground-level structures in the Classic) were not strongly associated with a particular set of activities, and were therefore more discrete in use from location to location within that category. This would indicate that some locations were more syntagmatically associated with defined sets of activities than others, somewhat similar to preparation stations in a commercial kitchen. In the case of the architectural fills in the Formative period, it is likely a question of the *provenance* of materials from more strongly categorized locations. The materials used as fill in construction appear to have been drawn from locations that were more specialized and/or paradigmatically discrete.

Overall, disposal of charred remains from cooking occurred across spaces and contexts, although some areas were kept cleaner than others. The interiors of structures, architectural fill, ashy deposits, burial matrix, burned deposits, and pit fills all had lower standardized densities of charred remains, indicating these areas were less commonly used as dumping locations after food preparation. There seems to have been stronger syntagmatic association between cultural ideas of cleanliness (vs. disposal of cooking remains) and these sorts of locations.

What is the relationship between "food" and "medicine"?

There is strong overlap between food and medicine in many cultures. As all food has an impact on the body, and every ingredient is potentially medicine, ingredients and meals are not necessarily static forms of sustenance (Fischler 1988:280). There are many species ethnographically documented to have overlapping uses as food and medicine. At the four ancient communities of my study, eleven species in particular potentially served dual culinary and medicinal roles.

Goosefoot (*Chenopodium* sp.) has been noted in use as a vermifuge (Atran 1993, Standley et al. 1946) and in poultices for infection (Standley et al. 1946). Decoctions of avocado *(Persea* sp.) leaves have been used for kidney medicines (Atran 1993), as well as the rind for a vermifuge and the seeds for poisoning vermin (Standley et al.1946) and for diarrhea, bladder complaints, and skin eruptions in the *Ritual of the Bacabs* (Roys 1965). Some arrowroot family *(Marantaceae*) species have been used as foods for invalids (Atran 1993), and cocoyol palm *(Acrocomia* sp.) has been noted as having medicinal uses (Rico-Gray et al. 1991). Various custard apple *(Annona*) species have been noted for uses including counter-evil eye, body rub for fevers and headaches (Atran 1993), to kill lice (Standley et al. 1946) and other types of medicine (Rico-Gray et al. 1991). Custard apple species have also been cited as used for snake bites, diarrhea, cramps, and "certain eruptions" (Roys 1965).

Nance fruits *(Byrsonima crassifolia)* have been used, when decocted, for skin eruptions (Atran 1993, Rico-Gray et al. 1991), and for dysentery, blood-vomit, and yellow fever (Roys 1965). Achira *(Canna* sp.) roots have been used as a vermicide in combination with certain mint family *(Lamiaceae*) species (Benancia Cupul Chí, personal communication), and as a remedy for nervous pains and spider bites (Roys 1965). Papaya *(Carica papaya)* has also been noted as having medicinal uses (Rico-Gray et al. 1991). Several species of gourds *(Cucurbita radicans* and *C. lundelliana*) have been cited as useful in fighting cutaneous infections and lice (Atran 1993).

All this is to say that when these species appear, it may be due to associations with food, medicine, or both at once. Such overlap complicates our categories of common foodstuffs, and our views of how their remains become incorporated into the archaeobotanical record.

How did people become acculturated through food?

With Northwestern Honduras at a "crossroads" of regional foodways, the disappearance of certain food species over time and the acquisition of new ones may have to do with cultural aspects of identity. That is, such transformations may implicate the ways that food came to define a people, or how people actively defined themselves through food (Soler 1997 [1973]: 55). This may occur through the processes by which foods come to be taboo (Young 1971, Douglas 1997 [1975]) or simply associated with inferiority (Barthes 1997 [1961]:24, Weismantel 1988). Lirén *(Calathea* sp.) may be a primary example of maintained identity (whether declared or unspoken) with more southern roots, whereas the more broad shift from root and tuber crops to grains, over time, may represent a general shift in cultural attitudes toward what was considered appropriate to eat or serve. However, tastes molded in the social dynamic may be at the core, as it is difficult to distinguish whether cultural shifts determine "natural preferences" or tastes nudge cultural shifts (Fischler 1980:1939).

Such transformations of foodways would have had implications for practical knowledge and learning, in terms of how foods were produced, treated, and served, and how people learned to produce, treat, and serve them. The fit between "appropriateness" of a given food practice to its social context is a process Mennell (1997) has described as the "civilizing of appetite". Daily practices involving foodstuffs may have been very conservative, over time, unless some sort of doxic break occurred. We see this in the continued use of many species between time periods (custard apple, various palms fruits, lirén, mint family species, beans, and maize), and the similarity of uses for artifacts across time periods. What was considered to be a "civilized" food practice, in other cases, did not persist from one period to another. The diminishing use of certain grain species (chia, goosefoot, and amaranth) and the increasing use of maize may be the result of heterodoxic friction, whether prompted by changes in land use, tastes, or cultural contexts. Regardless, plants likely used for grain remained equally ubiquitous over time, indicating the strength of this broad paradigm and the substitutability of elements within it.

The ways that we see paradigms and syntagms of foodways reinforced or transformed over time index processes of socialization, whether discursive or nondiscursive, and aspects of identity, whether intentional or unintentional. Cultural shifts, as marked through food, implicate transformations of appropriateness of various culinary practices over time, and their means of inculcation.

How did foodways interact with sociopolitical life and ritual?

Food crafts, maintains, and transforms social relations, as Counihan and Van Esterik (1997:3) emphasize. Memories are encoded in food, whether consciously or unconsciously, bidden or unbidden (Sutton 2001). With Honduras at a crossroads of cultural practices, it may be that some memories were deliberately emphasized, as seen in certain foods.

How did foods mark social and cultural differences? In considering interactions with neighbors, there is no direct evidence of plants traded into this area. I recovered no exotic food species that grow outside of habitats represented at these four ancient communities. It may be through methods of preparation, or quantities of particular foodstuffs as compared to others, that social differences and negotiations were marked, whether in feasts or daily meals. Botanical remains from feasting preparation or feasting disposal areas would grant huge insight into aspects of commensality and competition, as played out through foodways (following Bray 2003; Brown and Gerstle 2002; Dietler and Hayden 2001). However, as none of my samples were explicitly from such contexts, this must remain something of a question mark.

Do we see shifts in status, as related to the frequency of maize in the Formative versus the Classic period? Or do we have samples from higher- or lower-status community members, in which case the difference in frequency and variety of foods has more to do with what was available to a given subset of the community? It is harder to track such relative differences and then compare them between time periods. However, given the types of artifacts and structures associated with the food remains presented (Chapter 5), this seems unlikely. Social differences played out as little in foods as they did in other aspects of material culture in these four ancient communities, and foodways appeared to be similarly heterarchical.

How do foodways at these four sites articulate with a broader theoretical framework?

In drawing together these various aspects of foodways, a practice-based, linguistic approach serves as a good model. When combined with the use of complementary methods, such an approach helps to craft paradigms and syntagms of plant practices, and the ways they are articulated. In drawing together these elements, an idealized model of foodways might look something like **Figure 14.1,** where I plot the syntagmatic and paradigmatic axes of obsidian blade use, considering associations between categories, substitutions within categories, and contextual factors over the course of practice (as first outlined in **Figure 3.1**).

In this broad schematic, the first two sets of paradigms are given—things that have actually been recovered in association with each other ("tool" and "taxon"). The next set of paradigms ("activity") is hypothesized, drawn from analogous ethnographies and ethnohistories. This locutionary moment is encircled to indicate a snippet of "speech;" a single defined act. Subsequent circles indicate contingent future, continued, or broader locutionary moments. The instantiation of particular associations impacts the contingent sets of paradigms. That is, the next set of paradigms might include "discard of stripped maize cob" and "storage of stripped maize cob as cleaning implement," but only if a maize cob were stripped during the course of the prior locutionary moment. Each act is dependent on broader context (including resources, season, habitus, etc.) and may shift over time or pattern differently at greater scales. There are also immediate contextual factors which have influence over the "speech acts" of tool use and the longer series of speech acts. However, broad and immediate contextual factors are also influenced by such enactments.

How many of the contextual factors can we identify? We can track climate, both locally and regionally, through the use of oxygen isotopes, sediment cores, and pollen profiles. We can have a sense of practice through analogous examples in ethnographic and ethnohistoric literature. What is more difficult is teasing out factors that are strongly co-dependent. Calculations of demography, for example, would be much informed by studies of nutrition and subsistence, but those studies would also be much informed by calculations of demography.

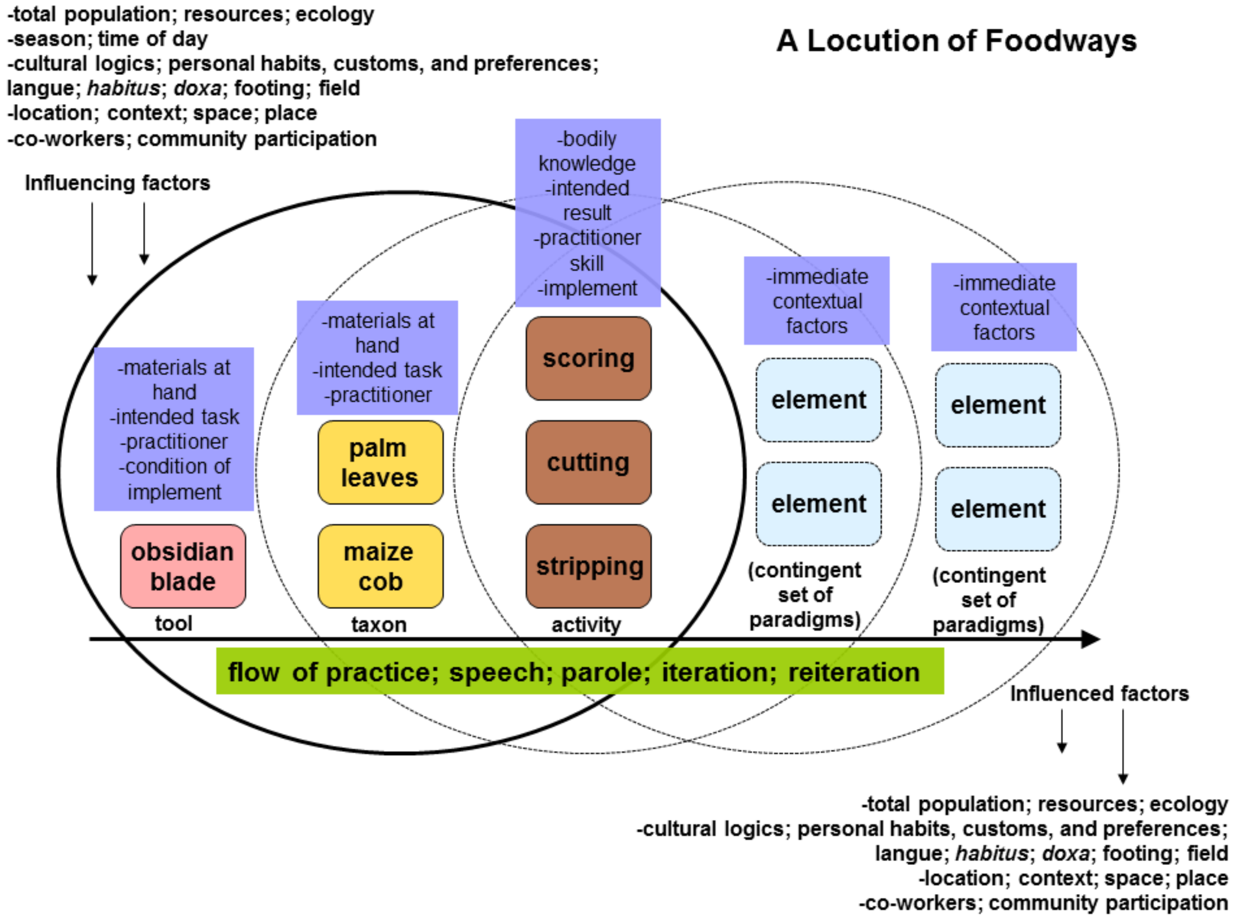


Figure 14.1. An example of a "locution" of foodways, as related to obsidian blade use.

Overall, what does such a schematic reveal? Though far from complete, it reveals a set of potential relationships and a possible grammar of tool use. It presents a set of factors and conditions which may be further explored through the incorporation of other studies, both archaeological and analogical. By reviewing the evidence in this way, we are able to compare these various taxa to the broad paradigms of expected plants. However, the combination of items recovered also reflects syntagmatic relations of foodways: the residues of daily residential practices. These practices include likely procurement from cultivated and fallow maize fields (subsequent to a large set of crop-production practices), weeding and/or expedient use of plants as fuel, home gardening, the disposal of hearth materials near residential structures, and the potential ritual or medicinal activity.

These practical combinations are analogous to a set of continuous "speech acts", subject to ecological diversity and historically contextualized in the long durée of Northwestern Honduran foodways activities. Such "speech acts", though granting us insight into the daily lives of pre-Hispanic peoples, require further community-level comparisons and short-term plant use histories, in order to better socially and historically contextualize the two axes of foodways.

Lessons learned: methodological approaches and research design

In the course of my studies, there were many lessons learned about the recovery and interpretation of the data sets, both specific to this area and for general paleoethnobotanical practice. The research design (Chapter 7) accommodated many of my questions, while other questions had to be answered with the data set made available to me. Broadly, using ubiquity helped to establish trends across each analytical axis, and accommodated issues surrounding varying sample sizes. Combining macrobotanical and microbotanical remains into a single data set required carefully combining overlapping species into unified taxonomic categories and overlapping sample locations into unified loci (Chapters 8 and 9). Ubiquity was helpful in this area, as well, given the differences in the types of samples and species recoverable for each. Moreover, calculating the richness of samples was a useful tool in both establishing trends and combining data sets across the axes of my analysis.

The complementary techniques of artifact residue analysis, phytolith analysis of sediments, and analysis of bulk flotation samples produced multiple sorts of remains. These various data points—phytoliths, starch grains, and macrobotanical remains—helped to widen the spectra of plants and broaden the "vocabulary" of foodways in this area (Chapter 8). Increasing the flotation sample sizes to >20 liters and the analysis of microbotanical slides to counts of 400 could broaden this vocabulary even further. Bulk flotation samples are difficult to curate in many areas where storage is at a premium (or even impossible). However, the high yield of data from phytolith analysis of sediments leads me to strongly urge other researchers to at least accumulate sets of 200g samples for potential future analysis. Moreover, in the course of interpretation, by considering multiple practices associated with each plant taxon, a fuller picture emerged of potential activities across the landscapes of these four ancient communities (Chapter 9). I have found that considering plant taxa as nodes of overlapping practices instead of bounded categories of economic value is good way to maximize possible interpretations of paleoethnobotanical data sets.

The artifacts were highly productive in terms of recovered plant remains (Chapter 10), although analysis would perhaps have been faster through use of flotation in some cases. Future studies could even target particular edges and surfaces of artifacts, to get a picture of discrete uses, as done by Perry (2001). The extractions from ceramics, especially, could have benefitted from targeted extractions of residues, and sonication using disposable appliance heads could have prevented some of the dissolution of the actual vessel materials. Broadly, however, an incredible quantity of botanical remains is potentially recoverable from artifacts, which leads me to urge researchers to leave a subset of their artifacts unwashed for future analysis.

When looking at contexts, I was surprised to discover the richness of plant species emerging from a wide variety of places (Chapter 12). In this region, at least, the common ancient practice of re-using detritus in fills, during both time periods, led to the recovery of diverse plant remains across contexts. The distribution of these remains in such a wide variety of places means that targeting particular contexts, such as middens and hearths, will not necessarily yield a richer set of taxa. For this reason, I would recommend sampling across a wide variety of contexts, where possible, in order to maximize the number of recoverable plant species.

The analysis of ethnobotanical practices across spaces is greatly enhanced when incorporated into the research design at the outset. Although circumstances outside my control led to a smaller set of available spatial categories to analyze, the ability to compare such spaces would not have been possible at all without attempting to maximize comparisons. Although areas immediately adjacent to buildings and outside patio areas appear the most productive, sometimes this is a matter of quantity (or density) of remains rather than quality (or diversity) of taxa represented (Chapter 11). For this reason, as with contexts, sampling across a variety of spaces would also be recommended, to yield the broadest spectrum of taxa.

Final Thoughts

Contexts influence spaces influence artifacts influence historical trajectories influence societies influence environments influence practices influence contexts, etc., in a complicated stew of materiality, spatiality, society, environment, history, ethnobotany, and activity. Without assigning a pat analog to each, together they represent the complicated interplay of doxa, habitus, footing, context, practice, history, field, and structuration. Elements may be similar or even identical over times and places. However, the *arrangement* of these elements is distinctive, and is both motivated and mitigated by the social factors that in turn motivate and mitigate the arrangement.

Defined categories of contexts, spaces, and artifacts can only reference the current social matrix. That is, they are not necessarily representative of typologies as constructed by past peoples themselves. In this way, typology forms part of a contemporary dialogue between archaeologist and element, archaeologist and archaeologist's culture (similar to Bender 1993, Tilley 1994). Types are components both of site formation processes and *information* formation processes. They are also an incomplete summation of material attributes of physical manifestations of data, as well as a search for potential meaning via the conduits of contemporary and historical analogy.

The set of taxa recovered from these macrobotanical and microbotanical remains implicates a wide range of ethnobotanical practices carried out by the people in the four ancient communities of Los Naranjos, Cerro Palenque, Puerto Escondido, and Currusté. Each taxon recovered indexes a diverse set of practices, in some cases complicating strict categories of "wild" and "cultivated", "food" and "medicine", and especially simpler categories such as "weed" and "economic plant". In focusing on the multitude of practices associated with each taxon, instead of fixed taxonomic categories, a more nuanced picture emerges of daily life in ancient Northwestern Honduras.

Moreover, this rich set of practices complements and is augmented by other practices in the wider field of cultural production. As Redfield (1950:31-2) described it, "The kitchen, invariably of poles and thatch, remains the center of the family life; here the women spend most of their time, and here old and young eat, the food handed around, served from the little three-legged table by the fire...In the kitchen the talk goes on and most of the associating of husbands and wives, parents and children."

It is partially through ethnobotanical practice that the field of cultural production is maintained, transformed, and/or reinforced, further maintaining, transforming, and/or reinforcing the practices made possible by it. In this way, artifacts and activity areas are not just loci for single activities or overlapping ethnobotanical activities, but rather are nodes of layered social production and reproduction, both discursive and non-discursive. Such sociality includes story-telling, reprimanding, joking, gossiping, explaining, singing, teaching, correcting, learning, controlling, helping, flirting, arguing, complaining, ignoring, guiding, considering, deciding, scheduling. Although many of these are aspects we can't directly identify through paleoethnobotanical methods, we can imagine them as additional strands and layers, in the fabric of ethnobotanical practice.

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Appendix 1:
Sediment sampling for phytoliths

There are at least five kinds of analyses for which small sediment samples would be potentially useful-- soil chemistry (phosphates, and trace elements like mercury, iron, etc.), phytoliths, starches, pollen, and lipids. The phytolith samples need no special preparation, and the starches don't require special utensil preparation, but if you follow the same protocols for all of them, this will make it easier and more expedient.

The analyses, require +/- 200 mL of soil each. If you fill a 4 x 6 bag (with enough room to tie off the top) this is more than sufficient for each of the microanalyses. That is, one bag per microanalysis type, 4 bags total. (the 4 x 6 size most closely approximates that of the Whirlpaks, approx. 200 mL.)

A trowel or spoon is fine (some iron contamination may show up in trace element analyses, however), but for the element and lipid analyses you will need to clean the tool with isopropyl alcohol before taking each sample. I would recommend having a dedicated trowel or spoon, used only for the soil samples, which are cleaned just before removing the samples using an abundance of isopropyl alcohol and paper towels.

Archiving sediments:
For the time being, remove only one set of 250 mL samples, to be ready to ship.
Leave 750 mL for other 3 potential analyses, to be archived separately.
Leave remainders of bulk samples for deep storage/archive, with potential for floating at end of season.

Materials:
4x6 bags
6 x 10 bags
Twine
Spoons (roughly 3 Tbsp.- sized)
Spoons (1 Tbsp. – sized)
Isopropyl alcohol
Paper towels
Durable bins: Some for storage, some for shipping

Appendix 2:
Processing and analyzing sediments samples for phytoliths
(as passed on from Dolores Piperno to Shanti Morell-Hart in 2006, Rob Cuthrell to Shanti Morell-Hart 2008; independent experimentation)

Phytolith Extraction from Sediments:

If extracting phytoliths for dating purposes, boil and sterilize glassware and tubes.

Basic procedure: 1) deflocculating sediment samples in water, 2) dividing sediment into a, b, and s fractions 3) microwave chemical digestion: removing carbonates with hydrochloric acid (HCL) solution, removing organic materials with nitric solution, removing humics with hydrogen peroxide solution, 4) floating phytoliths with heavy liquid (sodium polytungstate) solution, drying phytolith sample, 5) mounting phytolith sample, 7) scanning for phytoliths under the microscope. There are multiple washes and centrifuging steps between stages 3, 4, and 5.

1) Deflocculating Sediment Samples in Water:

- start with 150 mL of dry soil in a 1000 mL labeled beaker, [with a height of about 15 cm]
- add 1-2 tbs. deflocculant (sodium hexametaphosphate if dating phytoliths, baking soda (sodium bicarbonate) if not dating phytoliths), and 1000 mL of *very hot* water
- stir every 15 min. for 3 days, until the mixture is uniformly cloudy, with no remaining clumps, and the clay is relatively suspended
- on day of sieving, give one last stir, wait at least1 hour before sieving, to make sure silts have settled adequately

2a) Removing Sand (S) Fraction and Larger Sediments (D) Fraction

- set up a set of sieves in this order: No. 60 (250 um, for D fraction) on top of No.270 (53 um, for S fraction) on top of base pan (for A and B fractions)
- after waiting at least 1 hour for silts to settle, pour off top 500 mL from samples (this is to reduce the liquid volume, so that the remaining water fits in sieve pan)
-give mixture another vigorous stir, until all sediments are relatively suspended
-pour 1/3 of mixture through set of sieves, wait for liquid to go through, pour another 1/3, wait for liquid to go through, pour last portion
- keep an eye out for particulate charcoal (can be dated—only 100 micrograms needed for AMS dating)
- add 400 mL of clean water to corresponding labeled beaker
- using beaker "rinse water", rinse off the upper fraction through screens and into the base pan, by pouring approx. 100 mL at a time (any silt lumps can be gently "mashed" into the top screen while rinsing)
- keep an eye on run-off from screens into base pan-- when this water is fairly clean, remove upper (D) fraction (if still not fairly clean, do an early pour-off of base pan liquid into corresponding labeled beaker and continue rinsing process until water is fairly clear) - pour contents of bottom pan back into corresponding labeled beaker—total contents of beaker are usually +/- 1000 mL, (unless more rinsing is needed for in-screen fractions, and more than one beaker has been used)

- if particulate charcoal is needed for dating (or to preserve potential macrobots or fauna or lithics), save D fraction by overturning screen contents onto a labeled paper towel (wait a few days until fully dry, and bag this sample)
- if not preserving D fraction, dispose of screen No. 60 contents
- clean off No. 60 screen
- **replace** upper No. 60 screen, clean No.270 screen under No.60 screen, under running water, until water is completely clear
-concentrate sand (S) fraction in No. 270 screen under No. 60 screen and running tap water, by tilting screen so that water pushes the sand up against one side of the pan
-pour sand fraction into test tube (this is messy, and some sand will be lost) multiple test tubes may be necessary
- keep adding a bit of water (under No. 60 screen), concentrating sand, and pouring into test tubes, until most of sand has been removed from the screen (some particles will remain in the screen)
- clean off both screens **(*always leave larger No. 60 screen over smaller No. 270 screen to prevent damage*)**

2b) Removing Clay from Fine (A) and Course Silt (B) Fractions

- add water up to 900 mL mark (10 cm in height) to each beaker containing the A and B fractions
- stir vigorously (quickly and sequentially so that everything is approximately at the same stage of stirring)
- let sit for 1 ½ hours
- pour off excess water (+/- 400 mL)
- add water (up to 900 mL mark)
- let sit for 1 hour
- rinse, repeat 1 hour sequence (3 to 5 times) until water is fairly clear of suspended clay

2c) Preparing samples for Chemical Digestion

- redistribute fractions in test tubes to maximize processing-- coarse silt (B), fine silt (A), and sand (S) should all have, in test tube, +/- 1.5 cm (or up to 2 cm) of sediment at the bottom
- process one or several tubes of each sample at a time (depending on recovery strategy)
- centrifuge test tubes for 3 min. @ 1,000 rpm to consolidate sediments at the bottom of the tube

Don't use more than 1,000 rpm when sediment is in the tube at any time, but at phytolith isolation, washing, and drying stages, can go up to 1,500 rpm for 10 min

Make sure sediments are dried thoroughly overnight, at roughly 65 degrees in the oven, before weighing & placing in tubes.

3a) Preparing the microwave equipment

To begin, check the rupture membranes (clear plastic discs) located in the small grey pressure caps. When held under the light & moved around, membranes should appear 1) unbroken and 2) lightly dimpled, not deeply dimpled. [during microwaving, the rupture membranes burst when pressure builds too highly in the microwave tubes, in order to release pressure before microwave tubes themselves explode]

Replace damaged rupture membranes with new ones, located in sheets in a bag with a fluorescent yellow label, in Rob's grey drawer under the central counter

Ready the microwave tube carousel—ensure the tubes and fittings are clean. There are 12 microwave tubes on the carousel, each holding a roughly 50 mL volume of material. 11 are regular tubes, and the 12th is the tube which will contain the pressure sensor. The pressure sensor tube has a larger brown screw fitting, and a side pressure valve fitting. This is where the pressure sensor is inserted.

3b) Preparation of sediment and solution in tubes

Put together pieces of tubes, aside from caps, screwing together TIGHTLY.

Put, at most, 20-25 grams of material in each microwave tube. (RQC uses only roughly 10g). **Note which number on the carousel corresponds with which sample.**

Make sure the pressure sensor tube is the tube with the most sediment and (likely) most organic material, as this tube will have the greatest pressure when microwaved. i.e., you want to have the tube with the most pressure registering on the sensor, vs. the tube with the least pressure.

Place the tubes in the carousel. The carousel tubes should all be filled-- dummy tubes with water would work. (otherwise, microwave power will be too concentrated for few tubes inside.)

Place carousel of tubes under fume hood. Prepare a beaker of distilled water (to clean syringe). **Put on gloves and safety goggles.** Prepare nitric acid, hydrochloric acid, and hydrogen peroxide (or potassium chlorate) and place under fume hood. Have caps for tubes prepared and ready under the fume hood.

Recommended for 20 g of sediment (halve quantities for 10 g of sediment):

10 mL nitric acid
6 mL hydrochloric acid (10% aqueous solution)
2 mL hydrogen peroxide (30% aqueous solution)

Using a 50 mL syringe, express chemicals, in turn, into each tube, while stirring with a glass rod. **Add hydrogen peroxide slowly, and last, as it may react vigorously.** Use beaker of distilled water, as needed, to cleanse the syringe.

Place caps on all tubes, and screw on very tightly.

3c) Preparation of microwave

Place carousel in the microwave, matching up the "bumps" at the base, to lock carousel securely onto microwave tray.

Open the damper above the microwave, and ensure the oven damper is closed. To do this, unscrew the screw, slide out the metal sheet, and tighten the screw. Fumes from the microwave and oven go into the fume hood. If both dampers are open, fumes will spill into the other device.

Flush out the pressure sensor tube (extending from the interior of the microwave). To do this, prepare a 60 mL syringe with water, and attach long thin plastic tube. Attach this tube into the "flush relief" valve. Express the syringe to force the air bubbles out of the thin tube inside the microwave. Water will squirt out of the internal microwave internal sensor tube. Make sure no bubbles remain in the internal sensor tube.

Thread the internal hose into the carousel "mast", then turn the brown ring to lock it in.

Attach the internal sensor tube to the pressure valve on the pressure sensor test tube. Push the tube **all** the way into the side mount, as far as it will go. Screw the grey plastic nut into place while pushing the tube into the valve. This will result in an accurate pressure reading.

With the microwave door open, flip the ON switch on the right side of the microwave. This will turn the carousel a full rotation, once, both clockwise and counterclockwise, to test the threading of the internal sensor tube. Make sure the internal sensor tube doesn't get tangled. The internal sensor tube may be adjusted by pushing or pulling it gently, where it externally extends, on the left hand side of the microwave.

Close the microwave door.

3d) Setting and running the microwave

After closing the microwave door, several options should appear on the menu.

Go to F3 to "stored methods"
Go to "soil low" (RQC created this stored setting) and hit "enter".
Go to F1 to load the program.
Go to F3 to review the program, then F3 to go back to the previous menu.
(RQC has it set for 60 minutes at 80 PSI of pressure)
Go to F4 to start the program/microwave.
Once the microwave has started, keep an eye on the current pressure. Make sure the pressure gets up to 80 PSI. This may take 7-10 minutes.
The entire microwaving time should be 60 minutes.
Hit F1 at any time to abort process, in the case of low or non-existent pressure in the microwave.

3e) When microwaving is complete

Before removing the tubes from the microwave, make sure the pressure is down to roughly 20 PSI or less.

Remove the carousel of tubes and place under the fume hood. With gloves and goggles on, release/unscrew the grey pressure nuts/valve of each microwave tube slowly. **Do NOT unscrew the brown caps.** Allow the fumes to ventilate into the fume hood duct.

After the fumes have been ventilated, unscrew the brown caps. Remove the tops, and stir the sediment and solution in each microwave tube. (This will aid removal from tube). Pour the mixture into a prepared rack of empty and **labeled** 50 mL tubes. After pouring the mixture, carefully squirt water (using H2O squirt bottle) into the microwave tube to rinse into the prepared 50 mL tube.

Centrifuge the tubes, first setting the new centrifuge to "243" (this is the rotor model #). Rabbit & turtle—speed up or slow down the acceleration/deceleration process. Centrifuge at 3000 rpm for 5 minutes. (New centrifuge holds eight 50 mL tubes at a time, old holds four. Both centrifuges may be run at once.)

Prepare a tub of 2 L water plus 1 box baking soda. Pour off supernatant into this tub. Acids are thus neutralized into salt water.

(3f) Running samples again

If samples need more processing, add more hydrogen pyroxide and re-do process.

3g) Clean-up

Tubes, caps, rings, etc. may be cleaned with contrex (or alconox) solution. Grey valves/caps may be cleaned gently with contrex solution and a brush-- check for ruptured membranes when dry. If residues remain in microwave test tubes, they may be cleaned with acetone and rewashed.

4a) Making Heavy Liquid Solution:

- use dry sodium polytungstate
- final specific gravity: aim for 2.3 (i.e. weight of 1 mL is 2.3 g)
- start with water, add sodium polytungstate
- make slow solution, shaking, adding a bit at a time
- use a single 1 mL capsule-- set scale to zero with capsule, add 1 mL liquid, reweigh
- *if you run out of chemicals, and still aren't at the right specific gravity, you can boil to increase specific gravity*
- OK to be within 0.05 of 2.3

4b) Flotation of Phytoliths: Heavy Liquid Solution step

- add heavy liquid solution to each test tube, up to *below* base of tape (+/- 10 mL), so that surface of supernatant is visible
- *if organic material is still present in sample, the heavy liquid will turn red or black*
- stir each sample and invert tube with parafilm—invert slowly (+/- 5 times) **just before** centrifuging
- put into centrifuge immediately
- centrifuge for 5 min. @ 1,000 rpm
- lift test tubes out one at a time, **slowly**, to reserve surface tension (milky film atop test tube is phytolith "crust")
- use a Pasteur pipette to remove upper "crust" of phytoliths in a circular motion around the sides of the tube, just skimming the surface (first suction step)—add this solution to a labeled test tube
- use pipette to suction from center of test tube solution, and "clean" the sides of the tube with the pipette, then quickly remove upper portion of phytolith material in a circular motion around the sides of the tube, just skimming the surface (second suction step)-- add this solution to test tube—repeat:
- stir each sample and invert tube with parafilm—invert slowly (+/- 5 times) **just before** centrifuging
- put into centrifuge immediately
- centrifuge for 5 min. @ 1,000 rpm
- lift test tubes out one at a time, **slowly**, to reserve surface tension (milky film atop test tube is phytolith "crust"
-* do not fill test tube to more than ¼ of total volume with phytolith/liquid solution*

4c) Isolating Phytoliths: Removal of Heavy Liquid and Drying Phytolith Sample
- add water to test tube containing phytolith/solution extraction (up to the top of the tape)-- this will lower the specific gravity and cause phytoliths to sink
- parafilm, invert until heavy liquid and water are in solution
- centrifuge 10 min. @ 1,000 rpm
- invert test tube, remove liquid, re-add water, repeat
- perform 2-3 water washes, until water emerges clear
- pour off last of water from tube (after centrifuging)
- invert tube, quickly blot tube on a paper towel
- add acetone up to bottom of tape
- stir, invert with parafilm, until sediment is dislocated from bottom of tube
- centrifuge 10 min. @ 1,500 rpm
- cover test tubes loosely with parafilm (just to prevent blow-ins) and allow to completely desiccate (several days to several weeks)

[samples should eventually appear like a film of white clay or powder]

5) Mounting the phytolith concentrate material

For larger samples (the roughly 25 gram samples), hopefully the processing leaves several grams worth of material. At this point, it will be in the labeled 15 mL tubes.

-When the samples are fully dry, label a set of small 2 mL centrifuge tubes with the same set of labels. This will be the dry archived collection (separate from the wet archived collection and separate from the slides).

-Loosen the material in the 15 mL tubes, with a shaker or by hand or pipet or all of the above.

-Remove part of the material from the 15 mL tubes, and archive it in the 2 mL tubes. (A pipet works well for this—but individual pipets for individual samples!

-Break off the end of a clean pipet, and use this as the reserved pipet for the immersion oil.

-Lay out a large KimWipe—the immersion oil is messy. Keep a set of small Kimwipes on hand. [Immersion oil used: Type B from Cargille. Code 1248. Standardized at 23 degrees Celsius. Non-drying for microscopy. Viscosity, cSt = 1250 +/- 10%. Fluorescence = Low, relative to Cedarwood Oil.]

-On a clean small Kimwipe, label a slide with the same information listed on the tube, in both Sharpie and pencil.

-In each 15 mL tube, add enough immersion oil (with the clean pipet) to thin the phytolith material sufficiently for a slide. You'll want to be able to transmit light through the slide, and be able to distinguish different materials (vs. overly dark & overcrowded conditions).

-Using the reserved individual pipet, mix the oil with the material.

-Drop 1 drop of mixture onto the center of the slide. If material seems too filled with phytolith material, add a drop of pure immersion oil. Add, in total, 1-3 drops of mixture.

-Place a coverslip (large) over the mixture, and press lightly until mixture is evenly dispersed under the coverslip. Try to remove all of the air bubbles.

-Wipe any excess mixture from the sides of the slide.

-Apply a thick coat of clear nail polish to seal the edges.
[Sally Hansen hard-as nails "Invisible" works well].

-Make sure to curate the slides on their "backs", not edges.

7) Scanning for phytoliths under the microscope

[Samples are already divided into AB and S fractions, processed, floated, and mounted on slides.]
Counts: 100 in AB fraction and 100 in S fraction
-Many additional phytoliths of an AB size are sometimes released into S fraction after processing. In analyzing both fractions, this presents a better way to get those more trapped in the sediments.
-Magnification power for scanning slides: for S fraction, at 200x, for AB, at 400x.

-Beginning in one corner of the slide, mov systematically from top to bottom, left to right (as though reading a book in English). Moving from left to right, begin by moving to a field of view which overlapped only slightly with the previous, then slowly shift focus in and out. This enables a view "through" the transparent phytoliths, in order to gauge broad morphology. (i.e. starting on top surface, moving through the phytolith, then ending with the bottom surface).

-Morphology is also inspected by gently depressing the slide with a rubber-coated paperclip tip, in order to rotate the phytoliths in the immersion oil. This is especially helpful with phytoliths such as rondels, which appear spherical in plan but like spools in profile.

-Do not count the elongate and bulliform phytoliths that are common in grasses, since these are incredibly abundant and ubiquitous, and will dominate all slide densities and slow the identifications considerably (ie, would needed to bump the counts to 1000 or more per slide).

Appendix 3: Microbotanical sort form for artifacts

Northwestern Honduras Project 2008-2010
Microbotanical Sorting and Identification Form for Artifacts (1/2)

Provenance ____

Site____

Op_________ Subop_________ Locus_________

Artifact____

Phytoliths:	Adhering Sediment	Total	SOnicated material	Total
Arboreal “puckered sphere”				
Bromeliaceae leaf “warty sphere”				
Arecaceae “hat-shaped”				
Arecaceae “spinulose sphere”				
Acrocomia sp. mesocarp “fuzzy planet”				
Marantacea “thick glass shards sphere”				
Calathea sp. seed “burr-shaped sphere”				
Cucurbita sp. rind “scalloped”				
Lagenaria sp. rind “granulate scalloped”				
Phaseolus sp. pod “hook-shaped hairs”				
Maranta sp. seed “bart simpson head plus neck”				
Canna sp. leaf				
Manihot sp. “secretory cell”				
Heliconia sp. “muppet head/troughs”				
Cyperus sp. “double cones”				
Protium sp. “elliptical facetate”				
Zea mays cob “wavy-top rondel”				
Zea mays leaf “cross-body”				
Zea mays “vase form”				
Bambusoideae “blocky; peaked saddles”				
Arundinoideae				
Chloridoideae “broad saddles; thick margins”				
Panicoideae “bilobates”				
Panicoideae “rondels”				
Pooideae “rondels”				
Pooideae “cross-bodies”				
Pinaceae “elongate spiny”				
Scutiform “flat hat”				
UNKN 1 “bourbon glass”				
UNKN 2 “mouse dropping”				
UNKN 3 “honeycombed”				
UNKN				
UNKN				
UNKN				
UNKN				

Northwestern Honduras Project 2008-2010
Microbotanical Sorting and Identification Form for Artifacts (2/2)

Provenance ______________________________________

Site____

Op_________ Subop_________ Locus_________

Artifact____

Starch grains:	Adhering Sediment	Total	SOnicated material	Total
Ipomoea sp. “wood rose seed; scarab; bell”				
Calathea sp. “lamellaed slug”				
Dioscorea sp. “indented ghost”				
Zea mays hard flint “faceted; tooth”				
Zea mays flour “spherical; tangerine; iris”				
Maranta sp. “mussel shell”				
Capsicum sp. “lentil”				
Phaseolus sp. “kidney; Frisbee; coffee bean”				
Zamia sp. “large irregular flat”				
Manihot sp. “head with hint of neck; 2 basal divets; bell”				
Canna sp. “large irregular wedge w deep lamellae”				
Myrsoma sp. “gumdrop”				
Damaged/UNKN				
UNKN				
UNKN				
UNKN				
Other:				
Raphide				
Crystal druse				
UNKN				

Notes:

Appendix 4: Microbotanical form for sediments

Northwestern Honduras Project 2008-2010
Microbotanical Sorting and Identification Form for Sediments

Provenance ____

Site____

Op_________ Subop_________ Locus_________ Quantity (1oo mL)_____________

Phytoliths:	Adhering Sediment	Total	SOnicated material	Total
Arboreal "puckered sphere"				
Bromeliaceae leaf "warty sphere"				
Arecaceae "hat-shaped"				
Arecaceae "spinulose sphere"				
Acrocomia sp. mesocarp "fuzzy planet"				
Marantacea "thick glass shards sphere"				
Calathea sp. seed "burr-shaped sphere"				
Cucurbita sp. rind "scalloped"				
Lagenaria sp. rind "granulate scalloped"				
Phaseolus sp. pod "hook-shaped hairs"				
Maranta sp. seed "bart simpson head plus neck"				
Canna sp. leaf				
Manihot sp. "secretory cell"				
Heliconia sp. "muppet head/troughs"				
Cyperus sp. "double cones"				
Protium sp. "elliptical facetate"				
Zea mays cob "wavy-top rondel"				
Zea mays leaf "cross-body"				
Zea mays "vase form"				
Bambusoideae "blocky; peaked saddles"				
Arundinoideae				
Chloridoideae "broad saddles; thick margins"				
Panicoideae "bilobates"				
Panicoideae "rondels"				
Pooideae "rondels"				
Pooideae "cross-bodies"				
Pinaceae "elongate spiny"				
Scutiform "flat hat"				
UNKN 1 "bourbon glass"				
UNKN 2 "mouse dropping"				
UNKN 3 "honeycombed"				
UNKN				
UNKN				
UNKN				
UNKN				

Notes:

Appendix 5: Macrobotanical sort form for bulk flotation samples

Northwestern Honduras PEB: Sorting and Identification Form for Bulk Flotation Sample

SAMPLE NUMBER: ________________________

Excavation data

Site		Grid/GPS	
Structure/Operation		Unit/Suboperation	
Level/Locus		Location	
Min. depth		Max. depth	
Excavated by		Date excavated	
Context:			
Comments:			

Flotation data

Flotation number		Soil sample size (L)	
Floated by		Date floated	
Notes:			

Sorting data – light fraction

Sort sample number		Flot sample size (g)	
Sorted by		Date sorted	
Categories (present in which size of fraction):			
Charred seeds		Wood	
Lumps		Bone	
Snail		Modern macrobots	
Ceramic		Shell	
Other charred		Other	
Comments (condition, photos, etc.):			

Identification data

Identified by		Date identified	

Northwestern Honduras PEB: Macrobotanical Identification Form
Light Fraction of Flotation Sample

SAMPLE NUMBER: ___________________________

Excavation and Flotation Data

Site		Grid/GPS	
Structure/GPS		Unit	
Level		Location	
Min. depth		Max. depth	
Excavated by		Date excavated	

Sorting Data – Light Fraction

Sort sample number		Flot sample size (g)	
Flotation number		Soil sample size (L)	
Sorted by		Date sorted	
Identified by		Date identified	

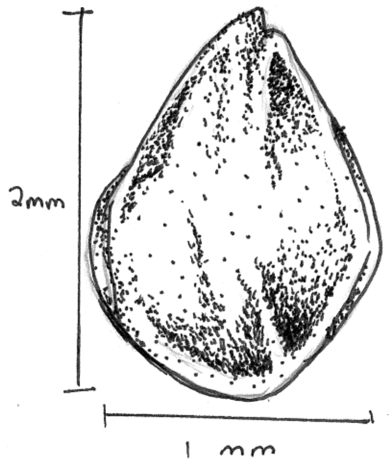
Family	Taxon	Part	Count	Total (g)	Avg. (g)	Comment

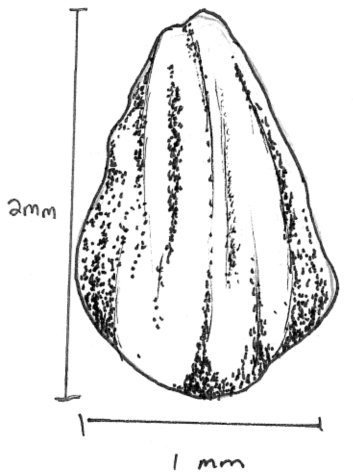
Total # fam	Total # taxa	Total # items		Total (g)		

Appendix 6:
Unknown and Tentatively Identified Macrobotanical Specimens

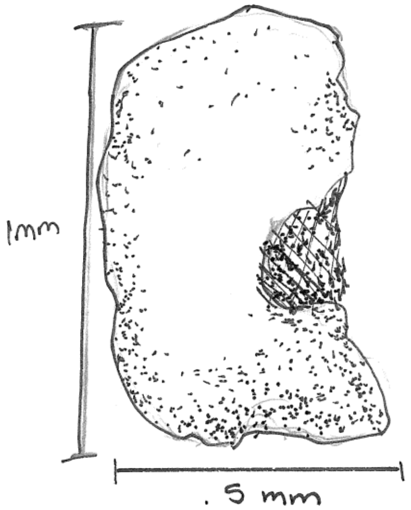
Illustrations by Sarah Davidson; Photographs by Maral Tavitian

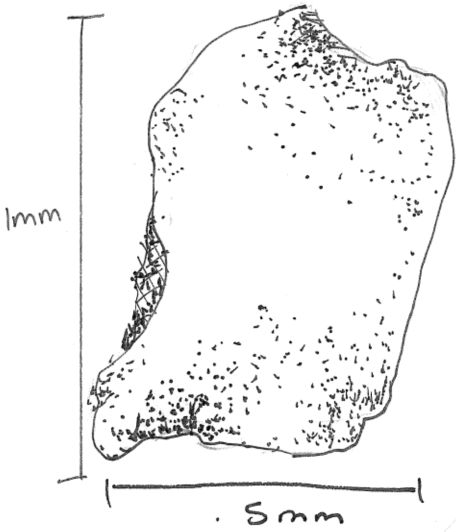
cf. *Chrysobalanaceae*
CR-32-25-AB-23

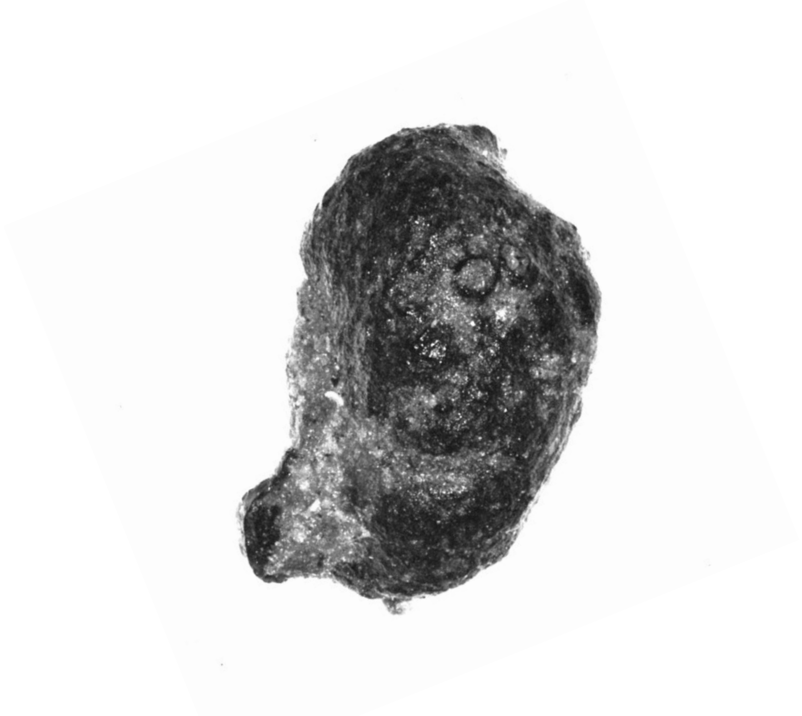




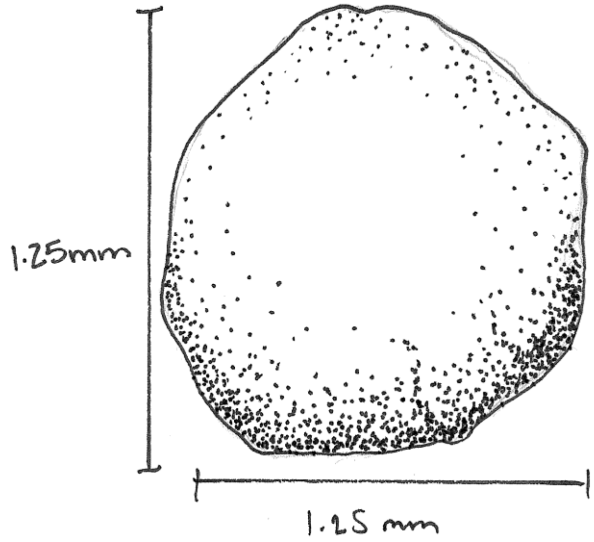
cf. *Fabaceae*
CR-32-25-AC-21

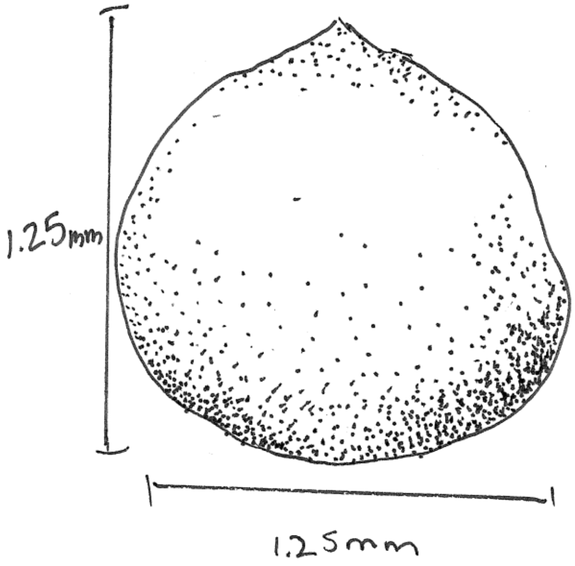




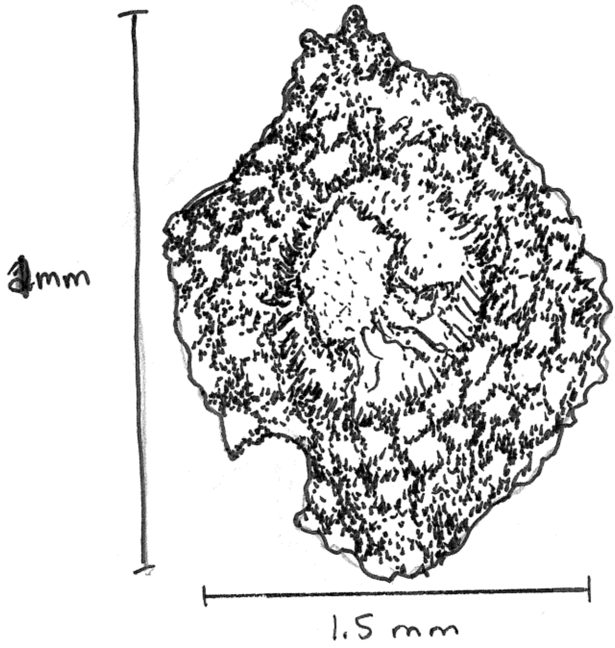


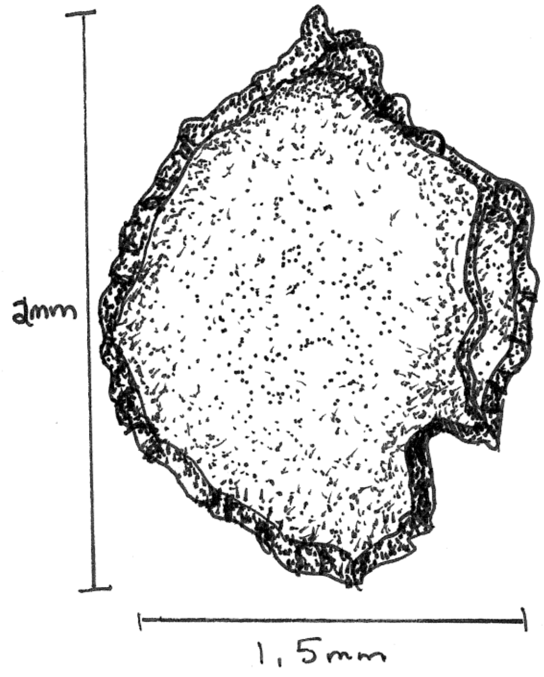
cf. *Lamiaceae*
CR-32-25-AC-3

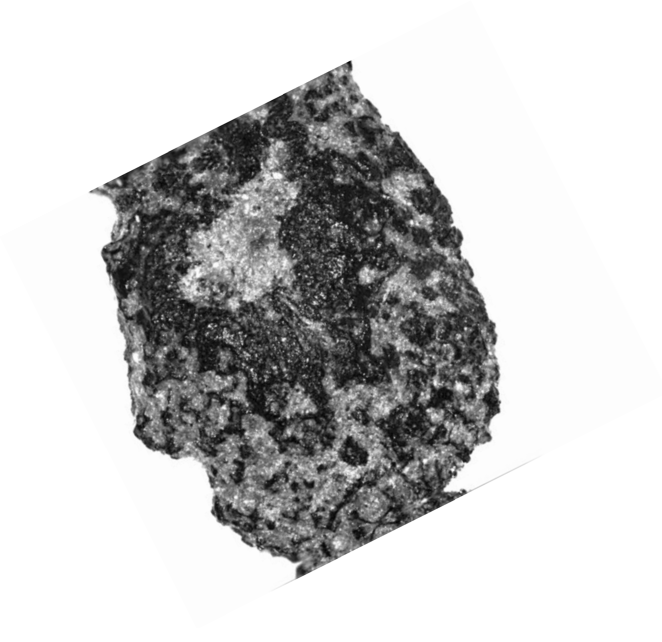




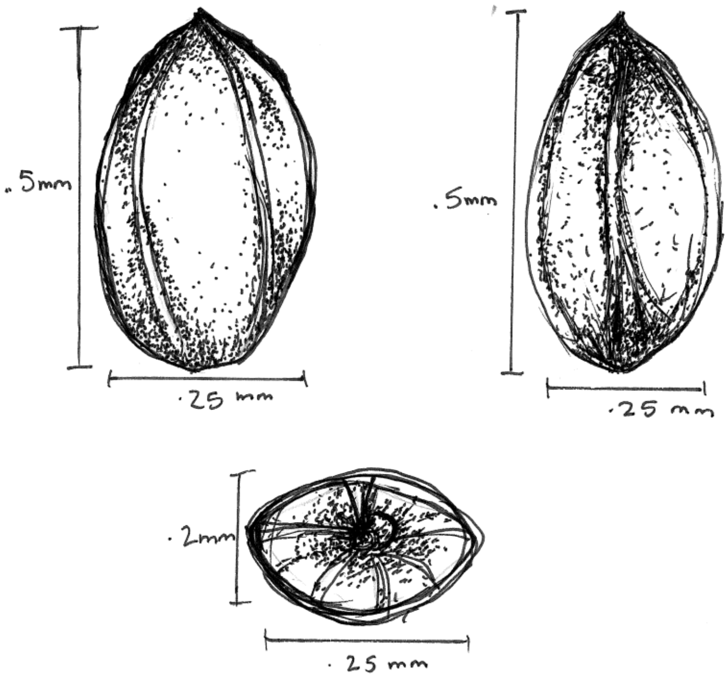
cf. *Myrsinaceae*
CR-32-25-AG-12



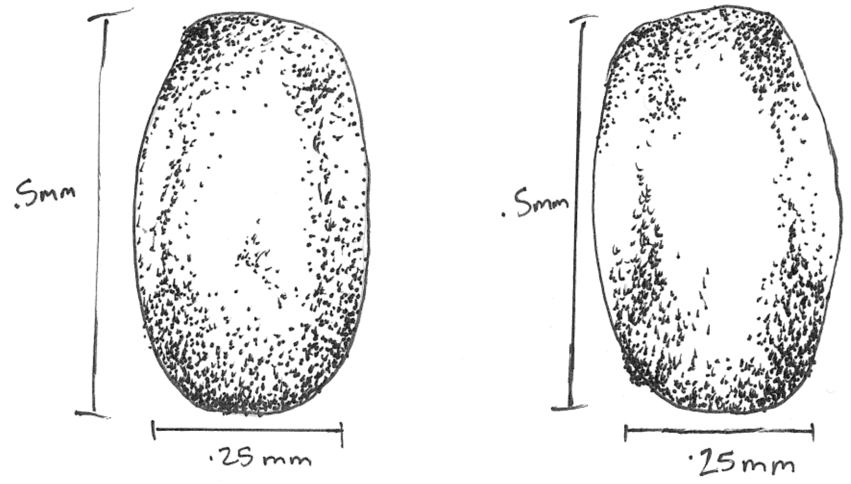




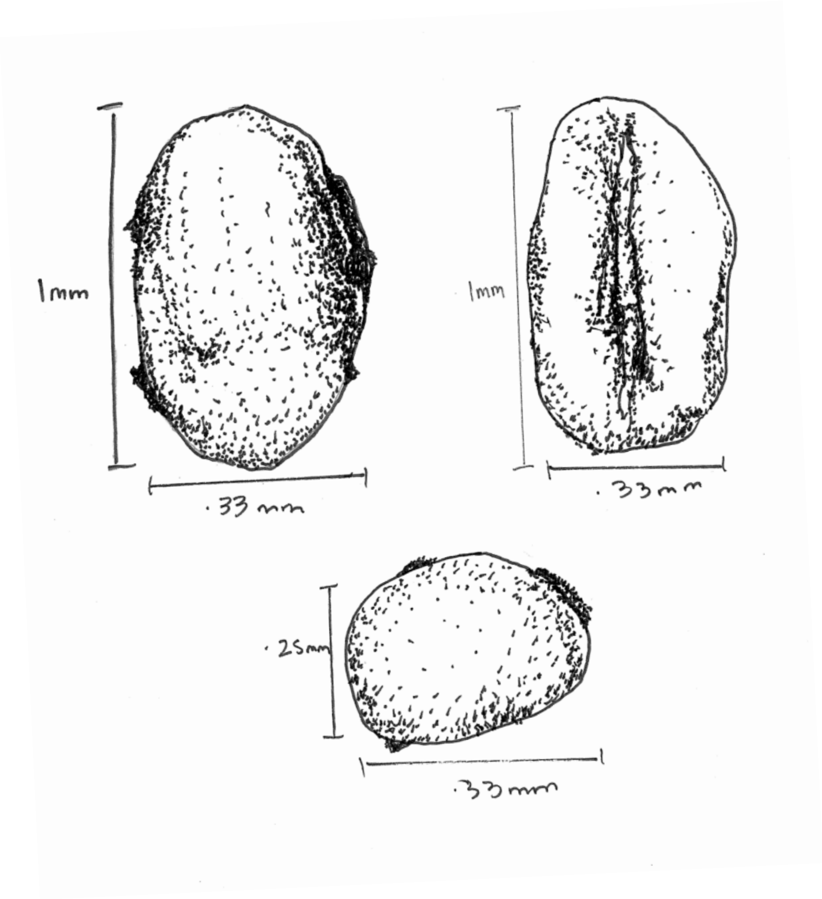
Poaceae 1
CR-32-22-AG-6



Poaceae 2
CR-32-22-AN-4



cf. *Salvia* sp.
CR-32-25-AG-12



cf. *Smilacaceae*
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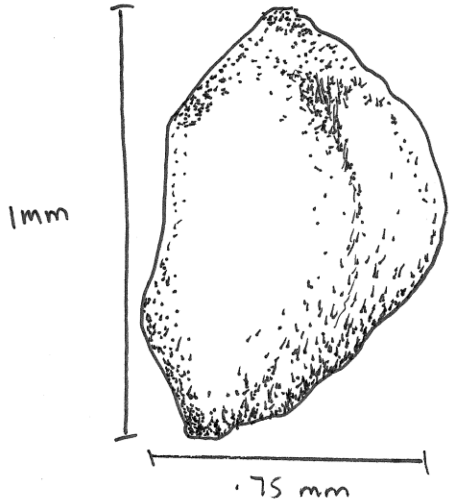

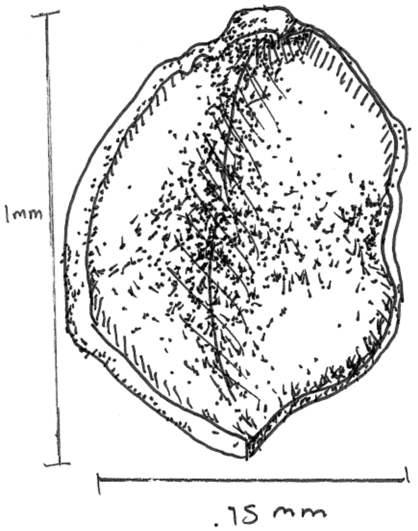

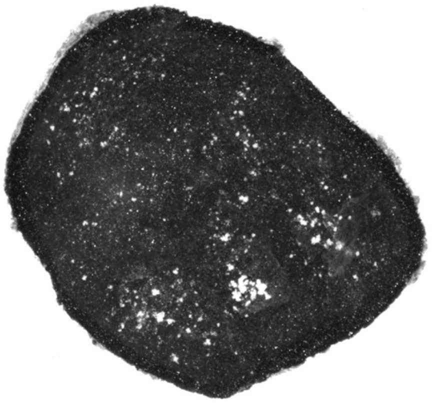

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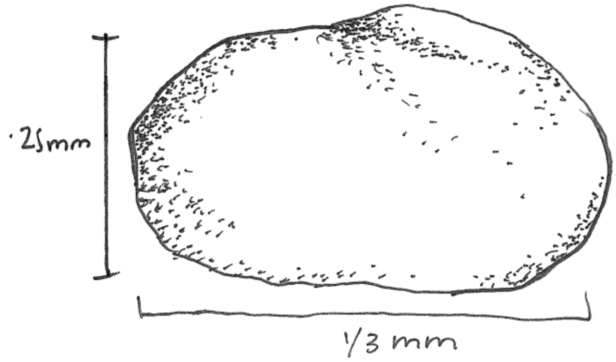

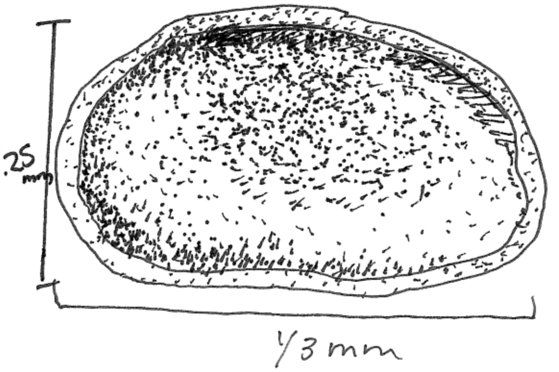

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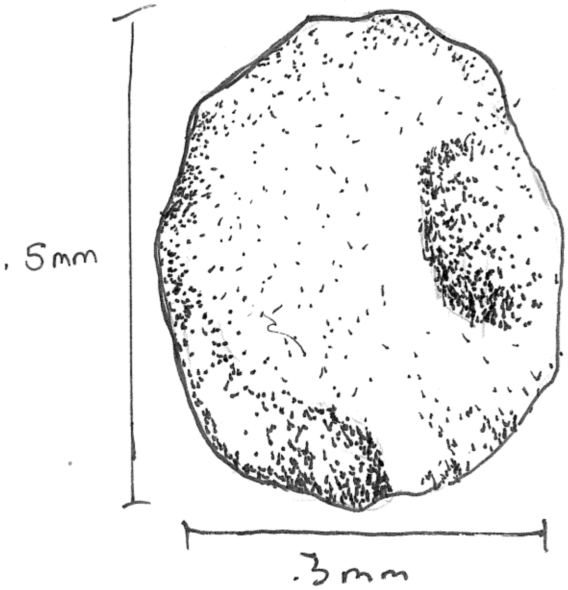

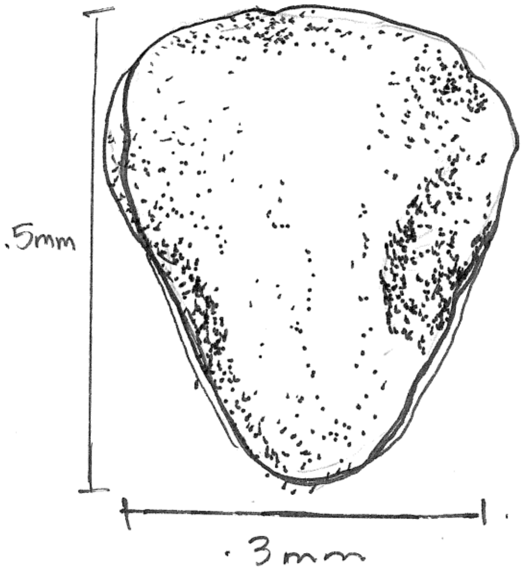

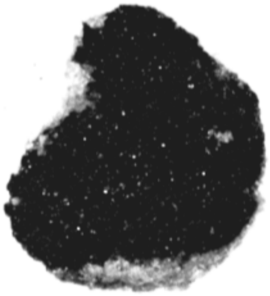

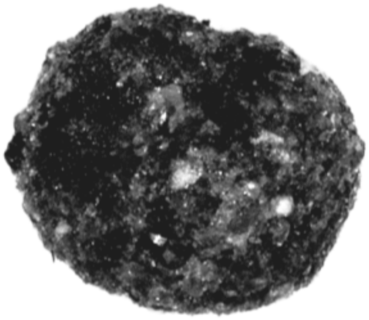

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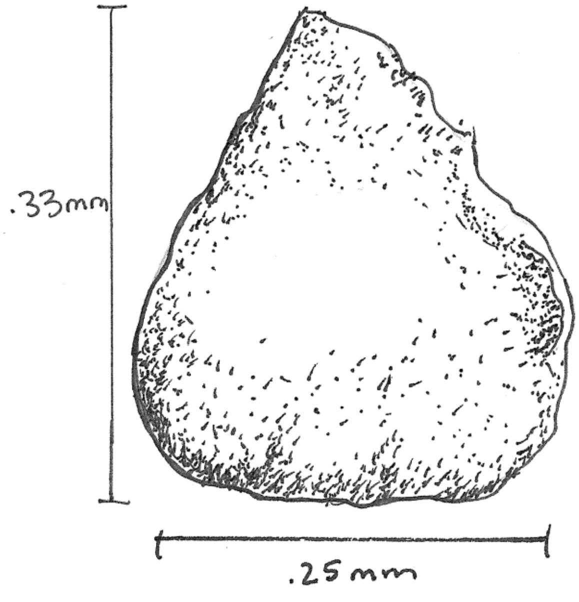

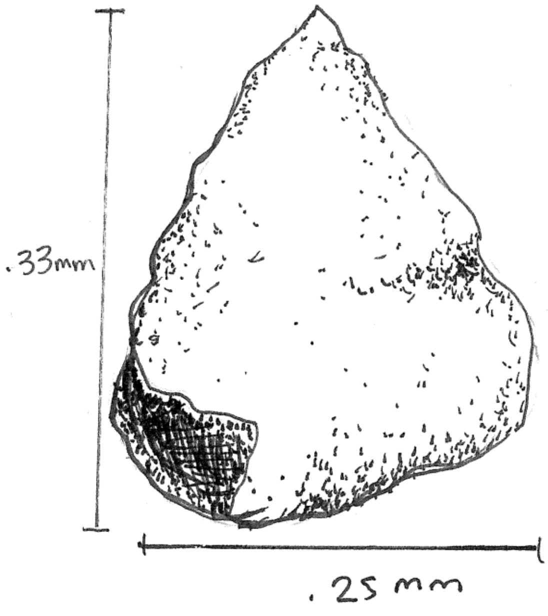

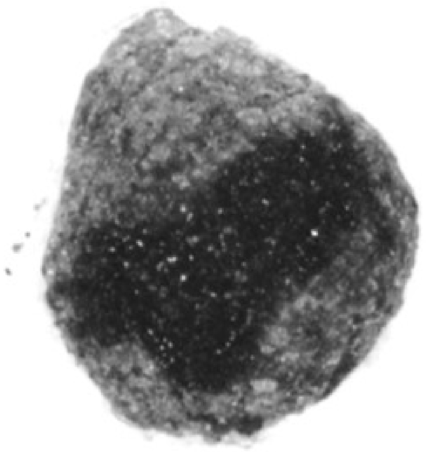

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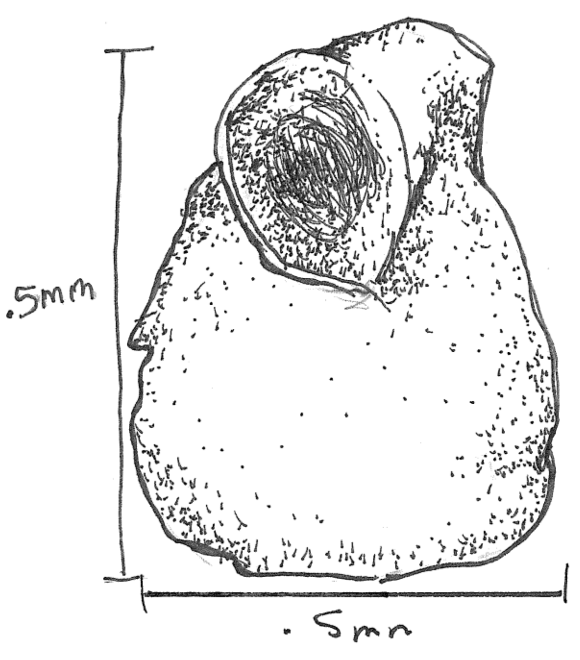
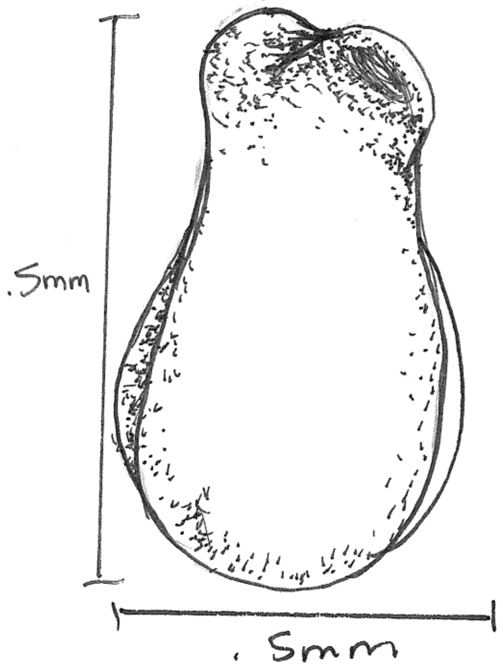
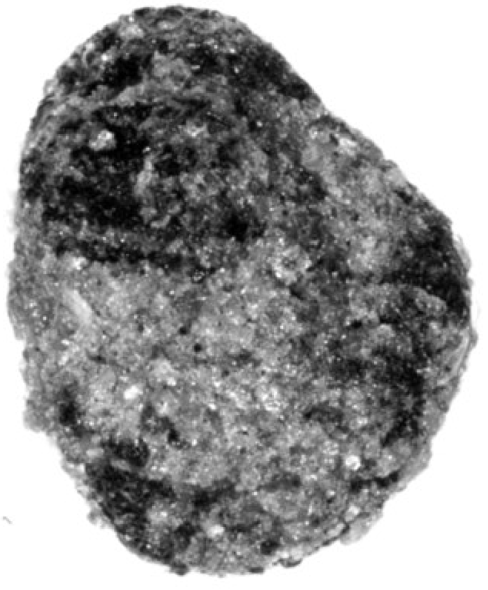
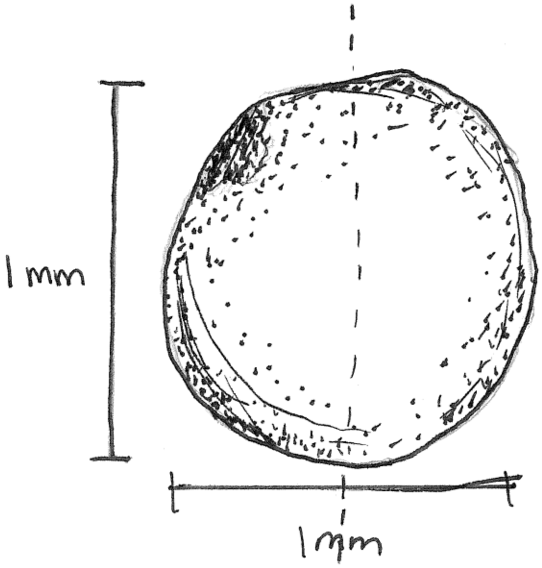
CR-32-25-AA-13

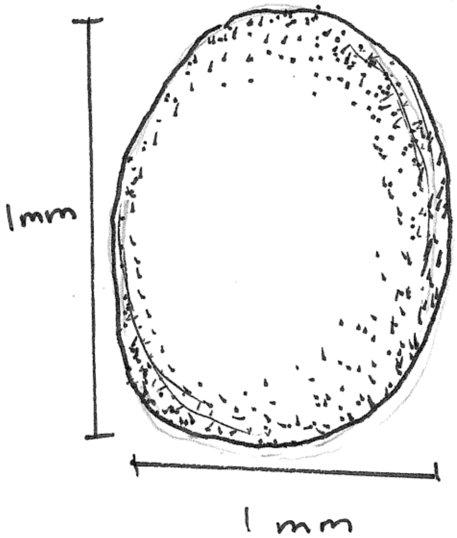






Unknown 28
CR-32-25-AC-2





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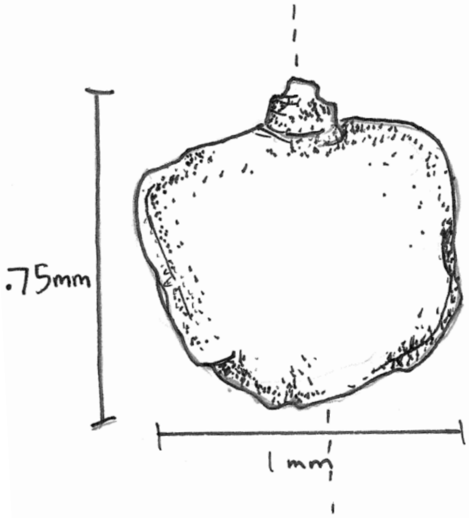

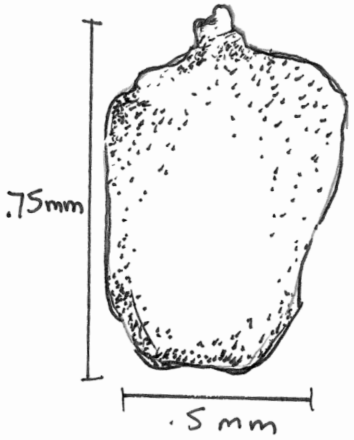

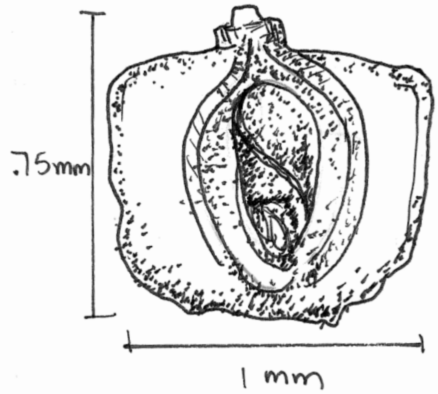

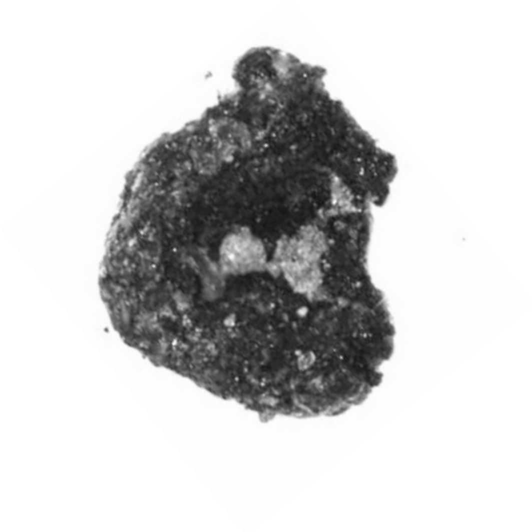

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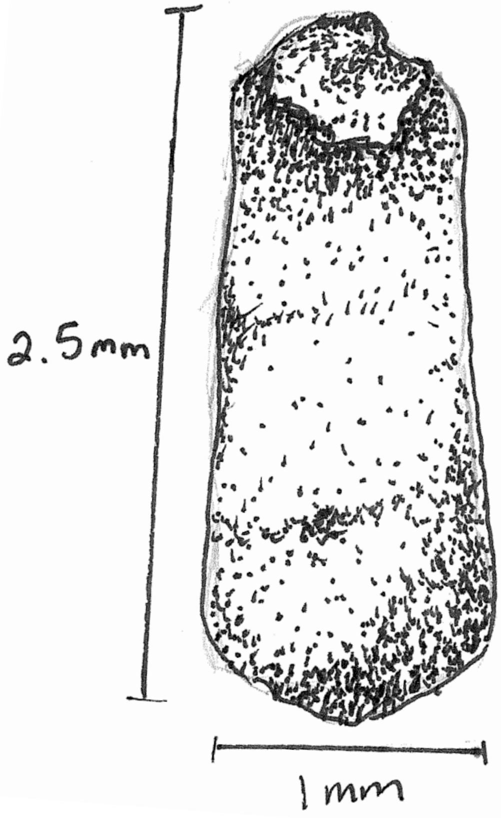
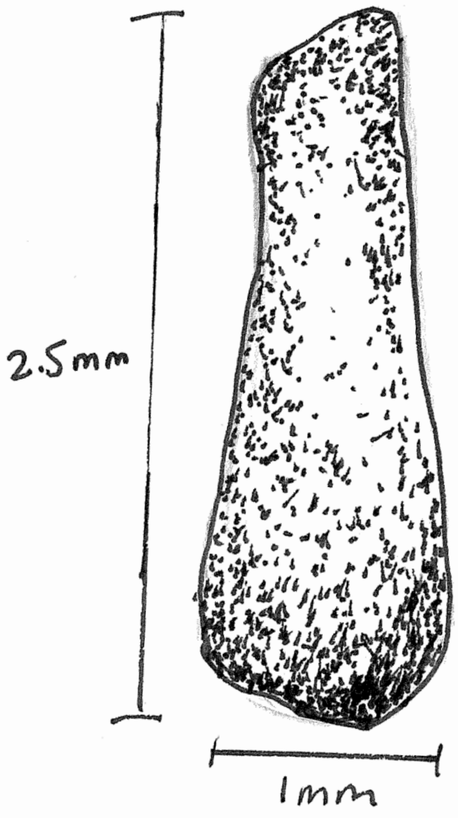
CR-32-22-AN-7





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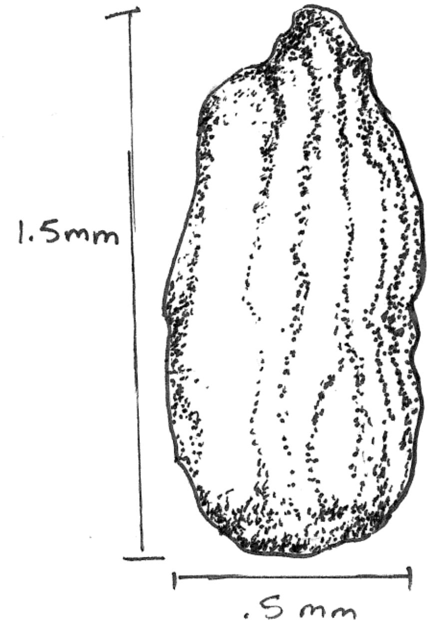
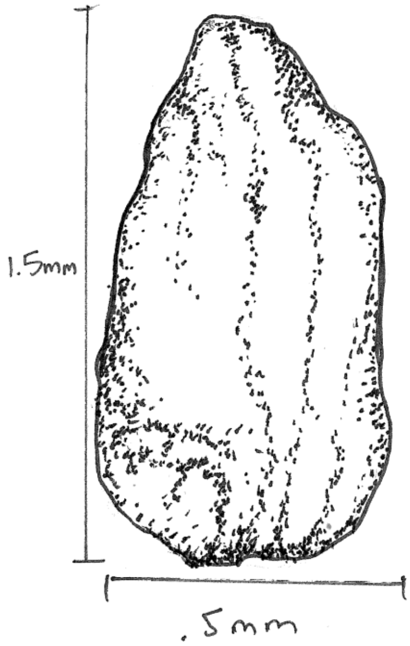
Cr-32-22-AM-10





Unknown 32
CR-32-23-AG-3