THE DIET OF SOVEREIGNTY: BIOARCHAEOLOGY IN TLAXCALLAN

By

Keitlyn Alcantara-Russell

Dissertation

Submitted to the Faculty of the

Graduate School of Vanderbilt University

In partial fulfillment of the requirements

for the degree of

DOCTOR OF PHILOSOPHY

In

Anthropology

August 7th, 2020

Nashville, Tennessee

Approved:

Tiffiny Tung, Ph.D.

William Fowler, Ph.D.

Carwil Bjork-James, Ph.D.

Edward Wright-Rios, Ph.D.

DEDICATION

To the past version of me who never dreamed I could do this. To the Frankensteined pieces and parts sewn together from my parents' (and big sister's) own journeys and struggles, the moments where we didn't think we could, and then we did anyway. To the recycled genes of grandparents and ancestors, whose loves and hurts shaped my drive to understand.

ACKNOWLEDGEMENTS

Preliminary field reconnaissance was funded by a Tinker Foundation Field Research Grant from the Center for Latin American Studies at Vanderbilt University. Fieldwork was funded by a Summer Research Award from the College of Arts and Sciences at Vanderbilt University, a Fulbright-García Robles Research Grant, and a Wenner Gren Foundation Dissertation Fieldwork Grant (#9448: The Diet of Sovereignty: Bioarchaeology in Tlaxcallan). Subsequent field and lab work was supported by Summer Research Awards from the College of Arts and Sciences and the Anthropology Department at Vanderbilt University, and a Russell G. Hamilton Graduate Leadership Institute Dissertation Enhancement Grant to support Ethnographic fieldwork. The public-facing aspects of my research were supported by a Public Scholar Fellowship from the Curb Center for Art, Enterprise and Public Policy at Vanderbilt, and an Imagining America Publicly Active Graduate Education (PAGE) fellowship and co-directorship. This community-based work will continue through an Engaged Anthropology Award from the Wenner Gren Foundation, to be used in Tlaxcala in the summer of 2021.

In addition to the generous funds provided by these organizations, I would like to recognize the humans who worked to help get funds disbursed, answer panicked emails, brainstorm together, and who ultimately became incredible friends and colleagues: **Alma Paz Sanmiguel**, **Colleen McCoy**, **Nicolette Kostiw**, and **Avery Dickinson De Girón** (Vanderbilt Center for Latin American Studies); **Jackal Tanelorn** (Fulbright-García Robles); **Shelley Darling**, **Frank Midgley**, **Sarah Nagy**, and **Crystal Jackson** (Vanderbilt Anthropology); **Kimberly Kane**, **Elizabeth Meadows**, **Jay Clayton** and **Mindy Kessler** (Curb Center). Special thanks to Imagining America and the PAGE co-director team – **Dillon S.**, **D. Romo**, **Gale**

Greenlee, and **Frances Lee**, for sparking my curiosity, and being a touchstone for the reason I continue to do this work.

To my committee members: **Tiffiny Tung**, who fought for me to move forward, shining a light on the possible paths I could take, and then letting go as I decided which was the best one for me. **William Fowler**, who lent me many a book from his vast Mesoamerican collection. **Edward Wright Rios**, whose course on the Mexican Revolution taught me to look beyond books to the art, music, and lived experiences of history. **Carwil Bjork-James**, for making time for meticulous handwritten comments and walk and talk discussions.

To the teams and individuals who made my fieldwork possible: The Instituto Nacional de Antropología e Historia Tlaxcala, Museo Nacional de Antropología e Historia, the Dirección de Antropología Física (especially **Dra. Josefina Mansilla Lory** and **David Corona**, manager of the osteoteca), the Instituto de Investigaciones Antropológicas at the Universidad Nacional Autónoma de México (especially **Dra. Maricarmen Serra Puche**, who mentored me with unbridled support during my Fulbright fellowship, and **Dra. Emily Mc Clung de Tapia** and **Dr. Julia Pérez Pérez** for their support from the Laboratorio de Paleoetnobotánica y Paleoambiente. The Proyecto Arqueológico Tepeticpac, led by **Dr. Aurelio López Corral** and Arqlgo. **Ramón Santacruz Cano**, and the Tepeticpac Archaeological Project, led by **Lane Fargher**, **Richard Blanton**, **Verenice Heredia Espinoza**, and **John Millhauser**. To the community of the Mercado Alternativo de Tlaxcala, especially **Zeferino Manoatl Tetlamatzli**.

To the Vanderbilt Bioarchaeology and Stable Isotope Research Laboratory team: BSIRL Queen, laboratory manager **Natasha Vang**. So, so much Natasha Vang. Thank you for being patient with me as I learned, for your epic succulent window garden, and your meticulous attention to laboratory details. To the ones who helped me grind and drill and pipette what felt like a million samples: **Sophie Stark**, **Stefan Marasligiller**, **Graylynn Oatess** – see, it only took 3 years and TADAH, here are the results!

To those who kept my soul alive: The students from Spring 2020 ANTH 5380: Food and the Body, who helped me think through food topics in new ways and humored our classroom cooking and gardening experiments. My plant and food soulmates, with whom I have spent hours nerding out about interesting plants and bugs: **Lacey Carpenter, Sofia Pacheco-Fores, Anna Guengerich, Miguel Cuj, Zeferino Manoatl Tetlamatzi, Felipe Nava Ahuatzi, Irad Santacruz Arcienaga**.

To the fierce, big-hearted, and quick-witted, talented network of peers-slash-friends: **James Zimmer-Dauphinee** for the tireless hours spent helping me understand R (and **Cate Zimmer-Dauphinee** for emotional support through the frustration!). **Gabriela Oré** for always making the PowerPoints sharp as hell, and marketing me like the magical agent she is. The cohort: **Gabriela Oré, Rosemary Lieske, Gloria Pérez**. I would not have made it through my first years without the cocoon we created, and I am so grateful. The older (cohort) siblings: **Carla Hernández Garavito, Scotti Norman, Sarah Levithol Eckhardt, Brian McCray, Matt Velasco**. **Terren Proctor**, confidence gnome extraordinaire, excel genius, and future Dr. Terren, baker to the stars. **Emma Banks**, one of the first people to teach me how to eat well in grad school, how to remember to sink your hands into the dirt and remember who you are. **Stephany Cuevas**, PhD in chingonidad, who helped me find my Mexican-American roots and hold them tight through the final gauntlet. **Elizabeth Brondos Fry**, statistics angel. **Tom Hardy**, OxCal whisperer.

To the old school friends who have committed to a lifetime of support, watching me turn from Katie to Kate to Keitlyn to Dr. Keitlyn: **The Altons/Louderbacks**, **The Villagrans**, **The Araizas**, **Katie Bevens** and **Laura Zanzig, and my extended family**.

To my family: My mom (**Janet Alcántara**) for endowing me with a love of nature. For collecting such beautifully packaged and meticulously labeled plant samples, and for bragging about me even when I beg you to stop. (She's real proud.) My sister (**Wendy Alcántara**) for helping me process the pain of grad school, making me laugh at what a jerk anxiety can be, and for your skills in last minute translation questions. My papa (**José Alcántara**) for a steady and constant calm to turn to. For easing my path by sharing experiences from your own journey through academia. And, (coincidentally?) for the dark sense of humor.

In short, while at times isolating, *I was never writing this dissertation alone*.

To anyone who gardened with me, painted with me, listened to me vent, went on walks, danced away tension (FLAIL!), fed me, laughed with me, mused with me, problem solved with me… you are the reason I was able to make it through. **Thank you**.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1

INTRODUCTION

In this dissertation, I turn to food, and in particular ancient and contemporary foodways, to trace storylines that exist beneath the surface of dominant narratives. Food can be used as an overt political tool, currying favor through elaborate feasts (Dietler 2001), or through the preparation and consumption of symbolically charged food. Yet even in the most mundane meals, those daily acts lost to time, the foods we choose to eat provide a concrete representation of the ways we believe our world is structured, and the ways that we adhere to or contest this structure. Both symbolic and utilitarian, food carries imbued meanings through time, meanings that are interpreted and enacted at multiple coexisting and sometimes competing levels—individual, small group, community, state, nation. In the context of political conflict and challenges to sovereignty, it is often the loudest or most deafening voice that goes down in history, shaping the narrative that is accepted as truth. Yet, I argue that foodways are particularly key to understanding resistance and resilience, as individual diets are shaped by knowledge about ingredients and their preparation, a codified language that reveals relationships to land, and insights into individual and community health and values.

As a case study and metaphor for larger social movements of resistance, I focus on the example of Tlaxcallan in Late Postclassic Central Mexico (AD 1325-1519). The Aztec Empire reached the peak of its expansion in the Late Postclassic, with allies and tributaries that spanned both coasts and blanketed Central Mexico. Throughout this expansion, the state of Tlaxcallan remained as a visible blemish—a territory just 120 km from the Aztec capitol of Tenochtitlan, surrounded by imperial powers, yet persistently resisting incorporation. In this dissertation, I turn to the Puebla-Tlaxcala Valley to understand the conditions of Tlaxcallan's sovereignty. In the same valley, the religious center and urban site of Cholula held a different, yet similarly unexplored relationship to the empire. Conflicting narratives present it as either an independent state, or an Aztec ally. What both of these sites represent is a challenge to the idea of conquest and resistance—rather than a uniform military annexation, these sites emphasize the ways in which internal, often inconspicuous, social dynamics lead to unique processes of negotiation. By combining bioarchaeology and paleodiet studies, I provide individual and population-level data for experiences of political negotiation within specific populations at the Tlaxcalteca site of Tepeticpac, and Cholula. Through these analyses I define what social organization looked like in these particular contexts and the role it played in defining each site's relationship to imperial expansion.

The Late Postclassic landscape of Central Mexico was dotted by hundreds of distinct ethnic groups, yet Aztecs narratives of imperial control obscured challenges to their authority, particularly through the minimization of the importance of Tlaxcalteca sovereignty. This reductionist history of indigenous society is a tactic used by the Aztecs to promote a narrative of totalizing power. In much the same way, the contemporary nationalist identity of Mexico is predicated on a united, monolithic Aztec ancestry that unites the nation— a narrative that erases and discredits the complexity and wealth of indigenous societies and their knowledge keepers, while appropriating their ancestors as a caricature of Mexican identity. Focusing on a single version of this history serves as a political tool to erase the complexity of the ancient past, and in so doing, erasing voices that challenge the dominant narrative —voices that bring forward a messy entanglement of stories rather than a single tidy past.

From the lens of bioarchaeology and biological anthropology, I explore how the bodies of individuals become tools to forward state narratives, while simultaneously recording the legion of unique experiences that become flattened to form a cohesive history. Through this dissertation I use bioarchaeological and paleodiet studies to repopulate the past with individual experiences that help to explain Tlaxcallan's capacity for imperial resistance. Particularly, my research highlights how social and political systems shape foodways, while also recognizing that individual diets give clues as to the ways that these systems are constantly negotiated by individual agents. Through this work, I challenge the narrative of imperial control, to demonstrate the ebb and flow of power and resistance that single storylines don't capture.

Antecedents

The multiplicity of relationships to the Aztec Empire have been explored by archaeologists throughout Mesoamerica. Important to these studies has been the theme of multi-tiered interaction— a theme explored in depth through household archaeology and political economy. Through the analysis of material remains (Brumfiel et al. 1994; Brumfiel 1996), architecture (De Lucia and Overholtzer 2014) household production and economic strategies (De Lucia 2013; Hodge and Smith 1994; Hirth 2016), and settlement patterns (Berdan et al. 1996; Nichols 2004), researchers have demonstrated the variety of population-level responses to empire, challenging perceptions of a uniform tactic of expansion. By zooming into household patterns of material production and consumption, these researchers demonstrate evidence of intra-site contradictions: even when sites are allies or tributaries of empire, households maintain autonomous economic and ideological practices that depart from imperial narratives. Thus, this work emphasizes the need for multi-scalar analyses that reveal greater depth and complexity to imperial-local relationships.

Within the Puebla-Tlaxcala Valley more specifically, my research builds on archaeological work by the Proyecto Arqueológico Tepeticpac and Tepeticpac Archaeological Project, which include surveys of the many settlements that made up the state center (Fargher et al. 2011), as well as widescale excavation and restoration efforts at Tepeticpac (López Corral and Santacruz Cano 2015, 2016, 2017) and the nearby ritual center of Tizatlán. Through these archaeological efforts, researchers unearthed an expansive site composed predominantly of residential and agricultural terraces and lacking in any architecture that could be considered a "palace." The materials used across the site were uniform, with structures that were austere and largely utilitarian. Numerous plazas and ritual buildings were constructed to be open and easily accessible. Within this work, Fargher et al. (Fargher 2011, 2017; López Corral et al. 2016; López Corral and Santacruz Cano 2019) have proposed that economic autonomy and an internal social organization around "collective action" and the formation of a Tlaxcaltecan republic facilitated Tlaxcallan's sovereignty. In summation, these authors argue that Tepeticpac represents a decentralized form of government led by a rotating council of elected officials— a system aimed at horizontal distribution of power. While not unique in its structure (tecalli, or "noble houses" being found both in the Puebla-Tlaxcala Valley and surrounding Central Mexico region), it is argued that tecalli allowed Tlaxcallan to flexibly adapt to quickly shifting sociopolitical contexts. Earned, rather than ascribed, status and participation in government created space for populations fleeing imperial rule to easily become established as contributing and supported members of society.

Building upon these foundations for the exploration of varied experiences of empire, I use bioarchaeology to focus on individual histories and the ways that they serve as detailed puzzle pieces within population-level narratives projected through architecture and site-level patterns. Specifically, I explore individual experiences by analyzing ancient diets through stable dietary isotopes and dental calculus. By looking at individual bodies and the experiences they document I investigate the role of foodways in enabling individual and collective response to the expanding Aztec state.

Introducing the Bioecological Model

The work of household archaeologists and political economists has done much to link population-level patterns to broader political, economic and social structures. Additionally, bioarchaeological research has worked to situate the individual body within these structures through the biosocial and biocultural model (Agarwal and Glencross 2011; Goodman and Leatherman 1998). Yet what is missing is a way to link all of these tiers together, not as discrete levels of interaction but as interlocking feedback loops.

Food traverses all levels of human interaction, from the way it is exchanged and manipulated through economic and political systems, to access and distribution within immediate networks, household or otherwise, to individual experiences. I argue that viewing these models through the lens of food creates a multi-layered bridge linking different levels of interaction and social structure. In order to systematically outline these networks, I adapt Urie Bronfenbrenner's (1979) Ecological Model. Originally intended to understand the intersecting local and systemic influences on child development from a pedagogical perspective, when applied to bioarchaeology, this model allows me to explore the changing and often contradictory relationships that together form parts of Cholula and Tepeticpac societies. I argue that this model expands beyond the philosophical nature of practice theory (Bourdieu 1977; Giddens 1984) to concretely map the experiences of individual agents within structures of community, using diet and foodways as the thread that weaves each loop of this spiderweb of interactions together.

In addition, the diachronic nature of this model allows me to bring my bioarchaeological findings into dialogue with contemporary politics. Archaeological research is often chronologically disjointed from history and the present by an invisible border between pre- and post-coloniality. I argue that the analysis of foodways creates a thread linking the ancient past and the present. The political and economic impacts of imperialism, colonialism, and, in contemporary times, capitalism and globalism have shaped the populations of ancient Tlaxcallan and contemporary Tlaxcala in distinct ways. Yet the persistence of particular foodways and agricultural practices reflect parallels in fights for food sovereignty - the right to take ownership over their relationship to land and food production. In addition, by contextualizing bioarchaeological findings from dietary isotopes and plant microfossils with ethnographic interviews about contemporary foodways in Tlaxcala, I work to translate bioarchaeological findings into material that is relevant to contemporary discussions about local knowledge about the relationship between food and body, and its value in community resilience and sovereignty.

Research Questions

My dissertation research uses paleodiet and bioarchaeological analyses to reconstruct social organization at Cholula and Tepeticpac, in order to better understand local tactics and capacities for imperial resistance. Through individual, population-level and inter and intra-population comparisons, I explore the following questions:

In what ways do shared Mesoamerican belief systems shape food decisions at Tepeticpac and Cholula?

How do foodways change within cycles of time (individual lifetimes; from the Early to Late Postclassic; between Postclassic and Contemporary Tlaxcala)?

How do individual and group networks interact to sustain social structures and/or shape change?

How do external factors, such as imperial expansion, warfare, and economic blockades shape relationships to food?

How might internal structures of food distribution and access influence capacities for imperial resistance?

Materials and Methods

These questions were answered through the bioarchaeological analysis of 58 individuals (48 primary and secondary burials and at least 10 individuals represented through commingled remains) from Tepeticpac and 100 individuals from Cholula. Calibrated radiocarbon dates were collected from six Cholula and six Tepeticpac individual burials from Cholula in the Early Postclassic (AD 869-1255, 2-sigma), while individuals from Tepeticpac span the Late Postclassic to Early Colonial (AD 1431-1646, 2-sigma). When preservation allowed, samples of enamel and bone were collected from each individual and processed for carbon, nitrogen and oxygen isotopes. In addition, 28 samples of dental calculus were collected from Tepeticpac individuals and analyzed for paleobotanicals by Dr. Julia Pérez Pérez at the Universidad Nacional Autónoma de México. Eleven archaeological faunal bone samples from Tepeticpac and 46 contemporary plant samples from Tlaxcala markets and kitchen gardens were also analyzed for dietary isotopes in order to create a food web for the Puebla-Tlaxcala Valley. By examining correlates of consumed foods, this project explores patterns of resource consumption and distribution, linking them to sociopolitical and economic responses to imperial expansion.

From this case study of the past, I further integrate ethnographic interviews from contemporary Tlaxcala populations to understand how many of these foodways, ingredients, and the protection thereof, is one way in which contemporary Tlaxcala continues to fight for state sovereignty within Mexico, and agricultural sovereignty in the face of globalized farming industries.

Organization of Dissertation:

In order to answer the proposed research questions, I begin **Chapter 2** by presenting the theoretical framework used in this dissertation. Influenced by the intersection of agency theory, household archaeology, structural violence and biocultural and biosocial bioarchaeology frameworks, I present the Bioecological Model as a way to examine the multiple and recursive levels at which sovereignty is negotiated, challenged, and maintained. In **Chapter 3**, I provide a historical and ecological overview of the Puebla-Tlaxcala Valley, arguing that although Cholula and Tepeticpac share access to similar ecological zones, their unique histories and sociopolitical relationships define both social order, and relatedly, patterns of food access, distribution and consumption. Throughout **Chapter 4**, I outline the methods used to analyze the human, faunal, and plant remains used in this study.

In **Chapter 5**, I present results from flora and fauna analysis in order to reconstruct a preliminary food web of isotope values for the Puebla-Tlaxcala Valley. In **Chapter 6**, I present results from radiocarbon and oxygen isotopes to chronologically and geographically define the communities under study. While radiocarbon is used to establish chronological distinctions between Cholula and Tepeticpac, and between generations at each site, oxygen is used as a proxy for identifying non-local individuals. Together, these data are used to create a baseline for "locality" and community at the two sites. In **Chapter 7**, I present dietary isotope and paleobotanic results from burials at Tepeticpac and Cholula. These analyses serve to highlight unique social structures at each site, as well as identifying local foodways and intra-site differences. I conclude with **Chapter 8**, in which I draw from ethnographic interviews of contemporary Tlaxcalteca residents and floodway stewards, to add depth of interpretation to isotope analyses.

Significance and Contribution

Through a bioarchaeological analysis of Postclassic foodways at Tepeticpac and Cholula, I rely on the introduced Bioecological Model to identify and map intertwining levels of agency. By comparing individual, community, and state foodways, I trace competing and intersecting experiences to better understand local responses to imperial expansion. As a central site of repeated daily actions that exemplify beliefs and values about the structure of the world, and one's position within it, exploring the constantly shifting and negotiated politics of foodways makes concrete the ephemeral nature of culture change. Through this dissertation, I use paleodietary data to revive the life histories of agents whose experiences and actions shaped the context for Tlaxcallan and Cholula's political obstinance in the Puebla-Tlaxcala Valley. Looking to these data as an echo of past actions and relationships, I use ethnography to demonstrate how throughout the chaotic violence of colonialism, indigenous Tlaxcalteca knowledge was far from erased. By combining bioarchaeological and ethnographic methods, I emphasize the need to examine not only abrupt moments of history (such as imperial conquest or colonialism) but also the mundane daily actions, within which threads of the past remain, embodied in day-to-day food traditions. Through oral history interviews, I draw parallels between these foodways and their underlying value systems, defined by relationship to land, to other community members, and to the unique history of a specific place. Following this archaeological past to the present demonstrates how Tlaxcala has in many ways become a metaphor for indigenous survival and resilience—a threat to nationalistic narratives of progress and globalization.

2

THE POLITICAL LIFE OF FOOD

This chapter introduces an adaptation of Bronfenbrenner's (1979) ecological model as a way to explore ancient diets and their relationship to social and political networks, both aspired and actual. From this unique perspective, this chapter establishes a multi-scalar analysis of foodways to interpret social and political lives at Tepeticpac and Cholula. This model emphasizes the independence and interweaving of the goals of individual agents, communities, states and regional political and ideological structures. Finally, the chronological element of this model links foodways across time, claiming the bioarchaeologist as an element that must also be contextualized in terms of their chronological and political relationships to the work.

Introduction

Through my dissertation work, I turn to diets to reconstruct social organization at Tepeticpac and Cholula as a way to understand how those groups shaped and responded to the expansion of the Aztec Empire into the Puebla-Tlaxcala Valley. To date, ethnohistorical research into social organization in Late Postclassic (AD 1325-1519) Central Mexico relies heavily on colonial-era accounts, recorded by Spanish conquistadors and priests (Cortés 2014; Durán 1964; Díaz del Castillo 1916; Motolinía 1950; Muñoz Camargo 1972; Torquemada 1995). These narratives were written as records that justified Spanish colonialism and the power of the Crown over a mighty empire. Thus, they center the influence of the Aztec core, and said empire, only exploring how populations interacted with the Aztecs at a state level. This creates a top-down perspective dominated by imperial versions of history. Countering this perspective, archaeological research at the household-level and at sites peripheral to the imperial core has demonstrated that state-empire interactions were varied (Brumfiel 1992, 1996, 2009; Brumfiel and Robin 2008; De Lucia 2013; De Lucia and Overholtzer 2014; Nichols and Smith 1994; Hodge and Smith 1994; Smith and Heath-Smith 1994). Responses to imperial incorporation were shaped by local political, economic and social histories, and the ways these interacted with specific moments of imperial expansion. For example, Berdan et al. 1996 explore how geographic distance and accessibility shaped relationships between the closely overseen central provinces and peripheral, or "strategic" provinces. Even within central provinces, the extent to which the empire influenced local economic and social structures varied. Work by DeLucia (2013) at Xaltocan demonstrates that household economies often operated independently of state or province-level tribute demands. In many cases, imperial "control" was largely symbolic, with local agency shaping wide-ranging and shifting adaptations to external political and economic climates (Hodge and Smith 1994). This chapter centers on the interaction and influence of multi-tiered levels of interaction, specifically, how local resistance was shaped by political and social structures and the constituents who existed within them. The two populations used in this study consist of local individuals from the elite urban core of Tepeticpac and commoners from the periphery of urban Cholula. Both populations represent citizens of the urban core, who likely led lives that were both influenced by and influenced the outcomes of central decision-making strategies.

In this chapter, I argue that looking at patterns of diet within the sampled populations of Cholula and Tepeticpac will add depth to understandings of imperial expansion and local political strategy and resistance. Foodways allow for the fleshing out of one-dimensional caricatures of states, repopulating the past with actors whose daily decisions were shaped by many factors, including history, economy, politics, ideology, and social organization. How do we get at the ways these different variables interact? Food becomes a metaphorical trail of breadcrumbs by which to reconstruct relationships, as they are made visible through economic exchange, social structures of access and sharing/restricting, and political relationships with both internal and external policies of "food norms." Drawing from both contemporary food studies in anthropology (Counihan 1999, 2019; Watson and Caldwell 2005; Weissner and Schiefenhovel 1996) and archaeological and bioarchaeological research (Dietler 2001, 2006; Dietler and Hayden 2001; Hastorf 2017; Twiss 2007), this dissertation uses foodways to explore overt and obscured interactions, with the goal of reconstructing Tepeticpac and Cholula's relationship to Central Mexican political and economic structures as well as internal structures unique to each site.

Throughout studies of conquest and colonialism, bioarchaeology has contributed significantly as a field capable of documenting the lived experiences of agents who were otherwise invisible in the material remains of societies (de la Cova 2012; Murphy and Klaus 2017; Larsen et al. 2001; Torres-Rouff 2015; Tung et al. 2016). While bioarchaeology has made great strides in recent years to draw descriptive methods in conversation with broader anthropological questions about social organization, I argue that it still struggles to encapsulate the limitless factors that interact to shape an individual's lived experience, and the way this experience then fits into the contemporary histories of particular geographical contexts. As a proposed intervention, I introduce an adaptation of Bronfenbrenner's Ecological Model, a pedagogical model that aims to understand the multi-level influences on child development. While alien to bioarchaeology, this model considers how agents (originally conceived as children) are linked to multiple levels of influence outside of their own bodies. By linking this theory to models of structure and agency as previously conceived in bioarchaeology, I expand on the impact of a multi-level model that connects past and contemporary structures of interaction. I will show how this model allows me to rebuild social organization at Cholula and Tepeticpac through food, and why foodways are a useful tool for getting at the multi-level contributors of imperial outcomes in Late Postclassic Puebla-Tlaxcala Valley.

Advantages of a Bioecological Model

Structure, agency, and then some

Practice theory has been used in archaeology to emphasize the way in which political and economic structures emerge from recursive relationships between *all* individuals of society, not just the elite or state institutions, filling the gaps left by overly structuralist models (Giddens 1984; Bourdieu 1977; Sahlins 1994). The idea of practice theory stems from Marx's *praxis*, or the idea that the action of production through day to day activities creates and reinforces society and social relationships. Work by Bourdieu (1977) and Giddens (1984) similarly emphasizes the contribution of all individuals in the creation of structure. These works emphasize how individuals, both within and outside of structures, may deviate from expected actions, reorienting the flow of power in small but potentially impactful ways. Yet, as I will argue, it is a model with limitations, particularly in its abstraction away from exploring the lives of real individuals in the past. As Tung (2014) argues, while all individuals are endowed with agency, societal structures limit the equitable distribution of agential capacities. In short, an individual's ascribed identity may empower or limit their capacity for impact. In the context of the Aztec Empire, this becomes an interesting approach with which to consider the limits of imperial expansion— can looking at individuals at Cholula and Tepeticpac help understand why the Puebla-Tlaxcala Valley was one of the last bastions against expansion? And how did internal dynamics of power influence this capacity for resistance?

Practice theory explores the different places that power lies, who has access to which types of power, and how that influences the shape of society and its capacity to change or remain in stasis (Sewell 2005). At all times, there are competing agendas and different objectives, even within structures like empires or states that may collectively, on the surface, appear to have a broad goal (Giddens 1984). The physical world can signal overarching goals and ideologies, through monumental structures like architecture, temples, constructed trade routes, or blockades. At the same time, hints towards competing individual goals are concurrently visible. In this study, I examine foodstuffs to understand how material goods may be funneled through individual channels and engaged with in ways that run counter to this larger narrative. Considering the role of individuals allows research to avoid abstractions, such as attributing actions to "the Empire" or "the State" (Wolf 1997). In the context of state formation and imperial expansion, practice theory allows researchers to recognize that the empire is composed of individuals, each acting both independently and as a group to interact and shape the world around them.

While practice theory emphasizes a recursive and complex relationship between individuals and the local and regional structures within which they exist, there are several specific structures at play in Late Postclassic Mesoamerica that I argue practice theory fails to overtly recognize— a critique also noted by other archaeologists (Schrieber 2004; Ortner 1989; Stein 2005). Although practice theory challenges theoretical concepts, it remains philosophical in application, failing to map clearly onto concrete worlds. The impact of this shortcoming can be seen in Ortner's (1984) critique of practice theory as applied to political interactions, noting that many studies of agency tend to focus on themes of domination and resistance, rather than considering other types of recursive relationships like cooperation, reciprocity, or solidarity. In short, practice theory as applied to archaeology often essentializes the past, making it about vague groups of humans, faceless in the fantastical ancient worlds quite different from our own.

The model that I introduce, when applied to bioarchaeology, has the capacity to not only consider the multiple levels of interaction and agent decision making, but also creates a distinct link from the past to the present. I argue that this link is pivotal to repopulating the past with real people rather than abstractions. In studies of the mighty Aztec Empire, the Puebla-Tlaxcala Valley appears only as a footnote in analyses of Late Postclassic Central Mexico, and Tlaxcala and Cholula are reduced to caricatures—the Tlaxcalteca warriors, the Cholulteca priests. While *some* members of the population were certainly warriors and priests, through bioarchaeological analysis of foodways, I seek to add greater texture to the social interactions of these past societies. Warriors and priests coexisted in community with mothers, with elders, with children—what did their interactions look like, and how can dietary patterns help reconstruct social organization? How did the nature of these relationships shift with time and changing political contexts?

Breaking down household walls

In the 1980s, household archaeology introduced the idea that the diversity of lived experiences found among non-elite publics allowed for a more thorough understanding of social networks in the past. Through household archaeology, researchers took a multi-scalar approach, assessing individual agency as well as how it nested within increasingly complex and global structures such as family, community, polity, and state, economic networks, to name a few (De Lucia and Overholtzer 2014; Brumfiel 1992). The work done by household archaeology has addressed some of the shortcomings of practice theory, namely, complicating the dichotomy of conqueror and conquered. In terms of studies of the Aztec Empire, household archaeology done across spaces within imperial communities, within conquered communities, and at the boundaries of both, has emphasized the capacity of conquered and incorporated peripheral cities to challenge imperial policies in diverse and contextually-specific ways (Brumfiel 1996, 1998; Nichols 1994, 2004; Minc 2009). For example, at Otumba, Nichols (1994) argues that despite incorporation into imperial networks, household craft production continued to be dispersed in "independent specialist" households (p. 184), rather than funneled directly towards imperial needs. Nichols compares this peripheral site to the centralized production in Huexotla and Xico, sites of the imperial core, to demonstrate the relationship between distance and autonomy. Brumfiel (1996) argues for a similar "hinterland" relationship at Xaltocan, where the presence of female figurines is seen as a rejection of the imperial ideology of male warrior dominance. In both of these cases, conquest did not equate to complete ideological or economic alignment with the empire. Rather, resistance is visible in day-to-day patterns of life at these sites.

Political economy studies across Mesoamerica have also contributed significantly to the recognition of multi-scalar agency. Hirth's (1996) examination of economic systems at multiple scales (household, local, and regional economies) demonstrates how minute differences within local contexts shape economies, and in turn how these local economies interact and influence larger economic networks, such as imperial market systems. Throughout Central Mexico, political economy studies have emphasized the importance of household agency across millennia of rapidly shifting political centers (Berdan et al. 1996; Blanton 1996; DeLucia 2014; Hirth and Pillsbury 2013; Hirth 2016; Nichols 1994; Smith and Berdan 2000; Smith and Berdan 2003; Smith and Heath-Smith 1994). A history of centralized structures of power that were unpredictable and unstable led to an economic structure that outlasted any single civilization, instead thriving through the ingenuity and adaptation of household-level production and exchange. Household archaeology succeeded in breaking down overarching structures like empires and states into economic levels of household, neighborhood, and community. At the level of individual, scholars Joyce and Meskell (Joyce 2004; Meskell and Joyce 2003; Meskell 2000) explore how material remains and physical changes to the body can further emphasize the ways embodied experiences shaped capacities for individual agency in the past. Operating at multiple levels, society is composed of overarching structures of beliefs and norms, and the lived day-to-day experiences and decisions made by individual actors. These authors demonstrate how ideals about how society was *supposed* to work were simultaneously maintained through repeated actions (for example, foodways and feasting) yet challenged by constant reinterpretation and reshaping as culture shifted with new generations, new political climates, and new belief systems. I argue that the Bioecological Model provides the necessary framework for conceptualizing the way all these levels fit together, as well as creating space for constant change, and the chronological contextualization of social structures at a particular moment in time.

Surprisingly, given its position as one of the last areas to be conquered, the Puebla-Tlaxcala Valley, and Tlaxcala in particular, remain nascent areas of archaeological research on imperial expansion and the limits to expansion. Foundational archaeological research was primarily descriptive (García Cook 1981, 2014; Muñoz Camargo 2000; Vega y Noguera 1927), recording the location and nature of sites for posterity. Recently, archaeological work has begun to expand the nature of questions about social organization and economic exchange systems within Tlaxcala, particularly at Tepeticpac (Millhauser et al.2015; Fargher et al. 2010; 2017; Corral et al. 2019). More extensive work has been done at Cholula, beginning with excavations of the Great Pyramid (Marquina 1970; Lopez Alonso et al. 1976) and expanding into conversations about the chronology of the site (McCafferty 1996 a,b), its relationship to surrounding areas and the nature of migration, lifeways and economy in this urban center (Bullock Kreger 2010; Lind 2008; McCafferty and McCafferty 2000, 2006). While these conversations have occurred independently, what is missing from household and economic studies is a way to link all these different levels together, particularly at the level of unique life histories. Adapting Bronfenbrenner's model to analyses of foodways at Cholula and Tepeticpac, I will explore the multi-scalar nature of social systems, while also challenging their capacity to account for the actions and lived experiences of individual agents.

You are what your ancestors ate: Toward a multi-scalar bioarchaeology

Bioarchaeology as a field thrives on reinserting individual stories into amorphous populations of the past, drawing from the lived experiences recorded within ancestral bodies (Stodder and Palkovich 2012). Contemporary bioarchaeological research grew from "first wave" descriptive studies to incorporate frameworks of cultural anthropology, contextualizing osteological observations within specific cultures and histories (Martin et al. 2013). Researchers in the "second wave" of bioarchaeology developed biocultural models that linked ecology and society to understand their reciprocal relationships with human sociality and politics (Goodman and Leatherman 1998). The "Biocultural model" links macro and micro processes yet is much more comprehensive than the binary description implies. This model situates bodies within a historically and culturally contextualized world, to understand how surrounding systems of social interaction, economy, politics and ecology influence individual decision-making, and capacity for physical fitness. Agarwal and Glencross (2011) take this model one step further, proposing a "third wave" of bioarchaeology, or the "Biosocial Model" that contextualizes the lived experience of the body in the past and pays attention to the way this work contributes to and shapes ideas and policies within the present world. These models help to consider the many intersecting factors that contribute to individual and group adaptations, particularly how they relate to social inequality, and unequal distribution of resources. Building on the biosocial model as a way to document lived experience in the past, I explore how foodways are used to unify and divide, to signal belonging, as well as individual agency and autonomy. Drawing comparisons between the past and present, I argue that foodways can play a key role in resistance, serving as a transmission of knowledge and a collective community identity that creates resilience in the face of external political and economic pressures.

Filling the gaps with a Bioecological Model

In sum, practice theory introduces the idea that influential agency comes from all actors, and that their agential potential is of varying degrees (Tung 2014) — yet doesn't quite get at concrete stories of lived experiences. Household archaeology and political economy also explore the diverse contributors to economy and political decisions, an approach that has been very useful in the household-heavy economy of Mesoamerica. Bioarcheology and the biocultural and biosocial models serve to link levels such as household, community, state, and individual but focus primarily on their relationship to health.

I propose that Bronfenbrenner’s ecological systems theory (1979, 1988) allows for the interpretation of foodways as a tool for getting at multi-level, individualistic analyses of interaction through diet, particularly in the Mesoamerican context where ideology, economy, ecology and political structures are central players in the biosocial landscape. By focusing first on the individual, this model is aimed at understanding how personal conceptions of “self” interact with external pressures and influences in the household, community, and regional political, social, and economic landscape. This model further allows for the contextualization of the body within worlds of knowledge and influence as they existed in the past, while also being acutely aware of the ways in which our own nested systems influence interpretations and research questions. Finally, a key insight of this model emphasizes the ways in which society and the human biosocial environment are under constant flux and negotiation. Thus, this model allows for “the evolving processes of interaction through which the behavior of participants in the system is instigated, sustained, and developed" (1979, p.17). Rather than examining the populations under study as static entities of “Late Postclassic Tlaxcalteca and Cholulteca,” this model centers individual experiences within specific moments in time, tracing how the lived experiences recorded in singular bodies reflect relationships to broader networks of interaction—belief systems, social hierarchies, and political policies. In Bronfenbrenner’s words, this model centers individuals as a "growing, dynamic entity that progressively moves into and restructures the milieu in which it resides" (1979, p. 22).

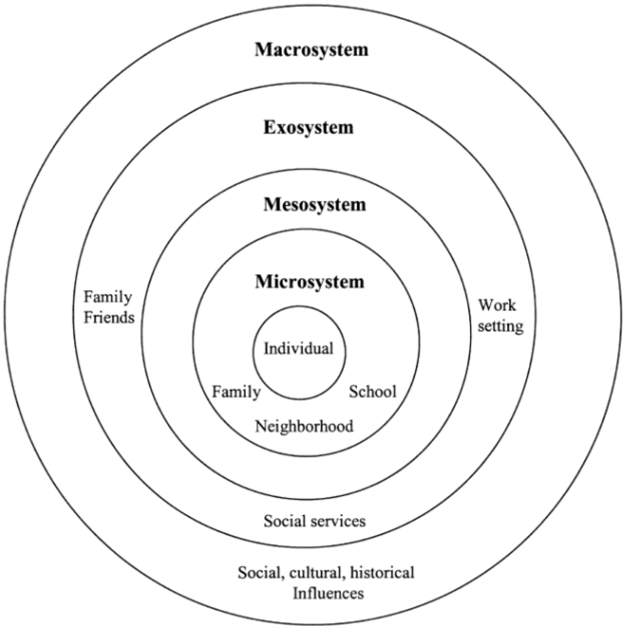
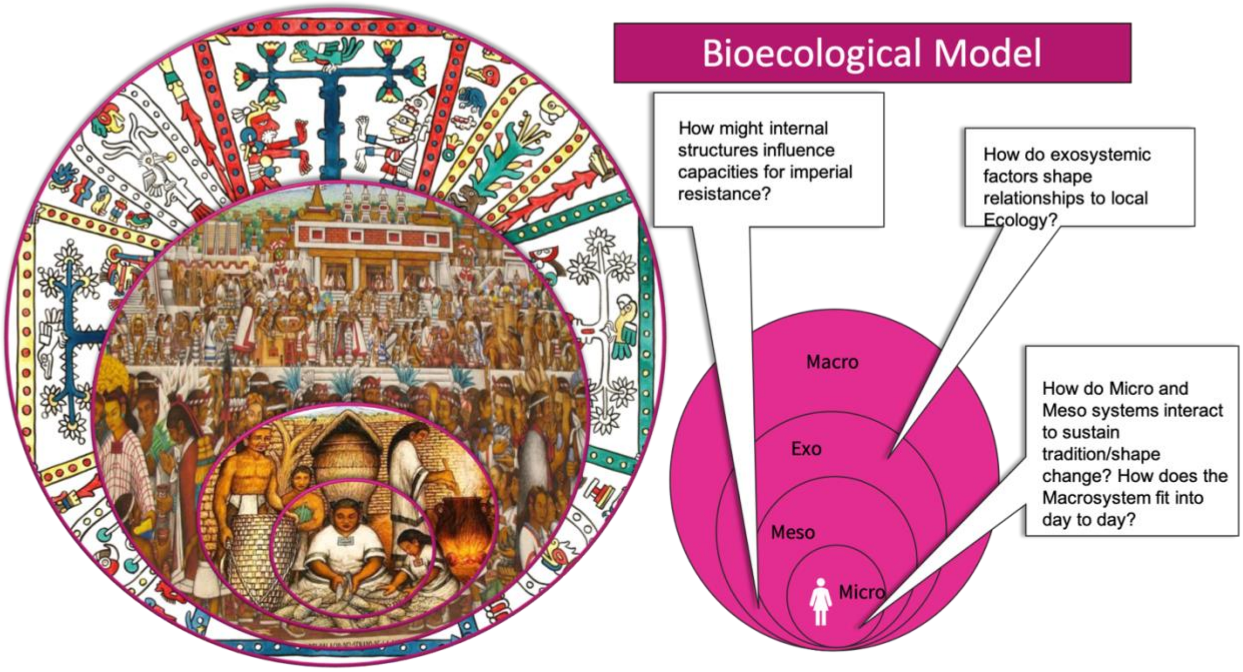


Figure 0.1: Social Ecological System Model, Bronfenbrenner 1979



How might internal structures influence capacities for imperial resistance?

How do exosystemic factors shape relationships to local Ecology?

How do Micro and Meso systems interact to sustain tradition/shape change? How does the Macrosystem fit into day to day?

Figure 0.2: The Bioecological Model

Developed as a theory for pedagogical development in educational psychology, there are many elements by which Bronfenbrenner connects interacting relationships of power like gears in a single machine of humanity. I draw from Bronfenbrenner's 1979 and 1988 versions of the ecological systems theory, based on the idea of nested systems:

1. **Microsystem**: individual level; how you, and whatever identities you occupy, relate to the social worlds directly around you, like your household, friends, and community members (1979, p. 22).
2. **Mesosystem:** the interplay of two or more spheres of interaction, like your interaction with household members vs. your interaction with household members when you are together at a community event (1979, p. 25).
3. **Exosystem:** external impacts on an individual (microsystem) — like warfare or economic blockades. These do not necessarily impact the individual directly, in that the individual may not be involved in hand-to-hand combat, but rather they are impacted by trickle-down effect in terms of decision possibilities (1979, p. 25).
4. **Macrosystem:** cultural and societal beliefs that impact how micro and mesosystems interact. These can be worldviews, ideas about gender, class, traditions, etc. Bronfenbrenner calls these the "blueprint" for how society should operate yet notes how individual identities interact with social environments can both limit and enable the blueprints to be enacted (1979, p.26).
5. **Chronosystem**: the idea that how the ways these various systems relate to one another may change over time. Time can be conceived at an individual level (for example, changes that happen at different stages of childhood development) or at a global level (changes in political structures, maintenance of traditions across time, adaptations to changes in climate). Together, these changes "alter the existing relationship between person and environment, thus creating a dynamic that may instigate developmental change" (1989, p 201)

The ecological systems theory established by Bronfenbrenner in 1979 was adapted and expanded by him until his death in 2005. As Rosa and Tudge (2013) outline, this model came to increasingly focus on the ways in which individual identities shaped capacities for development (the Person-Process-Context model, Bronfenbrenner 1989) and the importance in considering the historical era in which development occurs (Bronfenbrenner and Evans 2000). I propose a revisioning of this model through the lens of bioarchaeology, which I call the **Bioecological Model**. Relying heavily on the original model (1979) I also incorporate aspects of the chronosystem and focus on personhood present in the 1989 version of this model. Bronfenbrenner's work was shaped within a Western context, where each element refers to structures that would have looked quite different in the past. For example, for Bronfenbrenner, micro-systems are predominantly understood as households based on nuclear family structures (two parents and children). To adapt this model to Late Postclassic Mesoamerica, I will draw from literature documenting the ways Prehispanic Central Mexican society was organized (Codex Tlaxcala; Chavero 1979; Gibson 1967), encompassing spheres of influence as they would have existed within a Mesoamerican worldview.

While the original ecological systems theory shares many characteristics with the biosocial model (Agarwal and Glencross 2011), I argue that when applied to bioarchaeology, the **Bioecological Model** contributes an unparalleled and crucial concept of time and culture change that is visible in three key ways:

1) *Understanding the ways in which the ancient bioarchaeological worlds we study are inextricably linked to a history that, through events like conquest, colonialism, and globalization, are never completely decontextualized from the lives of the bioarchaeologists studying them.*

In the Puebla-Tlaxcala Valley, this allows my research to clarify why Tlaxcallan and Cholula's histories were written out of nationalist Mexican historical narratives, and why this moment of resistance— one which had an impact that shaped the course of New World colonialism - has yet to be studied.

2) *Deconstructing the false idea of static social systems, or "traditional" ways of being, to emphasize how societies are always in flux, adapting and changing to new contexts, like periods of imperial expansion*.

In studying individuals within a bioarchaeological framework, I am freezing Tlaxcallan and Cholula at different, yet very specific moments within the politics of the Postclassic. Yet, while these moments are a snapshot, this model helps to understand how a moment can contextualize what came before and after.

3) *Creating a postcolonial approach to understanding Mesoamerican society*.

By attributing value and significance to social and political change within the context of the past worlds and world views within which they occurred (rather than imposing Western understandings of "conquest," "tradition" or "resistance"). For example, "conquest" in the New World was forever redefined following European arrival, becoming associated with massacre, massive land displacement, and social restructuring. Yet imperialism and conquest are not fixed processes, but rather are defined anew with each chronological and regional context (Alcock et al. 2001). Thus, to understand the relationship of conquest/resistance in the Aztec Empire, it is necessary to look beyond official narratives, at how day-to-day life was impacted by this political moment.

Food as Bioecological Model Realized

In this dissertation, I explore how diets can become a tool for reconstructing social organization through patterns of access, consumption, and distribution. In addition, I argue that Bronfenbrenner's ecological systems theory provides a framework for drawing in additional evidence to contextualize diets as part of documenting and understanding lived experiences. The different levels of the model can be used in conjunction with different sources of evidence to understand how social structure impacted the life experiences of individuals in Late Postclassic Central Mexico, and how these experiences contributed to Cholula and Tlaxcallan's state-level relationships to imperial expansion.

Macrosystem: Beliefs about food are beliefs about you

Our realities are constructed worlds that train our brains to normalize certain acts and ways of being as the only valid option (Levi Strauss 1963). While a natural world exists independent of our cognitive distortions of it, our interactions with it are limited by boundaries that our minds and cultures create. Food lies at the intersection of biology and culture—something that we need to survive, but something to which humans have assigned meaning that goes above and beyond base survival (Fischler 1988; Goodman and Leatherman 1998). As Counihan (1999) argues, "Rules about food consumption are an important means through which human beings construct reality. They are an allegory of social concerns, a way in which people give order to the physical, social and symbolic world around them." (p. 113). Thus, while assigned meanings may be constructed and abstract, they shape what people eat, who is allowed to eat what, and when different foods are eaten. This, in turn, will lead to differential biological outcomes within communities, strongly shaped by these abstract beliefs made concrete through foodways.

In the context of imperial expansion and local resistance, how can foodways help to rebuild ideologies held by competing parties? Food gives insight into social structures and the symbology that holds them together. As a social being, food takes on meaning that can seem invisible to outsiders unfamiliar with a particular worldview. For example, Fischler (1988) uses the example of red meat and strength in European societies. As a physical, biological object, meat is the flesh of an animal. It can be consumed, yet through the act of consumption, it takes on meaning— in this particular case, it becomes equated with strength and virility. This meaning is not inherent in the meat and will not be understood in the same way by all cultures. But, exploring the history and context within which this meaning was created, and measuring the consumption and distribution of meat can help reconstruct its cultural significance.

Through interaction with objects imbued with symbology, structure is normalized through repeated actions that reinforce belief in a certain world structure (Douglas and Isherwood 1979). In this dissertation, the objects that I analyze are bodies—more specifically, the molecular ways that symbology becomes documented in bodies who repeatedly enact certain beliefs about the way the world is structured. For example, through broad patterns in dietary isotopes, combined with archaeological data on flora and fauna, I can explore what foods were normalized and used in everyday life. I can also compare this to foods documented in mural art or codices, which depict ritual contexts, to understand how daily diets related to foods that were imbued with special meaning. By looking at the population as a whole, I can also see how who eats what may map onto beliefs about social differences.

In the context of Late Postclassic Central Mexico, at its greatest level, worldview was structured by a shared "Mesoamerican" belief system about the way the world was innately structured. Cities were built to mimic this world view; festivals, planting rituals, feasts, all followed a calendar dictated by nature and the stars (Reilly III 2012). Even individual fates and social identities were determined at birth, based on the Mesoamerican calendar (Monaghan 1998). Thus, from the moment of birth, individuals were tied to others through a worldview and fate that transcended any specific cultural moment in Mesoamerica, mimicked across millennia, and outlasting the rise and fall of great civilizations.

Within this world view, crops like maize and amaranth permeated all aspects of life across Mesoamerica. Creation myths linked human origins to the birth of the first humans from maize stalks (Popol Vuh, Recinos 2010). A pantheon of maize-named gods protected all aspects of the planting season (Sahagun 2012). Maize was used as a form of money for exchange. It was capable of feeding tens of thousands with ease, and resistant to drought (Barros and Buenrostro 1997). As a staple crop, it provided nutrients (especially after the process of nixtamalization, which releases the niacin in corn), could be shaped into limitless forms (tortillas, tlacoyos, tamales, atole) and was easily storable and transportable. Crops that represented central resources of sustenance were also central to ritual events.

So, if everyone shared a common world view, how might it be possible to see differences? While core foods may be similar, the *way* they were eaten differed. Research comparing maize processing in Xochicalco, Copan, and Malpaso (Turkon 2007) suggests that across Mesoamerica, the labor involved in food preparation, the distribution of food preparation sites within the community, and the individuals involved in processing reflect social roles held within a society:

> "....despite, or perhaps because of, its mundane nature, the choice to consume labor intensive ground maize foods (when unground maize can also be consumed) and the form and manner in which they are consumed are directly related to economic and social roles of both the food preparers and the food consumers" (Turkon 2007 p. 154)

The way the ingredients are consumed are not necessarily the most efficient means of preparation, but rather serve as symbols of status. Similarly, Stuart (1990) argues that looking at the volume of the consumption of maize by household can highlight economic and status differences. When examined at a Mesoamerica-wide level, regional differences are visible even within shared ingredients. Through an intersection of household and local practices with regional systems, shared ideologies become adapted to local contexts. Thus, even with an ingredient that is widely used, meaning may vary, and can be visible in the *way* it is used, *who* is using it, and to *what ends*.

In the context of Tepeticpac, Fargher et al. (2010, 2017) draw from archaeological analyses of architecture and population distribution to argue for a unique social structure within this population. Despite coming from a Nahua cultural background shared across much of Central Mexico, construction efforts at Tlaxcallan imply the adoption of a novel social order that differed dramatically from the imperial hierarchies of the Aztec state. In particular, Fargher et al. argue that the Tlaxcalteca adoption of Tezcatlipoca (the god of war) was associated with an ideology of earned power through service. This system adapted hierarchies to allow newcomers (such as Otomí immigrants fleeing Aztec conquest) to integrate into society. Interestingly, Tezcatlipoca is also a god associated with the earth and maize cultivation (Barros and Buenrostro 1997). In short, Fargher et al.'s work has focused on architectural and material remains, arguing that a lack of high-quality building materials, a uniformity in residential structures, and the extensive use of publicly accessible plazas implies an egalitarian social structure. I explore this theory of egalitarianism through foodways.

In contrast to Tepeticpac's relatively short, 300-year occupation, Cholula's site history has a much greater time depth. However, a moment of population replacement is visible in changing material culture in the Epiclassic (~ AD 700) (McCafferty 1996). With the arrival of the Olmeca Xicalanca from the Gulf Coast, the archaeological record shows change to cultural systems and ideologies. As a site of ritual pilgrimage (McCafferty 2001), Cholula was always cosmopolitan, perhaps a trait that allowed it to outlast the rise and fall of many civilizations—yet what did this mean for the foodways and ideologies of its residents? Only 30 km from Tepeticpac, available regional resources likely varied little. Therefore, differences in foodways might signal the influence of differing political relationships, and the unique social structure of a ritual center.

At the level of Mesosystem, I compare and contrast the interpretations of Mesoamerican ideology and its relationship to foodways at Cholula and Tepeticpac. While the mesosystem might dictate certain core dietary trends (such as the importance of maize), the different political roles and distinct temporal contexts of these two sites shaped relationships of interaction spheres outside of the Puebla-Tlaxcala Valley, potentially shifting ideologies regarding social order and ritual. By looking at foodways at these two sites, I argue that social structures, and the way they are reinterpreted within each sites' unique history, will be visible in the distribution of different food goods at a population-level.

Exosystem: Food access and external systems of oppression

Bronfenbrenner defines the exosystem as a social system that does not directly interact with an individual, but rather impacts them through a ripple effect (1979 p. 8). In the context of the Puebla-Tlaxcala Valley, an example would be the warfare and economic blockades associated with Aztec imperial expansion. While there were certainly individuals participating directly in the policy and battles that shaped this political environment (Hassig 1945), the individuals analyzed for this dissertation do not show evidence for being either warriors or engaging directly in warfare. As residents of the urban centers of Cholula and Tepeticpac, these individuals instead would have felt the indirect effects of these events— decreased access to imported goods; changing local networks of exchange; increasing reliance on locally-grown ingredients, etc.

At this level, I engage with the idea of structural violence, an idea introduced by Galtung (1969) and expanded on more recently by Farmer (2004). Structural violence occurs indirectly, with no single perpetrator. Rather, it is created through social and economic structures that oppress, constraining agency and creating inequality that in turn fuels deeply biological effects. Lane et al. (2008) explore the structural violence that can occur through foodways in contemporary Syracuse, New York low-income neighborhoods. Their study shows how state-level economic policies limit healthy food options in low-income areas by creating "food deserts," or areas with no accessible super markets. An act which may at first appear benign is exacerbated by the community's already sparse resources, which limit capacities to travel to healthy food options. This in turn leads to the consumption of available processed foods, that impact population health—notably, through an increase in low birth weights. Thus, from birth, populations in this area become biologically disadvantaged, as low birth weight is associated with a host of lifelong health issues, such as asthma, hypertension, and high blood pressure. While no single person is to blame for this outcome, it creates a ripple effect, disempowering generations and exposing them to further exploitation.

Late Postclassic Central Mexico is a unique site for exploring this relationship of exosystem, as many researchers (Berdan 1992; De Lucia 2013; Hirth 2016; Minc 2009) have noted the ways in which political instability and constant restructuring of centralized powers led to the dominance of household-level systems of trade, production and subsistence. Thus, while structures such as the Aztec Empire might seek to portray their authority as absolute, the short temporality of its reign and the long history of independent economic networks leaves ample opportunity for agent-driven economies and structures operating outside of empire.

Bioarchaeologists researching structural violence have established several key patterns that signal the indirect impacts of warfare and social inequality yet focus primarily on signs of direct physical violence (de la Cova 2012; Serafin et al. 2014; Stone 2012). Tung et al.'s (2016) work in Peru stands out as an example of dietary violence, exploring the structural violence associated with the interaction of warfare during the decline of the Wari culture and the concurrent regional drought. Focusing on childhood diet (which also reflects mother's diet among breastfeeding children), Tung explores possible gender or age-based differences in health and diet during this period of stress. By focusing on children, who are rarely directly engaged in warfare, this study emphasizes how community stressors are disproportionately distributed among vulnerable members. While an entire community may face the effects of warfare, internal structures may redistribute the impacts, either consciously or subconsciously. Thus, it becomes a question of whose lives are more valued, and how this is reflected in the access, distribution and consumption of valuable foods. Tung focused on maize in the diet, finding that maize consumption declined across time (with increasing warfare and drought). While sex (girls vs. boys) did not correlate with access when they were children (Tung et al., 2014), subsequent research shows that in the post-Wari era, sex-based differences in diet emerge post-puberty, a finding that leads Tung (2019) to suggest that as gender norms were learned and enacted, there was bifurcation of diet between women and men. According to Tung, this signals one of the profound ways that diet and foodways were used to “make and mark identity.”

Similarly, in the Puebla-Tlaxcala Valley, imperial expansion correlated with widespread drought across Central Mexico (AD 1451-1454) (O’Hara and Metcalfe 1997). These droughts impacted the entire highland region but were particularly detrimental to the urban center of Tenochtitlan—a city that relied heavily on external crops to feed its populace. The dietary impacts to the Aztec state then radiated out, resulting in changing tributary policies, economic relationships, and a violent political and economic expansion into the Puebla-Tlaxcala Valley. By looking at population-level diets, I will analyze direct and indirect impacts of warfare as determined through variations in diet and access to different types of foods. Taking this analysis to the individual level (diets by age, sex, and burial area) will allow me to determine how sub-identities among Tlaxcaltecas and Cholultecas shaped food access at different points in time. While Tlaxcallan’s prowess for warfare and multiple triumphs over Aztec armies are well documented (Abasolo 2015; Isaac 1983; Hassig 1945), imperial policies aimed at resource constriction could have been designed to indirectly weaken the region. How the population responded to this constriction can also emphasize local structures of social inequality. Was the population as a whole protected from these external events? If not, whose diets were most impacted by this climate of warfare? Highly heterogeneous diets could imply independent protection at the household or individual level, whereas homogeneous diets could signal state-level structures of food distribution regardless of social identity.

Mesosystem: What you eat at a party

Sharing foods, restricting foods, or eating the same types of foods all help to affirm constructed realities about the way individuals relate themselves to one another, and to larger structures such as lineages, cities, ethnic groups, genders, and worldviews (Counihan 1999; Douglas 1997; Hastorf 2017). In constructing norms about who can eat what, when and how, food becomes more than a nutritional good, instead taking on additional value as a tool used to reinforce social bonds and identities (Twiss 2007; Hastorf 2017). Food sharing, foodways and traditions serve to reinforce common identities, and to teach community values. While food is a physical representation of social relationships, and mimics world views and understandings of social hierarchies, these structures are an idealized framework for how such power should flow and be distributed within the population. The Mesosystem, or the level of direct interaction between agents, highlights the way that day-to-day interactions—with family, neighbors, employers—reinforce decisions about foods through communication of values and traditions.

Structures, such as state authority can influence what foods are made available by shaping trade relationships, legality of particular goods, and norms shaping who is allowed to eat what (Tung 2012). At one level, states have enormous power to influence the health status of their citizens by shaping dietary possibilities within the constructed "world" of their domain. Yet these rules of operation are constantly confronted with social change—change that occurs with the passage of time, with ecological shifts like drought, or with confrontation between competing perspectives, particularly those of constituents. Dietler (2001) and Dietler and Hayden (2001) emphasize the contradictory role of food in maintaining hierarchies; state-sponsored events like feasts are fleeting and compete with the day-to-day sociality of mealtimes.

At the level of state, Dietler and Hayden discuss the coming together of multiple individuals (or microsystems) through "commensal consumption"—public displays of food sharing that reinforce fickle hierarchies. As Counihan (1999) argues, public displays of eating are much more voyeuristic than household foodways. Feasts thus tend to exemplify idealized, rather than realistic display of power/social relations. Dietler's (2001) "commensal politics" are used to describe a somewhat manipulative hospitality, wherein a false egalitarianism may be exemplified by food events that emphasize community and equality, and a way to "level the playing field" between individuals with varying access in the day-to-day. Yet, as Dietler argues, in most cases this is largely a symbolic action that does little to actually create equality, instead relying upon the image of equality to quell internal challenges to social hierarchies. At the same time, fleeting feasts play a recursive role with the day-to-day in that hierarchies introduced during feasting may be adopted and recreated at household levels, in attempts to live up to this idealized structure (Hastorf 2017).

Within the populations of Cholula and Tepeticpac, codices serve as records of "official" foodways, against which individual diets can be compared. For Tepeticpac, while architecture and ideology may reinforce the ideal of egalitarianism (Fargher et al. 2010), dietary isotope evidence, composed predominantly of daily meals, can show Mesosystem-level variations. Are there certain groups of people (as separated out by burial groups, for example) who share foodways that differ from "official" narratives? Could this idea of egalitarianism just be an internal political tactic used to unify against an external enemy? Was this ideal realized, in that all citizens had truly similar diets? Or was egalitarianism restricted to certain ritual events?

In other contexts, feasting is used to do the opposite, displaying food as a way to manifest and reinforce hierarchies of prestige by changing the symbolic value of certain foods—and people—by placing them in new contexts, serving them in a particular way, or by using foods that differ from day-to-day ingredients. Here, foodways can be used to exclude individuals, expose them as not understanding or not adhering to known taxonomies—of what food is ok to eat when, by whom, etc.—and thus placing them as outsiders. This can happen along age lines or other social distinctions such as gender, job, and ethnicity. As Twiss argues, "Societies often use culturally important foods and culinary patterns as metaphors of the self, and the use of a particular cuisine or food often marks the boundary between the collective self and other" (Twiss 2007 p. 3). For Cholula, a city with established hierarchies, and a population composed of locals and immigrants/pilgrims (Bullock Kreger 2010) dietary isotopes might expose outliers—those who either brought food traditions from afar or were negated participation in daily food practices because of an outsider status.

The mesosystem helps to think through the ways that daily interactions might be at odds or in tandem with state-level narratives. How Cholula and Tepeticpac navigated their relationship to imperial expansion was not only a decision made by political elites but was informed by internal cooperation or resistance. To understand these interactions, this dissertation explores patterns of similarity and difference within population-level diets (and individual, see below), comparing these patterns to official records of ancient foodways.

Microsystem: What you eat behind closed doors

The way that foodways are developed and maintained rely upon an interweaving of both personal practices and their relationship to customs at multiple levels; household, community, ethnic group, etc. (Hastorf and Johannessen 1993; Twiss 2007). While the mesosystem (individual interactions) may differ from the macrosystem (ideologies), microsystems (individuals) are yet another level at which contradiction may occur. By looking at diets at the individual level as potential microcosms of larger constructed realities, it is possible to see the ways that individual decisions vary or adhere to structural rules at both the community and state level.

Drawing from forensic methodologies, where life histories are built from detailed analysis of individual bodies, bioarchaeological "osteobiographies" narrate unique experiences of specific individuals (Castro et al. 2017; Mayes and Barber 2008; Stodder 2012). Through case-by-case analyses, bioarchaeology is able to fill in narrative gaps about the reality of lived experiences, and how they conform or differ to projected archetypes of social structure. In terms of diet, food is not only used to establish social networks and amass power, it is also used to define oneself, in the context of, but potentially at odds with a particular reality, history, and worldview. Eating is performative, as anyone who has brought the "wrong" type of lunch to elementary school can attest. It allows individuals to reinforce a desired identity or status, yet this identity may shift within different mesosystems (group contexts). Thus, analyses at the microsystem level allow for the exploration of a complex network of individual-specific interests and political strategies. By looking at the individual embodiments of individual lifeways, bioarchaeology subverts structural assumptions by seeking greater complexity: in what ways do individuals deviate from group patterns, and where do they adhere?

At Tepeticpac, individuals were excavated from two common burial areas. Burial positions and grave goods were largely homogeneous, with differences in the type and amount of grave goods differing only slightly. At Cholula, burials were found within household floors, and thus likely reflect kinship groups (López Alonso et al. 1976). Early mortuary theory argued that burial patterns were shaped by the social relationships the deceased had established during life, yet post processual critiques have drawn attention to the fact that burials often reflect *desired* social relationships expressed by those *enacting* the burial, rather than serving as direct expressions of the deceased's roles during life (Binford 1971; Bloch 1971; Saxe 1970). The mortuary context can therefore constitute a political arena, where, as Rakita et al. (2005) state, the living "negotiate, display, mask, or transform actual power or social relations" (p.7). Mortuary rituals can thus give us a view of the personal "ambitions of the bereaved" (Hutchinson and Aragon 2002), while also demonstrating how these might be constrained by broader social conventions. Analyses of mortuary landscapes are therefore the analysis of the intentions and strategies of the living through the placement and treatment of the dead (Ashmore and Gellar 2005; Goldstein 2002; Trinkhaus 1995). Burials thus reflect meso and macro-level ideas about identity and the relationship of the deceased to the community and worldview. By comparing these projected identities to the decisions and experiences of the individual recorded in their skeleton, bioarchaeological analyses of diet will highlight disjointed concepts—and coalescent aspects—of identity and belonging.

Beyond Structure and Agency

The binary of structure/agency limits the many diverse and changing roles of individuals within society in the past. Fluctuating day to day relationships are the foundation upon which larger structural social networks are built (Twiss 2007). Rather than a binary, varying sites of agency are deeply intertwined, constantly informing one another at multiple, simultaneous levels. While individuals may have the autonomy to decide what foodways to maintain, food choices are deeply conditioned by the worlds that surround us (Gumerman 1997). Macro, Exo, Meso and Micro-level learning is shaped at household, community and global cultural levels, which ingrain the rules of constructed social realities through daily repetition (Counihan 1999). Yet individual levels might also be the first sites where such roles are challenged, gaining momentum and a following to alter at a larger level.

Brumfiel (1992) argues that at any given time, social structure reflects the "…composite outcomes of negotiation between positioned social agents pursuing their goals under both ecological and social constraints" (p. 551). In the case of the Aztec expansion into the Puebla-Tlaxcala Valley, ideas about the Aztec imperial structure has dominated ethnohistorical Mexican narratives, emphasizing the empire's desire to economically cut off Tlaxcallan from trade routes, and to project an image of domination and supremacy. Within an exosystem context of constant warfare (both Early Postclassic Cholula and Late Postclassic Tepeticpac) and imperial expansion (at Tepeticpac), foodways at both Cholula and Tepeticpac would be experiencing some type of change, given shifting trade relationships, blockades and alliances. This model encapsulates how local responses to imperial expansion co-occurred at many simultaneous levels. Within Tlaxcalteca ethnohistoric accounts, political elites dominate narratives with the image of strong warriors and fierce patriotism (Torquemada 1995; Muñoz Camargo 1972; Muñoz Cargo and Acuña 2000). Yet how this played out in reality is something that is only visible by disentangling the diverse experiences that made up these structures. If state-level decisions about food acquisition and distribution were centered around a goal of shared identity and unity, but prevented individual agents from meeting their own needs (for example, if state-provided foods were not nutritionally rich, or diverse, or accessible to all), we might see a deviation from state-sanctioned foodways at the individual or household level. Such individual actions might then go on to influence state policies, shaping the effectiveness or ineffectiveness of food as a tool for constructing and reinforcing social order. To get at this contradictory and dynamic complexity in the past necessitates a research design that encompasses the multiple scales at which individuals participate in society. When paired with analyses of diet, the Bioecological Model provides the scaffolding to interpret individual, community and state foodways, as well as how they fit into the greater context of imperial expansion.

Chronosystem: Changing values of foods

The Chronosystem is a key and final part of Bronfenbrenner's model, emphasizing how each previous level of the model is constantly under flux and will lead to overarching structural changes with time. Foodways are an amalgam of traditions and identities, a community's history made comestible. Yet this history is never one single story, nor is it unilinear. Foodways, like culture, are ever-changing, an "eternal project" (Dietler 2007) drawing from the way things were to adapt to the way things are. Dietler argues that this change is always present, within the "often contradictory actions of individual human beings and social groups located differentially within complex relational fields of power and interest" (p. 225). In the context of this dissertation, the chronosystem helps to explain two important things: 1) *Imperial expansion and conquest*: The Terminal Late Postclassic was a moment of intense conflict, a time-specific context that may have heightened local emphases on difference in ideology and identity 2) *European Colonialism*: The Late Postclassic political dynamics of the Puebla-Tlaxcala Valley directly influenced the post-contact world, shaping the nature of Mexican patriotism and archaeology. The chronosystem links pre-contact worlds to the present, allowing for a reflection on the role of bioarchaeology in creating connections to contemporary politics in a way that is both relevant and necessary.

Imperial expansion and conquest

Particularly at moments of conquest and dramatic social change, differences in beliefs are brought to the forefront and used as political tactics. Foodways reflect the construction and interplay of various realities. When groups with different worldviews (or different interpretations of the same worldview) come in contact, there are disruptions and differences in the ways that they interact with the physical world around them. Inherent in the meanings assigned to objects are relationships of power, identity, and sovereignty to create one's own understanding of the world (Rogers 2005). Different meanings can challenge each other, overlap, destroy each other, come together to create new meanings, or any permutation of the above. And this can be happening in distinct ways for different members of the community. The binary of colonizer: colonized cannot encompass the interplay of competing goals and the multi-level structures that work to maintain individual and group identities in the face of change (Lightfoot 2005). It isn't a stark divide of domination vs. resistance, as relationships of power are not limited to just two groups, but rather are negotiated by all members of society at different scales that shift and are constantly reshaping at all times (Wernke 2013).

For example, Hastorf and Johansen (1993) have argued that in Peru, maize consumption by way of chicha production signaled changes in belief systems associated with Inka imperial expansion. Because of the production energy associated with chicha, it obtained a symbolic value as a drink associated with the gods—a symbol understood across Andean cultures. As the Inka expanded into surrounding territories, consumption of chicha was sometimes used to build alliances among imperial and local elites, visible through an increase in maize consumption as well as ceramics related to chicha production. While the symbolic importance of chicha was shared, imperial pressures altered patterns of local consumption. Relationships of similarity between individuals were emphasized through food, but only as a means of obtaining political outcomes related to a particular moment in time.

From the perspective of resistance, Ferguson's (1996) analyses of folk pottery in South Carolina plantations demonstrates how maintaining foodways that drew from African folk traditions was a daily defiance of imposed colonial ideology. By connecting to a time prior to slavery, the enslaved community used foodways to redefine themselves outside of plantation contexts. Food traditions, while geographically disjointed, were chronologically linked to an ideology of community and resilience.

The Aztec method of conquest and expansion was fairly indirect, maintaining their independent trade and market networks (Berdan et al. 1996; Nichols 1994; Smith and Heath Smith 1994). As Berdan (1992) argues, "local productive efforts, therefore, were not particularly upset by the act of conquest, although they were surely intensified" (p. 80). In this case, imperial influence on foodways was not about stripping populations of their resources, but rather about establishing ideological dominance. At Tepeticpac, Aztec policies gave an uncharacteristically direct blow by blocking trade routes. While chronology of the burials analyzed in this dissertation does not allow for a pre-and post-imperial expansion comparison, studies of imperial conquest throughout Central Mexico have shown what ideological resistance might look like. At Xaltocan, in the Basin of Mexico, a history of household crafting persisted throughout political shifts, interpreted as communal leadership at the micro-scale, despite macro-level changes, such as incorporation into the Aztec realm (De Lucia 2013).

By contextualizing the local history of the Puebla-Tlaxcala Valley through the chronosystem, the dietary data I analyze become a product of a particular moment, rather than a nebulous "Tlaxcalteca" or "Cholulteca" culture. Foodways are not static, and people are constantly adapting foodways to the needs and desires of new generations. However, at the same time, foodways are a central site of habitus, of repeated daily action that emphasizes the beliefs, values, and identities that remain relevant even within the rapidly changing political environment of imperial expansion.

European colonialism

While this dissertation focuses on Aztec conquest and expansion, this history is inextricably linked to the conquest of the New World, as the Spanish arrived and allied with Tlaxcala in 1519, altering the course of history in Mesoamerica. In archaeology, we often separate out this moment as “prehistory” or “precontact” and “postcontact” or “colonial”/ “historical” archaeology. Yet the site of Tlaxcala in particular emphasizes that one world did not replace the other, but rather, Spanish success was predominantly guided by Tlaxcala’s political relationship with the Aztec empire. Following this history even further, it leads to the formation of a Mexican state that disparaged Tlaxcala, erasing it from state-sanctioned versions of history. The very nature of this dissertation is predicated on a lack of archaeological, historical and ethnohistorical information about the Puebla-Tlaxcala Valley in the Late Postclassic. As critical analyses of state-controlled archaeology in Israel have shown, regulating what stories from the past come to light creates precedent for the social and political goals of the present (Hallotte and Joffe 2002). The anomaly of Tlaxcala’s resistance continues to be a thorn in the side of narratives that promote the idea of a unified and incontestable state sovereignty. Following this archaeological past to the present demonstrates how Tlaxcala has in many ways become a metaphor for indigenous survival and resilience—a threat to nationalistic narratives of progress and globalization.

European colonization is ongoing, a centuries old affirmation of the supremacy of the European race (Stam and Shohat 2012). Anthropology and archaeology are deeply steeped in the construction of colonial interpretations of history to further political goals of expansion (Leibmann 2008). For most U.S. trained academics, Westernized perspectives influence many of the assumptions we impose on the past, whether conscious or subconscious—how age or sex shape the capacity for certain roles or activities; the possible structures of human interaction; conceptions of social, economic and political "development" and "complexity."

To better contextualize my analyses of dietary data, I engage in ethnographic analogy, conducting oral history interviews with diverse members of the contemporary Tlaxcala community. In addition, interdisciplinary collaboration with archaeologists who explore materials and the landscape, both built and natural, I seek to understand how consumed diets relate to each step of planting, harvesting, preparing, distributing, selling, and sharing food.

Colonial narratives of the past create one-dimensional caricatures of indigenous voices and cultures, erasing the complexity and diversity that existed (Rogers 2005). In order to get at the multiplicity of experiences in the past, ethnographic analogy allows me to bring theoretical relationships of interconnection into a more familiar present, to understand how foodways currently relate to contemporary power relations. Food sovereignty is a battle that has been fought for millennia but is still very much a part of our own food decisions. Furthermore, by turning to informants that include direct descendants of Tlaxcallan's indigenous past, I seek to validate discredited indigenous communities as powerful and knowledgeable, reinserting them into colonial histories that discredited, dispossessed, and massacred these groups into invisibility (Liebman 2008). In my position as a Mexican-American, who has spent considerable time in

Mexico, I have learned firsthand how the indigenous pasts are tokenized while indigenous descendants are rejected from society. In Puerto Rico, Pagán Jiménez and Rodríguez Ramos (2008, p.24) reflect on a similar context, within which

> Las estructuras que actualmente regulan la praxis arqueológica en nuestra Isla continúan reproduciendo una versión extinta de nuestra historia indígena, la cual engrana perfectamente con la agenda de naturalizar la condición colonial en nuestro proceso identitario.
>
> *The structures that gave rise to and currently regulate archaeological praxis on our island have produced a version depicting our indigenous history as extinct, which fits perfectly with an agenda of naturalizing a colonial condition as part of our identity* (translation by K. Alcantara).

This is particularly true of Mexico's National Institute of History and Anthropology, where the Mexican national government has a monopoly over archaeology as a site of knowledge production, limiting the types of histories that have been allowed to be investigated and told.

Conclusion

What does food have to contribute to understanding imperial expansion and local resistance? As a good consumed by all on a daily basis, it has a unique capacity to reflect multi-scalar relationships and agentive acts, a capacity made visible through the Bioecological Model. When exploring counter-narratives within the Puebla-Tlaxcala Valley, as Gullapalli (2008) argues, "…archaeological evidence acts as a delimiter on the debatability of the past" (p.48). Data about what foods were consumed and by who are concrete and objective, measurable through isotopic values and plant microfossils. Yet, the meanings behind these patterns are not as clear or unidirectional. In fact, they mean multiple things in multiple contexts at multiple times. The past, much like the present, is a mess of competing stories that will never result in *an* answer or *a* history. But through this model, I seek to weave together a multitude of voices and actors, who existed and influenced the worlds in which they lived, giving voice to those who have fallen between the cracks of “official” versions of history.

3

ENVIRONMENT AND CULTURE HISTORY IN THE PUEBLA-TLAXCALA VALLEY

This chapter provides the reader with a description of the environmental context and culture history of the Puebla-Tlaxcala Valley, the region in which the sites of Tlaxcallan and Cholula sit. Taking a step back to explore the chrono, macro and exo-systemic contexts of life at Tepeticpac and Cholula, this chapter explores how economic, geographic, and deeply historical political taxonomies shaped the relationship between the Aztecs in the Basin of Mexico and the Tlaxcalteca and Choluteca of the Puebla-Tlaxcala Valley.

Introduction

Previous scholarship of the Aztec Empire has focused largely on imperial success attributed to military and political prowess. In agreement with several archaeological scholars, I argue that rather than being fully grounded in selective choice, the Aztec Empire's imperial agenda was also very much shaped by the landscape and longstanding political and economic relationships between different populations of the Puebla-Tlaxcala Valley and Basin of Mexico (Davies 1968; Fargher et al. 2010; García Cook 1981; Isaac 1983). Following the models put forth by these scholars, I suggest that environmental and historical data demonstrate that Tlaxcallan (and the larger Puebla-Tlaxcala Valley, **Fig. 3.1**) was not a final bastion of resistance facing impending incorporation, as the Aztecs suggest, but was, rather, one actor among many who were constantly challenging imperial power, leading to continually shifting power dynamics in the 16th century.

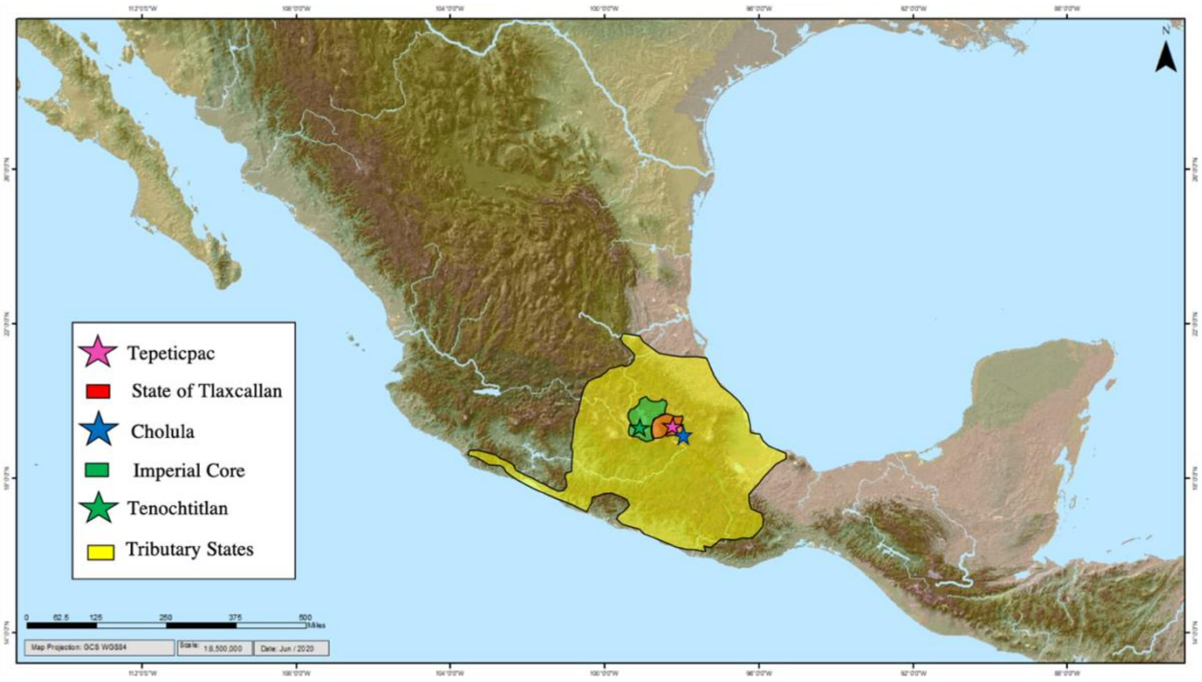


Figure 0.1: Location of Cholula and Tepeticpac within Aztec territories[1].

Throughout this chapter, I refer to agency theory as a way in which to highlight the impacts of individual actors in shaping the political and economic history of the region, as well as recognizing the ways in which both individual and group actors interacted with the environment of the area. While this chapter is centered at the level of site (macrosystems), rather than individuals, I argue that site and community-level decisions should be understood as driven by a confluence of diverse influences from individual agents. In studies of empire, an agency-centered approach refocuses attention on individual actors rather than an abstract idea of state or

---

[1] Base map by Gabriela Oré, imperial and state borders modeled after: http://www.aztec-history.com/aztec-empire.html

empire as the only influence, taking a bottom-up approach to explore a complex network of locally-specific interests and political strategies (Bourdieu 1977; Giddens 1984). Structural views, such as political economy, tend to ignore the fact that non elite individuals have influence, seeing them as victims who either passively submit to or ineffectually oppose imperial agendas (Pauketat 2000). An agent-focused approach allows researchers to challenge the idea of empire as a well-planned, decades-long strategic maneuver by leaders, or an act of social evolution. Instead, imperial growth or diminution can be reimagined as the result of changing social structures and political systems through time (chronosystem), shaped by the accumulation of various decisions made by multiple actors who were influenced by both local and global events. By considering the role of individuals, research can avoid falling into the abstraction criticized by Wolf (1997) in which "empire" becomes an entity in itself. Instead, an agency approach allows researchers to recognize that the empire is composed of individuals, each acting both independently and as a group to interact with and shape the world around them.

Agency theory also considers how biological limitations and local ecology shape individual responses to surrounding events. While environment would fall into the "exosystem" layer of the ecological system as defined by Bronfenbrenner, I argue that this Westernized, urban-centered framework fails to recognize a relationship to landscape that greatly influenced pre-industrial, pre-colonial indigenous relationships to land. Thus, I begin this chapter by looking at the environmental setting of the Puebla Tlaxcala Valley during the Postclassic period. Brumfiel (1992) argues that at any given time, social structure reflects the "…composite outcomes of negotiation between positioned social agents pursuing their goals under both ecological and social constraints" (p. 551). As this chapter will explore, the physical environment, most notably the topography dotted with sharp volcanic peaks, strongly contributed to patterns of settlement and expansion throughout the history of the region (**Fig. 3.2, Fig. 3.3**). Furthermore, the variation in ecological zones within close distances facilitated trade relationships from the earliest moments of state formation and also allowed exchange between multiple actors at individual, household, and larger institutional levels, providing actors with a unique point from which to interact and influence both global and local relationships. Finally, I argue that knowledge of the landscape, its flora and fauna, and their uses as resources was a key factor in population resilience and adaptation.

When considering structure and agency, history becomes of paramount importance for understanding the context in which political and economic relationships emerge, and how they impact and shape future generations. As Schreiber (2004) comments, "Colonies do not simply appear on an undifferentiated and uncomplicated cultural landscape, but rather are located among people and cultures with an ongoing, dynamic historic trajectory" (p. 245). A chronological approach can help to reveal how actions are strongly shaped by local contexts, such as preexisting political relationships of antagonism or support (Ortner 1989). In order to contextualize the Late Postclassic landscape within which the Aztec Empire expanded, I follow the environmental background with an overview of the cultural chronology of Cholula and Tlaxcallan and the Puebla-Tlaxcala Valley starting from its earliest point of large-scale agricultural settlement. Within this history, I will return to the themes of political and economic antecedents as points at which the imperial narrative of unilineal evolution and dominance is weakened by a history punctuated with shifting alliances and points of temporary consolidation followed by diffusion of multiple small, autonomous polities.

As is the case with many documentary sources, it is difficult to assess past challenges in power in a balanced manner when the historical records are largely written from the Aztec perspective. I argue that studying resource acquisition, distribution, and consumption can reveal local agency in shaping the negotiation and implementation (or hindrance) of imperial policies and practices. Studies of practice and agency have challenged the tenets of political economy by emphasizing the ways in which political and economic structures emerge from recursive relationships between *all* individuals of society, not just elites or state institutions (such as the Aztec Empire). One way to consider the intersection of individual and global influences is through the study of economy. In Late Postclassic Central Mexico, marketplaces and local exchange were loci of social and political interactions. Postclassic economic networks were a combination of global networks of exchange, imperial systems of exchange and tribute, and local household-level networks that predated and existed outside of imperial channels. Thus, although Aztec accounts emphasize imperial control through tribute and the strategic incorporation of key trade and market centers, household economies and individual actors also continued to influence the market, and the political relationships sustained through the market, by their relationships of exchange. As ongoing research into peripheral Aztec-period communities continues, it is clear that many exchange systems were maintained independently of the state and were often the primary local source of economic interaction (Hodge and Smith 1994). Importantly, I argue that the strength of these household and extra-imperial economic relationships is closely tied to a history of constantly shifting centers of power, in which a certain measure of household economic independence was more reliable than complete economic affiliation with large scale, yet fickle, states and empires.

The independent nature of household economy can be further seen in the political organization and practices of imperial expansion in the Late Postclassic. While the imperial Aztec state may have dominated the political landscape, Hassig (1945) argues it did so by loosely incorporating surrounding regions through “hegemonic expansion,” allowing them to remain largely autonomous. A hegemonic approach allowed the empire to spread quickly, and by leaving preexisting social and political structures in place, reduced the administrative burden put upon the empire. This tactic of expansion further took advantage of the political history of the area, which had emerged following several periods of decentralization to become a patchwork of independent polities whose political and economic networks operated largely independently of a central state (De Lucia 2013).

This more holistic negotiation between individuals and local sociopolitical and environmental structures is critical in challenging the dominant Aztec narrative of conquest and control. If only the dominant view is considered (for example, the goals of the empire), these fleeting negotiations and individual differences are obscured, leading archaeologists to make overarching assumptions about authority and social relationships, while failing to credit individual guiding actions that create larger structures (such as gendered access to goods or division of labor). Although elite and state actions might have more influence or visibility, many small-scale actions can also amass behind the scenes to transform outcomes. By considering the varied goals and factors influencing actors and broader systems, researchers can reveal differing and competing aims that cause structures to shift, helping to explain how seemingly static categories, such as state, are not stable but negotiated (Brumfiel 1992). By looking at geography, economic and political predecessors in the Puebla Tlaxcala Valley, this chapter uses the case study of Tlaxcallan and Cholula to demonstrate how factors such as environment, ecology, resources, and cultural and political histories must be considered in understanding the spread of empire. Political processes and decisions are not made solely by elites, but rather are shaped by local actions which are both unintentional and directly subversive acts. While the study of empire has historically taken a top-down approach to analyze the seemingly preeminent power and ingenuity of conquerors, archaeological investigations demonstrate that it is critical to also investigate the means by which local actors at all levels of society in turn shaped these expansion processes.

Natural Environment and Exosystemic Factors of Influence

The topography of Central Mexico is divided by the Eastern and Western ranges of the Sierra Madre volcanic peaks (**Fig. 3.2, 3.3**). Between the two ranges lies the Prehispanic Basin of Mexico, characterized by a large lake (which has since been drained in modern times), upon which the Aztecs established their island city of Tenochtitlan (**Fig. 3.2**). Approximately 120 km to the west of the Sierra Madre range, crossing over the Iztaccihuatl and Popocatepetl volcanoes, the Puebla-Tlaxcala Valley closely mimics the ecology of the Basin of Mexico, but without the large body of water. The Puebla-Tlaxcala Valley sits at an average height of 2160 m.a.s.l. (Flores Marquez et al. 2006) and is surrounded by the Trans-Mexican Volcanic Belt (Nixon et al. 1978). The mountainous topography of the region plays an important factor in many unique characteristics of Central Mexican social and political development. As Evans (2004) argues, the dramatic division of the landscape limited the development of widespread regions of centralized power throughout history. At the same time, the sharp changes in altitude created myriad unique ecological and cultural zones within short distances, leading to the early and longstanding practice of household craft specialization and trade. Sanders (1956) termed this area the "Central Mexican Symbiotic Region," dividing it into "*tierra caliente*" (below 1000 m.a.s.l., producing fruit, cotton, cacao and other tropical plants), "*tierra templada*" (1000-2000 m.a.s.l., with little to no frost, producing maize, maguey) and "*tierra fría*" (2000-2800 m.a.s.l., highly wooded area) (Hirth 2016).

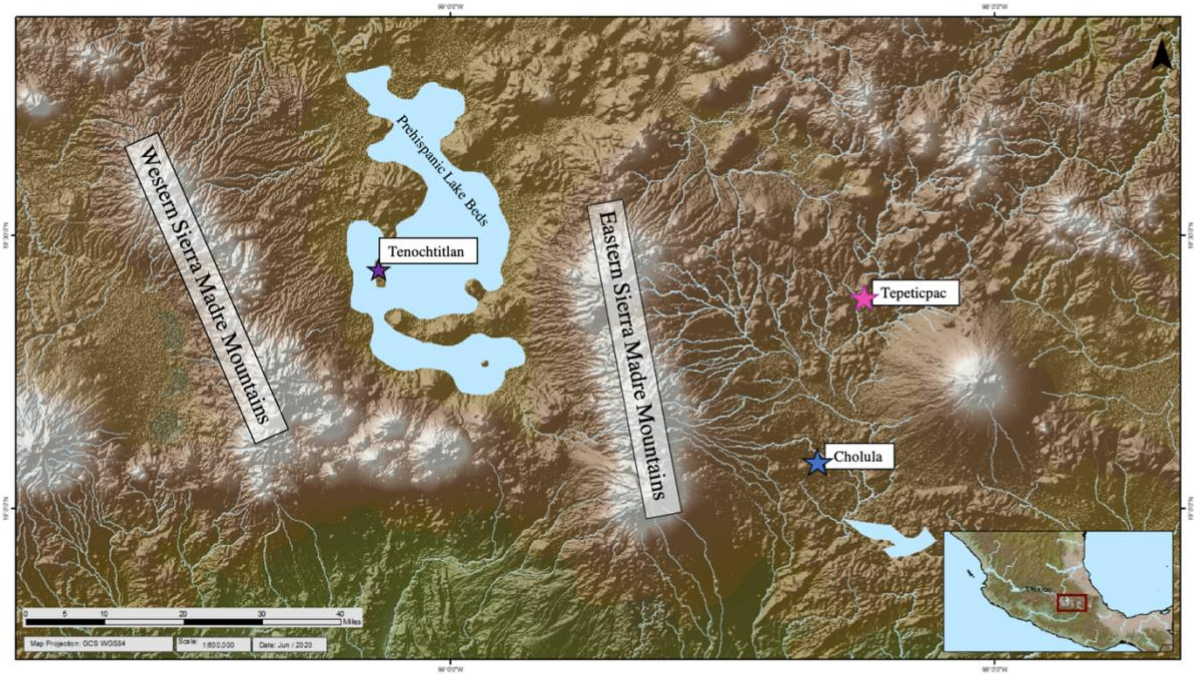


Figure 0.2: Topography of the Central Mexican Highlands, base map by Gabriela Oré

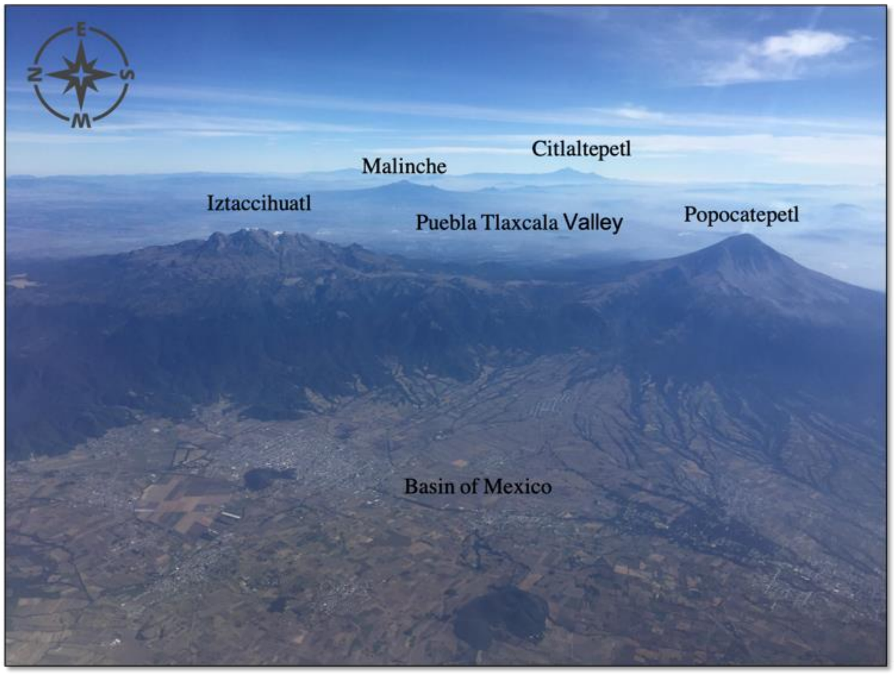


Figure 0.3: Volcanic landscape separating Basin of Mexico and Puebla-Tlaxcala Valley.[2]

---

[2] Photo K. Alcantara

The majority of the Puebla Tlaxcala Valley falls within the "*tierra templada*" category and experiences a rainy season May-October with approximately 500-1000 mm of rainfall per year. In winter months, the region can experience several months of drought from December through March (Altieri and Trujillo 1987). Temperatures range from as low as 0 degrees Celsius in January to as high as 27 degrees Celsius in April and May. While the peaks of the surrounding volcanoes can reach glacial temperatures and accumulate snow in winter months, the swampy flatlands of the central Valley, although more temperate, are still prone to frost, a factor which determines the timing of planting corn. The volcanoes also provide glacial and rain water that feeds into the main rivers of the Valley (the Atoyac and Zahuapan rivers) (**Fig. 3.4**). Soils are largely sandy and prone to erosion, which led to the Prehispanic practice of building terraces secured with maguey cactuses, a method that continues today.

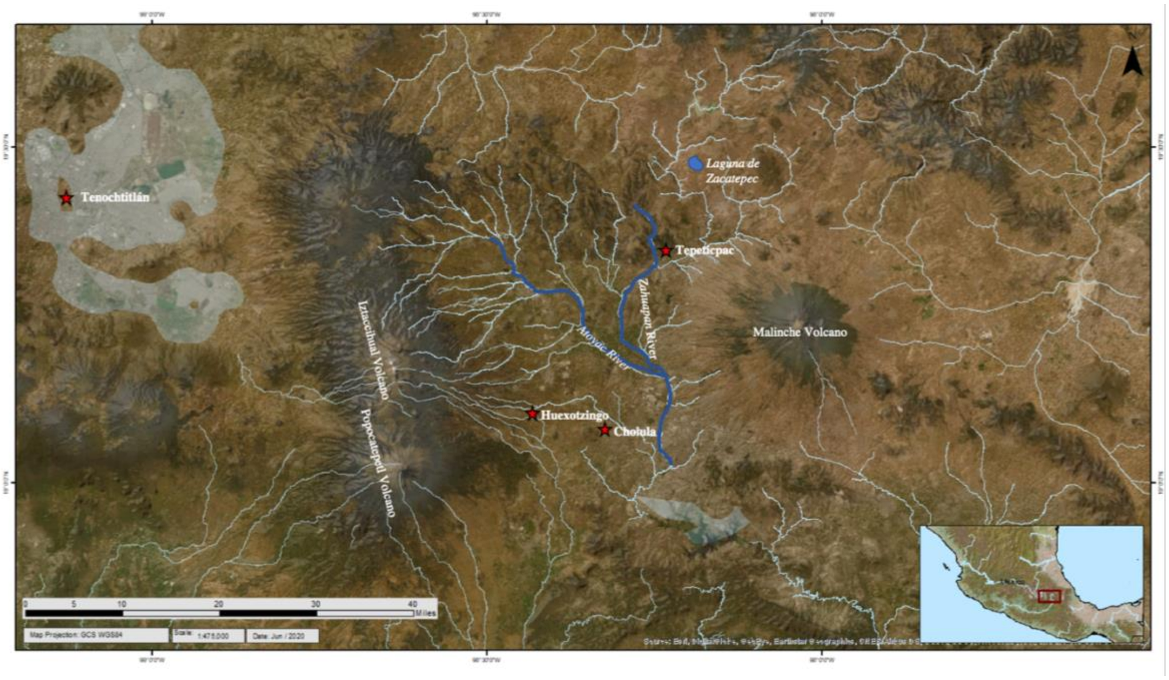


Figure 0.4: Volcanoes and waterways of the Puebla-Tlaxcala Valley[3]*.*

---

[3] Base map by Gabriela Oré.

The volcanic peaks of the Malinche to the East and Iztaccihuatl and Popocatepetl to the West are key figures both on the landscape and in the history of these areas; they are incorporated into local religion and lore as anthropomorphized mythical beings, often referred to in architecture and art. Carballo and Pluckhahn (2007) explore how the difficulty of crossing the volcanic peaks that divide the two Valleys from each other has constricted human movement towards certain transportation "corridors," that, in turn, has shaped the strategic placement of sites throughout history (**Fig. 3.5**). The site of Tlaxcallan, although dating to the Late Postclassic (AD 1200-1519), sits directly in a well-established corridor dating to the Early Formative (1200-800 BC) that connects the northern basin of Mexico with the Gulf Coast (Carballo and Pluckhahn 2007). Its position would also have impeded a central route for the Aztec trade during the imperially-imposed blockade, potentially forcing the Aztecs to sacrifice their own economic mobility for the political goal of weakening the Tlaxcaltecans. As Hassig (1945) discusses, the volcanic peaks would also have limited Aztec ability to efficiently and quickly deploy troops to the Puebla-Tlaxcala Valley, allowing Tlaxcallan to remained unchallenged until the Aztecs had sufficiently consolidated power and allies in all surrounding areas. Thus, its geographic location is closely tied to economic benefits (serving as a central node in trade routes), and political strategy (nearness to allies in the Puebla-Tlaxcala valley, while simultaneously occupying a defensible location on the hilltops that bound the valley). While limiting and shaping movement with their high peaks, and isolating the Basin of Mexico from the Puebla-Tlaxcala Valley, these volcanoes have also played a central role in shaping key political evolution throughout history in the Puebla Tlaxcala Valley by forcing human movement with eruptions and, by proxy, restructuring key political relationships (Plunket and Uruñuela 2008).

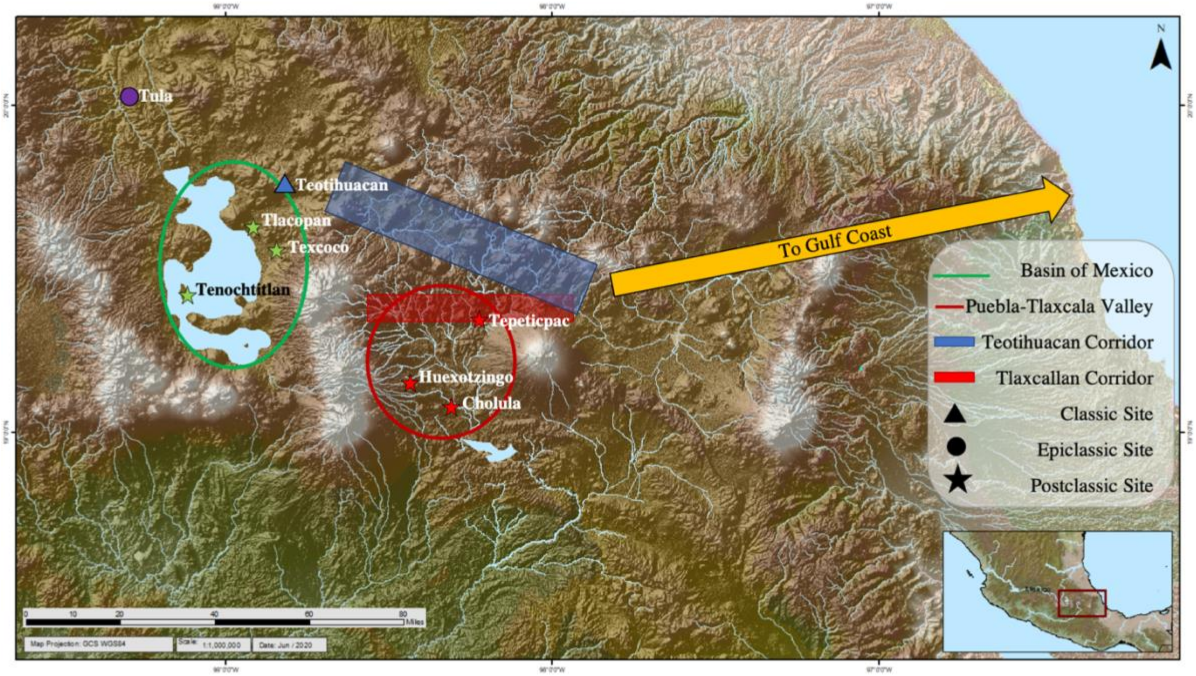


Figure 0.5: Relationship of the Basin of Mexico and the Puebla-Tlaxcala Valley[4].

As discussed earlier, the diverse and easily accessible ecological zones of the Central Mexican topography facilitated trade relationships whereby diverse goods, including foods, could be exchanged. To identify what foods might indicate trade, it is necessary to first establish the local resources of the region. In the Puebla-Tlaxcala Valley, the Zahuapan river runs north to south through Tlaxcala, converging with the Atoyac river in the southern Valley near Cholula (**Fig. 3.4**). While Lesure et. al (2006) explored the potential of the Zacatepec Lagoon (approx. 20km north of Tlaxcallan) as a source of lacustrine resources, they found little evidence that the lagoon would have contributed significantly to Tlaxcaltecan diets. Smith (2012) mentions that while the land, both in the Basin of Mexico and the Puebla-Tlaxcala Valley, was adequate for small-scale farming, intensive farming would result in degradation of the environment, a fact which perhaps led to the pervasive nature of household craft specialization and reliance on trade

---

[4] Base map by Gabriela Oré. Possible trade routes and corridors adapted from Carballo and Pluckhahn 2007

throughout the histories of these areas. Furthermore, in the Postclassic, high population sizes and dense occupation of the Basin of Mexico and the Puebla-Tlaxcala Valley led to overhunting (Hodge and Smith 1994), with animal protein being rare and consisting of small amounts of deer, and increased consumption of small mammals such as rabbit, dog, duck and turkey. While some sources suggest that the rarity of meat would have meant that elites were preferentially consuming this resource, perhaps leading to commoner malnutrition (Cook and Borah 1979), it is unclear if such pronounced social differences existed among the Tlaxcaltecans. The consumption of insects, such as maguey worms, grasshoppers, and ants is a traditional dietary practice that continues today and would have provided significant amounts of protein (Ramos Elorduy 1996), yet is understudied archaeologically, as such resources would leave no trace. In addition to animal and insect proteins, the diet included staples such as beans, maize, squash, chile, tomatoes, amaranth, nopal, chia and wild herbs (Smith 2012).

During the imperial blockade at the end of the Postclassic (AD 1465), the Aztecs report limiting access to luxury goods such as salt, cotton, quetzal feathers, gold and precious stones (Berdan and Anawalt 1997). This was not a complete blockade of non-local resources, rather, its aim was to impact elite access to goods associated with social capital. In fact, many of the items that were restricted had local homologues, such as *tequesquite* (a salt harvested from local swamplands) (Flores Hernández and Martínez Jerónimo 2016), and maguey fibers (Ibarra and López Corral 2017). However, while such goods may not have directly impacted the survival of local populations, the limitation of elite social capital can have ripple effects throughout all levels of society, particularly where the economic system may depend on this capital to obtain costlier goods that would then be redistributed within the population as a whole (Appadurai 1988; Polyani 2001). Thus, the question of the impact of an imperial blockade must consider not only whether basic resources necessary to survival were available, but also how limiting luxury goods may have impacted trade relationships, not only of elites, but of commoner households who relied on elite networks for global relationships of exchange.

Prehispanic Chronology: Contextualizing Chronosystemic Shifts

In this section, I focus on the major settlements of Prehispanic history in Central Mexico. While the focus will be on the Puebla-Tlaxcala Valley, I will frequently refer to the Basin of Mexico as well, as the Valley's development has been inextricably linked to the Basin's since the formation of the earliest states. The Prehispanic history of the Puebla-Tlaxcala Valley is separated into four distinct time periods: The Formative/Preclassic (2000 BC-AD 250), the Classic (AD 250-800), the Epiclassic (AD 800- 1200) the Postclassic (AD 1200-1519) (**Fig. 3.6**). This division in period is based on large-scale changes in population size, changing areas of population concentration, and the rise of key centralized states. As Smith (2012) points out, it is important to consider cultural continuity across time. No single culture appeared independently; as societies rose to power, their successes and traditions were shaped by political models of predecessors and were often legitimized by drawing on mythical connections to previous powers of the region.

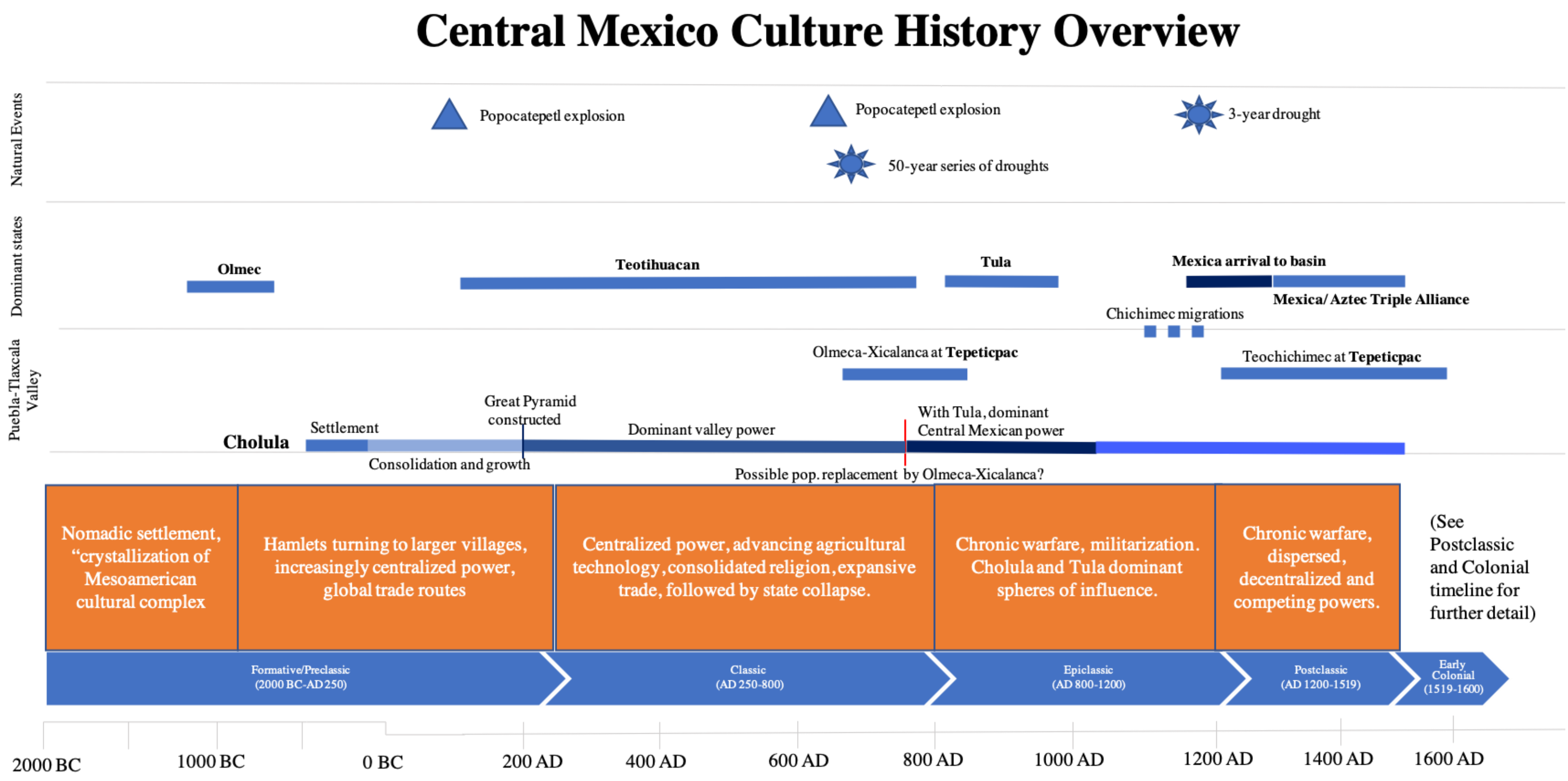


Figure 0.6: Summary of Culture History in Central Mexico, from Formative to Postclassic.

My approach to cultural history departs from a political evolutionary view, instead acknowledging how many players influence outcomes in a cumulative manner. The trajectory of state formation and collapse is influenced by decisions that are often unintentional, unpredictable, and much less neatly structural than can be accounted for in political evolutionary models. Social structures and political systems change through time, shaped by the accumulation of decisions made by the founding population and their descendants who were influenced by both local and global events. Focusing on economic systems in Late Postclassic Central Mexico helps facilitate the identification of actors at various levels, as well as points at which agents' decisions are both individual and global. Hirth (1996) argues that such an approach must be multi-scalar, exploring how household, local, and regional economies influence each other and interact with larger economic networks, such as imperial market systems. In Mesoamerica, a region marked by rapidly and frequently shifting political relationships, economic networks stand as a type of relationship that both predates and outlasts political instability, seemingly operating independently of the centralization of power. As Stein (2005) and many of the authors in his edited volume attest, purely structural approaches to empire erase interactions that reveal the convoluted and indirect path to empire formation. Structural views obscure overlapping categories and areas where the colonizers and the colonized may experience relationships of cooperation, tolerance, or ambiguity. In addition, the solidity of structure relies upon the assumption that these categories are static through time, rather than constantly negotiated. The following chronological summaries of each period will thus emphasize both political and economic relationships in each period as a way of identifying the various actors and their influences on shaping the Late Postclassic political and economic context.

Formative and Preclassic (2000 BC- AD 250)

The Puebla Tlaxcala Valley has long been a melding place of multiple ethnic groups. In the Preclassic, nomadic groups began to centralize into multiple small villages dispersed along the landscape. With settlement came the ability to accumulate and store resources and by 1500 BC, civic-ceremonial architecture, ball courts, and elite residences speak to the emergence of social inequality (Evans 2004). Importantly, in this period, we see a "crystallization of the Mesoamerican cultural complex" (Evans 2004, p. 99), in which certain models for social and political organization, as well as ideology, are formed and continue in various iterations throughout the remainder of Mesoamerican history.

During this period, the Olmec of the Gulf Coast dominate the political and economic landscape, strongly influencing trade and ideology from 1200-800 BC. Olmec trade first linked the Gulf Coast to the Central Highlands, establishing an early trade route that likely passed through the area surrounding Cholula. However, the first occupation of Cholula was likely not until much later, in the Middle Preclassic (BC 500-200). Cholula began as a small lakeside hamlet, slowly growing in size and with the earliest construction of the Great Pyramid dating to AD 200 (Bullock Kreger 2010). Plunket and Uruñuela (2000) argue that the explosion of the Popocatepetl volcano at the end of Preclassic (AD 100) may have forced smaller settlements near the volcanoes to move, possibly concentrating at Cholula and driving its growth from hamlet to city-center, made powerful by its ability to shelter widespread refugees from starvation and disease in the wake of the eruption. Its position along a key route that linked the Gulf Coast and Southern Oaxaca Valley to the Central Highlands would have further supported economic stability, allowing the site to remain occupied throughout the remaining periods discussed in this chapter.

In Tlaxcala, the Olmeca-Xicalanca (descendants of the earlier Olmec) constructed the site of Tepeticpac, Tlaxcala, a settlement with a large walled fortress that hints at the chronic nature of conflict in the area. This formative site would later be abandoned by approximately 764-882 AD (López Corral and Santacruz Cano 2020) and re-occupied in the Late Postclassic by the Tlaxcalteca, who took advantage of its hilltop location and defensible walls.

In both the Basin of Mexico and the Puebla-Tlaxcala Valley, the end of the Preclassic is characterized by hamlets turning into larger villages and the start of concentrations of power and emerging states. While in the Puebla-Tlaxcala Valley these villages remained largely widespread (with a small concentration at Cholula), the metropolis of Teotihuacan began to take shape and draw populations to the northern Basin of Mexico, population movement that was also catalyzed by the Terminal Formative explosion of the Popocatepetl volcano.

Thus, in brief, the Formative and Preclassic was a time of increasing sedentism and the beginnings of centralized power. The Olmec influence from the Gulf Coast established trade routes that linked populations from the coast to the central valleys of Mexico and facilitated the spread of ideas and goods, leading to "Mesoamerican" patterns of social organization, religion, art, and architecture. The majority of archaeological work focusing on this period has emphasized the impact of volcanic events in driving population movement and concentration (Plunket and Uruñuela 2000, 2005, 2008; Uruñuela and Plunket 2002) and exploring how the landscape shaped population settlement patterns (Lesure et al. 2006). Carballo et al. also note that with a move towards more centralized power at the end of the Formative, even populations that remained rural were linked to global trade routes at the household level, accumulating sumptuary goods that were used to display wealth and authority and recreating urban social categories in rural settings (Carballo et al. 2014).

Classic (AD 250-800)

The Classic is characterized by a period of centralization of power, advancement of agricultural technology, consolidation of religion, and expansive trade and commerce (García Cook 2014). In the northern Basin of Mexico, the notable state of Teotihuacan gained notoriety in approximately 100 BC, attracting over 100,000 people to this "City of the Gods." The extent of its control can be seen in expansive monumental architecture and architectural styles mimicked as far south as the Maya area, management of large-scale agriculture and grain silos that allowed food storage and protection from times of drought, and the emergence of a pantheon of gods adopted throughout Central Mexico (Evans 2004). Hassig (1945) refers to Teotihuacan as the "main outline of Mesoamerican Civilization" (p. 5), as many aspects of its social, political, and economic organization, as well as architectural and art styles and religious iconography, continued to be adopted throughout later Mesoamerican history and were often used as a way to establish political legitimacy through ties to this powerful ancestor. While small-scale exchange networks existed between the dispersed cities of the Preclassic, Smith (2012) characterizes Teotihuacan as the earliest empire, sparking well-established state-level trade relationships throughout Mesoamerica. As a result of these relationships, more well defined and permanent trade routes appear, including the "Teotihuacan Corridor" (**Fig. 3.5**), which closely follows the same trade corridor adopted by the Tlaxcaltecans several centuries later.

In the Puebla-Tlaxcala Valley, Cholula remained the dominant city at this time, though interpretations of the extent of its power vary between Hassig's (1945) depiction of it as an "impoverished version of Teotihuacan" and Plunket and Uruñuela's (2005) description of Cholula as a "thriving metropolis." Cholula's relationship to Teotihuacan remains unclear—while neither an enemy nor a subject of the dominant state, Cholula remained largely autonomous, yet some Teotihuacano architecture and ceramic styles are found there, suggesting cultural ties. Unfortunately, archaeological research that could clarify the nature of Classic-period Cholula is impeded by modern urban sprawl, limiting interpretations to the area immediately surrounding the Great Pyramid of Cholula. However, McCafferty (1996) documents that the Great Pyramid was subject to three construction phases at this time, suggesting a period of political growth. It is possible that Cholula's distant location from the Basin of Mexico, as well as its crucial role as a trade center connecting the Central Valleys to the Gulf, allowed it a uniquely independent position outside this increasingly centralized state.

The city of Teotihuacan was rapidly abandoned and burned to the ground in approximately AD 800, under circumstances that are poorly understood. Possible causes for the city's collapse include severe droughts from AD 700-750 and another volcanic eruption at the beginning of the 8th century (Plunket and Uruñuela 2008). While the causes of this collapse are unclear, it resulted in yet another period of wide-scale dispersal and resettlement; this time new territory was required for a massive urban population, likely contributing to the increased competition and warfare of small-scale communities in the Epiclassic. Cholula's connection to Teotihuacan is reinforced by evidence of an abandonment of the Great Pyramid at the time of Teotihuacan's collapse, and while the city itself was not abandoned, it too experienced a period of population dispersal and decreasing centralized power (McCafferty 1996). The Classic was a period of both flourishing cities and massive rapid collapse. While the centralization of power brought about by Teotihuacan led to population increase, social complexity, and well-established trade routes, its collapse again reinforced the Central Mexican pattern of household independence in order to adapt to the capricious nature of centralized states.

Epiclassic (AD 700-900) and Early Postclassic (AD 900-1150)

Amidst a period of chronic warfare and militarization in both the Basin of Mexico and the Puebla-Tlaxcala Valley, the city of Tula emerged, centralizing power for a short period of time from its position north of the Basin of Mexico (**Fig. 3.5**). Tula's role in the history of city states of this area is unclear. While it is portrayed in mythology as a city of gods, archaeological evidence suggests that it had a fairly small core yet took advantage of Teotihuacan-era social networks to incorporate many hinterland communities that had previously been a part of the massive city. Architecture and material remains also demonstrate a re-use of many militaristic and religious symbols from Teotihuacan, suggesting that the city drew heavily on preexisting ideological, social, political, and economic structures to facilitate its growth and validate its legitimacy (Healan 2012). While the creative use of a preexisting political model allowed the city to quickly gain power, the reign of Tula was short-lived, with the city falling into collapse in the mid-12th century.

At the time of Tula's reign, Cholula experienced a period in which no monumental architecture was built, indicating little political influence to mobilize labor (Plunket and Uruñuela 2006). Parsons (1968) refers to Cholula and Tula as the "two spheres of influence" at this time, with Cholula again serving as the main connection to the Gulf Coast and replacing Teotihuacan as the primary exporter of goods. However, even though it was no longer growing as a political center, its continued importance as a religious center is well-established (Rojas 1985). Following the collapse of Teotihuacan and the decline of power at Cholula, the Puebla-Tlaxcala Valley experienced an influx of immigrants. Most notable are the Olmeca-Xicalanca from the Gulf Coast, who settled at the center of Cacaxtla, just 33km north of Cholula, challenging Cholula's economic dominance in the Valley. Again, a lack of archaeological evidence makes the interpretation of Cholula's history difficult and has led to a debate about whether the Olmeca-Xicalanca ultimately replaced the population of Cholula (leading to new construction at the site in AD 800), or whether the Cholula regained power at this time, ousting the Olmeca-Xicalanca from the Valley (McCafferty and McCafferty 2000). One theory is that the Cholula allied with the Toltec to defeat the Olmeca-Xicalanca (Evans 2004). Regardless of their path to renewed dominance, as Tula began to wane at the end of the Epiclassic, Cholula was rising once again as a key power and economic center in the Valley.

Middle (AD 1100-1300) and Late Postclassic (AD 1300-1519)

While Tula provided a brief respite from endemic warfare through a centralization of power, following its collapse, both the Basin of Mexico and the Puebla-Tlaxcala Valley again returned to dispersed settlements with several small centers of power, a population increase, and near constant warfare over resources and land. Into this melee migrated the Chichimecs, a nomadic group sharing a common Nahua language, culture, and origin in "Aztlan," a mythical, unconfirmed site to the north of Central Mexico (Smith 1984). The various ethnic tribes from this Chichimec group arrived at the Basin of Mexico in waves, splitting into several different groups, two of which would become the Mexica (or Aztecs) and the Teochichimecs (or Tlaxcalteca). The Mexica arrived with the first wave of migrations in approximately AD 1200, with the Teochichimecs arriving to the Basin slightly later in AD 1250 (Smith 2012). Upon their arrival in the Basin of Mexico, the groups found a densely occupied space with territory tightly controlled by multiple small-scale cities. This section traces the parallel histories of the Aztecs and the Tlaxcalteca. First, I will give a detailed account of how the Aztecs arrived in the valley and what factors influenced their expansion. Next, I will detail the trajectory of the Tlaxcalteca, then explore the circumstances surrounding the increasingly belligerent nature of the Terminal Postclassic relationship between the Tlaxcalteca and the Aztecs (see **Fig. 3.7** for detailed chronology of the relationships between the Tlaxcalteca and the Aztecs).

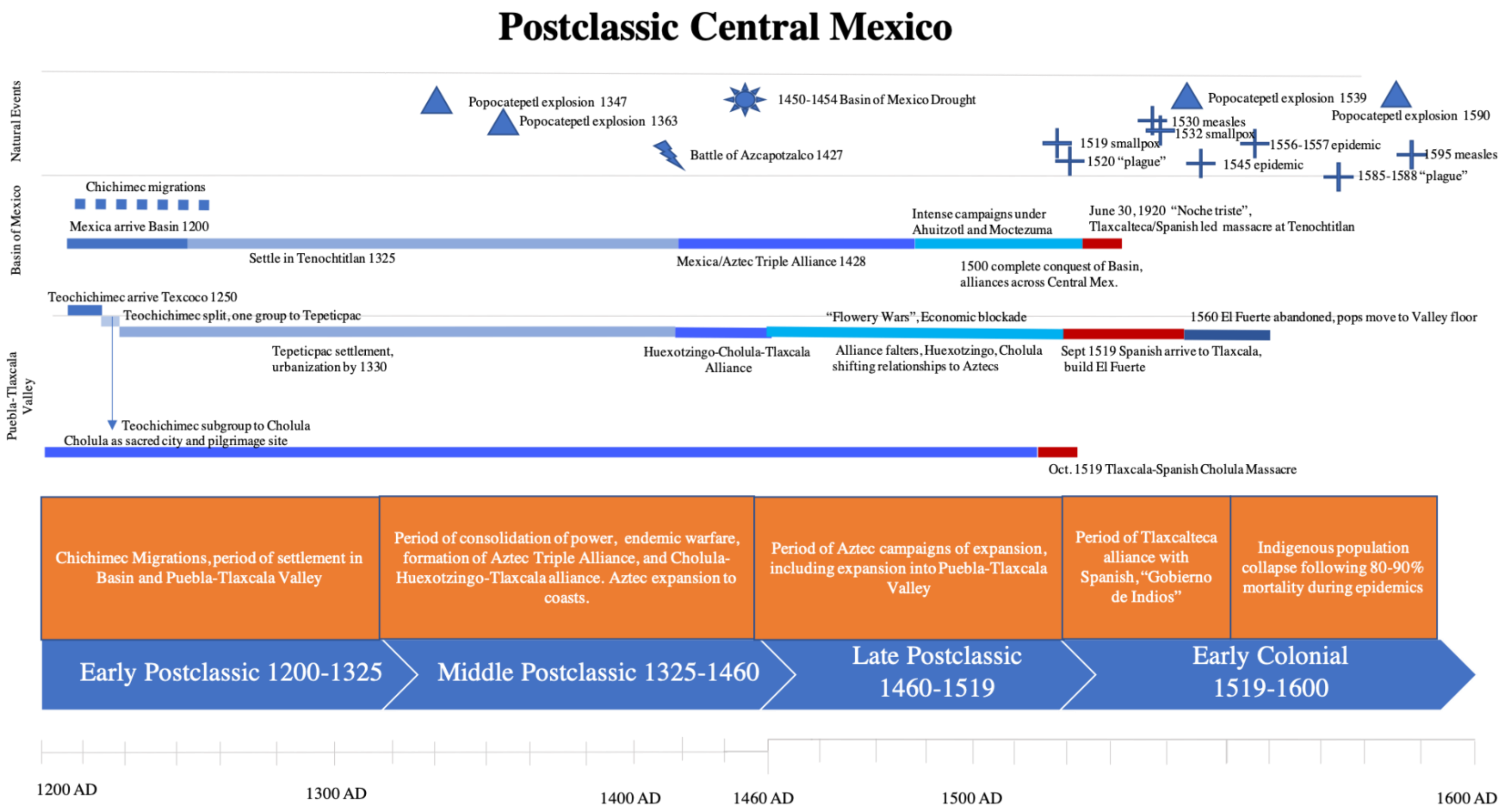


Figure 0.7: Postclassic Relationships of Tlaxcala, Cholula and the Aztec Triple Alliance

In the Basin of Mexico, the Mexica fought battles and formed alliances for nearly 125 years in an attempt to establish territory in a densely populated and highly defended area. The tribes would ultimately settle on an island in the middle of Lake Texcoco in AD 1325—terrain considered undesirable by all other groups in the area. For nearly a century, the Mexica served as allies and warriors for hire for surrounding polities, building social and political networks and taking advantage of shifting power dynamics to slowly grow in strength (Evans 2005).

On a similar timeline, the Tlaxcalteca arrived at the Basin of Mexico in AD 1250 and were granted a small area of land within the realm of the King of Texcoco, in the northeast part of the basin. Like the Aztecs, they experienced a similar difficulty in gaining territory, splitting into three groups to find new land. In approximately AD 1280, one group continued through the volcanic passes east to the Puebla-Tlaxcala Valley. As the original Teochichimec group divided, some individuals joined the populations of the cities of Cholula and Huexotzingo (López Corral, Fargher and Santacruz Cano 2016). At this time, the Puebla-Tlaxcala Valley was much less populated, dominated by the ethnic groups of the Otomies and Olmeca-Xicalanca. Gibson (1967) states that the Tlaxcaltecas gained a powerful role in the valley early on:

> They were said to have greatly enriched the Tlaxcala area, bringing the first maize and religious idols, and the first knowledge of adobe and stone construction. These Nahuatl speaking Tlaxcalans mixed to a certain extent with the Otomies, but in general they occupied a dominant central position, at whose edge the Otomí peoples then served as soldiers and as buffer guards (p. 2).

Settling in a strategic position upon Tepeticpac, the hill-top Formative-period site with pre-existing fortified walls established along a well-traveled route of trade, Tlaxcaltecans quickly established a foothold in this new territory. From Tepeticpac, the group led by a single monarch began to split into neighboring altepemeh, or towns, which spread across the landscape into the surrounding hills. Each altepetl was united under a tecalli, or “noble house,” of which the most visible were Tepeticpac, Ocotelulco, Tizatlán and Quiyahuiztlan. Tepeticpac served as the elite core, while Tizatlán was a military center, and Ocotelulco the economic center. The state of Tlaxcallan, as it became known, was thus a confederacy of altepemeh, whose rotating leaders served as a political council for state-level decisions. This political structure had origins in the Chichimec migrations, although it was not immediately adopted in Tlaxcallan (Torquemada 1995). It is argued that, in part, this political structure allowed the Tlaxcalteca to become renowned for their military prowess and trade relations, which extended to both coasts (Gibson 1967; Hassig 1945).

During this time Cholula holds an unclear role in the valley, at times serving as a Tlaxcalteca ally, at others appearing as an autonomous religious center and, during peak Aztec expansion, allying with the empire. While the Great Pyramid was never reoccupied, smaller religious centers characterize the city and the territory of the pyramid housed commoner residences. Lind (2008) characterizes Cholula as a sacred city and pilgrimage site, with a republic-like political structure of elected rulers. Interestingly, he also reports that priests were the predominant managers of external relations and politics and that the city was largely financed through offerings given from pilgrims. In addition to being a religious center, Cholula also managed a major market and continued to serve as a key trade post connecting to the Gulf Coast and south to the Oaxaca Valley and Maya area (Carballo and Pluckhahn 2007).

Terminal Late Postclassic

The last century before the arrival of the Spanish is both the period of most expansive imperial reach and the most tumultuous shifting alliances in the Puebla-Tlaxcala Valley. By 1428, the Mexica had established their legitimacy as a central power in the Basin of Mexico, solidifying their dominant role by forming a triple alliance with the Basin kingdoms of Texcoco and Tlacopan. This alliance, largely headed by the Mexica and centralized in their capital of Tenochtitlan, is what would be known as “The Aztec Empire.” Concurrently, a similar “triple alliance” formed in the Puebla-Tlaxcala Valley, made up of Tlaxcallan, Cholula and Huexotzingo (Abasolo 1996).

The mid-1400s became a period of Aztec conquest, with the dual aim of expanding the reach of the empire through alliances, expanded trade, and tributaries, while also consolidating power in the Basin of Mexico. Importantly, at points in its expansion, the great cities of the Puebla-Tlaxcala Valley also served as allies of the empire, notably in one of the most significant battles for territory that led to the defeat of one of the Aztecs' final competitors in the Basin of Mexico (the Battle of Azcapotzalco, AD 1427).

Despite imperial consolidation of power and expansion, the volatile and wavering alliances of the early Postclassic were far from extinct, as can be seen from imperial records of battles fought, in which participants often bounce from one side to the other. Following the death of the Aztec King, Tizoc (AD 1481-1486), who was particularly unsuccessful at expanding the empire, the succeeding kings Ahuitzotl (AD 1486-1502) and Motecuhzoma II (1502-1520) increased the frequency and intensity of campaigns of conquest. Hassig (1945) points out that while imperial campaigns at this time thoroughly blanketed Central Mexico from coast to coast, little military power focused on the Puebla-Tlaxcala Valley. Rather than launching large-scale military campaigns, the Aztecs invested in “Flowery Wars” with the populations of the Puebla-Tlaxcala Valley—low-intensity skirmishes determined by religious and astrological events, whose aims were to train warriors and capture sacrificial victims. As Hassig argues, this low-scale yet chronic warfare was intended to weaken and drain the powers in the Puebla-Tlaxcala

Valley (implying that they were indeed a threat), while not sacrificing significant military resources to an area that was hard to access and had few secure Aztec allies.

By the beginning of the 14th century, the Aztec Empire had completely conquered all populations in the Basin of Mexico and had established a consistent network of allies and tributaries across both coasts and in much of the Puebla-Tlaxcala Valley. The Valley "triple alliance" began to falter, with both Huexotzingo and Cholula allying with the Aztecs at different points in time. As Gibson (1964) narrates, "Nevertheless, the long struggle waged by Moctezuma and his predecessors against Tlaxcala reduced the province from a position of opulence and flourishing trade to a state of comparative poverty and constant military preparedness" (p. 15). Yet, as Hassig (1945) highlights, Tlaxcallan was not the only population impacted by a political climate of constant warfare. Many Aztec political decisions were a matter of weighing costs and benefits. While expansion increased the number of allies available, it also forced many populations to flee and ally with Tlaxcala (such as the Otomí), where they became a part of a protective militarized perimeter, shielding the Tlaxcaltecan core from imperial attacks and potentially contributing to Tlaxcaltecan social capital and access to additional trade relationships (**Fig. 3.8**). Additionally, the Aztec decision to create an economic blockade around Tlaxcala would also have eliminated a significant trade route that fed into the northern Basin of Mexico. While a secondary arm of the trade route connecting Central Mexico to the Gulf Coast ran through Cholula (possibly explaining why they appear to be more closely allied with the Aztecs at this time), the loss of one central route would still be felt economically.

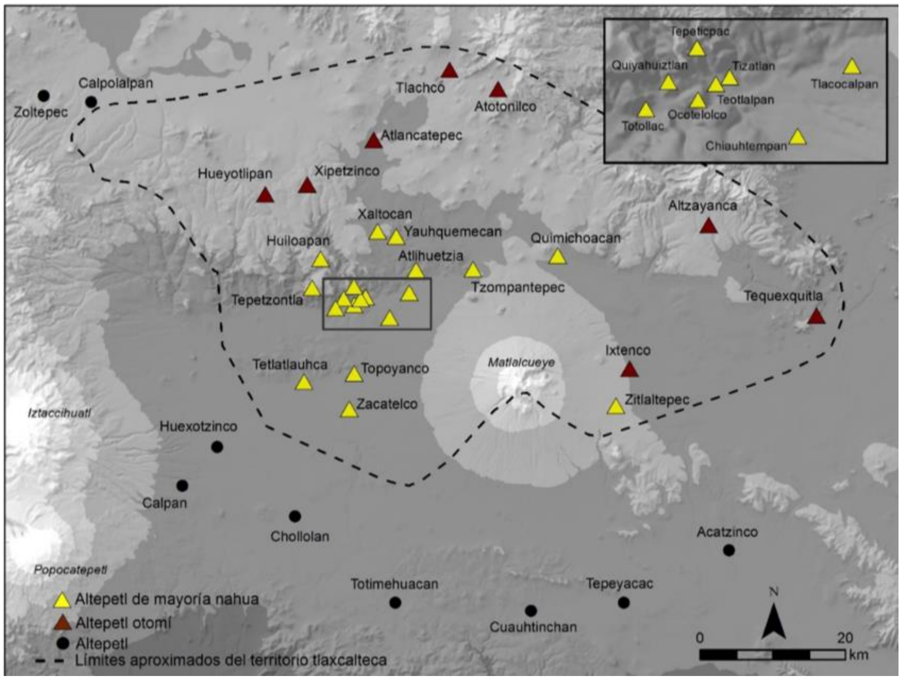


Figure 0.8: Late Postclassic limits of Tlaxcalteca territory[5]*.*

Conclusion

The remaining two decades before the arrival of the Spanish were characterized by imperial attention turned toward conquering the remaining territory of the Puebla Tlaxcala Valley. While Aztec accounts portray this endeavor as an imminent imperial success, an examination of the political and economic history of the area shows that the consolidation and stability of the empire was much more questionable than imperial sources imply. A history of dispersed, autonomous settlements meant that the "incorporation" of surrounding tributaries and allies was subject to constant volatility as polities reached for a certain measure of sovereignty, particularly in the economic realm. Furthermore, a recent drought and celestial event in the final

---

[5] *Note Otomí periphery. Inset shows "urban core" of Tlaxcallan, including Tepeticpac. Map courtesy of Proyecto Arqueológico Tepeticpac, INAH Tlaxcala.*

50 years before the Spanish conquest had challenged the empire's ability to keep a foothold in polities that were widely spread and inaccessible. Finally, in turning towards the remote territory of Tlaxcallan and investing in a series of "flowery wars" and economic blockades, the empire sacrificed significant energy that would have kept their core area from rebellion.

Ultimately, I argue that the culture history of Central Mexico demonstrates the difficulty of centralizing and uniting power across such an obstreperous landscape, while also emphasizing the importance of local agency in navigating the landscape through unique economic and political relationships. In the context of imperial expansion and local capacities for resistance, this chapter serves to highlight chrono, macro and exo-systemic patterns of change from the Formative to the Late Postclassic period—patterns which serve as templates for decision-making within Late Postclassic Tlaxcala and Cholula communities. Exploring this chronology through the lens of the Bioecological Model, the following **Ch. 5 and 7** use food ways to examine individual decision making at Cholula and Tepeticpac.

4

MATERIALS AND METHODS OVERVIEW

This chapter outlines the paleodietary methods used to establish dietary patterns from the Late Postclassic site of Tepeticpac, Tlaxcala and the neighboring site of Cholula, Puebla, which serves to contextualize diets in the Puebla-Tlaxcala Valley prior to Aztec expansion (AD 900-1200). In addition, I incorporate ethnographic analogy from ethnographic interviews conducted in contemporary Tlaxcala City, Tlaxcala to situate documented paleodiet ingredients within traditional recipes and social uses adapted to the sociopolitical contexts of contemporary grassroots food sovereignty movements.

Introduction and Research Design

This chapter begins with an overview of excavation methods, which establishes the context within which data were collected. It continues by detailing the bioarchaeological and paleodiet analyses that allow for a multi-level analysis of social interaction. By examining correlates of consumed foods (dietary isotopes and plant microfossils), I link patterns of resource access, consumption and distribution to sociopolitical and economic responses to imperial expansion. Using the Bioecological Model as a framework for my research design, the following methods are designed to identify correlates of Prehispanic foodways as they coexist on multiple, and at times conflicting levels of sociopolitical interaction.

Macrosystem: As physical manifestations of social structures and world views, I compare foodways at Cholula and Tepeticpac, two Mesoamerican sites from a similar ecological region within the Puebla-Tlaxcala Valley, to understand how foodways at each show unique temporal and cultural adaptations to political change.

Exosystem: By looking at within-group and between-group dietary differences, I explore how diet can reflect state-level policies, as well as the individual adherence or departure from group patterns. Additionally, given the chronological differences between Cholula and Tepeticpac, this analysis allows for the comparison of population-level responses during two distinct political moments.

Mesosystem: By establishing a demographic profile and using skeletal and burial characteristics to assign individuals to subcategories (age, sex, burial group, nonlocal status) I explore how individual and sub-populational group patterns (e.g. age group, skeletal sex) differ from "official" narratives recorded in codices, and the patterns seen in the populations as a whole.

Microsystem: The demographic profile further allows for the in-depth analysis of individual life histories, and how unique individual positionalities might influence the ways one adheres to or departs from state-level decisions and is influenced by external exo-level political events.

Chronosystem: I approach the category of chronosystem at three distinct levels: 1) *Individual life history*, through the comparison of diachronic dietary changes from dietary enamel (childhood) and bone (years preceding death) 2) *Postclassic Central Mexican history*, through the comparison of two temporally distinct sites (Cholula and Tepeticpac) which coexist within the same ecological region and Mesoamerican world view 3) Comparative analysis of relationships to landscape *in the Postclassic and the present*, through the incorporation of ethnographic interviews with contemporary small scale farmers and chefs in Tlaxcala.

Bioarchaeology Sample Populations

The analyses in this study are based on 58 individuals from Tepeticpac and 100 individuals from Cholula. Of the burials from Tepeticpac, 42 were complete primary and secondary burials while an MNI of 16 individuals represented amongst additional commingled remains. Samples from Cholula were exported under Oficio #401.3S.16-2017/794, and samples from Tepeticpac were exported under Oficio #401.3S.16-2017/975. Tepeticpac individuals date to the Late Postclassic (1400-1519 AD), dates confirmed by both material remains and radiocarbon results. Cholula individuals selected are from the Cholulteca III period, recorded in excavation notes as pertaining to the Late Postclassic (AD 1325-1500) (Lopez Alonso et al. 1976). However, as will be discussed in the results section, radiocarbon results from four individuals place these burials far prior to Mexica arrival, dating them to the Early Postclassic (AD 869-1253), the period following the collapse of Teotihuacan, and rise and fall of Tula. At Tepeticpac, samples were limited to individuals exposed during the 2015 field season, and do not include the total burial area. Samples from Cholula were limited by the extent of the 1967-1970 excavations, as well as sample preservation and accessibility (some individuals were incomplete in storage, as they were being used for museum displays). An additional 17 bone samples and four dental samples from archaeological fauna were exported from Tepeticpac under Oficio #401.3S.16-2019/160, in order to reconstruct a broader food web at this site. Faunal samples were unavailable for Cholula.

Table 0.1: Summary of samples analyzed[6]

		Tepeticpac	Cholula	Tlaxcala City	Mexico City	**Total**
Fauna	$\delta^{15}N_{coll}$	11	—	—	—	11
	$\delta^{13}C_{coll}$	11	—	—	—	11
Flora	$\delta^{15}N_{coll}$	—	—	30	15	45
	$\delta^{13}C_{coll}$	—	—	30	15	45
Burials	Dental Calculus	20	—	—	—	20
	$\delta^{14}C_{coll}$	6	6	—	—	12
	$\delta^{15}N_{coll}$	59	20	—	—	79
	$\delta^{13}C_{coll}$	59	20	—	—	79
	$\delta^{13}C_{carb}$	51	19	—	—	70
	$\delta^{18}O_{carb}$	51	19	—	—	70
	$\delta^{13}C_{ap}$	76	42	—	—	118
	$\delta^{18}O_{ap}$	76	42	—	—	118

---

[6] Sample totals include only results that were not impacted by diagenesis.

Tepeticpac: Archaeological Excavation

Excavations of burials at Tepeticpac were part of the fourth field season of the Proyecto Arqueológico Tepeticpac (2015), directed by Aurelio López Corral and Ramón Santacruz Cano, and supported in part by the Tlaxcallan Archaeology Project (NSF # 1450630), directed by Richard Blanton, Lane Fargher, John Millhauser, Verenice Heredia Espinoza. Detailed goals and methods of the excavation can be found in the archaeology reports (López Corral and Santacruz Cano 2015, 2016, 2017), but broadly center on identifying social structure through site occupation patterns and architecture.

The following is a summary of archaeological methods followed by the Tlaxcallan Archaeological Project and Proyecto Arqueológico Tepeticpac. Areas of excavation were divided into 2x2 meter units, with excavation proceeding through natural layers. Arbitrary layers were set at .05, .10, .20 and .40 m when natural layers were unclear. UTM coordinates were set for each unit, and altitudes were taken for each layer using a total station. Recovered burials were mapped, photographed, bagged, and given a unique code that included: Operation, Unit (2x2 m), Layer (cultural layer), Level (depth), Element number (grouping of burials), Burial Number (individual), Excavator and Date. Burials were excavating using dental picks, bamboo picks, and soft brushes. They were first pedestalled to allow for a clear photo and map of the burial position, then each skeletal element was removed and wrapped in aluminum foil for safe transportation to the laboratory.

Despite widespread excavation of residential terraces and occupational areas by the Proyecto Arqueológico Tepeticpac and Tlaxcallan Archaeological Project, burials were only found in central plazas (**Fig. 4.1**). The first were recovered as part of Operation 3, the restoration of the South Perimeter Wall on Terrace 14 (López Corral and Santacruz Cano 2015) (**Fig. 4.2**).

In this instance, the collapse of the wall revealed burials at the edge of the plaza. Excavations extended to 7 units, removing 13 primary and 3 secondary burials from direct impact of the restoration. It is likely that the plaza contains additional burials, as skeletal elements were visible, protruding from the walls of the units.

Operation 13 was designed to test the hypothesis that burials were only found in central plazas. This excavation consisted of 3 units at the SE corner of Plaza 3, removing 19 primary and 13 secondary burials. This plaza was the site of modern agricultural use; thus, the central area of the plaza was heavily damaged by a plow zone—damage that could be seen through commingling and damage of remains at the edge of unit N22E82 (**Fig. 4.3**). Additionally, one month into excavation and recovery, this area was subject to looting, which displaced and commingled 3 known complete burials (Burials 11, 12, 13) and damaged the edges of the site (Elements 14,15,16).

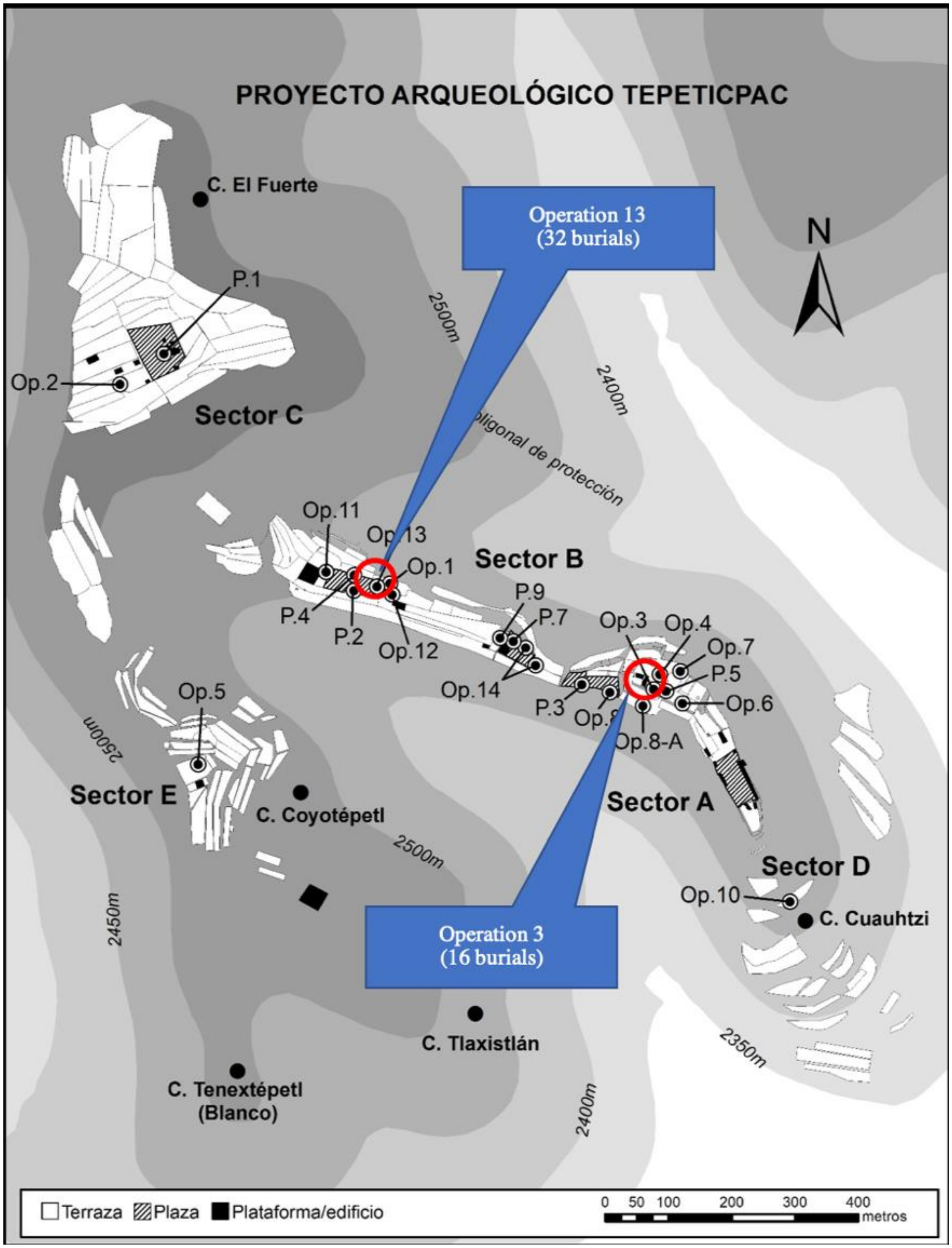


Figure 0.1: 2015 Burial excavation sites denoted by red circles[7]*..*

---

[7] Map courtesy of Proyecto Arqueológico Tepeticpac, INAH Tlaxcala. Annotations by K. Alcantara

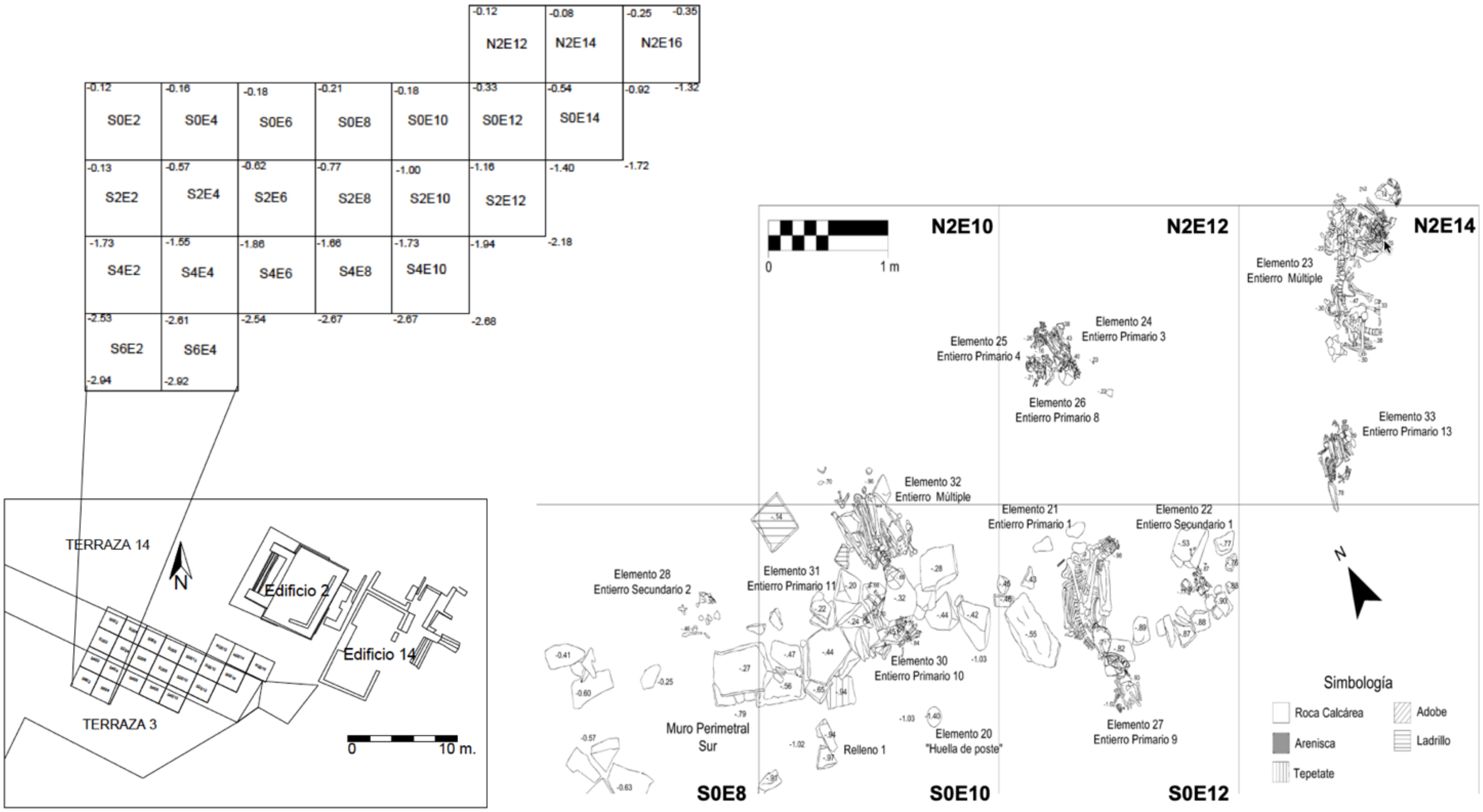


Figure 0.2: Location and orientation of burials excavated from Operation 3[8].

[8] *Map courtesy of Proyecto Arqueológico Tepeticpac, INAH Tlaxcala.*

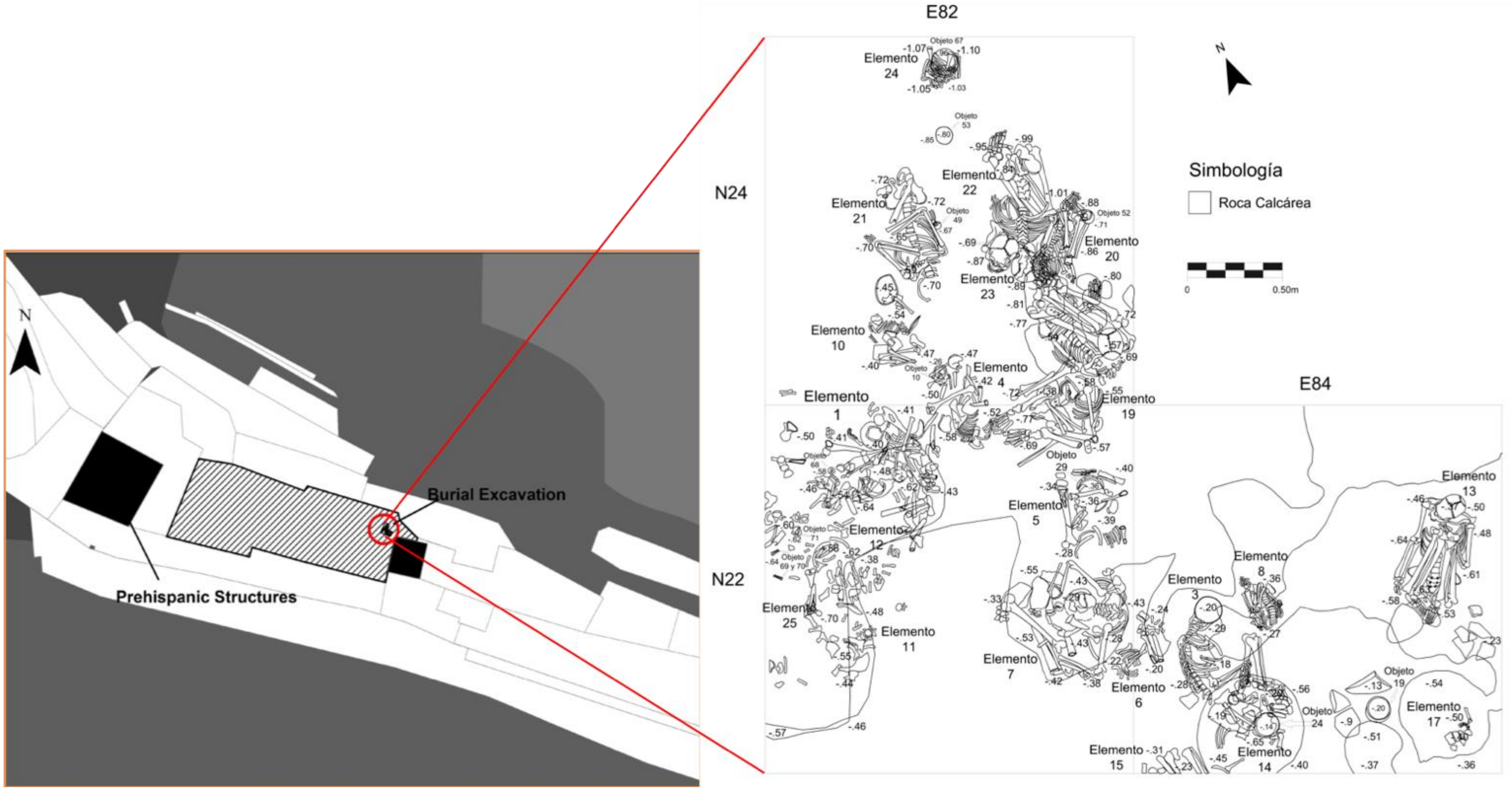


Figure 0.3: Location and orientation of burials excavated from Operation 13[9]*..*

---

[9] Map courtesy of Proyecto Arqueológico Tepeticpac, INAH Tlaxcala.

Tepeticpac: Field Data Collection

Field laboratory methods

Conservation of skeletal material

Once the remains arrived at the field laboratory, surface dirt was removed first with bamboo dowels and dry, soft toothbrushes and remaining layers of dirt were removed using a mix of 30% ethyl alcohol with distilled water. In the case of very fragmentary bones, the element was covered in a mix of 100 mL Paraloyd and 233 mL Xilol, in order to stabilize the fragments and avoid further fragmentation. This process was completed according to conservation protocols established by the Instituto Nacional de Antropología e Historia de México. This preservative can be removed from the remains with acetone. For fragmentary bones that could be repaired, fragments were reunited with a mix of acetone and 15% mowital. This mixture can also be removed with acetone.

Inventory

The inventory of skeletal remains serves to document the completeness of the burial sample, both to support the validity of interpretations and to highlight any burial patterns, such as the systematic removal of certain skeletal elements for ritual use (Feinman et al. 2010). Once free of surface soil, each skeleton was placed in anatomical position. Drawing from protocols established by Buikstra and Ubelaker (1994), each primary burial was scored for both the presence and completeness of each bone (see **Appendix A** for inventory sheets). A rough sketch was used to visualize the completeness of each skeleton, with separate forms for adults and subadults, as the lack of fusion of bones in subadults can lead to an increased number of observable elements. An inventory form was used to record each individual bone examined, with each bone scored for completeness following Buikstra and Ubelaker (1994):

blank=missing
1 = >75% present = complete
2 = > 25-75 % present = partial
3 = < 25% present = poor

While not central datasets in this dissertation, pathology and trauma were also recorded for future publications, following standards set forth in Buikstra and Ubelaker (1994) (**Appendix A**). In addition to the sketch sheet, as a record of each burial, each individual was placed in anatomical position and photographed. Then, a macro lens was used to photograph specific pathologies and traumas, as well as to document each sample taken. The photos were taken with a Nikon D600, and include a 5 or 10 cm scale.

Establishing minimum number of individuals (MNI)

With the exception of areas damaged by looting or plow zones, the majority of burials were primary, single burials with excellent to good preservation (MNI=32/58). Because no commingled remains were found in undamaged areas, it is likely that looting and plow damage, rather than burial removal and reburial, were the primary factors through which primary burials became commingled. Due to the extensive damage to these commingled remains, rearticulating burials was not possible. Instead, commingled remains were grouped by archaeological element, with MNI determined by the highest number of sided bone elements (accounting for differences in size/age).

Because skulls provide numerous points from which to determine age and sex (discussed below), five commingled crania were coded as unique individuals for whom skeletal (cranial fragment) and dental samples were taken, and pathology and trauma were coded. In addition to these five skulls, two loose teeth (distinguished as coming from two different individuals due to wear) were sampled from the commingled area. While it is not possible to determine age (beyond adulthood/childhood) or sex from the loose teeth, these teeth were included in the sample in order to explore how these individuals compare to patterns of the larger population.

Cholula: Field Data Collection

The Cholula skeletal sample was recovered during excavations conducted 1967-1970 by the Proyecto Arqueológico Cholula, directed by Miguel Messmacher and Ignacio Marquina (Marquina 1970) and stored at the Dirección de Antropología Física in Mexico City. Excavation records identify this population as pertaining to a peripheral "low status" residential population that occupied the hillside ruins of the pyramid, with ceramic chronologies placing them in two periods: Cholulteca II (AD 900-1325) N=78, and Cholulteca III (AD 1325-1500), N=231. Based on these reports, I selected a subset of 100/231 individuals from the Cholulteca III phase, as a comparative population contemporary to Tepeticpac. With the goal of limiting additional destruction to these burials, I relied on individuals already sampled by Bullock-Kreger (2010) in her study of strontium and paleopathology. As much as possible, I attempted to include a subsample of males, females, and range of ages proportionate to the complete sample of 231 individuals. Due to the time since excavation, outdated preservation techniques (such as lacquer to preserve the bones) and extensive use in previous research, the preservation of the remains has degraded and much contextual information (like unit number) has been lost. Some burials were mislabeled or could not be identified. Additionally, site excavation reports are limited in contextual information such as the relationship of burials to each other and to the site as a whole.

Inventory

For each burial sampled, I inventoried completeness (using the same standards described above), as well as assuring that age and sex data matched those listed on Bullock-Kreger's list. In the case that my age/sex estimations differed from that of Bullock-Kreger, this discrepancy was noted on the inventory form. As at Tepeticpac, a photo record was obtained for each burial. However, given space and time limitations, a complete anatomical photo was not possible. Instead, complete cranial photos were taken, with additional pathologies and traumas recorded with a macro lens. Each sample was also photographed before export.

Establishing Demographic Profiles: Micro and Meso Spheres of Interaction

Estimation of skeletal sex

Population variations in access to food, distribution of foods, and consumption of different categories of foods, are shaped by individual identities and positionalities within society (Fischler 1988; Twiss 2007; Counihan 2008). Two ways in which bioarchaeology seeks to recreate identity in the past are through establishing age and sex, or the "demographic profile." While these two attributes do not represent the entirety of individual identity, examining patterns of health and diet through these lenses can help to highlight social structures of access in the past (Turkon 2007; Van der Veen 2007; Metcalfe et al. 2009). The estimation of skeletal sex is based on the idea that following puberty, an increase of testosterone in males and estrogen in females will lead to sexual dimorphism between males and females (Yilmaz et al. 2005). In general, it is found that testosterone increases muscle mass, and thus male skeletons are more robust. In contrast, female skeletons are more gracile, while estrogen prepares the body for childbirth by widening the pelvis. However, it should be noted that both males and females possess a certain measure of both estrogen and testosterone, and the extent to which gracility/robustness is developed is a spectrum, rather than a clear-cut dimorphism. Because of this, skeletons are scored on the following scale from Buikstra and Ubelaker (1994):

0 = undetermined sex (skeleton too incomplete)
1 = female (undoubtedly gracile)
2 = probable female (gracility indicates more likely female)
3 = ambiguous sex (displays both gracile and robust features)
4 = probable male (robustness indicates more likely male)
5 = male (undoubtedly robust)

Because the hormonal changes that lead to sexual dimorphism do not occur until adolescence, the sex of prepubescent children cannot be determined from skeletal remains (White et al. 2011). However, isotopes from adult dentition, which forms in childhood, can provide insight into differences that individuals experienced as young children as a result of their gender.

Skeletal sex was estimated using characteristics of the skull and pelvis outlined in Buikstra and Ubelaker (1994) and Hernández Espinoza and Lagunas Rodríguez (2015). Cranial characteristics observed include supraorbital ridges, supraorbital margin, occipital crest, mastoid process, and mental eminence. Each characteristic was classified with a value between 1 (feminine, gracile) and 5 (masculine, robust) (Acsadi and Nemeskeri 1970). This same classification was used for the characteristics of the pelvis (preauricular sulcus, sciatic notch, subpubic concavity, ischiopubic ramus, ventral arc) (Milner 1992).

Estimation of age category

In this particular study, establishing skeletal age was important to understand how social roles change with skeletal maturity, and how this might tie to dietary shifts. For example, in childhood, at what age do children start to consume solid foods? When do those solid foods become the same ones that the adults eat? Do children experience the same variations in access (a proxy for status or social identity) as adults? Furthermore, establishing skeletal age can also highlight anomalies in the body. A skeletally young individual with extensive degenerative damage to their joints could indicate either an unhealthy individual, or an individual subject to a particular repetitive activity such as labor from a young age (Larsen 1997; Schrader 2012; Woo and Schiulli 2013). Thus, understanding the way the body adapts to changing and varied activity roles is important for distinguishing age-progressive changes to the body vs activity-related changes to body.

Subadult age estimation

In subadults, age was established using rates of dental development (Buikstra and Ubelaker 1994; Moorees and Fanning 1963) and epiphyseal fusion (Scheuer and Black 2000). Dental development begins in-utero, and proceeds at an expected rate (although health and other complicating factors may alter this slightly) until the final tooth, the 3rd molar, erupts between the ages of 18-21. Thus, childhood age can be established within a specific range of approximately 18 months. In addition to dental development, when long bones were present, age estimation was based on the fusion of epiphyses (Krogman and Isçan 1986; McKern and Stewart

1957; Suchey et al. 1984; Ubelaker 1987), and on diaphyseal length (Scheuer and Black 2000), measures of bone growth and development that have been correlated to known age categories.

Adult age estimation

Cranial suture fusion

In adults, age was based on cranial suture fusion (Mann 1987; Meindl and Lovejoy 1985; Todd and Lyon 1924) and dental wear (Scott 1979). Cranial sutures are the result of the fusion of individual cranial bones. Formed separately at birth to allow for rapid brain growth, and flexibility in the birth canal, cranial bones continue to fuse well into adulthood. While Buikstra and Ubelaker (1994) present protocols for estimating age based on the average of suture closure at 17 different sites, no recovered skulls were complete enough to measure all 17 points. Thus, cranial suture closure of the frontal, sagittal, coronal and palatine sutures were used to group individuals into broad age categories, using the key below, based on Buikstra and Ubelaker (1994):

Blank = unobservable
0 = open (Adolescent)
1= minimal closure (Young Adult)
2 = significant closure (Middle Adult)
3 = complete obliteration (Old Adult)

Dental wear

Once all adult dentition has erupted, it is subject to the process of degeneration as a result of abrasion from food consumed. Like cranial suture closure, this can give insight into a *general* adult age category. However, it is also important to consider how individual and population-level diets might influence dental wear in a manner disproportionate to age. At Tepeticpac, the nominal extent of dental wear indicates that the diet was not abrasive, and thus even individuals who were categorized as older based on cranial suture closure could still be coded for dental wear. In contrast, the individuals of Cholula displayed higher rates of antemortem tooth loss, carious lesions and abscesses, making this a less useful method with that population.

Coding for age

As dental and bone development allow for more specific age estimation in childhood, age categories fell within 18-month to several year groupings through adolescence, with adult individuals grouped within 10-year categories. At different points in the analysis (for example, when looking at weaning ages) data will be grouped by either specific age (as close to a set year as possible), age category, or general age. The categories used appear below:

Table 0.2: Age categories used in analysis

Specific Age	Age Category	General Age
≤1 year	Infant	Subadult
1-3	Toddler	
4-12	Child	
13-20	Teen	
21-30	Young Adult	Adult
30-50	Adult	
50+	Old Adult	

In the context of dental enamel analyses, the data from individuals are assigned to one of three age categories: Early Childhood (EC), Middle Childhood (MC) or Adolescence (T), depending on the time of tooth formation.

Table 0.3: Dentition by age development category (after Buikstra and Ubelaker 1994)

Tooth	Crown begins forming	Crown complete	Age Development Category
Deciduous dentition	~5 months in utero +/1 2 months	~9 mos-1 year	Early Childhood (EC)
1st permanent molar (M1)	~9 months	~3 years	Early Childhood (EC)
Permanent incisors, canines	~ 9 months	~ 4 years	Early Childhood/Middle Childhood (MC)
Premolars	~ 2 years	~ 5 years	Middle Childhood (MC)
2nd permanent molar (M2)	~ 3 years	~ 7 years	Middle Childhood (MC)
3rd permanent molar (M3)	~ 10 years	~ 15 years	Adolescent/Teen (T)

Paleodiet and Isotope Analyses: Linking Micro to Meso/Exo/Macro

To test how changing political and economic dynamics impacted individual and group foodways at Tepeticpac and Cholula, I analyzed carbon ($\delta^{13}C$), nitrogen ($\delta^{15}N$) isotopes in bone collagen, carbon ($\delta^{13}C$) and oxygen ($\delta^{18}O$) isotopes in bone carbonates and dental apatite, and plant microfossils in dental calculus. The isotopic composition of bone collagen reflects dietary protein sources in the few years before death, while that of dental apatite reflects complete diet during the period of enamel formation. The analysis of microscopic plant fossils in dental calculus allows for the identification of consumed plants. In addition, I included modern plant and archaeological fauna samples for isotopic analysis in order to contextualize dietary isotope data from burials within a broader regional foodweb.

Principles of isotope analyses

Isotopes are multiple forms of the same element, where the nuclei are composed of the same number of protons but vary in the numbers of neutrons. This in effect does not alter the nature of the element, but does alter its weight, creating "heavier" and "lighter" isotopes. For example, the element carbon has 6 protons, yet its isotopes have 2 to 8 neutrons ($_{8}$C to $_{14}$C). Isotopes can be stable or unstable, radiogenic or nonradiogenic.

Radiocarbon dating

Unstable, radiogenic isotopes decay over time. Because carbon-14 decays at a known rate, the amount of remaining $_{14}$C can be used to calculate how much time has passed since death (Schwarcz and Schoeninger 1991). In this study, radiocarbon dating is used to establish precise dates for the burials at Cholula and Tepeticpac.

Dietary isotopes

The stable isotopes examined in this study include δ_{13}C, δ_{1}N/$_{14}$N, δ_{18}O. which exist in the atmosphere. The relative abundance of each type of isotope in the atmosphere is essentially consistent, or stable, through the time frames analyzed in this study. The details of their incorporation into the body through consumed foods and liquids is explored in detail by specific isotope below. Generally, as animals consume foods, their molecular compounds become a part of the animal's tissue, carrying the isotope ratios from consumed foods with them (DeNiro and Epstein 1978, 1981; Schoeninger and DeNiro 1984). However, each time that dietary isotopes go through the process of incorporation into an organism's tissues, or metabolism, they go through a chemical process called fractionation (Katzenberg 2000; Hoefs 1997; Monson and Hayes 1982a,b). During this reaction, lighter isotopic compounds react more quickly, altering the ratio slightly. This change is designated with the symbol ‰, which indicates change in parts per thousand. Through analysis, bioarchaeologists are able to measure this change from atmospheric abundance to abundance found in bone and teeth to reconstruct the dietary network that led to these ratios (Hobson and Collier 1984; Farnsworth et al. 1985; Ambrose and DeNiro 1986; Walker and DeNiro 1986; Müldner and Richards 2005; Keenleyside et al. 2006; Bocherens et al. 2007).

There are two main types of tissue that are used for dietary isotope analysis: collagen (found in bone and tooth dentin), and apatite (found in bone and tooth enamel and dentin). Bone is made of both collagen and hydroxyapatite. In contrast, dental enamel is primarily comprised of hydroxyapatite, the mineral component. Starvation studies have shown that the way foods are incorporated into the body varies by type of tissue (DeNiro and Epstein 1981). Collagen, the organic portion of bone, draws carbon and nitrogen primarily from proteins in the diet. The mineral portion of tissue (apatite found in enamel and carbonates from bone) represents dietary carbon and oxygen isotopes incorporated from all aspects of the diet (lipids, proteins, and carbohydrates) (Kreuger and Sullivan 1984). The information about diet that researchers extract from tissue is limited by the timing of tissue formation. Because dentition forms in utero and remains unmodified through life once it is fully formed, dietary isotopes obtained from dentition reflect diet at the time of childhood, with the third molar completing formation around 10-16 years of age (Buikstra and Ubelaker 1994). Thus, the isotopes obtained from enamel apatite reflect childhood diet, even when found in the skeletons of adults. In contrast, samples from bone, which remodels every 1-3 years, will represent the last years of an individual's life (Chisholm et al. 1983). By including both bone and enamel samples, this study tracks changes in diet throughout the life course. Due to the nature of preservation of archaeological remains at Cholula and Tepeticpac, this study focuses only on enamel apatite, bone collagen, and bone carbonates.

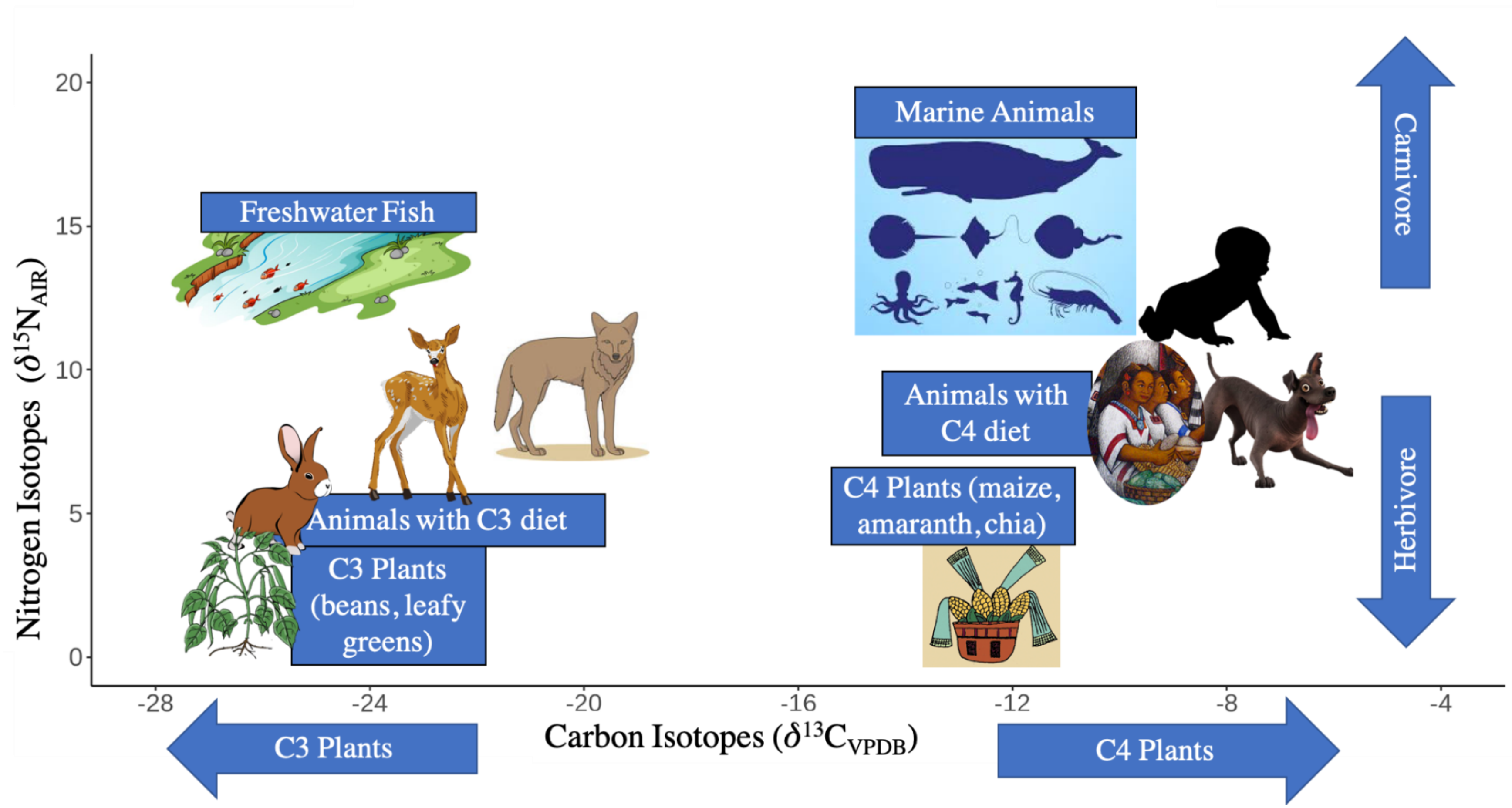


Figure 0.4: Projected food web for bone collagen values from carbon and nitrogen[10].

---

[10] Modeled after Tykot 2002, Buhay 2012 and Warinner 2013.

Carbon

Carbon and plant diets

Dietary carbon isotopes ($_{12}C$ and $_{13}C$) are primarily used to determine the types of plants being consumed (Lee Thorpe et al. 1989; DeNiro and Epstein 1978; Vogel 1978; Tieszen et al. 1983; Kennedy 1988). Atmospheric CO_2 is incorporated into plants through photosynthesis, as plant stomata open to absorb $_{12}C$ and $_{13}C$ from their environments. Three known photosynthetic pathways exist: C_3 (widespread grasses, trees, shrubs, tubers), C_4 (arid climate grasses, like maize, amaranth, and chia), and CAM (cacti and succulents). These pathways are defined by the plant's environment. Plants in more arid environments (C_4 plants, most commonly, maize, amaranth and chia) must be more efficient in photosynthesis, in order to reduce the amount of water that escapes when stomata open to absorb carbon. Thus, C_4 plans preferentially select greater amounts of $_{13}C$ than $_{12}C$, effectively gaining more carbon with less energy. CAM plants use both types of photosynthetic pathways, adapting as needed based on environmental conditions.

After being absorbed by the plant, carbon isotopes are metabolized into carbohydrates, protein and lipids. For dietary carbon, this process has an average change of 5‰ for each step, though this differs between bone collagen (4‰) and carbonate (11‰) (Koch et al. 1995). Fractionation at each trophic level further increases the proportion of $_{13}C$ by approximately 1.5‰ (van der Merwe and Tschauner 1999). However, when all of these variations are accounted for, C_3 and C_4 pathways produce distinct $\delta_{13}C/_{12}C$ ratios that do not overlap: C_4 plants fall in the range of -9 to -14‰ (Tykot 2002 argues that -10‰ is an appropriate average for Mesoamerica) while C3 plants range from -20 to -35‰. CAM plants produce ranges between those of C3 and

C4 depending on the method of photosynthesis that is primarily used given the particular environment. In Central Mexico, CAM plants, such as maguey (Agave spp.) and nopal cacti (Opuntia spp.) can produce values similar to C_4 plants (Tykot 2002), yet they have not been considered as central dietary components. Because of the clear distinction between C_3 and C_4 values, $_{13}C/_{12}C$ ratios are most often used to examine the proportion of maize to other plants in the diet.

For carbon, the ratios of $_{13}C/_{12}C$ are reported in relation to international standards based on a Cretaceous fossil, the *Belemnitella Americana*, which has an abnormally high $_{13}C/_{12}C$ ratio, and thus was established as the zero point for $_{13}C$. These standards are based in a formation (called the Pee Dee formation) off of the coast of South Carolina, and are referred to as the PeeDee Belemite standards, or PDB standards (van der Merwe 1982).

Carbon and marine diets

Carbon dietary isotopes can also be used to compare marine vs. terrestrial diets, as carbon in marine contexts is absorbed from dissolved carbonate that produces a $\delta_{13}C$ value of 0‰, whereas terrestrial atmospheric values are around -7‰. Thus, marine diets will appear isotopically distinct from terrestrial diets (Chisholm et al. 1982; Hobson and Collier 1984; Kennedy 1988; Sealy 1986l; Tauber 1981). Freshwater organisms also produce unique carbon values, as they draw carbon from numerous sources, which vary widely in ranges, with $\delta_{13}C$ decreasing as waters deepen (Katzenberg 2008; Shoeninger and Moore 1992). Such contributions to the diet can be recognized through elevated $\delta_{13}C$ found in dietary proteins from bone collagen (Tykot 2002; Lopez Costas and Müldner 2016).

Carbon contributions to whole diet

Bones and teeth draw from different portions of dietary carbon to build their tissue, with collagen disproportionately reflecting protein portions of the diet, whereas mineral portions are composed of carbohydrates, lipids and proteins (Kreuger and Sullivan 1984). Because carbon is found in both collagen and apatite, comparing values from the two elements will allow for a more complete view of diet (Tykot 2006; Leatherdale 2014). As Lee Thorpe et al. (1989) discuss, comparing the ratios of carbon in collagen and apatite can give insight into the type of diet (herbivorous, carnivorous, omnivorous), as the proteins, carbohydrates and lipids within each type of diet are used by the body in different ways. For example, a plant-heavy diet will primarily rely on plant proteins and carbohydrate energy, whereas carnivores get proteins from prey, as well as energy from the lipids and proteins of meat. Studying this difference in collagen and apatite dietary carbon sources can further help interpret how the body processes foods, as collagen contributes to body growth and development, while apatite is related to energy storage and expenditure (Ambrose and Norr 1993, 1997, 2003; Kellner and Schoeninger 2007; Kreuger and Sullivan 1984; Lee-Thorp et al. 1989; Tieszen and Fagre 1993).

Research uses

In this study, carbon isotopes are primarily used to identify the categories of plants contributing to prehispanic highland Mexican diets, and to explore whether marine resources are contributed to diets (which would indicate maintained connection to Gulf trade routes).

Oxygen

Similar to carbon isotopes, oxygen isotopes exist in the atmosphere and are incorporated into enamel, bone, and soft tissue. Oxygen is incorporated into bodies through respiration, drinking water and water in food (Makareqicz and Sealy 2015; Katzenberg and Harrison 1997). The ratio of ^{16}O/^{18}O is altered as water goes through different physiological changes, which are greatly influenced by environmental variations (Knudson 2009; White et al. 2004). ^{18}O is the heavier isotope of the two, and will drop out with increased altitude, distance from the coast, latitude and decreasing temperatures. In contrast, the lighter ^{16}O is lost during evaporation. Additionally, these values may change throughout the year, as temperatures and rainfall fluctuate. The resulting values of land water (meteoric water, or $\delta^{18}O_{mw}$) is a ratio of the known atmospheric standard (Vienna Standard Mean Ocean Water, or VSMOW) to the resulting ratio on land. Though not as precise as radiogenic strontium (87Sr/86Sr), regional variations have resulted in oxygen isotopes being used as loose proxies for identifying individual mobility and highlighting “local” and “nonlocal” oxygen values (Price et al. 2010; White et al. 2004).

Research uses

Oxygen isotope values can be altered through different cultural processes, including cooking and storage systems, varying sites of source water, and weaning patterns. The details of these cultural factors will be discussed further in the interpretation chapter. For this study, oxygen isotope analysis will be used to highlight nonlocal individuals, identifying changing patterns in water consumption with age, and to explore population patterns that might demonstrate variations in cooking or water consumption.

Nitrogen

While $\delta_{13}C/\delta_{12}C$ isotope ratios can capture the categories of plants and animals that humans eat, in the 1980s it was discovered that nitrogen isotopes also reflect important parts of diet (Schoeninger, De Niro and Tauber 1983). Rather than distinguishing between different photosynthetic pathways, $\delta_{15}N/\delta_{14}N$ ratios become distinct as they pass through trophic levels, or levels of the food chain. Atmospheric nitrogen is measured at 0‰ and increases 2-3‰ with each trophic level (Schwarcz and Schoeninger 1991). Like carbon, nitrogen is incorporated into plants from the atmosphere, but the process by which it incorporates is distinct. Plants with leguminous roots have a unique bacterium, *Rhizobium*, that allows them to directly absorb nitrogen from the atmosphere, thus maintaining the atmospheric value of 0‰). Conversely, non-leguminous plants can absorb nitrates from decomposed organics in soil (which produce a higher amount of $_{15}N$, starting at about 2‰) (Katzenberg 2008).

Within the food chain, plants are eaten by herbivores, both plants and herbivores are eaten by omnivores, who then are eaten by first level carnivores, with second level carnivores feasting on the first level carnivores. Meat eating humans occupy this second level, with the most representative third level carnivores being those who consume human tissue: cannibals, human infants (who consume their mother's tissue through breast milk), and those suffering from starvation (who essentially consume their own tissue). Starvation studies have contributed to knowledge on the effects of protein stress, due to insufficient consumption of dietary proteins. With protein stress, the body responds by breaking down its own existing tissue, which is high in $_{15}N$ as the tissue of a 2_{nd} level carnivore. Thus, this auto-consumption, or re-use of existing tissues is equivalent to the individual becoming a third-level carnivore (Katzenberg 2000). In order to establish the source of dietary nitrogen in human tissue, the ratio of $^{15}N/^{14}N$ measured with the mass spectrometer is compared to naturally occurring atmospheric nitrogen (AIR), which holds a stable value, and thus is used as a zero point.

Nitrogen and weaning

The presence of elevated ^{15}N in infants and young children has led researchers to use $\delta^{15}N$ to explore ages of weaning in prehistoric groups, as the period when children cease to be third-level carnivores and switch to weaning foods such as gruel is marked by a decrease in ^{15}N (Wright and Schwarcz 1999). Studies of Classic period Maya populations by Wright and Schwarcz (1999) show that when comparing teeth formed at early, middle and late childhood (M1-M3), $\delta^{15}N$ values decrease as early as premolar formation, implying that the high amount of proteins from breast milk can be visibly seen to decline shortly after the formation of M1 (around 3 years of age). Furthermore, the change between M1 and M3 was not strong, suggesting that solid foods may have been introduced before M1 stopped forming (around 1-2 years of age), or that the mother's diet was heavy in proteins. Weaning was complete by the age of 5 years. While a general trend in age of weaning can be seen, there was also a variety of age ranges of weaning diets, suggesting that nitrogen values can show intra-population differences in weaning practices, possibly tied to differences in access or preference for different weaning foods.

Nitrogen and marine diets

In addition to diets becoming enriched in^{15}N among third-level carnivores, ^{15}N is also highly enriched in marine environments. In these environments, atmospheric nitrogen is largely fixed by algae, a process which leads to more elevated $\delta^{15}N$ (above 20‰). Additionally, marine environments contain more trophic levels, producing more positive values than terrestrial food networks (Tykot 2006; Schoeninger at al 1983; Katzenberg 1989). Because of this distinction, δ_{15}N has most frequently been used in studies seeking to differentiate between marine and terrestrial based diets and to explore ages of weaning (Slovak and Paytan 2011). Because marine and freshwater proteins can lead to elevated $_{13}$C, nitrogen is essential to identify whether enrichment is due to the presence of marine or terrestrial resources (Schoeninger and De Niro 1984; Schoeninger 1995; Slovak Paytan 2011)

Research uses

In this study, nitrogen values are used to identify access to marine goods, establish variations in protein sources throughout the population, and to identify weaning patterns.

Plant microfossils: Phytoliths, starch, pollen, fibers

Dental calculus forms throughout the life course, trapping organic matter from consumed foods on the tooth surface. Research in the 1990s discovered that calculus could be removed from dentition and examined under a microscope to identify plant silica, starches, pollen and fibers (Cummings and Magennis 1997; Henry and Piperno 2008; Piperno 2006). In archaeological remains, these microbotanicals can become fossilized, allowing them to be analyzed with electronic microscopy, in order to identify structures that link them to consumed plants.

Research uses

In order to better interpret the isotopic dietary values, which show photosynthetic category, but not specific plants consumed, I also included the analysis of plant microfossils, found in dental calculus (calculus).

Paleodiet Sampling Strategy

To determine the diets of each individual, dental enamel, bone and dental calculus were sampled. To contextualize resulting values within the broader regional food web, values from human remains were compared to modern plant and archaeological faunal samples. Bone, dental and plant samples were exported to and prepared for analysis at the Vanderbilt Bioarchaeology and Stable Isotope Research Laboratory. Dental calculus samples were exported to and analyzed by the Laboratory of Paleoethnobotany and Paleoenvironment at the Institute for Anthropological Investigation of the Universidad Nacional Autónoma de México. Water, plant, bone and enamel samples were analyzed with the mass spectrometer at Yale Analytical and Stable Isotope Center. Twelve human bone samples were sent to the Pennsylvania State Institute of Energy and Environment for AMS dating (Folio #401.3S.16-2017/812) (See summary chart in Table 4.1).

Dental enamel sample

For each individual, the ideal sample was the 1st, 2nd, and 3rd molar, since these represent different periods of mineralization that characterize early, middle and late childhood, respectively. Sampling each molar allows for a diachronic view of changes in diet throughout childhood, which can reflect changes in social roles and the accompanying access to different types of foods. However, in many cases, preservation or antemortem tooth loss prevented the sampling of all three molars. Thus, some individuals are only represented by a single tooth. Details of sampled enamel can be found in **Table 6.3** and include a total of 76 samples from 39 Tepeticpac individuals and 50 samples from 50 Cholula individuals.

Bone sample

When possible, bone fragments were taken from the same individuals for whom dental enamel was collected. Fragments of cranial bone and rib were preferentially collected, but in instances where these bones were not available, fragments of long bone or phalanges were substituted. The chronologies of Tepeticpac and Cholula are currently defined by ceramic sequences which provide a general time frame for "Late Postclassic" (1300-1519 A.D.). Because Aztec expansion into the Puebla-Tlaxcala Valley occurred between 1450-1519 A.D., more specific dates were necessary to understand through which political moment the analyzed individuals lived. Thus, a subset of 12 samples of 2-4 grams of cortical bone were taken from individuals at each site (3 from each of two plazas in Tepeticpac; 6 from Cholula) for radiocarbon analysis.

Plant and faunal samples

In order to establish a baseline of values of foods that were likely consumed by individuals at this site (Bogaard and Outram 2013), I sampled archaeological fauna found within household contexts at Tepeticpac in the 2012 and 2013 excavations of Operation 2, 3 and 5. While not directly associated with the burials under study, these samples are associated with the Late Postclassic period. The samples include 11 faunal bone samples from 8 species exported to the Vanderbilt Bioarchaeology and Stable Isotope Research Laboratory (Folio #401.3S.16-2019/160).

Modern plant samples were collected by Janet Alcántara from local Tlaxcala market contexts, and by the author from household gardens and small-scale farms. These samples were selected based on the known use of such ingredients in pre-contact Tlaxcala, and in early colonial introductions to diet. The plant samples include 24 samples from distinct species (**see Table 5.1**).

Water samples

In order to establish the $_{18}$O values from this area, I worked with archaeologist Felipe Nava-Ahuatzi to collect local water samples from six sites. The water was drawn from a variety of sources (well, spring, river, tap), many of which date to Prehispanic times and continue to be used today. The water was collected in 20 mL acid-washed scintillation vials, with the site name, date collected, type of source, and coordinates of collection sites noted (See **Ch.6**, **Table 6.2** for details). The samples were then sent to Yale Analytical and Stable Isotope Center for analysis.

Dental calculus (plant microfossil) samples

Dental calculus samples were only collected when calculus was loose and at risk of loss during the process of skeletal and dental analysis. The amount and location of the dental calculus sample site was noted on the analysis sheet, and the sample site was photographed. Once documented, the calculus was removed with a dental pick, and stored in a 1.5 mL vial, upon which was recorded the contextual information for the sample. A total of 28 dental calculus samples were collected from 25 individuals. From these samples, Dr. Julia Pérez Perez and C.

Cristina Adriano-Morán of the Laboratory for Paleoethnobotany and Paleoenvironment at the Universidad Nacional Autónoma de México extracted phytoliths, starch, pollen and fibers. The methodology used for the analysis and preparation of samples can be found in Pérez Pérez and Adriano-Morán 2018.

Laboratory Preparation of Dietary Isotopes

During analysis of dietary isotopes, tissue was processed to extract and measure the ratio of incorporated isotopes by isolating collagen or apatite.

Bone samples

While the extent to which collagen absorbs external contaminants has been debated (Schoeninger and DeNiro 1982; Kreuger 1991; Lee-Thorpe and van der Merwe 1991), it is used more frequently than carbonates, because it is easier to remove exogenous contaminants (Lee-Thorpe 1989). However, combining collagen and carbonate analyses provide a more complete view of diet, as later studies realized (Sullivan and Kreuger 1981; Nelson et al. 1986; Schoeninger and DeNiro 1982; Lee-Thorp 2000; Koch et al. 1997; Kohn 1999; Sponheimer and Lee-Thorp 1999). Thus, when preservation allowed, bone samples were processed for both collagen and carbonates.

Collagen extraction

Exported bone samples were approximately ~2 g samples of cortical bone. Once in the Vanderbilt Bioarchaeology and Stable Isotope Laboratory (BSIRL), bone samples were crushed, with approximately 100 mg of bone weighed out. Approximately 200-300 mg of crushed bone was weighed out for Cholula samples, as they were far more poorly preserved. Crushed bone sample were placed in glass vials labeled with the sample code and sonicated with 5 ml of ultrapure water to remove surface contaminants. Cleaned samples were placed in acid-washed vials with aluminum foil-lined caps, which inhibits chloroform interaction with plastic cap lining. Samples were demineralized with .5 M Hydrochloric acid solution, vortexed, and placed uncapped in fume hood for 24 hours at room temperature, or until the sample was sufficiently demineralized to a translucent but solid material (max. 3 days). The HCl was then pipetted off and the sample rinsed five times with ultrapure water to remove remaining acid and prevent further reaction. To extract humic acids, samples were placed in 5 ml of 1.0 M sodium hydroxide, agitated on a vortex mixer, left to sit for 30 minutes, then rinsed. This step was repeated 5 times. To extract the lipids from the sample, it was treated with a mix of 1 mL:2 mL:0.8 mL chloroform, methanol, and water and left to sonicate for 30 minutes. Liquid was removed and step repeated 5-8 times, depending on the density of lipids in the sample, then rinsed 5 times with ultrapure water. If any remaining organic material was present, I repeated the HCl step. If not, the sample was placed in .01 M HCl, then placed in a dry bath at 58 degrees Celsius, tented with aluminum foil and left for 16-18 hours. Collagen was then collected using vacuum filtration, frozen for 6-24 hours, then freeze dried at -50 degrees Celsius for 72 hours. Freeze dried samples were capped, secured with parafilm, and shipped to Yale Analytical and Stable Isotope Center for analysis.

Radiocarbon analysis

The process for AMS dating also produces collagen results for carbon and nitrogen isotopes. Thus 12 samples (yielding a total of 10 results) were prepared and analyzed by Anthropology Graduate Student Bianca Gentil at the Pennsylvania State Institute of Energy and Environment.

Bone carbonate preparation

Within apatite, dietary studies focus on the ion carbonate (CO_3), which is formed from bicarbonates in the bloodstream that reflect carbohydrates, lipids, and proteins in the diet (Katzenberg 2000). To prepare the bone samples for analysis of bone carbonate, approximately 100-150 mg of bone was drilled from the same sample used for bone collagen, using a diamond tip Dremel drill. Due to differential preservation, not all individuals were sampled. Only those that produced viable collagen data and who had enough sample remaining were used.

In the laboratory, 1.5 ml of 1-1.5% sodium hypochorite (NaClO) was added to the collected bone powder to allow organic contaminants to separate to the surface and be removed. Samples were left in NaClO and placed, uncapped, in the desiccator for 48 hours, then rinsed to remove remaining NaClO. External carbonate contaminants were removed with 1 ml of 1 M acetic acid ($C_2H_4O_2$) buffered with calcium acetate ($C_4H_6CaO_4$), left for 3.5 hours and then rinsed. Finally, samples were dried in a dry bath and sent to Yale Analytical and Stable Isotope Center for analysis.

Enamel apatite samples

In the field laboratory, each tooth was cleaned with distilled water to eliminate surface contaminants and allowed to dry completely before drilling. Using a Dremel handheld drill and diamond tipped bit, the lingual or buccal surface of the tooth was gently scraped to remove the contaminated surface layer of enamel. A single line was drilled toward the occlusal surface of the buccal or lingual side to produce a sample of approximately 2 mg of enamel. A preliminary sample of 36 samples from 19 teeth representing 11 individuals was taken in 2015. In this sample, each tooth was drilled twice (at the cemento-enamel junction and at the occlusal surface) to identify even more minute changes in time. However, results showed that there was very little difference in values from the two periods of mineralization within the sample tooth, so for future samples only one sample mid-crown was taken. The samples were then shipped to Vanderbilt University Bioarchaeology Stable Isotope Research Laboratory.

In BSIRL, organic contaminants were removed with a solution of 30% hydrogen peroxide (H_2O_2), and exogenous carbonates were removed using a solution of .1 M acetic acid ($C_2H_4O_2$). Finally, samples were rinsed in the drying agent, methanol (CH_3OH), and placed in the desiccator to dry. Processed enamel powder samples were sent to Yale Analytical and Stable Isotope Center for analysis.

Plant samples

Samples were dried naturally before exporting. Once in the lab, they were ground to a fine powder using a stainless-steel mortar and pestle. A sample of 100-500 mg from each plant was sent to Yale Analytical and Stable Isotope Center for analysis.

Faunal samples

The faunal samples were prepared for bone collagen and dental enamel analysis following the protocols used for human remains listed above and then sent to Yale Analytical and Stable Isotope Center for analysis.

Water samples

Water samples were collected in 20 mL acid-washed scintillation vials and sent directly to Yale Analytical and Stable Isotope Center for analysis.

Mass spectrometer and assessing sample integrity

Once carbonates and collagen have been isolated, the material is vaporized and ionized, and sent through the ion Isotope Ratio Mass Spectrometer, which measures the ratio of abundance of different isotopes (Katzenberg 2000). The sample abundance is then compared to a standard, known value of atmospheric abundance, with the difference between the ratio and the standard recorded as δ with the results being reported as a ratio in parts per mille (Katzenberg 2008)

$$\delta \text{ in ‰} = (R(\text{sample})-R(\text{standard})/R(\text{standard})) \times 1000$$

These standards help to ensure the precision of the mass spectrometers and allow individual lab results to be compared internationally. They also allow for the recognition of poor sample integrity (a sample too degraded to produce viable results). While recent research has found collagen to retain form and isotope ratios even when highly degraded (Dobberstein et al. 2009), I reinforce the validity of my sample results by adhering by accepted ratios established by

DeNiro and Weiner (1988). Their research demonstrated that ratios of carbon to nitrogen falling between 2.9 and 3.6 are deemed "good" samples, while ranges outside this mean indicate significant decomposition of collagen, and an unreliable result (DeNiro and Weiner 1988). For carbonates, study of dental enamel has shown that it is not susceptible to diagenesis (Koch et al. 1997). However, the more porous biogenic carbonate found in dentin and bone is more easily contaminated by burial environments. While washes that remove exogenous carbonates are built into our laboratory protocols for bone and dental carbonate preparation, it is still necessary to understand the values that might indicate continued contamination. Lee Thorpe and van Der Merwe (1987) found that uncontaminated samples showed only a <2-5‰ difference between carbon in enamel and carbon in bone—thus samples that fall within this difference likely indicate little alteration to bone carbonates.

Statistical Methods to Determine Inter and Intra Site Differences

A student t-test[11] was used to determine statistically significant differences within samples larger than 30, or when there was a statistically significant difference in variance. For smaller (10-30) sample sizes or for skewed data, I used a Mann Whitney U[12] test to compare group medians. Significance for both tests is reported at ($p<.05$). For samples that were too small for meaningful statistical inference, I provide descriptive statistics. Descriptive statistics were run using RStudio version 1.2.5001, and used to record the average, standard deviation, maximum and minimum of the carbon, nitrogen and oxygen isotopic values.

---

[11] http://vassarstats.net/tu.html

[12] http://vassarstats.net/utest.html

Ethnographic Interviews

While paleodiet analyses provide information as to who was eating what, ethnographic interviews allow for the interpretation of the recipes and social contexts within which these ingredients were consumed, using ethnographic analogy of traditional food practices in the present. Many of the food traditions that shaped Prehispanic diets are alive and well in Tlaxcala, particularly a heavy reliance on maize. The nearby town of Ixtenco is one of the places with most varieties of maize, fiercely protected by its community members. Plants like maguey and nopal cacti, as well as local insects like ants, maguey worms, and grasshoppers, also continue to be used in both traditional and popular cuisine. Importantly, indigenous *cocineras tradicionales* (traditional chefs) and agriculturalists have been the stewards of these foodways, as individuals both ignored by nationalist history and escaping much of the *mestizaje* (cultural mixing) experienced by Prehispanic elites who adapted to Spanish hierarchies.

Inclusion/exclusion criteria

Individuals selected for interviews include local chefs and small-scale organic farmers who work predominantly with plants and ingredients indigenous to the area. The goal of these interviews is to select individuals with diverse backgrounds of experience (traditional small-scale household chefs to high-end restaurant chefs) and with a multi-generational family history in Tlaxcala. While community members, particular traditional household chefs and farmers, can be considered a "vulnerable population," through decolonial interview practices (Alonso Bejarano et al. 2019), such as semi-structured interviews, and a clearly translated research design written for a public audience, I create mechanisms in order to decrease their vulnerability and include local stakeholders in the research design and analysis.

Enrollment/randomization

The participants were recruited in person. As a result of archaeological fieldwork conducted in the area since 2014 (a total of 1.5 years of residency in the area), long-term, collegiate relationships already existed with many of the potential interviewees. This had the added benefit that many interviewees are already familiar with the nature of the research. However, in all cases a sample script for invitation to participate (see **Appendix B**) was shared with the participants.

Data collection methods

Farmers and chefs were recruited from in and around Tlaxcala City, the contemporary place-name given to the Tepeticpac area. During the research period of June 15th-July 15th 2019, I was able to conduct 5 semi-structured interviews, centered on the following themes: ingredients considered “traditional” in Tlaxcalteca cuisine; knowledge about ingredients and their relationship to landscape and the history of foodways in the region; social practices surrounding the preparation and consumption of these ingredients. Sample questions can be found in the **Appendix B**.

All interviews and interactions were conducted in Spanish. I approached subjects by informing them of the nature of the project both verbally and with a written invitation transcript (**Appendix B**). Before beginning the interview, I read an oral consent form (see **Appendix B**) that clearly stated the aims of the research project and the types of questions that would be asked. It was made clear to participants that answering the questions was voluntary and that participants might choose to skip any response or end the interview at any time. Participant consent was obtained via signature. While approximately one hour was budgeted for each interview, the actual time often extended to two hours. All interviews were recorded with the consent of the interviewee.

A business card with my e-mail and local and international phone numbers was given to each interviewee to facilitate contact before and after the interview. It was agreed that any transcriptions of the interview to be used for research or publication will be provided to the interviewee upon request, so that they may confirm or remove information at their discretion. This portion of the methodology was approved via IRB #191184 “Foodways in Contemporary and Ancient Tlaxcala, Mexico.

Summary

The analyses in this study are based on enamel and bone samples from 58 individuals from Tepeticpac and 100 individuals from Cholula, as well as 6 water samples, 11 faunal bone samples from 8 species, and 24 plant samples. Ethnographic interviews from 5 farmers and/or traditional chefs were used to contextualize paleodiet data, using ethnographic analogy to link ingredients to social foodways. This chapter begins by explaining how remains were excavated (in the case of Tepeticpac) and analyzed in the field laboratory (both Cholula and Tepeticpac). After demographic profiles were established, samples were taken for paleodietary and isotopic analyses to determine how changing political and economic dynamics impacted foodways at Tepeticpac and Cholula. Samples of local water, plants, dental calculus and archaeological fauna served to establish a clear baseline of regional foods and their values to which enamel and bone values from burials could be compared. The chapter concludes with an overview of Ethnographic interview methods. In sum, this chapter lays out the structure of analyses upon which the following chapters rely.

5

THE TEPETICPAC FOODWEB

In this chapter I argue that analyses of dietary isotopes for ancient populations in the Puebla-Tlaxcala Valley must first be contextualized within culturally-specific foodways and knowledge of the landscape. I present results from the isotopic analysis of archaeological fauna from the site of Tepeticpac and contemporary samples of comestible plants indigenous to the Puebla-Tlaxcala landscape. Results from this chapter serve to create a more detailed food web of resources from which to interpret human dietary patterns in Chapter 6.

Introduction

While environments contain a vast amount of comestible resources, there are cultural values, political histories, and community knowledge that reduce what *could* be consumed (i.e. items that would not kill you if consumed) and shape what is considered culturally appropriate or "edible" (Hastorf 2017). Within Mesoamerican archaeology, early and recent paleodietary studies tended to focus analyses on the differentiation between C_3 and C_4 plant diets, with maize being considered as the C_4 "staple" of Mesoamerican foodways. Those foundational studies provide a basis to expand upon and interrogate assumptions about diets and foodways in Prehispanic Mesoamerica. Similarly, previous studies have documented the consumption of protein sources, focusing primarily on the distinction between terrestrial fauna and marine resources. In this study, I expand on these studies to consider the central role of plant-based proteins and insects as a major and sustainable protein source in ancient diets. At the same time, studies of protein sources have centered on the consumption of faunal and aquatic animals, without considering the central role of plant-based proteins and insects. Through ethnographic interviews of local small-scale farmers and chefs in Tlaxcala, as well as in conversation with community members, many of whom were involved in excavation and analysis, I was confronted with the deep ecological complexity of diets in contemporary Tlaxcala, with a provenance in Mesoamerican food traditions. Drawing from knowledge gained through oral history interviews, and with a heavy reliance on ethnohistoric documentation of Late Postclassic foodways, this chapter provides the first isotopic baseline within the Puebla-Tlaxcala valley, providing carbon and nitrogen isotope ratios from 46 modern plants species and 11 archaeological fauna species (from Late Postclassic Tepeticpac excavations conducted by the Proyecto Arqueológico Tepeticpac in 2012 and 2013).

While human tissues can reveal patterns of C_3/ C_4 and CAM plant consumption through the unique carbon and nitrogen values associated with each photosynthetic pathway, this survey is intended to go beyond a maize (C_4):C_3 dichotomy to consider what other plants have values in the C_4 range and are documented in ethnohistoric sources as central components of diet. The isotopic analyses of plant samples is strengthened by an analysis of plant microfossils from dental calculus from burials at Tepeticpac, discussed in **Ch. 7**. The goal of this chapter is thus not only to document previously unrecorded flora and fauna collagen and carbonate values in the Puebla-Tlaxcala valley, but also to establish a baseline of comparative isotope values so that these food sources might be compared to human dietary isotope values from the Puebla-Tlaxcala Valley discussed in **Ch. 7**. The results will also serve to explore local capacities for ecological sustainability, particularly in the case of Tlaxcallan's period of economic blockade.

The Mesoamerican Foodweb

To date, dietary isotope studies in Mesoamerica have centered on the research cores of Teotihuacan (Casar et al. 2017; Somerville et al. 2016, 2017; Sugiyama et al. 2015; Sugiyama 2017) and its interaction with the Maya area (Acevedo et al. 2006; Somerville et al. 2013, 2016; White 2005; White et al. 2001; White and Schwarcz 1999; Wright and White 1996; Wright et al. 2010; Williams et al. 2009) and the Oaxaca Valley (Warinner et al. 2013). This extensive research has in large part focused on the reconstruction of social and political relationships at sites within these areas, in order to understand key moments of political change. While this work has set the stage for understanding the ways people have interacted, there are some pervasive assumptions surrounding edibility and patterns of consumption: 1) maize as the dominant C_4 plant, when both wild and cultivated resources such as amaranth and cacti are clearly other ^{13}C-enriched plant food options that could have been a dominant food source and 2) terrestrial meat as the central source of protein, downplaying plant and insect contributions to the diet. I argue that locally-defined dietary diversity is necessary to conceptualize understandings of nutrition and health on a case-by-case basis.

Locally-defined dietary diversity

As a geological space, Central Mexico has been a site of high biodiversity since its formation in the Cretaceous (144-65 mya), shaped by fertile soils fed by surrounding volcanic ranges (Cervallos-Ferriz 2012; Piperno 2006). This geological and ecological history contributed the capacity to sustain growing human populations (see **Ch. 3**), not only due to the highly productive landscape, but also due to the broad range of naturally-occurring comestible resources and intergenerational knowledge systems about how to process them. For Teotihuacan and the

Oaxaca Valley, the majority of research has focused on large-scale food production to sustain city centers, production that has been assumed to rely heavily on maize as a central crop. Within this research, maize production and consumption are used to gauge the balance between production, population growth, and over-farming. Thus, many paleodiet analyses centered on exploring how much maize was consumed, as a proxy for the role of agriculture in society and (Zizumbo-Villareal 2010; Smith 2005; Piperno 2006). These studies operate under the assumption that agriculture was maize-dominant and that diets were predominantly agriculture-based. I argue that a focus on formally produced agriculture (particularly, the maize-beans-squash trio) is heavily influenced by contemporary understandings of food productivity and does not accurately reflect the diversity of food resources of the Prehispanic past. Maize was certainly a central crop, yet among the stalks were many other resources—wild succulents like verdolagas (purslane), nopal cactus and their fruits, maguey, protein-rich chapulines, or jumiles (grasshoppers and stink bugs), gusano de maguey (maguey worms), ants and their eggs (escamoles), and fungi like huitlacoche (corn smut). The botanical food world of Central Mexico was infinitely more complex than the monocrop rows of white and yellow corn that define agriculture today.

This argument about food diversity has been made by several archaeologists and bioarchaeologists studying Mesoamerica. Chinque de Armas et al.'s (2015) study of Canímar Abajo (samples from 1380-800 BCE and 360-950 CE) in Cuba uses dental calculus and dietary isotopes from bone collagen to emphasize the complex use of local wild plants. The earliest domesticated maize appears around 5400 BP (Guila Naquitz, Oaxaca - Piperno and Flannery 2001), with sedentary agriculture-based populations increasing across Mesoamerica by 2500 BC. Yet even in sedentary contexts, domesticated maize plants were grown in tandem with wild and cultivated plants, rather in the monocrop rows of contemporary agriculture. In Cuba, Chinque de Armas et al. find that maize was cultivated amidst a patchwork of other cultigens and wild resources. They found starch remnants from not only maize (*Zea mays*), but also the common bean (*Phaseolus vulgaris*), sweet potato (*I. batatas*) and barley (*Hordeum pusillium*). These data are interpreted as complex foodways that draw from multiple intersecting plant resource types.

In the Maya area, Williams et al. (2009, 2017) depart from the narrative that over farming of maize, paired with climactic changes, led to the Classic-period Maya "collapse." Using food webs, the authors seek to understand locally-specific responses to the dramatic political restructuring of the Late Classic/Early Postclassic. By creating a foodweb that emphasizes the complexity of local marine resources within the coastal Ambergris Caye populations of Marco Gonzalez and San Pedro, the authors demonstrate how marine proximity resulted in diets becoming enriched in ^{13}C (Williams et al. 2009). Without context and a holistic understanding of stable isotope analysis, this could be interpreted as high reliance on carbon enriched plants, such as maize, particularly if the researchers had focused only on carbon in collagen and no other isotopes. Yet by comparing carbon and nitrogen isotope values at both sites to the regional foodweb, they find that only one site (Marco Gonzalez) had significant C_4 contributions to diet, including maize, given the site's relationship to trade networks, where maize was a central item of trade. In contrast, San Pedro diets were primarily marine, even though the populations were only about 5km from one another and equidistant to the coast. Locally, both had access to the same ^{13}C-enriched resources, yet Marco Gonzalez' location on a harbor facilitated access to mainland maize.

In this case, a culturally-specific foodweb helped to clarify the values of locally-available resources, while also identifying the presence of imports. Within the narrative of maize consumption and political collapse within Late Classic Maya populations, Williams et al. demonstrate local resilience to political and ecological change. Rather than showing the Maya as a maize-based, mono-cropping society vulnerable to drought or other natural disasters, the authors use a local food web to demonstrate that diets among the Maya of Ambergris Cay were distinctive from one another, rather than sharing a single maize-dependent food structure. This diversity allowed individuals to shift diets over time, replacing maize with other regionally available resources when necessary, rather than causing a total community collapse.

This maize-centric dietary isotope analyses has also been critiqued by Warinner et al. (2013), whose work seeks to provide a more systematic analysis of highland Mesoamerican plants, in order to understand how plant proteins and isotopic values contribute to Mesoamerican diets. The authors completed an analysis of 300 plants from local markets in Oaxaca, surrounding fields, and comparative herbarium collections. Their research found that not only did local plants show a much higher isotopic diversity than previously recorded, but the consumption of CAM plans and other C_4 grasses makes the identification of maize consumption based on carbon values alone near impossible. Wild C_3 plant averages in Oaxaca were approximately 1-2‰ less enriched than standard values used in isotopic analyses (approx. 26.5‰ mean for C_3 plants, based on Africa savanna grasses). Additionally, the wide range of nitrogen values means legumes are not easily distinguishable from animal resources, likely due to cultivation and soil conservation practices (fertilization and raised field agriculture). A similar study in the Andes demonstrates that broad isotopic diversity was widespread in the Americas

(Tung and Knudson 2018). In short, the food webs that we use may serve as initial guides, but significant cultural competency and knowledge about local foodways and their histories is necessary to create context-specific food webs.

Work by Mc Clung de Tapia and colleagues (Mc Clung de Tapia et al. 2013; Mc Clung de Tapia and Zurita 2000; Mc Clung de Tapia 1977, 1979; Mc Clung de Tapia and Aguilar 2001; Mc Clung de Tapia and Martinez 2005) has centered on paleobotanical studies (predominantly phytolith and microfossil analyses) in Central Mexico to document Prehispanic foodways. Their work has emphasized the plant-based nature of Prehispanic Mesoamerican diets, as well as the biodiversity in resources. Tracing the history of these foodways through a mixture of ethnohistoric documents and archaeological findings, Mc Clung de Tapia et al. (2014) emphasize how Postclassic diets were based in foodways that date back to the Holocene (~12kya). Beyond key grain crops, plant-based resources include fruits, herbs, and condiments (e.g., epazote, chile, pápalo). Her work shows the time depth of knowledge about local flora, as well as exploring the ways such goods were integrated into everyday life. Flannery's () work in ancient Oaxaca also emphasizes reliance on plant-based proteins (specifically, nopal cactus-based).

While the reliance on biodiversity has become a central theme of paleodietary studies, studies of the significant roles of plant-based drinks remain on the periphery. The maguey cactus, a plant which in Prehispanic and contemporary eras holds a central role in delimiting land parcels and reducing erosion with its roots, is also the producer of alcoholic (pulque, mezcal) and non-alcoholic (aguamiel) drinks. Work by Correa-Ascencio et al. (2014) has demonstrated that such drinks could serve as calorie-rich dietary supplements, particularly during periods of drought. Maize was also used to produce a form of beer or wine (Smalley and Blake 2003; Zizumbo Villareal et al. 2009), as well as non-alcoholic atole, which could also be made from grains such as amaranth. Cacao, though not indigenous to the Central Mexico region, gained value as an import, often serving as a form of monetary exchange—yet one of its many uses was as a drink (McNeil 2006). Studies in the Andes have shown evidence that plant-based drinks, such as chicha, or maize beer, could visibly impact dietary patterns, reflecting changing social relationships expressed through the consumption of such ritual goods (Kellner and Schoeninger 2008). The expansion of this area of study is thus sorely needed in Mesoamerica to fully understand the complexity of paleodietary data.

A final central nutrient source to be considered is the central role of insects as a source of protein. To date, no comprehensive paleodiet study exists to explore the influence of insects on human dietary isotope signatures. However, studies of animals who consume insects as a primary food source have shown that such a diet will enrich both carbon and nitrogen values within the tissues of the consumer (Pearson et al. 2003), particularly if the insect consumed is in a larval stage (Tibbets et al. 2007). The role of insects in Prehispanic diets is well documented, both by early colonial chroniclers (Hernández 1942; Sahagún 2012; López de Gómora 1578) and by historians, biologists, and anthropologists (Castello Yturbide 1986; Ramos Elorduy et al. 2015; Lesnik 2018). Prehispanic knowledge of insects is expansive, with thousands of species and their uses documented in the Florentine Codex, Codex Mendoza, and in Sahagún's "Historia general." Consumed not only as raw ingredient, insects were also turned into drinks, dough, medicines and condiments. Their isotopic contributions to diet will be explored by the author in future research. In the context of this chapter, it is important to consider that as a high-protein, carbon and nitrogen-enriched food source, insects reflect and compound the contributions of surrounding plant resources to the diet.

Edibility and Ecosystem in the Puebla-Tlaxcala Valley

Ecosystem

As discussed in **Ch. 3**, the Puebla Tlaxcala Valley is characterized by the presence of multiple ecological zones within short distances of one another, leading to capacities for local household economy and exchange. The area occupied by Tlaxcala (the state) includes the wooded highland forests surrounding the skirt of the Malinche volcano, the salt flats and lagoons of the valley floor, and the "tierra templada" of surrounding hillsides, dedicated to the growing of maize and maguey (Fig. 3.2, Fig. 5.1). Cholula occupied a similar ecosystem, but with closer access to more temperate areas in the southern valley (for example, Atlixco) and the Oaxaca Valley corridor.

Figure 0.1: Bounds of the Postclassic state of Tlaxcala (blue dotted line)[13]*.*

---

[13] Based on model from Proyecto Arqueológico Tepeticpac.

In terms of resource accessibility, these areas are characterized by access to riverine animals (small shrimp, river insects, small fish, lizards), limited consumption of fauna (deer, peccary, rabbit, dog), and a dominating reliance on plants (Parsons 2008; Santley and Rose 1979, Mc Clung de Tapia et al. 2014). Mc Clung de Tapia et al. (2013) divide plant consumption into domesticated crops (maize, beans, squash), cultivated crops (maguey and nopal), wild plants (mushrooms, huauzontles, verdolagas, quelites) and fruit trees (tejocote, capulín, and avocado). Ethnohistoric records of foods and ingredients demonstrate the key role of plants in the diet and the extensive regional landscape knowledge bases held by local populations (Florentine Codex, Sahagún 1979, 1982; Hernández 1942, 1943, 1946). Additionally, a long history of ethnobotanical analysis from archaeological sites has confirmed the extensive use of domesticated, cultivated *and* wild crops, from the Holocene to the present (MacNeish 1958; Flannery 1986; Piperno and Flannery 2001; Mc Clung de Tapia 1977). A systematic study of multiple diachronic sites within and surrounding the Basin of Mexico records the presence of 90 different taxa of plants (Mc Clung de Tapia 2013). A systematic study of multiple diachronic sites within and surrounding the Basin of Mexico records the presence of 90 different taxa of plans (Mc Clung de Tapia 2013).

Edibility and public memory

Because of Tlaxcala's unique history of Spanish conquest and subsequent relative autonomy as an indigenous-led government within New Spain (Baracs Andrea 2008; Gibson 1967), the Puebla-Tlaxcala Valley, and Tlaxcala in particular is rich in ethnohistoric resources and public memory (Muñoz Camargo 1984; Lienzo de Tlaxcala; Buenaventura Zapata y Mendoza 1995). This history did not lead to a clear linear connection between the population of

Prehispanic Tlaxcala and that of Tlaxcala of today—there have been many complex sociopolitical shifts in this time. I argue the persistence of Prehispanic resources is the result of revisiting and reinterpreting traditions as responses to traumatic events including, but not limited to, colonialism, the end of the Spanish Viceroyalty, the revolution, and the impacts of NAFTA. In Tlaxcala, as in other indigenous-led regions, foodways are a site of cultural resilience that outlasts and exists both within and beyond a given political moment.

Explorations of Late Postclassic Central Mexican diets rely heavily on the comprehensive ethnohistoric accounts of the Early Colonial period. In particular, friar Bernardino de Sahagún's multi-volume, encyclopedic "Historia general de las cosas de la Nueva España" (the Florentine Codex) and Francisco Hernández' "Historia de las plantas de la Nueva España" contain extensive detailed illustrations and names for comestible plants and animals, as well as medicinal plants. The indigenous knowledge recorded in these sources provides a temporal marker for how foodways existed at a particular point in time—or at least, how they were recorded at a particular point in time.

Sample Selection

When selecting flora and fauna samples, I drew from ethnohistoric resources, which I interpret as the idealized public face of foodways. Pairing these resources with archaeological and paleobotanical research conducted within Central Mexico, including the bioarchaeological dietary isotope analyses in **Ch. 7**, allows for in-depth research into the ways "official" food traditions were incorporated into individual and group foodways. Establishing an isotopic baseline for dietary reconstruction thus becomes a key starting point for understanding the relationship between the values of available foods, and their parallels with isotope ratios found in human bone and teeth. What is reported in this chapter is a preliminary analysis of sampled materials, upon which future and more thorough and systematic research will be based, expanding and increasing sample sizes. The selected fauna were limited to a subsample of zooarchaeological remains from excavations at Tepeticpac, whose genus and species could be identified. The flora were selected based on ingredients that were available in local markets and that are central to small-scale rural farming contexts in contemporary Tlaxcala.

Flora

Distinguishing photosynthetic pathways

The photosynthetic pathway of a plant is central to the distinction in stable carbon isotope ratios in the consumer. The ratio of $^{13}C/^{12}C$ in a particular plant sample is reported in relation to the Vienna Pee Dee Belemnite (VPDB) reference standard—a fossilized shell that serves as a calibration point. The majority of plants follow the Calvin cycle (C_3 pathway), in which stoma openings preferentially absorb atmospheric ^{13}C and ^{12}C, though they tend to discriminate against ^{13}C. This results in $\delta^{13}C$ values that are more negative, ranging from -20 to -37‰ VPDB (Kohn 2010). In the Oligocene epoch (24-35 million years ago), shifts in climate led to the biological adaptation of a new photosynthetic pathway, known as the Hatch-Slack, or C_4 pathway (Sage 2003). With increased aridity worldwide, C_4 plants discriminate against the smaller isotope (^{12}C), in order to capture larger volumes of carbon in the short amount of time the stomata are open, so as not to lose moisture. By preferentially selecting ^{13}C, C_4 plants end up with an isotopic value that is more enriched in ^{13}C than ^{12}C, and thus represented in more positive values, ranging from -9 to -16‰ VPDB (van der Merwe and Tschauner 1999). Finally, Crassulacean acid metabolism plants (CAM) use a mix of C_3 and C_4 pathways, preserving moisture with the C_4 pathways at all moments except the afternoon, when the possibility of losing moisture is reduced. A controlled growth study of succulent (CAM) plants showed that due to this ability to adapt to changing climatic and environmental conditions, CAM plants can range from -28 to -13.3 ‰ VPDB (Osmond et al. 1973; Black and Osmond 2003).

Plant sample

To capture a range of C_3 and C_4 plants, 45 plant samples representing distinct species were collected from household gardens and local markets in Tlaxcala (see detail noted in **Table 5.1**). When possible, plants came from non-fertilized contexts, as nitrogen in fertilizer can artificially increase nitrogen values in fertilized plants (Augustine and Frank 2001; Frank et al. 2000; Spzak et al. 2014). All plants from kitchen gardens were non-fertilized, in that synthetic fertilizers were not used, and plants obtained from the market were sold as non-fertilized. By comparing the results of these plant samples to existing studies of Mesoamerican wild and domesticated plants, this study provides a range of values for evaluating elevated nitrogen and carbon values as a result of fertilization. In Western contexts, fertilizer is understood to be either a commercial-grade chemical substance that increases soil fertility, or "organic" animal or human waste. Given the results reported in the below sections, it is clear that several samples were nitrogen-enriched. Future ethnographic analysis will seek to better understand the growing processes used in household gardens and create a more comprehensive definition and understanding of "fertilizer."

Lab procedures

Following collection, plant samples were air-dried in a fieldhouse in Tlaxcala by hanging in a shaded, dry location at room temperature. Samples were individually labeled and packaged in mini Ziplock baggies and exported using USDA permit #PCIP-19-00165, registered to Dr. Tiffiny Tung of BSIRL. Once returned to the Bioarchaeology Stable Isotope Research Laboratory at Vanderbilt University, samples were either ground using a steel mortar and pestle, or for more fibrous plants, ground with a Spex 5120 Mixer/Mill.

Fauna

Distinguishing trophic levels and diet

As discussed in **Ch. 4**, nitrogen values from archaeological animal remains allow for the reconstruction of food webs, as the proportion of ^{15}N increases at each level of the food chain. Thus, the documentation of nitrogen values among sampled fauna will aid in establishing local nitrogen isotope values for different animal proteins within the food web. The δ^{13}C values, in contrast, reflect the plant-based components of animal diets. The majority of wild plants use the C_3 photosynthetic pathway; thus, animals who graze tend to have more negative carbon values. C_4 plants, in contrast, include domesticates like maize and amaranth, that share a proximity to human settlements and are closely linked to culturally-defined practices of food consumption. As Somerville and colleagues have shown at Teotihuacan (Somerville et al. 2010, 2016, 2017; Sugiyama et al. 2015), animals such as hare, deer, and even exotic animals such as macaws display ^{13}C-enriched diets distinct from their wild counterparts when held in captivity. Additionally, in work at Colha, Belize, White et al. 2001 found that deer and dog diets heavy in

C_4 plants indicate a more codependent relationship to humans, either through animal husbandry or scavenging from human food waste deposits.

Fauna sample

Eleven fauna bone samples were collected from zooarchaeologically identified species from the 2011-2012 excavations at the site of Tepeticpac by archaeologists Dr. Aurelio López Corral and Ramón Santacruz Cano. The eleven samples represent eight distinct species (**Table 5.2**).

Lab procedures

The bone samples were processed for carbon and nitrogen from collagen. Faunal samples were processed to extract bone collagen using the same method outlined in **Ch. 4**. As with human bone, diagenesis in faunal samples was determined through C/N abundance ratios, discussed in **Ch. 4**.

Results

Stable isotope results for plants

To adjust for atmospheric shifts in $\delta^{13}C$ following the Industrial Revolution (Marino and McElroy 1991), carbon values for plants were adjusted upwards by +1.5‰. Because some samples were collected fresh, while others were taken from dried storage contexts, seasonality was not considered within these values. However, in Warinner et al.'s (2013) study of the Oaxaca Valley, plants showed no significant difference between collection seasons. Thus, all flora samples were grouped in this study (**Fig. 5.1**). For sampled C_3 plants (n=34), the mean adjusted $\delta_{13}C_{col}$ was -25.7‰ (s.d.=1.5) and the mean $\delta_{15}N_{col}$ was +3.9‰ (s.d.=4.2). Within these values, four plants fell outside the expected nitrogen values, possibly due to fertilization (#4113, *Chenopodium ambrosioides seed*, also known as wormseed or epazote; #4106, *Urtica droica*, or stinging nettle; #3683, *Chenopodium ambrosioides leaf*, or quelite; and #3679, *Malva silvestrus*, or marshmallow). When these plants are removed from the sample, C_3 $\delta_{15}N_{col}$ average drops to +3.1‰ ±3.3.

For C_4 plants (n=8), the mean adjusted $\delta_{13}C_{col}$ is -10.8‰ ± 1.05 and $\delta_{15}N_{col}$ is +2.6 ±2.77‰. One C_4 plant (*Cymbopogon citratus*) is a European import adopted into indigenous healing practices following colonialism. When removed from the sample, the mean adjusted $\delta_{13}C_{col}$ is -10.6‰±.97, and the $\delta_{15}N_{col}$ is +2.5‰ ± 2.97. Sample #3676, amaranth, has a much higher nitrogen value ($\delta_{15}N_{col}$ is +4.9‰), which will be explored during the section on fertilizer effects. When removed from the average nitrogen values, the average $\delta_{15}N_{col}$ drops to +2.3±2.81‰. Statistical differences between C_3 and C_4 nitrogen values are not significant (*t*-value = -0.34774; *p*-value = .729734). Statistical differences between C_3 and C_4 carbon values are significant (*t*-value = -29.47114; *p*-value = < .00001), meaning that C_3 and C_4 plant species do not overlap in values. However, as can be seen in fauna and human diets in this study, individuals whose diets incorporate both C_3 and C_4/CAM plants produce intermediate values which can prove difficult to interpret.

For CAM plants (n=3), the mean adjusted $\delta_{13}C_{col}$ is -12.1 (s.d.=1.13‰), and $\delta_{15}N_{col}$ is +5.7 (s.d. = 2.72‰). Sample #3677, a nopal cactus, has elevated nitrogen values. When removed from the sample, average CAM $\delta_{15}N_{col}$ drops to +4.2 (s.d.= 2.62‰). Because of the small sample size of C_4/CAM plants in this study, it is not possible to determine whether CAM and C_4 plants are capable of producing significantly distinct values. Future work will increase the sample size to explore whether CAM vs. C_4 diets can be distinguished.

Table 0.1: Stable isotope results from modern cultivated plant samples

[1]kitchen garden [2] Mercado Central de Tlaxcala [3]Mexico City market

Sample ID	**Plant**	**Tissue**	**Adjusted $\delta^{13}C_{colVPDB}$ ‰**	**$\delta^{15}N_{colAIR}$‰**	**C%**	**N%**	**C:N**
Cultivated C4							
4108	Amaranthus hybridus L.[1] (amaranth)	Seed	-12.7	4.9	39.3	2.9	13.5
3676	Amaranthus hybridus L. [1] (amaranth)	Seed	-10.8	6.9	42.2	2.3	18.0
3686	Zea mays [1] (orange maize)	Seed	-10.2	3.2	41.6	1.0	41.2
3687	Zea mays [1] (large blue maize)	Seed	-9.7	-0.9	41.9	1.2	35.8
3688	Zea mays[1] (small blue maize)	Seed	-10.3	-1.4	41.6	0.9	44.7
3689	Zea mays[1] (small red maize)	Seed	-10.1	1.6	43.7	1.4	31.2
3690	Zea mays[1] (red and white maize)	Seed	-10.3	3.0	40.8	0.9	47.3
Cultivated CAM							
4114	Agave salmiana[1] (agave)	Leaf	-13.3	4.4	37.5	0.3	109.6
4115	Opuntia[1] (nopal)	Leaf	-11.1	4.0	43.7	0.4	107.5
3677	Opuntia [1]	Leaf	-11.9	8.9	35.5	2.7	13.2

	(nopal)						
Cultivated C3							
3675	Chenopodium nuttaliae[1] (huauzontle)	seed	-25.2	0.1	37.6	4.7	8.0
3683	Chenopodium nuttaliae[2] (quelite)	leaf	-25.7	10.0	36.1	5.9	6.1
4093	Calendula officinalis[3] (calendula)	flower	-28.3	4.6	47.6	1.9	25.4
4095	Valeriana officinalis[3] (valerian)	root	-26.3	1.9	42.3	0.8	51.8
4096	Tagetes erecta[3] (marigold)	flower	-27.1	7.6	48.5	1.5	32.7
4097	Aloysia citroclora[3] (lemon verbena)	Leaf	-26.6	7.4	42.2	2.7	15.7
4098	Arnica montana[3] (arnica)	Stalk	-25.8	5.0	44.8	3.1	14.3
4101	Eryngium carlinae[3] (Hierba del sapo)	Flower	-25.5	1.2	50.3	2.2	22.8
4103	Passifloraceae[3] (Passion Flower)	flower	-24.2	-1.4	43.2	2.9	15.2
4104	Similax ornata[3] (Sarsaparilla)	Leaf	-25.4	1.0	44.5	1.2	38.5
4109	Prunus salicifolia[1] (capulín)	Seed	-24.5	5.6	52.3	1.4	37.6
4110	Phaseolus coccineus[1] (runner bean)	Seed	-25.9	3.0	43.0	3.8	11.2
3678	Phaseolus [1] (alberjones)	Seed	-25.8	0.4	42.1	6.3	6.7

3700	Phaseolus[1] (brown beans)	Seed	-26.3	-1.0	41.4	3.3	12.7
3704	Phaseolus[1] (ayocote)	Seed	-22.3	-0.7	40.9	3.7	11.1
4111	Chenopodium nuttalliae[1] (huauzontle)	Seed	-26.7	-0.8	43.3	2.4	17.7
4112	Cucurbita maxima[1] (squash)	Seed	-24.5	5.2	58.8	5.5	10.6
3699	Cucurbita maxima[1] (pumpkin)	Seed	-24.3	4.4	58.3	5.8	10.1
4113	Dysphania ambrosioides[1] (epazote)	Seed	-25.4	14.9	45.5	2.9	15.4
3691	Pisum[1] (white peas)	Seed	-25.6	3.7	41.3	3.6	6.9
3697	Pisum[1] (chicharo)	Seed	-25.6	3.7	41.3	3.6	11.6
3698	Capsicum [1] (chile)	Seed	-28.5	4.3	53.3	1.4	39.2
3679	Malva silvestrus[2] (mallow)	Leaf	-25.9	12.3	39.5	5.7	6.9
3680	Coriandrum sativum[2] (cilantro)	Leaf	-25.5	0.7	42.2	3.9	11.0
3682	Salvia hispanica[2] (chia)	Seed	-26.5	2.7	53.2	3.4	15.5
3684	Porophyllum linaria taget[2] (Mexican pipitza)	leaf	-25.4	5.4	40.0	3.6	11.0

3685	Cretageus mexicana[2] (tejocote)	fruit	-29.1	1.4	40.6	0.5	81.8
Non-indigenous C4							
4094	Cymbopogon citratus[3] (lemongrass)	Leaf	-15.1	3.4	44.7	1.6	28.5
Non-indigenous C3							
4099	Foeniculum vulgare[3] (fennel)	Leaf	-25.9	3.4	42.1	3.6	11.3
4100	Citrus sinensis[3] (orange blossom)	Flower	-24.8	-4.3	47.4	0.6	84.3
4102	Moringa oleifera[3] (Moringa)	Leaf	-26.9	3.2	43.7	5.1	8.6
4106	Urtica droica[3] (nettle)	Leaf	-25.6	11.5	36.0	4.6	7.8
4107	Mentha pulegium[3] (pennyroyal)	leaf	-26.8	6.6	44.0	3.9	11.4
4105	Equisetum arrense[3] (horsetail)	stalk	-27.1	7.3	0.7	-28.6	47.7

Table 0.2: Archaeological fauna from Late Postclassic Tepeticpac

Sample ID	Animal	Tissue	$\delta_{13}C_{colVPDB}$ ‰	$\delta_{15}N_{colAIR}$‰	C%	N%	C:N
3706	*Canis familiaris* (Dog)	Bone	-12.0	7.7	33.1	12.3	2.7
3708	*Odocoileus virginianus* (White-tailed deer)	Bone	-6.1	10.0	25.7	9.5	2.7
3715	*Eulipotyphla* (Mole)	Bone	-11.7	3.8	8.1	3.0	2.7
3714	*Melleagris gallopavo* (Turkey)	Bone	-11.6	7.4	30.4	11.2	2.7
3722	*Callipepla* (Quail)	Bone	-10.0	7.5	34.2	12.5	2.7
3723	*Aylvilagus floridanus* (Rabbit)	Bone	-9.6	8.5	6.9	2.4	2.9
3724	*Anas* (Duck)	Bone	-16.2	6.3	36.4	13.3	2.7
3709	Water viper	Bone	-15.3	8.4	33.2	12.5	2.7
3710	*Aylvilagus floridanus* (Rabbit)	Bone	-18.9	5.4	17.2	6.4	2.7
3713	*Leporid* (Hare)	Bone	-21.7	3.0	23.9	8.9	2.7
3716	*Odocoileus virginianus* (White-tailed deer)	Bone	-21.0	3.9	30.8	11.3	2.7

Stable isotope results for fauna

The 11 archaeological fauna samples were taken from nine distinct species, selected from zooarchaeological remains found throughout the site of Tepeticpac in excavations conducted in 2012 and 2013. The isotopes results are summarized in **Table 5.2**. The mean $\delta_{13}C_{col}$ value for animals is -14.3 (s.d.=5.4‰), with an expansive range from -21.7 to -6.1‰. The mean $\delta_{15}N_{col}$ value for animals is +6.3 (s.d.=2.49‰), with a range from 3 to 10‰.

Discussion

From the samples analyzed, contemporary flora from the Tlaxcala region group distinctly into ranges that follow the values of known Mesoamerican C_3 and C_4 plants. The three CAM samples overlap with ranges expected of C_4 plants, suggesting that CAM resources in Prehispanic diets may be indistinguishable from C_4 resources, and both contribute to enriched $_{13}C$ values. Within archaeological fauna, the majority of animals fall within a C_4- feeder or mixed C_3-C_4 diet range, with little evidence that C_3 plants were a central component of diet among sampled fauna. Trophic level differences are visible between some herbivore vs. omnivore animals, such as rodents vs. dogs.

However, for white-tailed deer and rabbits, for whom two distinct individuals were sampled, diets are seen to vary wildly within species categories. In particular, the turkey, dog, quail, rabbit and white-tailed deer enriched in carbon are also more enriched in nitrogen than the fauna with a mixed diet. What unique feeding behaviors were these fauna experiencing that their less-enriched peers did not? The $\delta^{15}N$ and $\delta^{13}C$ data collected from flora and fauna in Tepeticpac gains additional value when brought into comparative analysis with other studies throughout Mesoamerica. In particular, the discussion will focus on the themes of biodiversity in Mesoamerican agriculture, foraging, foodways and the role of fauna in human-animal interaction, including isotopic evidence for domestication and/or animal foraging within human food way spheres.

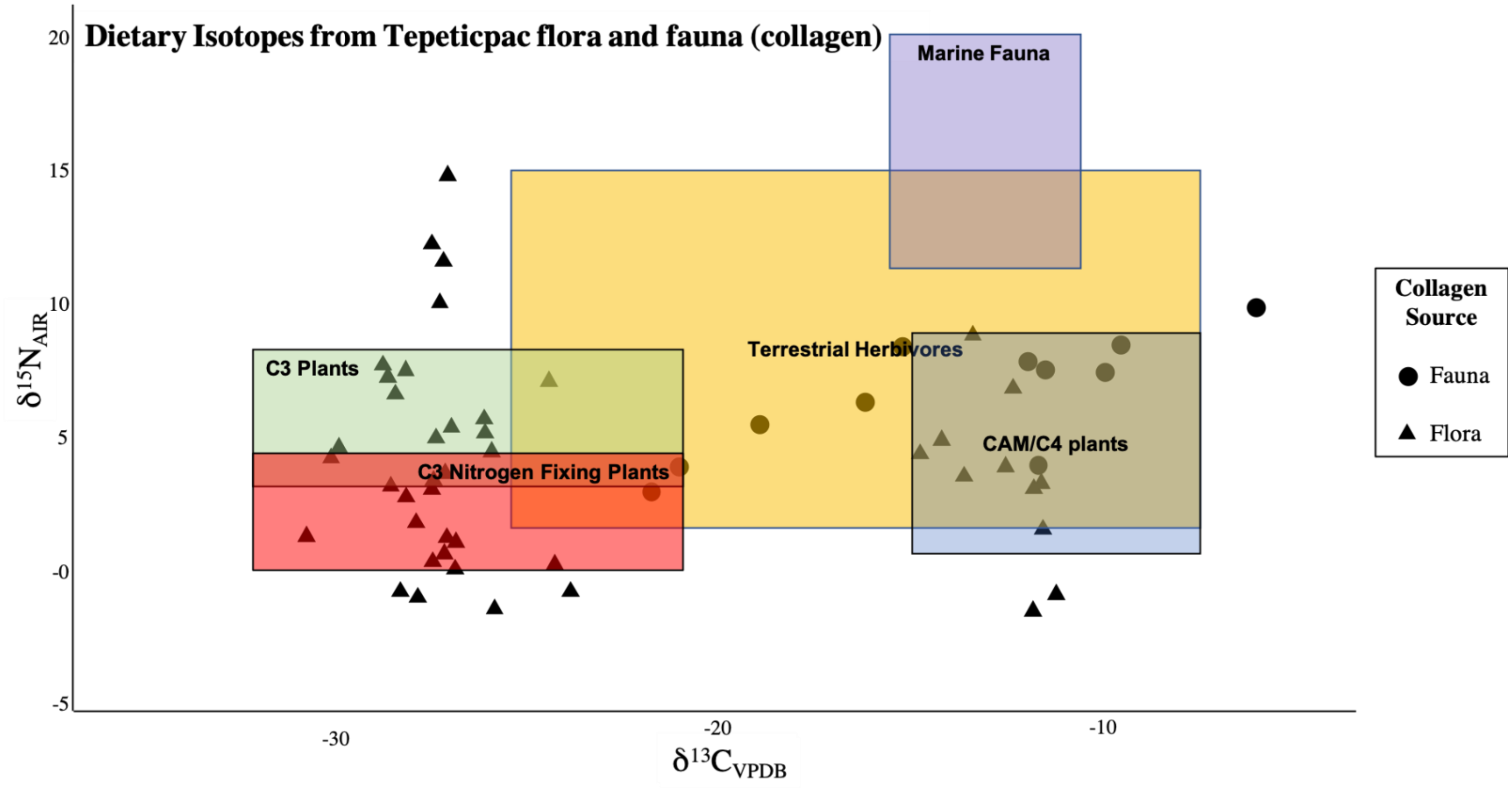


Figure 0.2: Overview of food web with Tepeticpac flora and fauna values[14]..

[14] Projected food-type ranges based on Tykot (2006) and White et al. (2001).

Flora

C4: More than maize

Ethnohistoric sources emphasize the importance of maize in Prehispanic Mesoamerican diets—the Popol Vuh described it as the embodiment of the first humans (Recinos 2010). Its importance remains central to Mexican cuisine, notable in the continued use of Nahua food words: tamal, elote, comal, metate. Sahagún records dozens of words associated with the many ways maize was prepared and incorporated into meals (Sahagún 1979). Known as the "meat of the poor" (Cardoza y Aragón 2006), maize was abundant, efficient, and adaptable. Yet it did not stand alone. A problem with focusing on the centrality of maize in Mesoamerican diets is that it overlooks the wide biodiversity in ancient foodways. Yes, maize was central. However, it was accompanied by a wide array of additional, longstanding plant-based staples, such as amaranth, various legumes, and succulents (Correa Ascencio et al. 2014; Evans 1990; Hernández 1942; Sahagún 2012; Castello Yturbide 1986; Zizumbo-Villareal et al. 2009). In fact, through an analysis of ethnobotanical remains from sites that span the Formative to the Postclassic Mc Clung de Tapia (2013) argues that the constant presence of particular plants across time likely speaks to their importance in Prehispanic diets and reveals local knowledge about the environment and ecology. Importantly, biodiversity, visible through the presence of ethnobotanical remains from amaranth and other chenopods, nopal, beans, corn as well as several herbs and wild greens shows that many of the plants recorded in codices stem from knowledge that date much further back, to up to 2,000 years ago.

Generally, dietary isotope analyses are used to distinguish the amount of maize (the largest C_4 domesticate) consumption in diets in the Americas. Maize is associated with the agricultural revolution, a key sociopolitical moment that allowed for population growth and the concentration of wealth and power (Cohen and Armelagos 1984). Indeed, in the Central Mexican Valleys, MacNeish (1958) argues that this transition was a gradual shift from foraging to incorporating more and more domesticated and cultivated plants, such as maize, into the diet. At the same time that agriculture emerged, wild and cultivated plants continued to remain as key contributors to diet in Mesoamerica.

From the isotopic data collected in this study, it is clear that agave, nopal and amaranth ($\delta^{13}C_{coll}$ = -13.3‰, -11.1‰/11.9‰, -12.7‰/10.8‰, respectively) produce values similar to those expected for maize (approx. -12.5‰). As discussed in the Florentine codex, amaranth was used in many of the same ways as maize as a dough for tortillas and tamales; as a thickening agent for atole; as a ritual food. Thus, C_4 crops are major cultigens that form dietary complexes with domesticated crops such as maize and cannot be distinguished isotopically within the Tepeticpac sample. This is a finding congruent with patterns in other regions of the Americas (Tung and Knudson 2018), where studies of C_4 crops are beginning to challenge and wrestle with the complexity of expanding beyond the maize-only model.

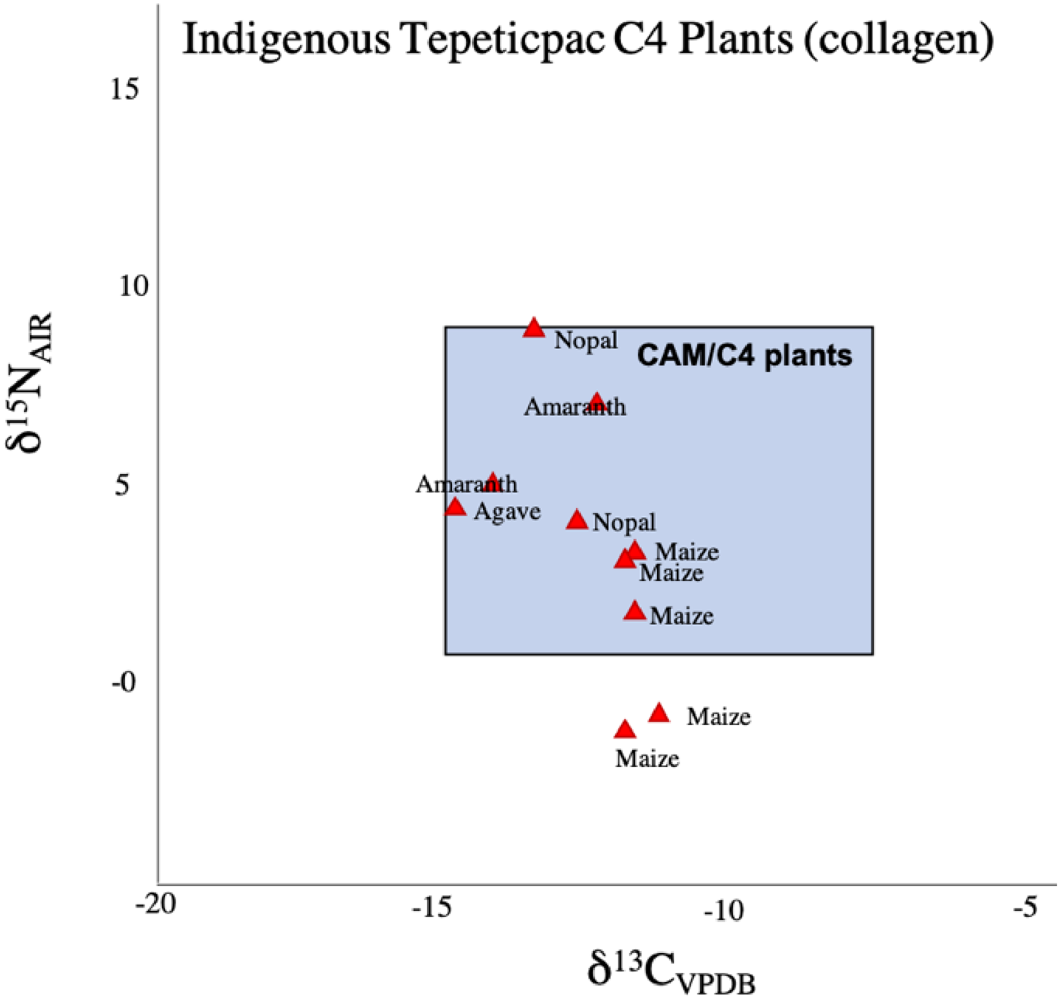


Figure 0.3: Dietary isotope values for modern indigenous C4 plants[15]*...*

---

[15] Latin names can be found in Table 5.1

Comparative diets: $\delta^{13}C$ wild and cultivated biodiversity

In their comparative analysis, Warinner et al.'s (2013) summary of Mesoamerican paleodietary studies found that C_4 plants throughout Central Mexico, Belize, Guatemala, and Honduras fell within a $\delta^{13}C$ range of -9 to -12.5‰, and C3 plants fell within a range of -25 to -27‰. Leguminous plants fell within a $\delta^{15}N$ range of 0-1‰ while non-leguminous values fell between 2-9‰ (Coyston et al. 1999; DeNiro and Epstein 1981; Emery et al. 2000; White 2005; White and Schwarcz 1989; White et al. 1993, 2001; Wright 1997). Their own study sampled approximately 400 plants from the Oaxaca Valley in an attempt to capture the wide biodiversity of this region. These plants came from Oaxaca Valley markets (n=196), lowland Oaxaca markets (n=45), modern wild plants (n=150) archaeological collections (n=5) and the Harvard University Herbaria collection (n=8). Within this study, wild C3 plants had a $\delta^{13}C$ mean of -28 ± 2.3‰, while market plants had a mean of -27.3 (s.d.=2.0‰), which they note is 1-3‰ less enriched than recorded paleodietary ranges. Wild C_4 plants had a $\delta^{13}C$ mean of -13.3 (s.d.=.54‰), while market C_4 plants had a mean of -12.1(s.d.=1‰). The authors also examined CAM plants and found market CAM plants had a mean of -13.1 (s.d.=.7‰) and wild CAM plants had a mean of -14.3 (s.d.=3.39‰). Important in these data is the evidence that CAM plants as well as amaranth overlap with maize values. Additionally, the authors note that CAM has often been considered unique from C_3 and C_4 plants in the breadth of its possible values—as a plant that can shift from C_3 to C_4 photosynthetic pathways to adjust to changing ecological humidity and aridity. However, in this study, no dramatic variation was noted—CAM plants fell consistently within C_4 ranges. The authors also note that wild versions of plants tend to have greater variability in values, visible in wide standard deviation—a pattern they attribute to high biodiversity, both within market and wild Oaxacan plants.

Within Tepeticpac plant values, C_3/ C_4/CAM plants fall within the Mesoamerican range of expected values (**Fig. 5.3**). When compared to Warinner's Oaxaca study, there is lower variation in isotope values, but this is likely the result of a much smaller sample size. Similar to Warinner et al. (2013), CAM values, here combined with C_4 values due to small sample sizes, remain clearly distinguishable from C_3 plants, aligning with Oaxaca wild and market C_4 plant ranges. At Tepeticpac, archaeological findings have confirmed the extensive use of maguey for fiber production (Ibarra et al. 2018). Contemporary uses of CAM plants include the incorporation of nopal cactus into main dishes and drinks and the consumption of pulque, aguamiel, and mezcal from maguey cactus. At the nearby Epiclassic site of Xochitecatl-Cacaxtla, researchers argue that the presence of multiple ovens associated with maguey processing indicate the importance of mezcal production in this region from an early date—perhaps even indicating its origin in the Puebla-Tlaxcala Valley (Lazcano Arce 2003; Puche et al. 2000, 2012). With this combined information, it is likely that CAM plants, as sources of a multiplicity of foods and drinks (Hernández 1946; Sahagún 1979) are a common contributor to enriched δ^{13}C values in Mesoamerican diets, particularly in the Puebla-Tlaxcala Valley.

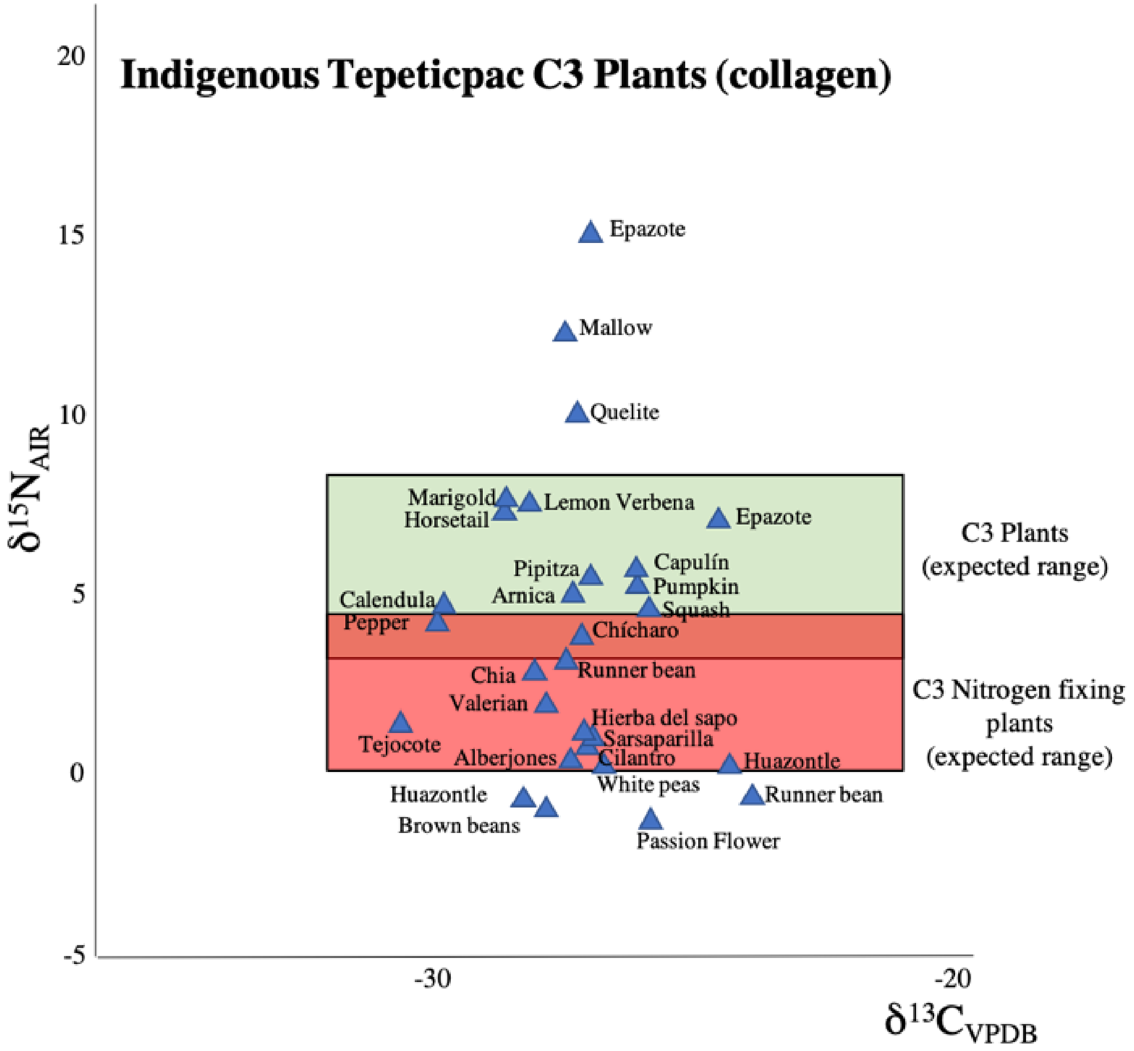
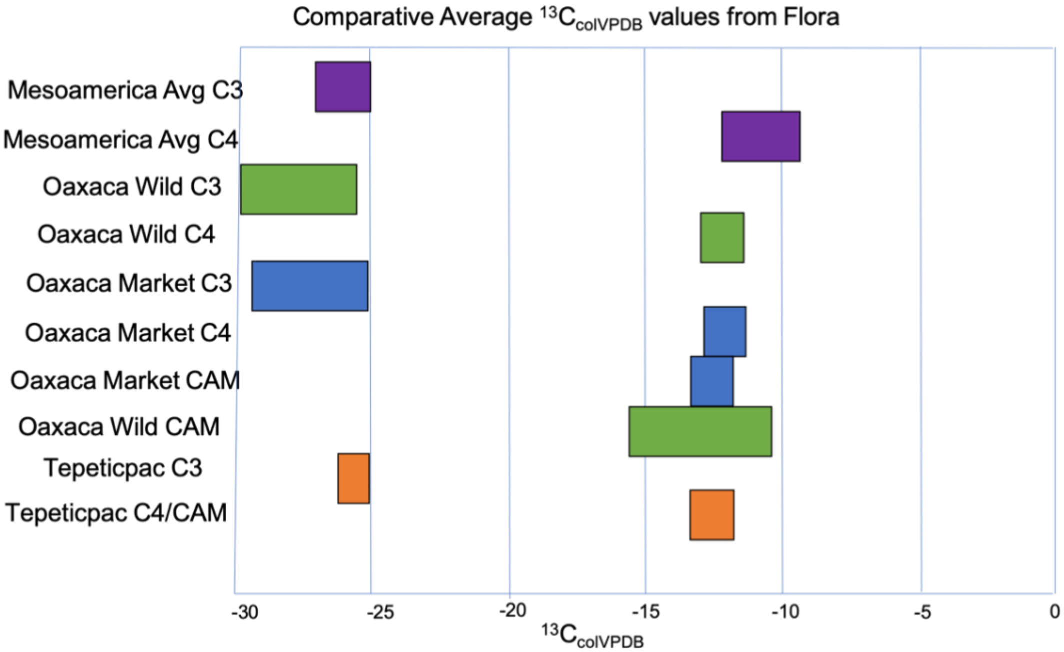


Figure 0.4: Dietary isotope values for modern indigenous C4 plants[16]*..*

---

[16] Latin names can be found in Table 5.1.

With regards to C_3 plants, there are a wide variety of wild and cultivated fruits in Mesoamerica, including wild plum, mesquite, tejocote and capulín (Mc Clung de Tapia 2013). In addition, many herbs and condiments used to season food or for medication are included in this category (Sahagún 1982; Hernández 1946). Among the plants sampled, C_3 values at Tepeticpac are more narrowly distributed than C_4 values. This is likely a result of the majority of C_3 samples coming from market contexts, which represent cultivated rather than wild species, and thus a decrease in biodiversity. Future analyses will expand on the sample size from Tepeticpac specifically and Tlaxcala more broadly. While these results show that generally, Mesoamerican-wide ranges are useful for predicting locally-specific ranges, Warinner et al.'s (2013) Oaxaca study shows how varied these local ranges can be when you take into account widescale analysis of local



resources.

Figure 0.5: Comparative $^{13}C_{col}$ *data from Mesoamerican Flora*[17].

---

[17] Mesoamerican flora from Warinner et al. 2013; Tepeticpac flora values from this study.

δ_{15}N: Fertilizer effects

Fertilization of crops is known to artificially increase δ_{15}N values. While in the most extreme of cases, plants fertilized with seabird guano have been found to show nitrogen values of 25.5-44.7‰ (Spzak et al. 2012), camelid dung, used as a fertilizer in the Andes, was found to produce values +1.8-4.2‰ higher than expected plant ranges (Spzak et al. 2012). Humans consuming a plant-based diet should in theory reflect this diet through nitrogen values that are one trophic level (+3‰) higher than local plant values. If humans are consuming herbivores, this trophic level is doubled (herbivores eat plants, +3‰, humans eat herbivores, +3‰). A confounding factor described by Bogaard et al. (2007) is that manuring can increase starting plant values to at least one trophic level of difference, producing human values that fall within those expected for an omnivorous diet, even if only plants are being consumed.

For the Tepeticpac samples collected from small-scale kitchen gardens, I was able to confirm the lack of synthetic fertilizer during ethnographic observation and participation in farming/gardening. During the time that I participated in gardening practices, no external fertilizers (e.g. compost, human or animal waste) were used to increase the production rate of the plants. For the samples obtained from the markets, the sellers were asked how the plants were grown, and verbally confirmed that fertilizers were not used. However, looking at the data, there are a few samples whose nitrogen values were higher than expected for non-fertilized plants, particularly, samples #3683, quelites, #4113, epazote, and #3679, mallow (#4106, nettle, also falls within this group but is not an indigenous plant). These samples fall approximately +7‰ higher than expected C_3 plant ranges, and thus will be used with caution when considering how they relate to potential human diets based in C_3 plants. As mentioned previously, future analyses will include an ethnographic study that explores local definitions of “fertilizer” and standard agricultural field maintenance practices.

The samples collected for this particular study are based on contemporary farming techniques. Those collected from kitchen gardens are farmed in a manner derived from knowledge about indigenous farming techniques, where the biodiversity of farming plots (for example, planting maize with nitrogen-fixing beans to maintain nitrogen levels in soil) negates the need for external fertilizers (Montagnini 2006). However, fertilization processes in Late Postclassic Mexico have been recorded, particularly within the chinampa system made famous within the Basin of Mexico and Tenochtitlan floating gardens (Robles et al. 2019). The extensive terrace systems that have been archaeologically mapped at Tepeticpac (Fargher et al. 2011; López Corral and Santacruz Cano 2020) support an agricultural system where the majority of plant foods came from hillside maguey terraces (such as those described by Evans 1990, Pérez Rodríguez 2016) rather than lakebed islands. Future research will explore the potential of measuring nitrogen values from paleobotanical remains and creating a working definition of “fertilization” that includes any practices that might inflate nitrogen values.

Fauna

Domestication of fauna

Within Mesoamerica, the relationship between animals and humans does not take the shape of European animal husbandry, and thus, the idea of “domestication” has been a site of debate. Archaeologists have examined the systematized relationship between humans and animals through architecture that indicates animal management and processing (Manzanilla 1993; Manzanilla 1996; Valadez 1993), while zooarchaeologists have quantified the amount and types of animals consumed, ritually slaughtered, and/or cared for by looking at concentrations of faunal assemblages in refuse areas. Through dietary isotope studies, researchers have sought to define unique human-animal relationships through the presence of C_4-heavy animal diets, as the majority of C_4 plants are closely tied to domesticated or cultivated crops (Somerville et al. 2010, 2014; White et al. 2001). Studies by Somerville et al. (2016) and White et al. (1993, 2001) have shown that due to the higher consumption of C_4 foods in human diets, similarly ^{13}C-enriched fauna can indicate a relationship where selected animals are intentionally fed stored grains, or animals with access to C_4-dominant agricultural areas forage within C_4 crops.

Somerville et al.'s (2016) study of cottontail and jackrabbit bone collagen from Teotihuacan (AD 1-550) faunal assemblages found that leporids from Teotihuacan contexts had an average $\delta^{13}C_{collagen}$ value of -15.7 (s.d.=2.9‰). They interpret this as either the result of "crop raiding," e.g. leporids feasting on densely grown maize crops, and then being caught and consumed, or as a result of a diet heavy in C_4 grasses that grow in the region. Another possibility is trade, where certain animals with high $\delta^{13}C$ are coming from contexts with different animal management practices. Interestingly, they found that leporid $\delta^{13}C$ values increased as the city grew and decreased following its decline—supporting a hypothesis in which leporid and human food systems were codependent.

In McCafferty et al. (2014) the authors record values for wild turkey from the Pueblo II (AD 1050-1150) and III (AD 1150-1300) periods in ancestral Puebloan sites in northern New Mexico. Their analysis of 48 collagen samples produced an average of $\delta^{13}C$ of -8.8 ±2.0‰, which is interpreted as a range for pure maize feeders. A similar study of Turkey from Shields Pueblo, Colorado (Rawlings and Driver 2010) shows a broad range of $\delta^{13}C$ values between -8.41 and 10.11‰.

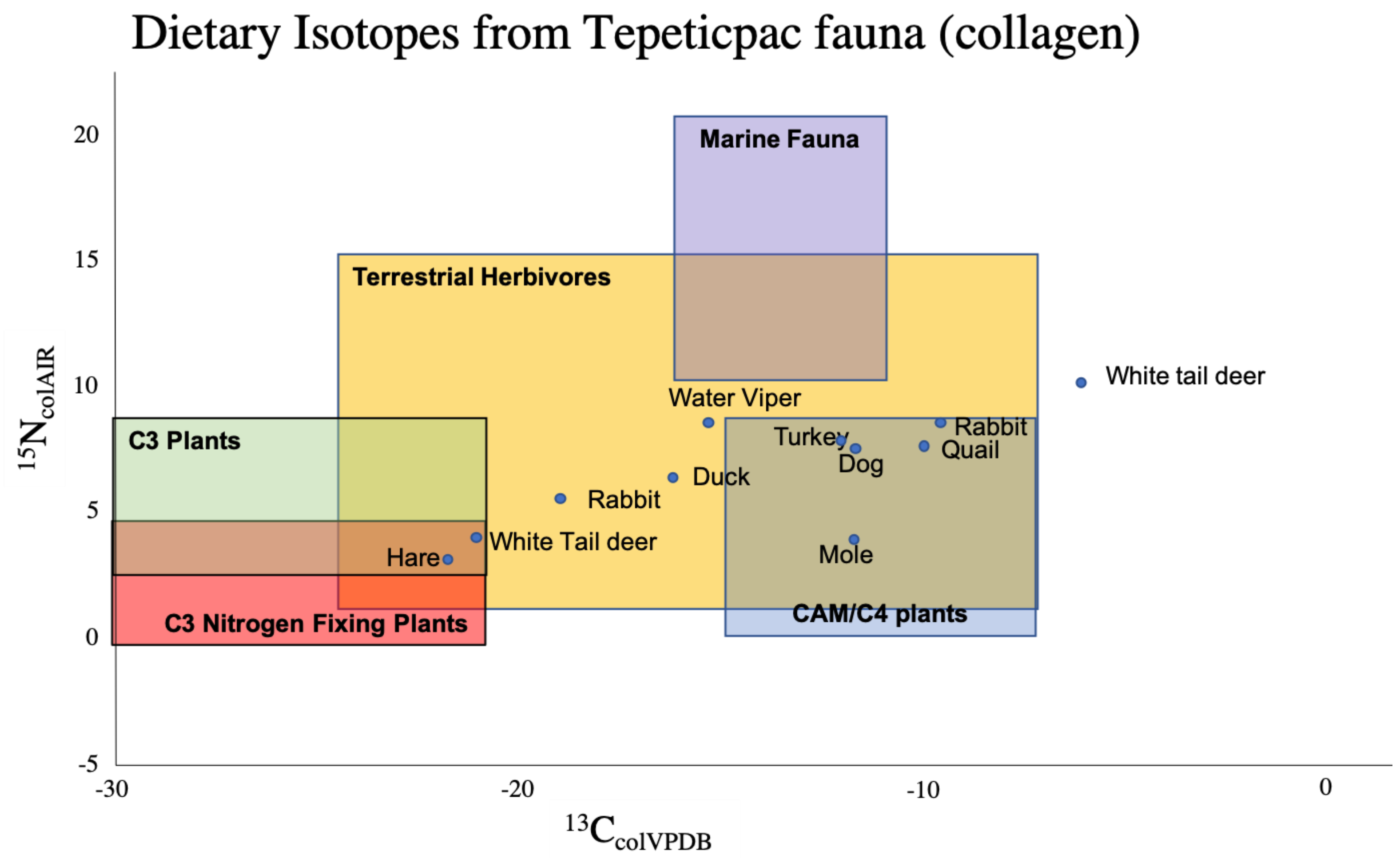


Figure 0.6: Carbon and Nitrogen isotope values for archaeological fauna[18]..

---

[18] Fauna collected from Proyecto Arqueológico Tepeticpac excavations. Latin names can be found in Table 5.2

Patterns of faunal diet at Tepeticpac

Fauna sampled at Tepeticpac are split between those with primarily C_4 diets (*Canis familiaris* [dog], *Odocoileus virginianus* [white-tailed deer], *Eulipotyphla* [mole], *Melleagris gallopavo* [turkey], *Callipepla* [quail], and *Aylvilagus floridanus* [rabbit]) and a gradient of those with mixed C_3/C_4 diets (*Anas* [duck], water viper, *Aylvilagus floridanus* [rabbit], *Leporid* [hare], and *Odocoileus virginianus* [white-tailed deer]). Of those with heavily C_4 diets, the dog, deer, turkey, quail, and rabbit are animals known to have been kept in pens and used for sacrificial rituals within Mesoamerican society (Durán 1964). Their values (-12 to -9.6‰), with the exception of the white-tailed deer, are grouped within the range of C_4 plants, and are slightly less than ranges given by McCafferty et al. (2014) and Rawlings and Driver (2010) for 100% C_4 animal diets (approx. -8-9‰).

Rabbit #3723 ($\delta_{13}C$ of -9.6‰) approaches these pure-C_4 diet levels and falls along the values (-9.0 to -8.0‰) found by Tykot et al. (1996) when examining values among dogs fattened on maize for sacrifice at the Preclassic Maya site of Cuello. This rabbit stands in contrast to rabbit #3710, which clearly falls closer within a C_3/C_4 mixed diet range. Comparing these two distinct diets demonstrates that within the same species, animals could have unique feeding patterns. As Somerville et al. (2016) argue with animals at Teotihuacan, this could be due to "raiding" C_4 crops or intentional human feeding. When compared to the mole, a likely rodent pest within crops, the rabbit values are more positive. When compared to turkey, dog, and quail, other animals who were known to be kept in captivity, the rabbit is again, more enriched in $\delta_{13}C$. The animals who are more enriched in $\delta_{13}C$ are also more enriched in $\delta_{15}N$ (with the exception of the mole, who likely falls into the "crop raiding" category), indicating dietary resources unique from their scavenging peers. I argue that these values thus indicate an instance of intentional feeding of primarily C_4 foods that went beyond the scope of scavenging. This is a pattern that can also be seen between the two deer in the sample.

White-tailed deer

White-tailed deer often exist at the margins of social spaces, among areas that have been prepared for crops, such as the milpa. When foraging, their diets will often consist of a mix of C_3 and C_4 resources. In a study comparing dogs and deer at the Preclassic Maya site of Colha, Belize, White et al. (2001) found that 16 deer samples spanning two periods (Early Middle Preclassic, 1000-600 BC and Late to Terminal Late Preclassic, 1000 BC-AD 250) shared uniform values of $\delta_{13}C$ at -21.1±1.0‰. In contrast, within the Tepeticpac sampled deer, sample #3708 ($\delta_{13}C$ of -6.1‰), stands out as even more enriched than animals projected to have a 100% C_4 diet (McCafferty et al. 2014; Rawlings and Driver 2010). Warinner and Tuross (2009) argue that nixtamalized corn produces more enriched values, thus it is possible that this deer was not only eating 100% C_4 diet, but a nixtamalized C_4 diet. As the nixtamalization process is clearly linked to human foodways and food preparation techniques, it is unlikely that these values are coming from crop raiding. It is more likely that they are the result of feeding the deer, or perhaps of scavenging amidst prepared food waste. The values for deer #3708 are much different from its C_4-feeding counterpart, with $\delta_{13}C$ values of -21‰, in line with the values from Colha, Belize for deer that live within forests surrounding urban areas (White et al. 2001). The difference between these two animals of the same species is drastic and indicates distinct food sources for each.

Interestingly, a set of burials (Burial 3.21.1 and Burial 3.27.9) were found with a plate depicting the head of a deer (**Fig. 5.5**). Among the characteristics of Tlaxcalteca identity is the centrality of hunting as a group identity—the god Camaxtli, or hunting god, was considered to be the central god, whose day of celebration (Quecholli) is enacted with a feast including sacrifice of a deer (Durán 1964; Olivier 1962). Multiple other sources describe the relationship between deer and ritual throughout Mesoamerica (Pohl 1981, 1994; Tozzer and Allan 1910). Future research based on a larger sample size of deer from Tepeticpac will expand the range of δ_{13}C values among deer remains found within the site to further explore whether an argumentcan be made for specialized diets among deer prepared for ritual use.

Figure 0.7: Deer imagery on plate associated with Burial 3.21.1 and Burial 3.27.9[19].

---

[19] Image by K. Alcantara, map by Proyecto Arqueológico Tepeticpac.

Conclusion

In sum, the preliminary construction of a Tepeticpac food web supports that argument that interpretation of $_{13}$C enriched diets should be locally contextualized to understand what other resources may be contributing to enriched values. Research has shown that CAM plants (agave, maguey, nopal) and other C_4 resources (amaranth, millet) cannot be distinguished from maize values (Casar et al. 2017; Warinner et al. 2009; 2013;). Regional foodweb reconstructions have repeatedly shown how varied and regionally unique local resources can be evidence that I will argue later supports cases of community resilience and resistance.

At Tepeticpac, maize was a central food source, but supplemented by a wide range of other resources that produce similar δ^{13}C values. Thus, defining C_4 plant ranges as "maize" is not an effective categorization to capture the wide range of C_4 resources in Tepeticpac diets. In particular, I emphasize the importance of considering CAM plants, particularly maguey and nopal, as common resources which may also fall within the C_4 plant value ranges. CAM plants not only had ritual and traditional uses that were important, but also adapted to drought easily—a key threat to food security during the final decades of the Postclassic. By including a broader range of plants, both cultivated and wild, into the Mesoamerican food web, this analysis shows how agency and individual autonomy can be cultivated by resilient communities operating outside the confines of agricultural systems. Furthermore, this work reveals the adaptations developed by individuals at Tepeticpac, showing how they could also rely on resources that are resilient to environmental pressures like drought. Trade within Mesoamerica was a longstanding and beneficial system but exploring local landscape knowledge and availability of resources emphasizes that trade may not have been necessary for communities to thrive locally. Understanding this can help to decrease oversimplification of not just foodways but social systems.

By establishing a food web for Tepeticpac, I am able to approach interpretation of human values with particular parameters in place. First, it is clear that C_3 and C_4/CAM plants self-separate into non-overlapping values, which will allow me to more easily interpret the photosynthetic plant source for human values. While four flora samples were unexpectedly nitrogen-enriched, indicating that understandings of "fertilization" processes differ culturally, these samples did not belong to the kitchen-garden and small-farm grown flora. Given what is known about terrace farming practices in Prehispanic Tlaxcala (Crews and Gliessman 1991), the methods used were likely more similar to those used by the small farm practices, where biodiverse raised field systems allow for a largely self-sustaining system of nutrient exchange between plants. Considering this pattern, it is unlikely that fertilization practices significantly distorted nitrogen values of plants within the ancient foodweb.

Faunal data show that animals (most notably deer, dog, turkey, quail and rabbits) are part of human foodways, which can then be extrapolated to understand that some meat consumption was taking place. Establishing ranges for these animals also clarifies the "starting values" of meat sources in the human diet—for many animals, an already C_4-rich diet will lead human consumers to also have increasingly enriched $\delta_{13}C$ values. To determine how *much* of the C_4 in diets comes from low-protein plants like un-nixtamalized maize vs. high protein resources like amaranth or meat, **Ch. 7** turns to a model of carbon-apatite spacing.

Finally, the ritual importance of many ingredients is made clear in this chapter-ingredients are not simply chosen from foods that are available, but foods that are nested within systems of social value. The politics and economics of this choice-making will be explored in more detail in **Ch. 7**, as we turn to individual decision-making vs. group ideology.

6

DEFINING COMMUNITY: MOBILITY AND LOCALITY WITHIN SAMPLES AT TEPETICPAC AND CHOLULA

In order to interpret "community" patterns of diet, this chapter uses oxygen isotopes as a loose proxy for the identification individuals who are "local" to the Puebla-Tlaxcala Valley. By identifying a core local population and those who arrive from external locations, this chapter sets up a framework for understanding food as a tool for belonging and/or identifying difference. Radiocarbon dating is used to identify inter-generational cohorts of community, to explore how tradition might change or persist over time.

Introduction

Individual and group capacities for agency and, in this case, resistance often rely on particular social identities—for example, the symbol of a strong, resilient Tlaxcaltecan warrior. These identities and beliefs about the way the world is structured are reified at multiple levels (e.g., those represented in the Bioecological Model) and they are made concrete through actions that embody these beliefs. Yet, as scholars such as Isbell (2000) and Cohen (2003) argue, it is crucial to critically examine the permeable boundaries of group similarity and difference, viewing "community" not as a concrete entity, but as a system of ideas and actions constantly in flux. In this chapter, I examine the ways in which oxygen isotope values can be used to explore notions of "local" within a region, and I discuss how the new radiocarbon dates presented here can provide a certain perimeter of known chronological relationships, a combination of data that helps to situate place and time. In turn, those datasets aid in examining how community was created and maintained at Tepeticpac and Cholula.

The concept of community can be used to group individuals and create boundaries between those who share similar characteristics and those who do not. At the same time, these boundaries are largely ideological, and thus may mean different things to different people at different times (Anderson 2006; Cohen 2003). The creation of community, then, is found within the spaces of interaction and daily practice (e.g. at the Mesosystem level). Community becomes a symbol and framework guiding expectations of how to act, yet individual agency constantly contributes idiosyncratic experiences and interpretations of the symbol (Giddens 1984; Bourdieu 1977). A large part of the definition of community is thus based in the moments within which idiosyncratic interpretations interact—the sharing of space and coexisting at a particular chronological time (Isbell 2000). At the same time, community is not exclusively defined by shared space and chronological overlap, evidenced in the persistence of particular ideologies and identities across generations. By focusing from the micro-level outward, this chapter seeks to understand how communities shift and change, based on the recursive relationship of individual-level idiosyncrasies and structural ideologies.

Within the theoretical framework of the Bioecological Model, in this chapter I explore the geographical and chronological boundaries of interaction, to clarify the contexts of influence that shaped and were shaped by individual agents. By establishing these bounds, I set the groundwork for Ch. 7, in which I explore how food becomes a concrete site at which we can measure the ways in which individuals adhere to, depart from, and shift group understandings of community identity.

Radiocarbon Dating: Which Snapshot of Time is This? (Chronosystem)

Contextual evidence from archaeological excavation placed Cholula and Tepeticpac samples in the Late Postclassic period (AD 1325-1519) (Marquina 1970; López Corral and Santacruz Cano 2015). To confirm dates, three samples each from two plazas at Tepeticpac and six samples total from Cholula were sent to Pennsylvania State Institute of Energy and Environment for AMS radiocarbon analysis under Oficio #401.3S.16-2017/812. The results are presented below, each of which was calibrated in OxCal version 4.3.2 (**Fig. 6.1**) using the IntCal 13 calibration curve for the northern hemisphere, calibrated at 1 and 2-sigma (Stuiver and Pearson 1993; Stuiver and Reimer 1993) (**Table and Fig. 6.1**). The results are presented below, each of which was calibrated in OxCal version 4.3.2. and the IntCal13 radiocarbon calibration curve for the northern hemisphere, calibrated to 1 and 2-sigma ranges (Stuiver and Pearson 1993; Stuiver and Reimer 1993).

Table 0.1: Radiocarbon (AMS) dates from Tepeticpac and Cholula burials

Site	Lab Code	Burial ID	Mat.	14C age (B.P.)	1σcal (A.D.)	2σ cal (A.D.)
Tepeticpac	**BLG2**	Op. 3, El 32, Burial 12.1	bone	355 ± 25	1473-1522 (35%) 1575-1625 (33.2%)	1454-1529 (45.9%) 1544-1635 (49.5%)
Tepeticpac	BLG5	Op. 13 El 3, Burial 1.1	bone	370 ±20	1460-1514 (50.6%) 1600-1617 (17.6%)	1451-1523 (62.3%) 1572-1630 (33.1%)
Tepeticpac	**BLG6**	Op. 13 El 20, Burial 15.1	bone	330 ± 20	1512-1529 (12.0%) 1545-1601 (42.2%) 1617-1634 (13.9%)	1488-1604 (76.0%) 1609-1640 (19.4%)
Tepeticpac	BLG7	Op. 13 El 1, Skull 1	bone	380 ± 20	1453-1495 (53.5%) 1602-1615 (14.7%)	1446-1522 (71.3%) 1575-1624 (24.1%)
Tepeticpac	BLG8	Op. 3, El 21, Burial 1.1	bone	430 ± 20	1439-1457 (68.2%)	1431-1479 (95.4%)
Tepeticpac	**BLG9**	Op. 3, El 26, Burial 8.1	bone	310 ± 20	1522-1575 (50.5%) 1585-1590 (3.2%) 1625-1642 (14.6%)	1497-1506 (2.1%) 1512-1601 (71.3%) 1616-1646 (22.0%)
Cholula	BLG13	Burial 83C, Unit 21L-11G	bone	940 ± 20	1037-1050 (12.3%) 1083-1127 (41.4%) 1135-1151 (14.5%)	1030-1155 (95.4%)
Cholula	BLG14	Burial 100-1, Unit 19J-cuadro1	bone	835 ± 20	1183-1225 (58.3%) 1233-1244 (9.9%)	1165-1255 (95.4%)
Cholula	BLG15	Burial 150, Unit 19J-cuadro 7	bone	955 ± 20	1029-1047 (21.9%) 1091-1121 (37.4%) 1140-1148 (9.0%	1022-1059 (29.1%) 1069-1155 (66.3%)
Cholula	BLG16	Burial 185-1 Unit 21K-32J	bone	NO RESULTS		
Cholula	**BLG17**	Burial 291 Unit 21K-14Y	bone	1135 ± 20	888-902 (16.6%) 920-962 (51.6%)	778-789 (1.8%) 869-982 (93.6%)
Cholula	BLG18	Burial 301, Unit 21K-40Z	bone	NO RESULTS		

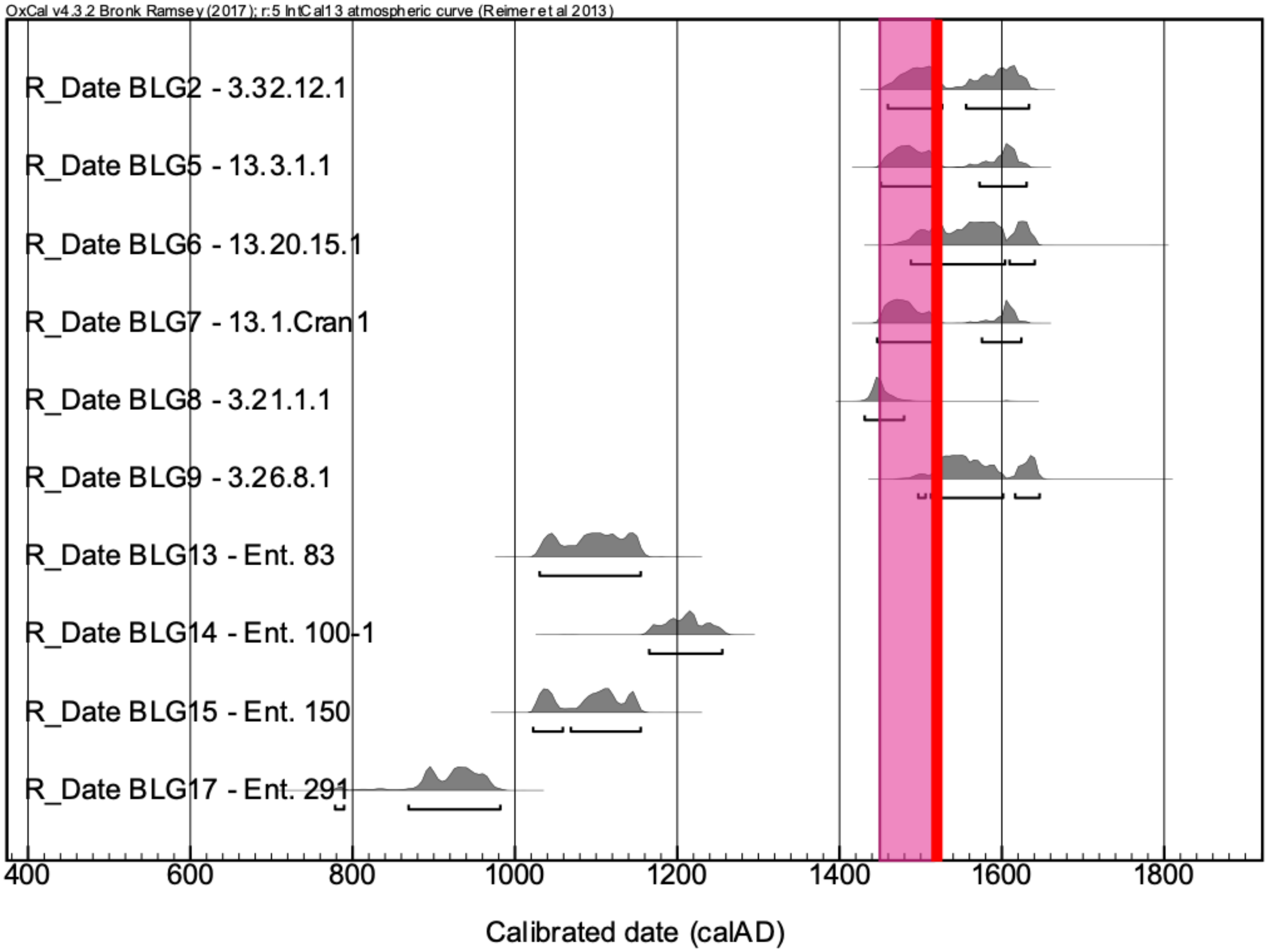


Figure 0.1: Radiocarbon dates from Tepeticpac (BLG 2-9) and Cholula (BLG 13-17)[20].

---

[20] Pink stripe indicates period of Aztec expansion into the Puebla-Tlaxcala Valley. Red stripe indicates Spanish arrival to Central Mexico.

Tepeticpac

Tepeticpac samples are within the range of the Late Postclassic (AD 1431-1519) with some peaks in the Early Colonial period (AD 1519-1646). The earlier range of dates corresponds with the period of Aztec expansion into the Puebla-Tlaxcala Valley (AD 1460-1519) (Abasolo 2015; Berdan et al. 1996; Gibson 1967; Muñoz Camargo 1984), a period of drought, economic tensions, and chronic warfare in the borderlands of Tlaxcala, ending with the Spanish arrival in 1519. Later peaks expand as late as AD 1646, with burials 3.32.12.1, 13.20.15.1, and 3.26.8.1 potentially falling into the Early Colonial period (although in all cases, a Terminal Postclassic date is also presented as a potential range).

The archaeological excavations conducted in the areas of Operation 3 and Operation 13 did not recover any colonial-era materials (López Corral and Santacruz Cano 2015), and burials in these two areas of Tepeticpac follow Prehispanic, flexed burial positions, indicative of being buried in a petate, or woven mat (**Fig. 6.2**). This stands in contrast to El Fuerte, a portion of the site just 1 km up the hill from Op. 3 and Op. 13, the location of one of the earliest Spanish churches in Tlaxcala. Santacruz Cano and López Corral (2011) document that this church was first erected in AD 1524, with the permanent structure completed around AD 1540-1550. Built atop the remains of a Prehispanic temple, child burials were found in the plaza directly in front of the church. In this context, all burials were found extended, with arms crossed at the chest—a position consistent with post-contact European (and Franciscan) burial practices. Although some of the Tepeticpac burials have a date that potentially overlaps with this period of evangelization, the flexed burial pattern could indicate either a rejection of Spanish burial practices, continued autonomy, or an earlier burial date. A future research project is currently being designed to explore this period of transition at Tepeticpac.

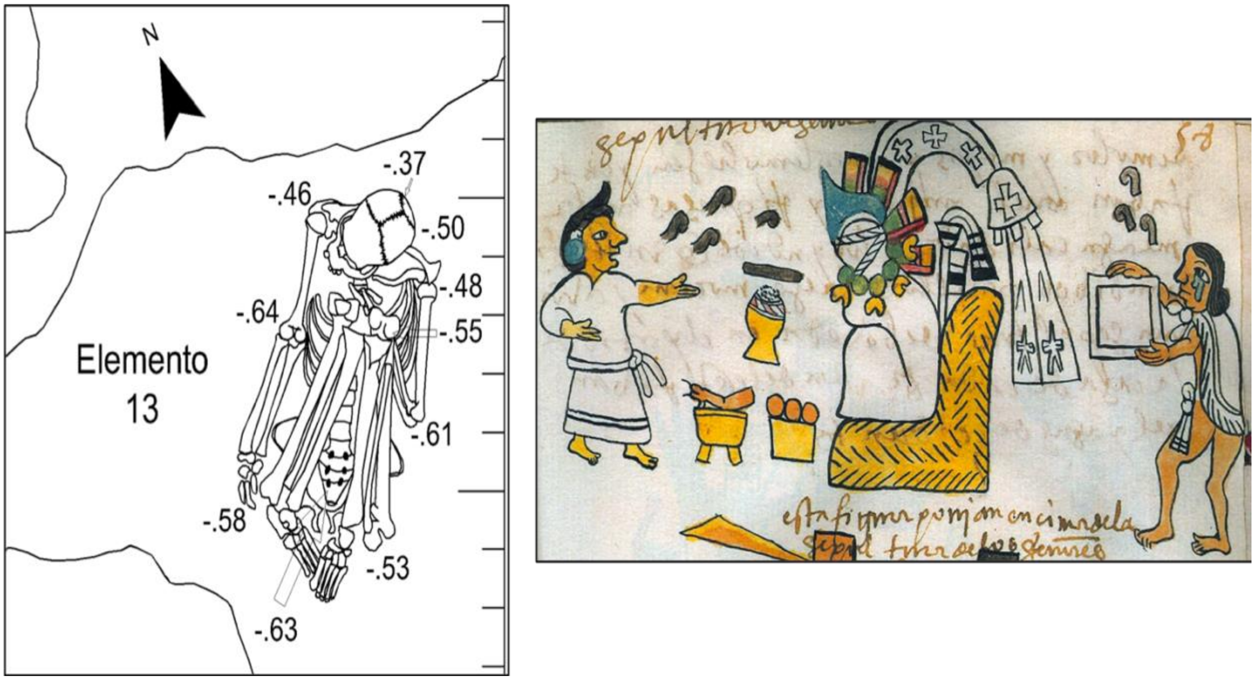


Figure 0.2: Tepeticpac Op.3, Burial 10[21].

Because of Tlaxcala's alliance with the Spanish, it did not suffer totalizing colonization and destruction as in other areas of Central Mexico (Warinner et al. 2012; King and Higelín de Ponce de León 2017). In fact, it was allowed one of the greatest measures of colonial autonomy in New Spain, remaining relatively autonomous until around AD 1600 (Gibson 1967). From the moment of Spanish arrival in 1519, a series of plagues (1519–smallpox; 1520–"plague"; 1530–measles; 1532–smallpox; 1585-88 "plague"; 1595 measles) dramatically reduced the indigenous population of Central Tlaxcala from about 300,000 to 100,000 by 1600 (Halberstein et al. 1973), or a 90% drop in population size (Borejsza 2013) by the 1630s. Such persistent biological onslaught of infirmity pushed populations from the hilltops of Tepeticpac and surrounding señorios into the colonial city in the valley floor below in the earliest decades of the 1600s. If the three burials with possible dates in the Early Colonial era date to post-1600, their presence in

---

[21] Map by Proyecto Arqueológico Tepeticpac. Codex Tudela, Folio 48, image of flexed burial, bound and buried with petate (reed mat).

Tepeticpac would likely indicate a sustained relationship with place, despite the collapse of this particular community. The ambiguous chronology for these three burials, one of which spans a moment of significant social upheaval, will be taken into consideration during interpretation of stable isotope results.

Cholula

Dates from previous analyses based on ceramic and material remains had placed Cholula samples in the Late Postclassic (AD 1250-1521) (Lagunas et al. 1976; Lopez Alonso et al. 2002; Marquina 1970; Messmacher 1967). However, radiocarbon AMS dates from this study produced dates from AD 869-1255, a period that is characterized as the Early Postclassic (AD 900-1250). Excavated in the 1970s, poor storage, poor preservation, and degradation of the bone collagen are likely to blame for two samples that yielded no results. Yet the four samples that produced Early Postclassic dates had C:N ratios ranging from 3.24-3.36, well within accepted range for viable values (DeNiro1985). These results mean that unlike the burials at Tepeticpac, the Cholula burials do not reflect the period of imperial expansion. At Cholula, the Early Postclassic was a complex political moment, characterized by poorly understood ethnic invasions, first by the Olmeca Xicalanca at the end of the Classic period (approx. AD 900) and then the Tolteca Chichimeca (approx. AD 1168) (McCafferty 1996). Thus, the dates of the burials in question span both of these crucial moments in Cholula's history. Because of this, data from Cholula burials will be integrated in this study as a regional comparison, to study how diachronic shifts in ethnic power, politics, and trade relationships shaped foodways and consumption of regional ingredients.

Situating the burials in time

The AMS results show that the Tepeticpac individuals are within the temporal range of AD 1431-1635 (204 years), and Cholula individuals range from AD 778-1255 (477 years). Estimates of the expected number of generations per 100 years base their numbers on approximately 20-35 year gaps between generations. This may have been a slightly lower age gap for pre-industrial populations but, as an estimate, this project assumes about four generations per 100 years. This means that within the Tepeticpac population up to eight generations are represented. Thus, individuals buried in the same site and same plaza did not necessarily coexist during their lifetimes. At Cholula, approximately twice that (16 generations) may be represented. Studies of intergenerational change among contemporary immigrant communities show that even when faced with extreme political change and cultural rupture, inter-generational understandings of "identity" can serve to link individuals even when they do not co-exist in space and time (Benton et al. 2014; Berry et al. 2006; Levitt et al. 2011; Wiley et al. 2008). I analyze the "populations" of Cholula and Tepeticpac not as individuals who coexisted in space and time, but rather as members of a particular food way history (or **macrosystem**), exploring to what extent community identity was shared across generations, or drastically altered.

Linking Body to Land

Before exploring "local" patterns of diet, it is necessary to first establish that the population under analysis consists of individuals who resided at and/or spent significant periods of time in Cholula and Tepeticpac, respectively. Because oxygen from ingested local water sources becomes incorporated into bones and teeth, it is used as a rough proxy to link individuals to a given locale (White et al. 2001, 2004; Wright and Schwarcz 1999). In order to document whether the burials at Tepeticpac and Cholula were local individuals, defined as individuals who spent their childhood and most of their adulthood at the respective site of study, modern water samples from the local area were compared to oxygen values from enamel carbonates. Oxygen isotopes from biophosphate ($\delta^{18}O_p$) and carbonates ($\delta^{18}O_{carbPDB}$) in dental enamel reflect the water consumed by an individual (Sponheimer 1999). Dental enamel forms in childhood, thus values reflect the geographic source of drinking water (as a proxy for locality) during childhood. When possible, enamel samples were taken from molars 1, 2 and 3, which form at different points during juvenile development, capturing diet and ingested water sources during Early Childhood (molar 1), Middle Childhood (molar 2) and adolescence or Teen (molar 3).

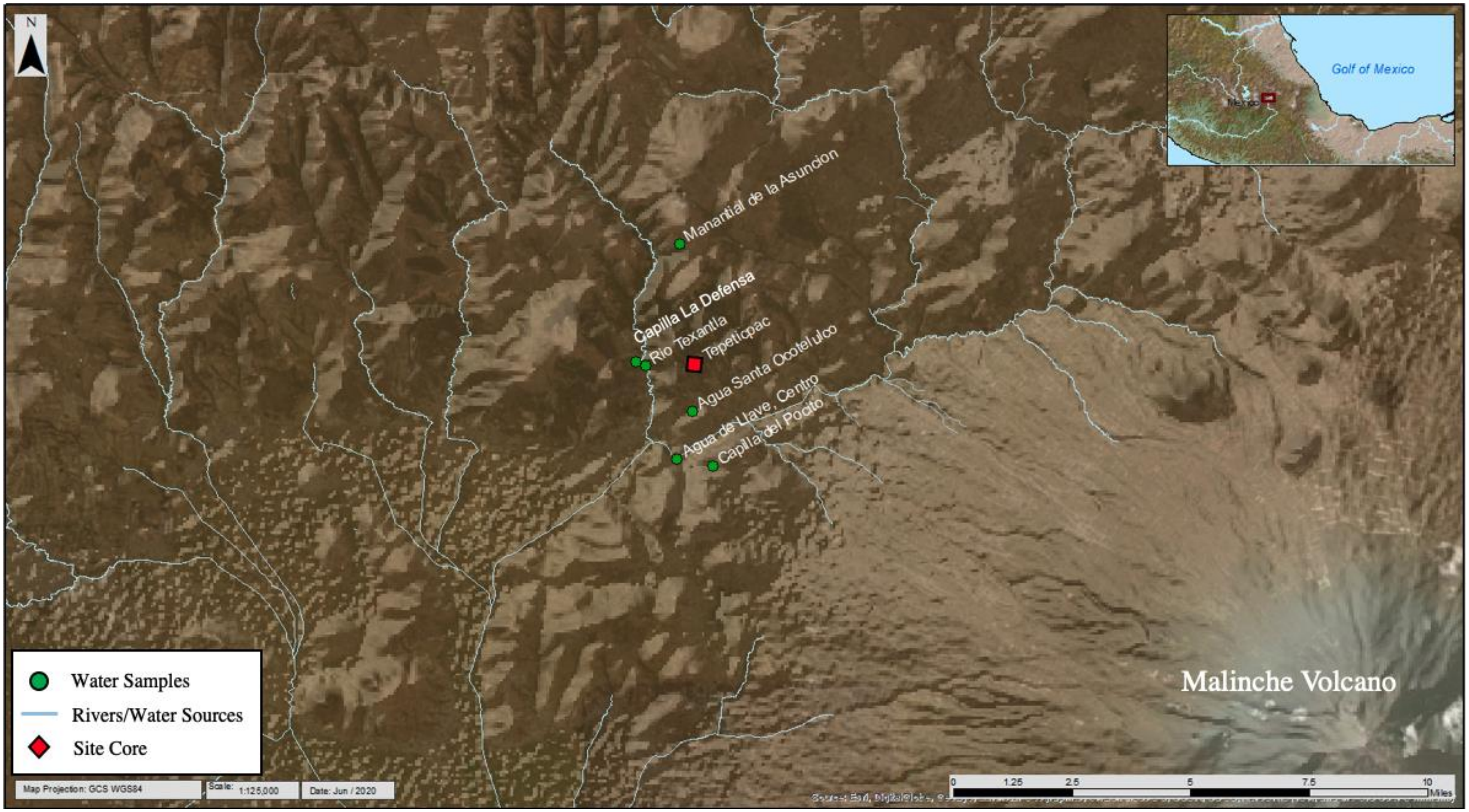


Figure 0.3: Location of Tepeticpac water samples δ18O analysis[22]*.*

---

[22] Map by Gabriela Oré.

To compare oxygen values from bone carbonates and enamel carbonates to oxygen values found in water, reported in a standard known as the Vienna Standard Mean Ocean Water (VSMOW), human values were converted from VPDB to VSMOW (Coplent et al. 1983), using the following formula:

$$\boldsymbol{\delta^{18}O_{VSMOWcarb} = (1.03091 x \delta^{18}O_{VPDBcarb}) + 30.91}$$

The resulting $VSMOW_{carb}$ values, which represent the carbonates from dental enamel and bone, were converted into phosphates, using the following formula from Iacumen et al 1996:

$$\boldsymbol{\delta^{18}O_{VSMOWphos} = (.98x\ \delta^{18}O_{VSMOWcarb})\ -8.5}$$

A final conversion of phosphates to drinking water using the following equation from Luz et al. (1984), which allows for enamel values to be directly compared to ground water values:

$$\boldsymbol{\delta^{18}O_{VSMOWdw} = (\delta^{18}O_{phosVSMOW} - 22.7)/0.78}$$

However, the majority of comparative values drawn from external publications are reported in $\delta^{18}O_{phosVSMOW}$ so data reported in maps and graphs is presented in this $\delta^{18}O_{phosVSMOW}$ format unless otherwise noted.

Oxygen isotopes from water samples (Tepeticpac)

In order to establish a baseline of "local" groundwater oxygen values, with the assistance of local archaeologist Felipe Nava-Ahuatzi, we collected 11 samples of ground water taken within 5-10 km of Tepeticpac. We selected samples from a river source, freshwater spring, two wells, and tap water from a residence within the city center (**Fig. 6.3**). With the exception of the tap water, these were sources that are known to have been used in the Prehispanic era and continue to be sites of cultural importance. Although the largest water source of Tlaxcala, the Ayotzinapa River, is highly contaminated and no longer used as a drinking source, many hillside rivers and natural springs (now protected as holy water sources by churches), remain in use.

The samples were sent to the Yale Analytical Stable Isotope Center, where stable oxygen isotope values were measured. Water samples were analyzed with a Thermo DeltaPlusXP stable isotope mass spectrometer, and replicates of international standards show a standard deviation of ±.3‰ for δ_{18}O. Results from the 11 modern water samples produced $\delta_{18}O_{phosVSMOW}$ values ranging from -8.3‰ to -10.1‰, with a mean of -9.1‰ (s.d.= 0.61) (**Table 6.2**). For the 10 samples from Tlaxcala (i.e., excluding the one water sample from Mexico City), the mean $\delta_{18}O_{phosVSMOW}$was -9.2 (s.d.= 0.5).

Table 0.2: Oxygen values from Central Mexico water sources

BSIRL Code	State	Source	Source Type	Season	$\delta_{2}\mathrm{H}_{\mathrm{VSMOW}}$ phosphate (‰)	$\delta_{18}\mathrm{O}_{\mathrm{dwSMOW}}$ (‰)
1919	Tlaxcala, Mexico	Centro	Tap	Summer (rainy season)	-59.6	-9.1
1920	Tlaxcala, Mexico	Texantla River	River	Summer (rainy season)	-52.5	-8.3
1921	Tlaxcala, Mexico	Capilla Del Pocito	Well	Summer (rainy season)	-63.5	-9.7
1922	Tlaxcala, Mexico	Capilla La Defensa	Well	Summer (rainy season)	-67.2	-9.6
1923	Tlaxcala, Mexico	Manantial de la Asunción	Spring	Summer (rainy season)	-68.5	-10.1
1924	Tlaxcala, Mexico	Agua Santa Ocotelulco	Spring	Summer (rainy season)	-67.7	-9.5
3474	Mexico City, Mexico	Colonia Roma	Tap	Winter	-58	-8.0
3476	Tlaxcala, Mexico	Texantla River	River	Winter	-64	-8.6
3478	Tlaxcala, Mexico	Centro (tap water)	Tap	Winter	-67	-9.0
3480	Tlaxcala, Mexico	Capilla La Defensa	Well	Winter	-69	-9.5
3482	Tlaxcala, Mexico	Capilla Del Pocito	Well	Winter	-67	-9.0

Ecological factors like seasonality can affect oxygen isotope values in water, leading to slightly different values from the same region (Longinelli 1984; Luz 1984; White et al. 1998), and cultural factors, such as water storage and food preparation techniques (Gagnon 2015), can also greatly enrich the stable oxygen isotope value as the lighter oxygen-16 isotope evaporates. As such, these will be considered in the interpretations of the oxygen isotope values from the human enamel. I will compare ground water values to oxygen isotope values obtained from bone carbonates and enamel carbonates after they have been converted to make them comparable to the water sources. Through these summaries and comparisons, I will establish a range of "local" Puebla-Tlaxcala Valley $\delta^{18}O$ values.

Oxygen isotopes from water samples (Cholula)

Due to the complete urbanization of modern-day San Pedro de Cholula, no contemporary water samples were collected from the area. Oxygen values for Cholula were instead drawn from comparative work of White et al. (2007).

Interpreting oxygen isotopes from enamel carbonates

White et al. 2004 suggest that by adjusting $^{18}O_{phosVSMOW}$ values downwards by -.7‰ in 1st molars of breastfeeding-age children and -.35‰ in canines and premolars, data from children can be compared directly to post-weaning "local" values. The reported values are thus adjusted to account for this factor of oxygen enrichment.

Levinson et al. (1987) shows that there is about a 3.5‰ difference between consumed water in the phosphates of bone and teeth ($\delta^{18}O_{phosVSMOW}$) and local water values (also represented in $\delta^{18}O_{phosVSMOW}$), and for this reason, $\delta^{18}O$ values obtained from enamel carbonates ($\delta^{18}O_{SMOW}$) must be converted to make them comparable to $\delta^{18}O$ obtained from surface water

($\delta^{18}O_{dwSMOW}$; see conversion above). While the source of water is a key factor in resultant stable oxygen isotope ratios (rainwater, rivers, melted snow, lakes, wells from the same area can have different $\delta^{18}O$ values). It is also incorporated into the body through a variety of methods, such as inhalation and consuming different sources, such as boiled water, brewing, mother's milk, spring water, storage in cisterns, water in food, etc. (Gagnon et al. 2015; Turner et al. 2009). Thus, establishing local values requires sampling from multiple individuals to establish a local range.

While ranges can vary by population context, studies have found that a 1-2‰ variation can be expected (Longinelli 1984; Pestle et al. 2014; White et al. 1998; 2001; 2004). Although oxygen isotope values obtained from an individual's enamel carbonates have been shown to be reliable predictors of whether a person is local or non-local to a region (Redfern et al, 2016; Turner 2009; Toyne 2014), some of the variability in values may be related to cultural variability in water consumption: the consumption of different water sources in the same valley, water and cooking preparation techniques, health, age, etc. Thus, residential location alone does not determine individual oxygen isotope ratios, as social identity (age, sex, health status, economic position—all of which influence which beverages individuals consume) can also affect the stable oxygen isotope ratio in a person's enamel carbonates.

Oxygen values from enamel reflect mobility during dental formation (childhood), while oxygen values from bone carbonates reflect oxygen incorporation within the last few years of life. Among adults, a comparison of enamel and carbonate values can thus provide a diachronic analysis of mobility throughout the life course. Although we were unable to test specifically for diagenetic contamination of the bone carbonates (Beasley et al 2014), the reliable carbon and nitrogen isotope results from bone collagen suggest that the inorganic carbonates were likely not greatly affected by diagenesis.

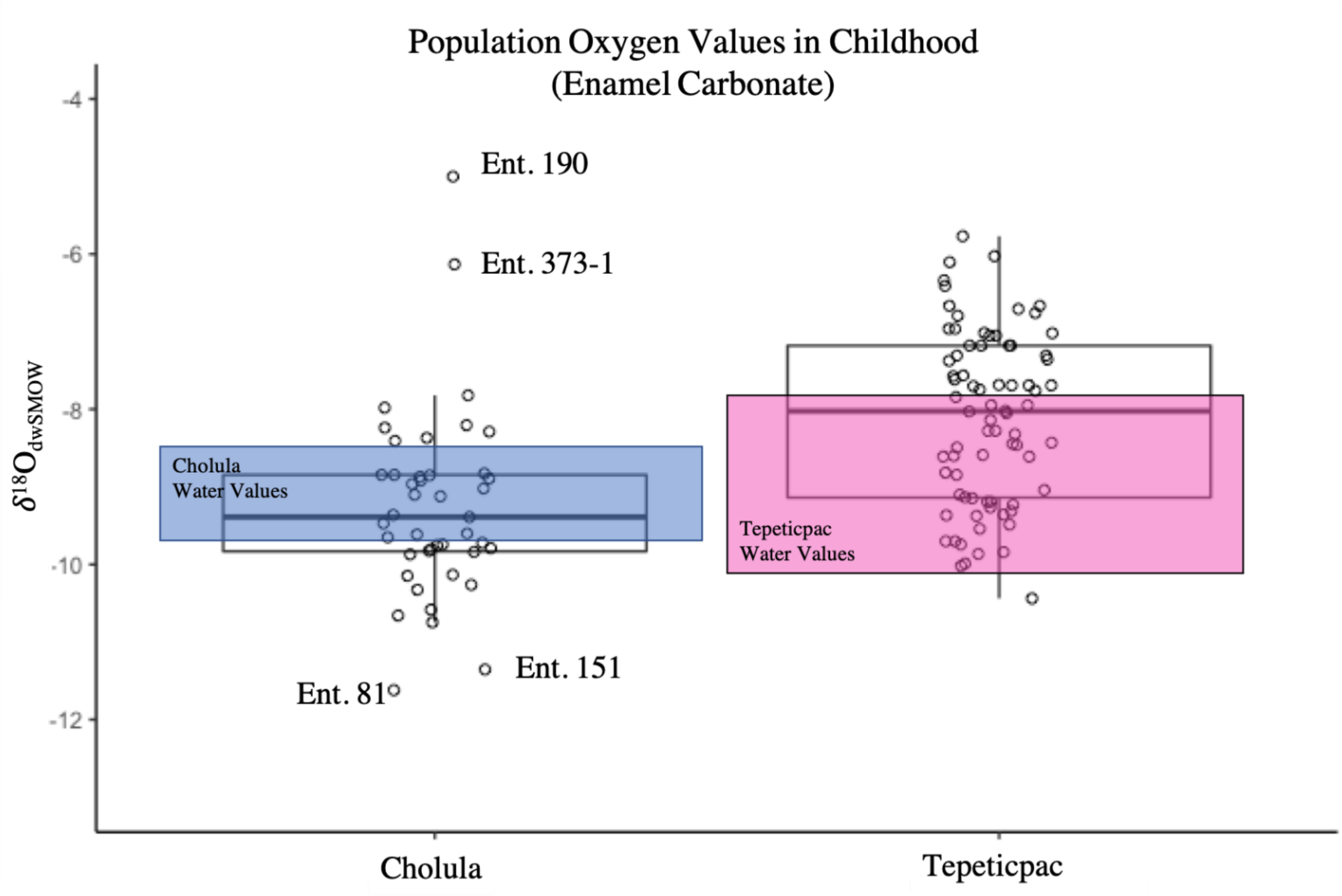


Figure 0.4: $^{18}O_{dwSMOW}$ values from enamel carbonates at Cholula and Tepeticpac[23]*.*

---

[23] The oxygen isotope values have been converted from $\delta^{18}O_{carb\ VPDB}$ to $\delta^{18}O_{dw\ VSMOW}$ to be comparable to modern water samples (colored boxes). Original values can be found in Table 6.3

Table 0.3: Stable oxygen isotope values from enamel carbonates at Tepeticpac and Cholula

BSIRL Code	Site	Arch Code	Tooth	Tooth section	Age Dev. Categ.	$\delta^{18}O_{carb}$ VPDB	$\delta^{18}O_{carb}$ SMOW	$\delta^{18}O_{p}$ VSMOW	$\delta^{18}O_{pV}$ SMOW (adjusted)	$\delta^{18}O_{dw}$ SMOW
446	Tepeticpac	3.32.12.1	MxM2	OCC	MC1	-5.9	24.8	15.8	15.4	-9.3
448	Tepeticpac	3.21.1.1	MdM1	OCC	IEC1	-5.6	25.1	16.1	15.4	-9.4
449	Tepeticpac	3.21.1.1	MdM1	CEJ	IEC2	-6.0	24.7	15.8	15.1	-9.8
450	Tepeticpac	3.21.1.1	MdM2	OCC	MC1	-6.1	24.6	15.6	15.3	-9.5
451	Tepeticpac	3.21.1.1	MdM2	CEJ	MC2	-5.9	24.8	15.8	15.5	-9.3
452	Tepeticpac	3.21.1.1	MdM3	OCC	T1	-6.6	24.1	15.1	15.1	-9.7
455	Tepeticpac	3.22.ES1	Mxdc	CEJ	FET-I2	-4.3	26.5	17.5	17.5	-6.7
457	Tepeticpac	3.28.ES2.3	MdM2	CEJ	MC2	-6.2	24.5	15.5	15.1	-9.7
459	Tepeticpac	3.33.13.1	MxC	CEJ	MC2	-4.6	26.1	17.1	17.1	-7.2
460	Tepeticpac	3.33.13.1	MdM1	OCC	IEC1	-4.4	26.4	17.4	16.7	-7.7
461	Tepeticpac	3.33.13.1	MdM1	CEJ	IEC2	-6.5	24.2	15.3	14.6	-10.4
462	Tepeticpac	3.32.12.1	Mx M1	OCC	IEC1	-6.1	24.6	15.6	14.9	-10.0

463	Tepeticpac	3.32.12.1	Mx M2	CEJ	MC2	-6.4	24.4	15.4	15.0	-9.8
464	Tepeticpac	3.32.12.1	Mx M3	OCC	T1	-6.1	24.6	15.6	15.6	-9.1
465	Tepeticpac	3.32.12.1	Mx M3	CEJ	T2	-6.5	24.2	15.3	15.3	-9.5
466	Tepeticpac	3.23.6.1	MdI1	OCC	IEC1	-5.0	25.7	16.7	16.7	-7.7
467	Tepeticpac	3.23.6.1	MdI1	CEJ	IEC2	-5.2	25.5	16.5	16.5	-7.9
468	Tepeticpac	3.23.2.1	Mx M2	OCC	MC1	-5.0	25.7	16.7	16.4	-8.1
469	Tepeticpac	3.23.2.1	Mx M2	CEJ	MC2	-5.4	25.3	16.3	16.0	-8.6
470	Tepeticpac	3.24.4.1	Mddc	BULK	FET-I	-3.8	27.0	18.0	18.0	-6.0
472	Tepeticpac	3.24.3.1	Mx di1	CEJ	FET2	-4.7	26.1	17.1	17.1	-7.2
473	Tepeticpac	3.28.ES2	Mx M1	OCC	IEC1	-3.9	26.9	17.9	17.2	-7.1
474	Tepeticpac	3.8.ES2	Mx M1	CEJ	IEC2	-3.8	27.0	17.9	17.2	-7.0
476	Tepeticpac	3.28.ES2	Mxdm1	CEJ	FET-I2	-3.5	27.3	18.2	18.2	-5.8
478	Tepeticpac	3.23.2.1	Mx M3	CEJ	T2	-5.2	25.6	16.5	16.5	-7.9
479	Tepeticpac	3.23.2.1	Mx M1	OCC	IEC1	-4.9	25.8	16.8	16.1	-8.4
480	Tepeticpac	3.23.2.1	Mx M1	CEJ	IEC2	-5.5	25.2	16.2	15.5	-9.2
1980	Tepeticpac	3.32.12.1	Mx C	BULK	MC	-4.0	26.8	17.7	17.7	-6.4

1982	Tepeticpac	3.26.8.2	MdM1	BULK	IEC	-4.3	26.5	17.5	16.8	-7.6
1983	Tepeticpac	3.23.2.3	MdC	BULK	MC	-4.3	26.5	17.5	17.5	-6.7
1984	Tepeticpac	3.30.10.1	Mx P3	BULK	MC	-5.4	25.3	16.3	16.0	-8.6
1985	Tepeticpac	3.27.7.2	MdM2	BULK	MC	-6.2	24.5	15.5	15.1	-9.7
1986	Tepeticpac	13.3.1.1	Mx M1	BULK	IEC	-3.8	27.0	18.0	17.3	-7.0
1987	Tepeticpac	13.3.1.1	Mx M2	BULK	MC	-4.4	26.3	17.3	16.9	-7.4
1988	Tepeticpac	13.3.1.1	Mx M3	BULK	T	-5.0	25.8	16.8	16.8	-7.6
1989	Tepeticpac	13.3.1.2	MdM2	BULK	MC	-4.2	26.6	17.6	17.2	-7.0
1990	Tepeticpac	13.7.5.1	Mx M2	BULK	MC	-4.7	26.0	17.0	16.7	-7.7
1991	Tepeticpac	13.7.5.1	Mx M1	BULK	IEC	-5.5	25.3	16.3	15.6	-9.1
1992	Tepeticpac	13.7.5.2	Mx C	BULK	MC	-5.1	25.7	16.7	16.7	-7.7
1995	Tepeticpac	13.8.6.2	Mddm1	BULK	FET-I	-4.8	26.0	17.0	17.0	-7.3
1996	Tepeticpac	13.11.9.1	MdM2	BULK	MC	-4.1	26.7	17.6	17.3	-7.0
1997	Tepeticpac	13.11.9.1	MdM3	BULK	T	-4.7	26.1	17.0	17.0	-7.3
1998	Tepeticpac	13.11.9.1	MdM1	BULK	IEC	-5.1	25.7	16.7	16.0	-8.6

1999	Tepeticpac	13.13.10.1	MdM1	BULK	IEC	-4.8	26.0	16.9	16.2	-8.3
2000	Tepeticpac	13.13.10.1	MdM2	BULK	MC	-6.0	24.7	15.7	15.4	-9.4
2001	Tepeticpac	13.13.10.1	MdM3	BULK	T	-5.7	25.1	16.1	16.1	-8.5
2077	Tepeticpac	13.19.14.1	MdM2	BULK	MC	-5.0	25.8	16.8	16.4	-8.0
2078	Tepeticpac	13.19.14.1	MdM3	BULK	T	-4.7	26.1	17.1	17.1	-7.2
2079	Tepeticpac	13.22.17.1	MdM1	BULK	IEC	-4.4	26.4	17.3	16.6	-7.8
2080	Tepeticpac	13.22.17.1	MdM2	BULK	MC	-3.6	27.1	18.1	17.8	-6.3
2081	Tepeticpac	13.22.17.1	MdM3	BULK	T	-4.5	26.2	17.2	17.2	-7.1
2082	Tepeticpac	13.23.18.1	Mx M1	BULK	IEC	-3.6	27.2	18.2	17.5	-6.7
2083	Tepeticpac	13.23.18.1	MdM2	BULK	MC	-3.5	27.3	18.3	17.9	-6.1
2084	Tepeticpac	13.24.19.1	Mx di1	BULK	FET-I	-4.7	26.1	17.1	17.1	-7.2
2085	Tepeticpac	13.20.15.1	MdM1	BULK	IEC	-4.5	26.3	17.3	16.6	-7.8
2086	Tepeticpac	13.20.15.1	MdM2	BULK	MC	-4.7	26.1	17.1	16.7	-7.7
2087	Tepeticpac	13.20.15.1	MdM3	BULK	T	-4.4	26.4	17.4	17.4	-6.8
2088	Tepeticpac	13.20.15.4	Mx P3	BULK	MC	-4.4	26.3	17.3	17.0	-7.4
2089	Tepeticpac	13.17.ES 3	MdM1	BULK	IEC	-4.3	26.5	17.5	16.8	-7.6

2090	Tepeticpac	13.13.19.2	Mx C	BULK	MC	-5.0	25.8	16.7	16.7	-7.7
2091	Tepeticpac	13.1.Craneo 1	Mx M2	BULK	MC	-4.0	26.8	17.8	17.4	-6.8
2092	Tepeticpac	13.1.Craneo 1	Mx M1	BULK	IEC	-4.6	26.1	17.1	16.4	-8.1
2093	Tepeticpac	13.1.Craneo 2	Mx M1	BULK	IEC	-4.9	25.8	16.8	16.1	-8.4
2094	Tepeticpac	13.1.Craneo 2	Mx M2	BULK	MC	-6.5	24.2	15.2	14.9	-10.0
2095	Tepeticpac	13.1.Mand1	MdM3	BULK	T	-5.9	24.8	15.8	15.8	-8.8
2096	Tepeticpac	13.1.Mand1	MdM2	BULK	MC	-5.3	25.4	16.4	16.1	-8.5
2097	Tepeticpac	13.1.Mand2	MdM1	BULK	IEC	-5.5	25.3	16.3	15.6	-9.1
2098	Tepeticpac	13.1.Craneo5	Mx M1	BULK	IEC	-6.0	24.7	15.7	15.0	-9.9
2099	Tepeticpac	13.1.Craneo5	Mx M2	BULK	MC	-5.1	25.6	16.6	16.2	-8.3
2100	Tepeticpac	13.1.Craneo3	Mx M1	BULK	IEC	-5.2	25.5	16.5	15.8	-8.8
2101	Tepeticpac	13.1.Mand 2	MdM1	BULK	IEC	-5.4	25.4	16.3	15.6	-9.0

2102	Tepeticpac	13.1.Mand2	MdM3	BULK	T	-6.3	24.4	15.4	15.4	-9.4
2103	Tepeticpac	13.1. Mand3	MdM2	BULK	MC	-4.9	25.8	16.8	16.4	-8.0
2104	Tepeticpac	13.1.DS#3	MdM3	BULK	T	-5.7	25.0	16.0	16.0	-8.6
2105	Tepeticpac	13.1.DS#2	MdM3	BULK	T	-6.2	24.5	15.5	15.5	-9.2
2106	Tepeticpac	13.1.DS#1	Mx M1	BULK	IEC	-4.8	25.9	16.9	16.2	-8.3
1925	Cholula	Ent.69A-1, U 21L-14G	MdM1	BULK	IEC	-6.6	24.1	15.1	14.4	-10.7
1926	Cholula	Ent.81, U 21L-2C-2D	MdM2	BULK	MC	-7.7	22.9	14.0	13.6	-11.6
1927	Cholula	Ent.127, U 21L-27M	MdM2	BULK	MC	-4.9	25.8	16.8	16.5	-8.0
1928	Cholula	Ent.134, U 21L-32[a]	Mx M1	BULK	IEC	-5.4	25.4	16.4	15.7	-9.0
1929	Cholula	Ent.151, U 19J-Cuadro 6	MdM1	BULK	IEC	-7.2	23.5	14.5	13.8	-11.4
1930	Cholula	Ent.153, U 21K-38V	Mx M3	BULK	T	-5.2	25.6	16.6	16.6	-7.8

1931	Cholula	Ent.157, U ?	MdM3	BULK	T	-6.8	23.9	15.0	15.0	-9.9
1932	Cholula	Ent.182-1, U 21K-36S	MdM1	BULK	IEC	-5.8	24.9	15.9	15.2	-9.6
1933	Cholula	Ent.183, U21K-32T	Mx M2	BULK	MC	-6.1	24.7	15.7	15.3	-9.5
1934	Cholula	Ent.185-1, U 21K-32T	MdM2	BULK	MC	-5.6	25.1	16.1	15.8	-8.9
1935	Cholula	Ent.385-1, U?	Mx P4	BULK	MC	-5.6	25.1	16.1	15.8	-8.9
1936	Cholula	Ent.186, U 21K-24H	Mx M1	BULK	IEC	-5.3	25.5	16.4	15.7	-8.9
1937	Cholula	Ent.190, U21K-36S	Mx I1	BULK	IEC	-3.0	27.8	18.8	18.8	-5.0
1938	Cholula	Ent.196, U21K-35S	MdM1	BULK	IEC	-6.0	24.7	15.7	15.0	-9.8
1939	Cholula	Ent.204, U21K-35S	Mx M1 or 2	BULK	IEC/MC	-5.8	24.9	15.9	15.6	-9.1
1940	Cholula	Ent.206, U21K-33Q	MdC	BULK	MC	-6.1	24.6	15.6	15.6	-9.1
1941	Cholula	Ent.208, U 21K-23R	MdP3 or 4	BULK	MC	-6.7	24.0	15.0	14.6	-10.3
1942	Cholula	Ent.210-1, U21K-36S	MdM1	BULK	IEC	-5.3	25.5	16.5	15.8	-8.9

1943	Cholula	Ent.213, U21K-24G	MdM1	BULK	IEC	-6.0	24.8	15.8	15.1	-9.8
1944	Cholula	Ent.214, U21K-24	Mx M1	BULK	IEC	-6.2	24.5	15.5	14.8	-10.1
1945	Cholula	Ent.216, U21L-4W	Mx M2	BULK	MC	-5.7	25.1	16.1	15.7	-9.0
1946	Cholula	Ent.232, U21K-19M	MdM1	BULK	IEC	-4.8	26.0	16.9	16.2	-8.3
1948	Cholula	Ent.245, U21K-29F	MdM1	BULK	IEC	-4.9	25.9	16.8	16.1	-8.4
1949	Cholula	Ent.263, U21K-40F	MdM3	BULK	T	-6.6	24.2	15.2	15.2	-9.6
1957	Cholula	Ent.294, U 21K-40Y	Mx M2	BULK	MC	-6.3	24.4	15.4	15.0	-9.8
1958	Cholula	Ent.295, U 21K-39Y	MdM1	BULK	IEC	-5.7	25.1	16.1	15.4	-9.4
1959	Cholula	Ent.299, U 21K-39Y	Mx C	BULK	MC	-5.9	24.8	15.8	15.8	-8.8
1960	Cholula	Ent.301, U 21K-40Z	Mx M1	BULK	IEC	-6.2	24.5	15.5	14.8	-10.1

1962	Cholula	Ent.328, U 21K-32Z	Mx M2 or M3	BULK	MC/T	-6.3	24.4	15.4	15.1	-9.8
1964	Cholula	Ent.370A, U?	Mx M2?	BULK	MC?	-6.7	24.0	15.0	14.7	-10.3
1965	Cholula	Ent.370B, U?	MdM1 or M2	BULK	IEC/MC	-6.3	24.5	15.5	15.1	-9.7
1966	Cholula	Ent.372-2, U 20J-34X	MdC	BULK	MC	-5.9	24.8	15.8	15.8	-8.8
1967	Cholula	Ent.373-1, U 20K-17U	Mx P3	BULK	MC	-3.5	27.3	18.3	17.9	-6.1
1968	Cholula	Ent.397-1, U 21L-1N	Mx I2	BULK	IEC	-5.4	25.3	16.3	16.3	-8.2
1970	Cholula	Ent.398, U21K-1O	MdM2	BULK	MC	-6.9	23.8	14.8	14.4	-10.6
1972	Cholula	Ent.414 1&2A, U 20J-40P	MdM3	BULK	T	-6.7	24.0	15.1	15.1	-9.7
1973	Cholula	Ent.426-1, U?	Mx M1	BULK	IEC	-5.2	25.5	16.5	15.8	-8.8
1974	Cholula	Ent.417, U20J-42K	MdM1	BULK	IEC	-5.9	24.9	15.9	15.2	-9.7
1975	Cholula	Ent.420, U 20J-38L	MdM2	BULK	MC	-7.1	23.6	14.7	14.3	-10.7
1976	Cholula	Ent.424, U20J-39F	MdM1	BULK	IEC	-6.0	24.7	15.8	15.1	-9.8

1977	Cholula	Ent.432, U20J-39P	Mx M2	BULK	MC	-6.0	24.7	15.7	15.4	-9.4
1978	Cholula	Ent.433, U 29J-39º	MdM1	BULK	IEC	-4.9	25.9	16.9	16.2	-8.4
1979	Cholula	Ent.428, U?	MdM1 Or M2	BULK	IEC/MC	-5.1	25.6	16.6	16.3	-8.2

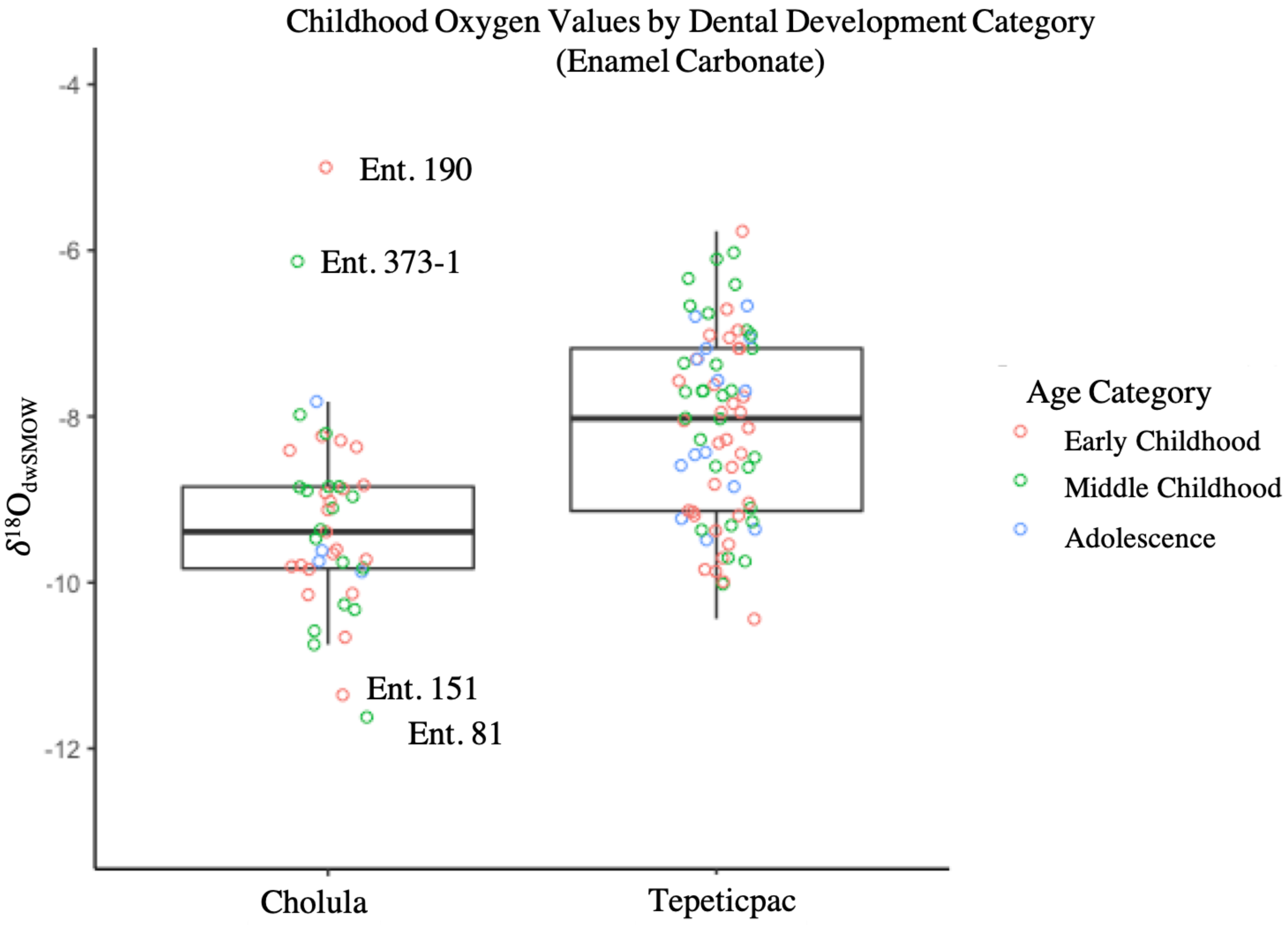


Figure 0.5: $_{18}O_{dwSMOW}$ *from enamel carbonates, analyzed by dental development category*

Oxygen isotope results from modern groundwater and enamel carbonates

Converted δ_{18}O values obtained from enamel and bone carbonates are compared to the δ_{18}O values obtained from enamel carbonates and from water, all of which have been converted to $\delta_{18}O_{dwVSMOW}$ (Coplen et 1l. 1983; Iacumen et al. 1996; and Luz et al. 1984) for ease of comparison in the following results sections (**Fig. 6.5**).

Table 0.4: Summary table of oxygen values used in study

Site	Sample Type	Mean $\delta_{18}O_{dwVSMOW}$	Range $\delta_{18}O_{dwVSMOW}$	‰Variation
Tepeticpac	Bone Carbonates	-7.4‰	-10.6‰ to -4.7‰	5.9‰
	Enamel Carbonates	-8.5 ‰	-11.6‰ to -5.0‰	6.6‰
	Water	-9.1‰	-10‰ to -8‰	2.0‰
Cholula	Bone Carbonates	-8.9‰	-8.9‰ to -7.5‰	1.4‰
	Enamel Carbonates	-8.7‰	-11.6‰ to -5‰	6.6‰
	Water (White et al. 2007)	(not given)	-9.4‰ to -8.3‰	1.1‰

<u>Enamel carbonate results: Tepeticpac</u>

Oxygen values for Tepeticpac are based on valid results from 76 enamel samples representing 39 individuals. Tepeticpac water values had a mean $\delta_{18}O_{dwSMOW}$ of -9.1‰ and range of -10‰ to -8‰. Converted enamel carbonate values, representing childhood water intake, had a mean $\delta_{18}O_{dwSMOW}$ of -8.1‰ (s.d. = 1.1) with a range of -10.4‰ to -5.8‰ (4.6‰ variation) (**Table 6.3, 6.4**). Given Levinson et al.'s (1987) expected range of difference of 3.5‰ between consumed and ground water, Tepeticpac's core population is undeniably local to the Central Mexico region (from the Puebla-Tlaxcala Valley to the Basin of Mexico). The range of enamel values is even tighter when examined by age groups, where it becomes clear that much of the variation is likely due to the influence of breastfeeding and weaning in Early Childhood and Infancy. This will be discussed further in the **Ch. 7**, section on weaning.

Enamel carbonate results: Cholula

Oxygen values for Cholula are from 43 enamel carbonate samples representing 43 individuals (**Table 6.3**, above). White et al. (2007) document Cholula local water values with a $\delta^{18}O_{dwSMOW}$ range of -9.4 to -8.3‰ for water[24], while the Cholula enamel carbonate samples from this study have a $\delta^{18}O_{dwSMOW}$ range of -11.2 to -5.0 (mean=-8.7‰, s.d. = 1.2). When adjusted to account for the enrichment of weaning-age individuals (White et al. 2004) these values shift only slightly (adjusted $\delta^{18}O_{dwSMOW}$ range of -11.6‰ to -5‰; mean = -9.3‰, s.d. = 1.2). The broad range (6.6‰ variation), is impacted by four outliers. Two individuals (Ent. 190, a 50-60 year old female, and Ent. 373-1, a 60-70 year old female) are visibly enriched in comparison to the core population, with values at -5‰ and -5.7‰ $\delta^{18}O_{dwSMOW}$, respectively. In their analysis of oxygen and strontium from dental enamel within this same population, Bullock Kreger (2010) notes “greater than normal variation” (p. 269). Through strontium isotope values, Bullock Kreger identified two distinct outliers (Ent. 373-1 and Ent. 292) with values similar to that of the Oaxaca Valley to the south. Unfortunately, as discussed previously, the Puebla-Tlaxcala Valley shares similar oxygen values to the Basin of Mexico and Teotihuacan area; thus, identifying migration within and between these zones is difficult. However, Bullock Kreger’s analysis of strontium isotopes that identified non-locals provides further evidence that outlier oxygen isotope values at Cholula are likely evidence of non-locals at Cholula (**Figs. 6.4-6.6, 6.8**).

---

[24] Converted from original reported $\delta^{18}O_{phos}$ range of 15.4 to 16.2‰

The oxygen isotope data indicate that Ent. 190 and Ent. 373-1 moved to Cholula from some other locale sometime after early childhood (incisor was sampled) and after middle childhood (premolar was sampled), respectively. In addition to these two females with more positive oxygen values, two individuals with more negative values also appear as outliers: Ent. 151, a 40-50 year old male (1st molar sampled), and Ent. 81, a 40-50 year old female (2nd molar sampled). Again, these individuals gesture to early and middle childhoods spent in locales outside of the immediate region.

When these four outliers are removed, the range of values at Cholula is reduced to -10.7 to -7.8‰ (a 2.9‰ range). Thus, while there are more non-local individuals at Cholula, within this sample there also appear to be a core of individuals who grew up in Cholula and/or nearby areas and at least some temporary (and perhaps permanent) population movement by children. Although, the continuity in oxygen isotope values from enamel among the Cholula population complicates a distinct designation of a binary "local" vs. "nonlocal," these outliers show the utility in using this method to estimate who might have spent time away from Cholula, and then explore how their lives were similar or different to others in the community.

Bone carbonate results: Tepeticpac

Analysis of bone carbonate is derived from 51 carbonate samples from 51 individuals at Tepeticpac (**Table 6.5**). The average $\delta 18\mathrm{O}_{\mathrm{bonecarbdwSMOW}}$ is -8.91‰ (s.d. = 0.9). This population has a range of -10.6‰ to -7.47‰, or approximately 3.1‰ range. The stable oxygen isotope values of the enamel carbonates (childhood water source) and the bone carbonates (adulthood water source) are statistically significantly different (t =3.94, p = .000134), but they do not exceed the difference of machine error (Pestle 2014). Thus, the sources of drinking water for children and adults at Tepeticpac were similar and do not reflect a population with high levels of migration and/or seasonal mobility as at metropoles like Teotihuacan.

Bone carbonate results: Cholula

Analysis of bone carbonate at Cholula is derived from 19 bone carbonate samples from 19 individuals (**Table 6.5**). The average $\delta_{18}\mathrm{O}_{\mathrm{bonecarbPDB}}$ is -6.0‰ (s.d. =.70, range = -6.0 to -4.9). The converted bone carbonate values showed a mean $\delta_{18}\mathrm{O}_{\mathrm{dwSMOW}}$ of -8.9‰ (s.d. = .9), with a range of -8.9‰ to -7.5‰. These values fall within White et al.'s (2004, 2007) documented Cholula water values with a $\delta_{18}\mathrm{O}_{\mathrm{dwSMOW}}$ range of -9.4‰ to -8.3‰, and appears as a decrease from the more broadly distributed childhood values (range = 6.6‰ variation) to adult values (range = 1.1‰ variation). However, t-test results show that these differences are not significant (t= +1.13, p < .2629783). Futures studies of a larger sample will explore whether at Cholula, the majority of population movement occurred during childhood, with adults remaining more closely tethered to place.

Table 0.5: Stable oxygen isotope values from bone carbonates (Tepeticpac and Cholula)

BSIRL Code	Site	Arch Code	Element	$\delta^{18}O_{carb}$ VPDB	$\delta^{18}O_{carb}$ SMOW (Coplen et al. 1983)	$\delta^{18}O_p$ VSMOW (Iacumen et al. 1996)	$\delta^{18}O_{dw}$ SMOW (Luz et al. 1984)
2722	Tepeticpac	13.23.2.1	Rib frag	-4.4	26.4	17.4	-6.8
2723	Tepeticpac	13.23.17.1	Rib frag	-4.3	26.4	17.4	-6.8
2724	Tepeticpac	3.21.1.3	MT2	-4.2	26.6	17.5	-6.6
2725	Tepeticpac	13.20.15.2	Rib frag	-3.1	27.7	18.6	-5.2
2726	Tepeticpac	13.5.3.1	Rib frag	-4.4	26.4	17.4	-6.8
2727	Tepeticpac	3.23.5.1	Rib frag	-3.9	26.9	17.9	-6.2
2728	Tepeticpac	13.27.7.1	Rib frag	-4.3	26.4	17.4	-6.8
2729	Tepeticpac	3.27.9.1	Tibia frag	-5.4	25.4	16.3	-8.1
2741	Tepeticpac	3.23.6.1	Rib frag	-4.9	25.8	16.8	-7.5

2742	Tepeticpac	13.11.9.1	Rib frag	-5.0	25.7	16.7	-7.7
2743	Tepeticpac	13.9.7.1	Cran frag	-4.4	26.4	17.3	-6.9
2744	Tepeticpac	3.31.11.1	Fibula frag	-3.8	27.0	17.9	-6.1
2745	Tepeticpac	3.24.4.2	Radial frag	-4.1	26.7	17.7	-6.5
2753	Tepeticpac	13.1. Craneo 4	Cran frag	-5.6	25.2	16.2	-8.4
2754	Tepeticpac	13.1. Craneo 5	Cran frag	-6.2	24.6	15.6	-9.1
2755	Tepeticpac	13.10.8.1	Cran frag	-4.7	26.1	17.1	-7.2
2756	Tepeticpac	3.30.10.2	Rib frag	-3.6	27.2	18.1	-5.9
2757	Tepeticpac	13.7.5.1	Cran frag	-5.2	25.6	16.5	-7.9
2771	Tepeticpac	3.28.ES2	Cran frag	-4.3	26.5	17.4	-6.7
2772	Tepeticpac	13.24.19.1	Cran frag	-4.9	25.8	16.8	-7.5
2773	Tepeticpac	3.32.12.3	Cran frag	-6.4	24.3	15.3	-9.5
2774	Tepeticpac	3.33.13.1	Cran frag	-4.6	26.1	17.1	-7.2

2775	Tepeticpac	3.30.10.1	Pelvis frag	-4.8	26.0	17.0	-7.3
2776	Tepeticpac	3.32.12.2	Fibula frag	-5.8	24.9	15.9	-8.7
3081	Tepeticpac	3.32.12.4	Tibia frag	-6.2	24.5	15.5	-9.2
3082	Tepeticpac	3.22.ES1.2	MC	-3.0	27.8	18.7	-5.1
3083	Tepeticpac	3.23.5.3	MC	-2.8	28.0	19.0	-4.8
3084	Tepeticpac	3.24.4.1	Rib frag	-3.6	27.2	18.2	-5.8
3085	Tepeticpac	3.17.5.5	Radial frag	-4.3	26.4	17.4	-6.8
3086	Tepeticpac	3.23.2.1	Vert	-3.8	27.0	18.0	-6.1
3087	Tepeticpac	3.30.10.1	MC	-4.1	26.7	17.7	-6.5
3088	Tepeticpac	3.23.ES2.2	Phalanx	-4.3	26.5	17.5	-6.7
3089	Tepeticpac	3.23.5.2	Fibula frag	-5.1	25.7	16.7	-7.7
3090	Tepeticpac	3.24.3.1	Rib frag	-3.4	27.4	18.4	-5.6
3091	Tepeticpac	3.23.7.2	Phalanx	-2.8	28.1	19.0	-4.7

3092	Tepeticpac	3.23.2.2	Phalanx	-3.6	27.2	18.2	-5.8
3093	Tepeticpac	3.23.1.2	Rib frag	-4.1	26.7	17.7	-6.4
3094	Tepeticpac	3.22.ES 1	Capitate	-3.3	27.5	18.4	-5.5
3107	Tepeticpac	13.6.4.1	LB frag	-3.0	27.8	18.8	-5.0
3108	Tepeticpac	13.14.11.1	Rib frag	-5.8	24.9	15.9	-8.7
3109	Tepeticpac	13.23.18.1	Cran frag	-3.3	27.5	18.4	-5.5
3110	Tepeticpac	13.7.5.6	LB frag	-5.1	25.7	16.7	-7.7
3111	Tepeticpac	13.8.6.1	LB frag	-4.1	26.7	17.7	-6.4
3112	Tepeticpac	13.19.14.2	Cran frag	-4.1	26.6	17.6	-6.5
3113	Tepeticpac	13.1. Craneo 3	Cran frag	-5.2	25.6	16.6	-7.9
3114	Tepeticpac	13.20.15.3	Rib frag	-4.8	25.9	16.9	-7.4
3115	Tepeticpac	13.4.2.1	Rib frag	-5.6	25.2	16.2	-8.4
3116	Tepeticpac	13.7.5.3	frag	-4.1	26.6	17.6	-6.5

3117	Tepeticpac	13.1. Craneo 2	Cran frag	-5.7	25.0	16.0	-8.6
3118	Tepeticpac	13.17.ES3	Cran frag	-4.4	26.4	17.4	-6.9
3119	Tepeticpac	13.13.10.1	Cran frag	-5.7	25.1	16.1	-8.5
3151	Tepeticpac	13.19.4.1	Rib frag	-3.1	27.7	18.6	-5.2
3120	Cholula	Ent295 U21K-39Y	Rib frag	-5.1	25.6	16.6	-7.8
3121	Cholula	Ent155 U21L-9L	Rib frag	-5.5	25.2	16.2	-8.3
3122	Cholula	Ent68-A U21L-7H/75	Rib frag	-6.0	24.7	15.7	-8.9
3123	Cholula	Ent163 U21K-36C	Rib frag	-5.9	24.8	15.8	-8.8
3124	Cholula	Ent131 U21L-32A	frag	-5.5	25.3	16.3	-8.2
3125	Cholula	Ent214 U21K-24H	Cran frag	-6.9	23.8	14.8	-10.1
3126	Cholula	Ent151 U19J-Cuad6	Rib frag	-5.9	24.8	15.8	-8.8
3127	Cholula	Ent149 U19J-Cuad1	Cran frag	-5.3	25.5	16.5	-8.0
3128	Cholula	Ent101 U7A-7Z	Phalanx	-4.9	25.9	16.9	-7.5

3129	Cholula	Ent204 U21K-35S	Rib frag	-6.5	24.2	15.3	-9.5
3130	Cholula	Ent186 U21K-24H	Rib frag	-5.4	25.3	16.3	-8.2
3131	Cholula	Ent182-1 U21K-36S	Rib frag	-5.9	24.8	15.8	-8.8
3132	Cholula	Ent373-1 U20K-17U	Rib frag	-6.1	24.6	15.6	-9.1
3133	Cholula	Ent259 U21K-41D	Rib frag	-7.3	23.4	14.4	-10.6
3134	Cholula	Ent246-2 U21K-8V	Phalanx	-6.7	24.0	15.0	-9.8
3135	Cholula	Ent420 U20J-38L	Rib frag	-7.1	23.6	14.6	-10.4
3136	Cholula	Ent86A U21L-11E	Rib frag	-6.5	24.2	15.2	-9.6
3137	Cholula	Ent226 U19J-30D	Phalanx	-5.2	25.5	16.5	-8.0
3138	Cholula	Ent156 U?	Rib frag	-5.8	24.9	15.9	-8.7

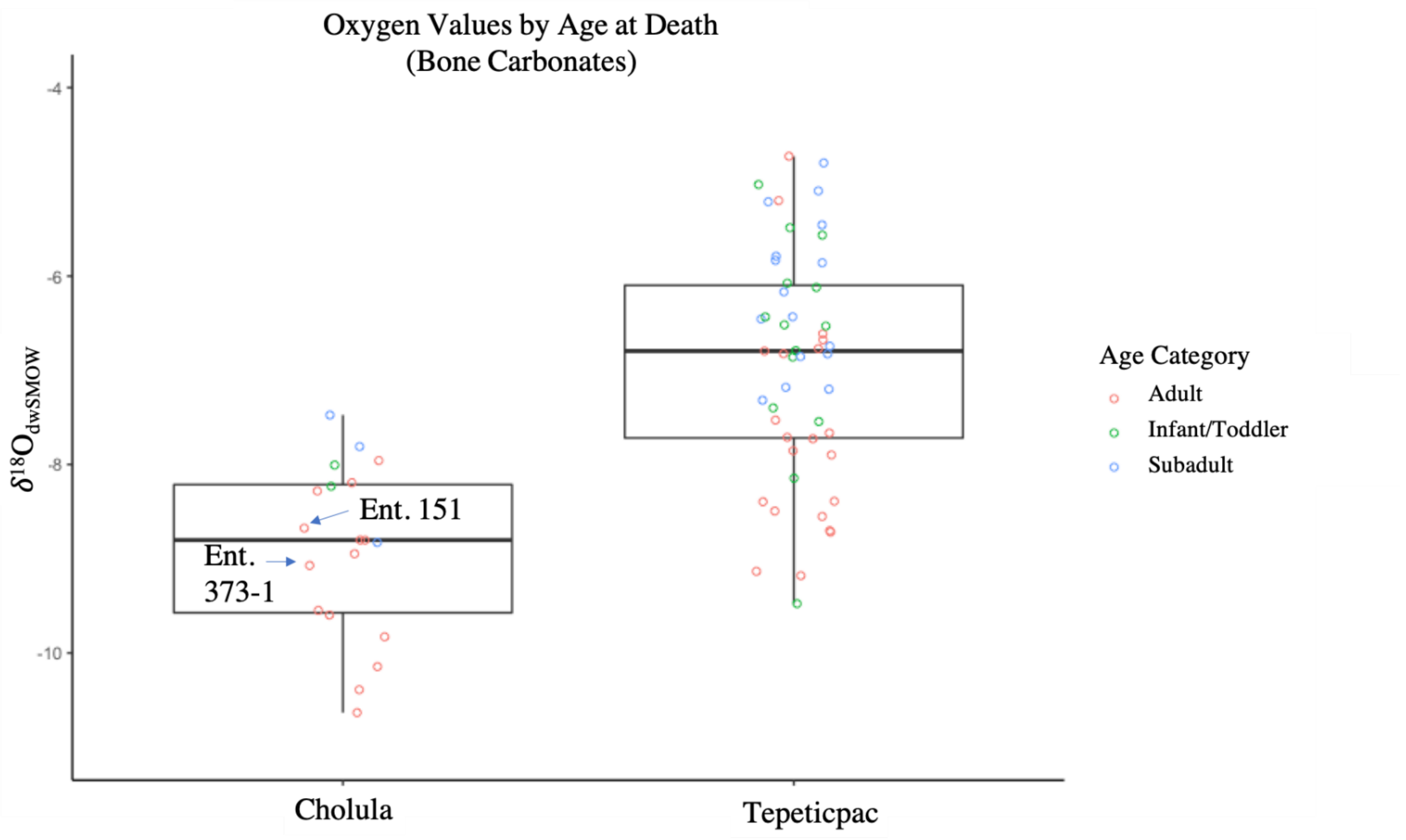


Figure 0.6: $^{18}O_{dwSMOW}$ values from bone carbonates at Tepeticpac and Cholula[25].

---

[25] Analyzed by age at death. Subadults are broadly grouped into Infant/Toddler (pre-weaning) and Subadults (middle childhood through adolescence). Note: bone carbonates were not recovered from outlier burials Ent. 190 or 81.

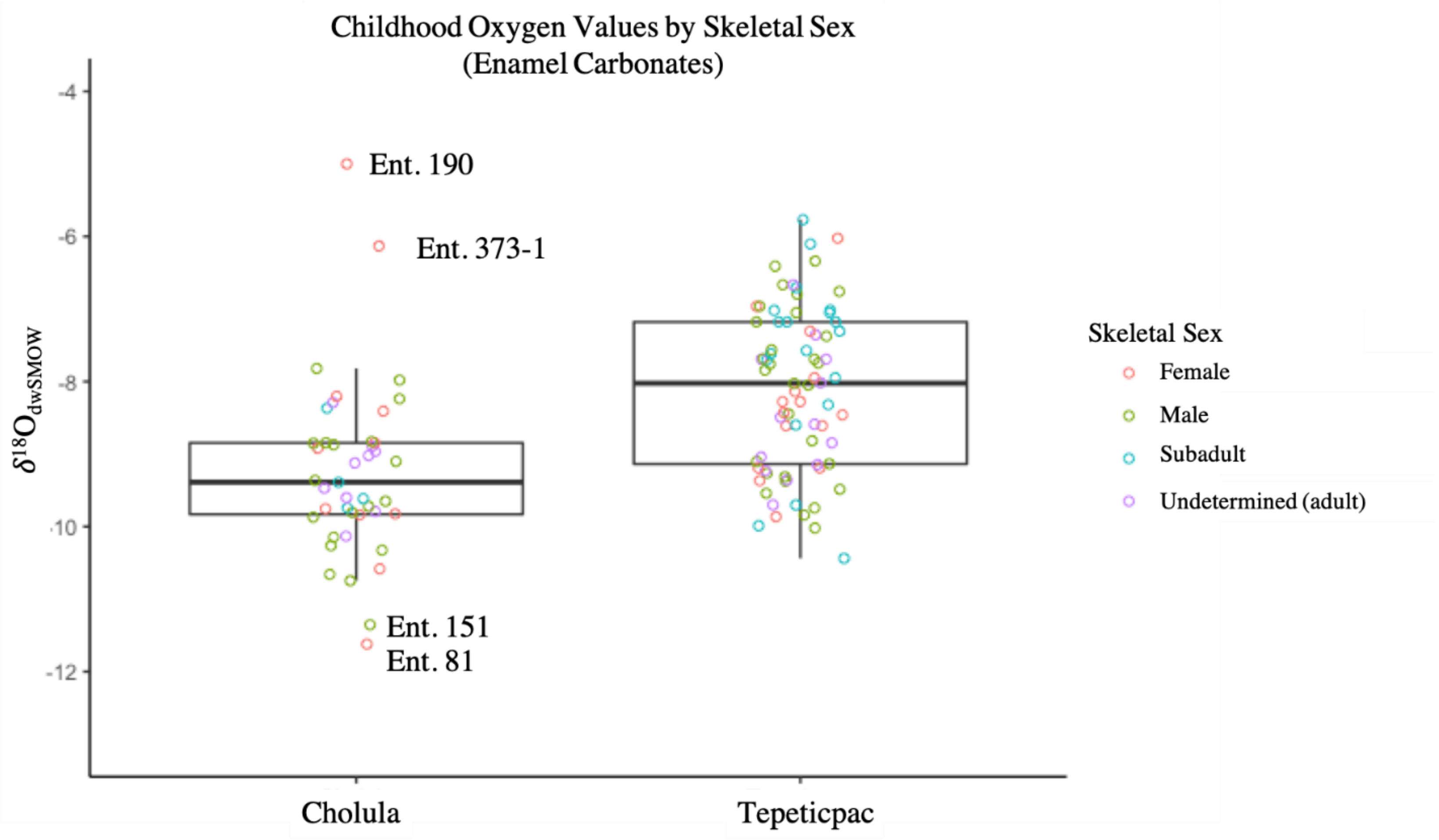


Figure 0.7: Sex-patterned variations in childhood oxygen sources[26].

---

[26] $^{18}O_{dwSMOW}$ from enamel carbonates.

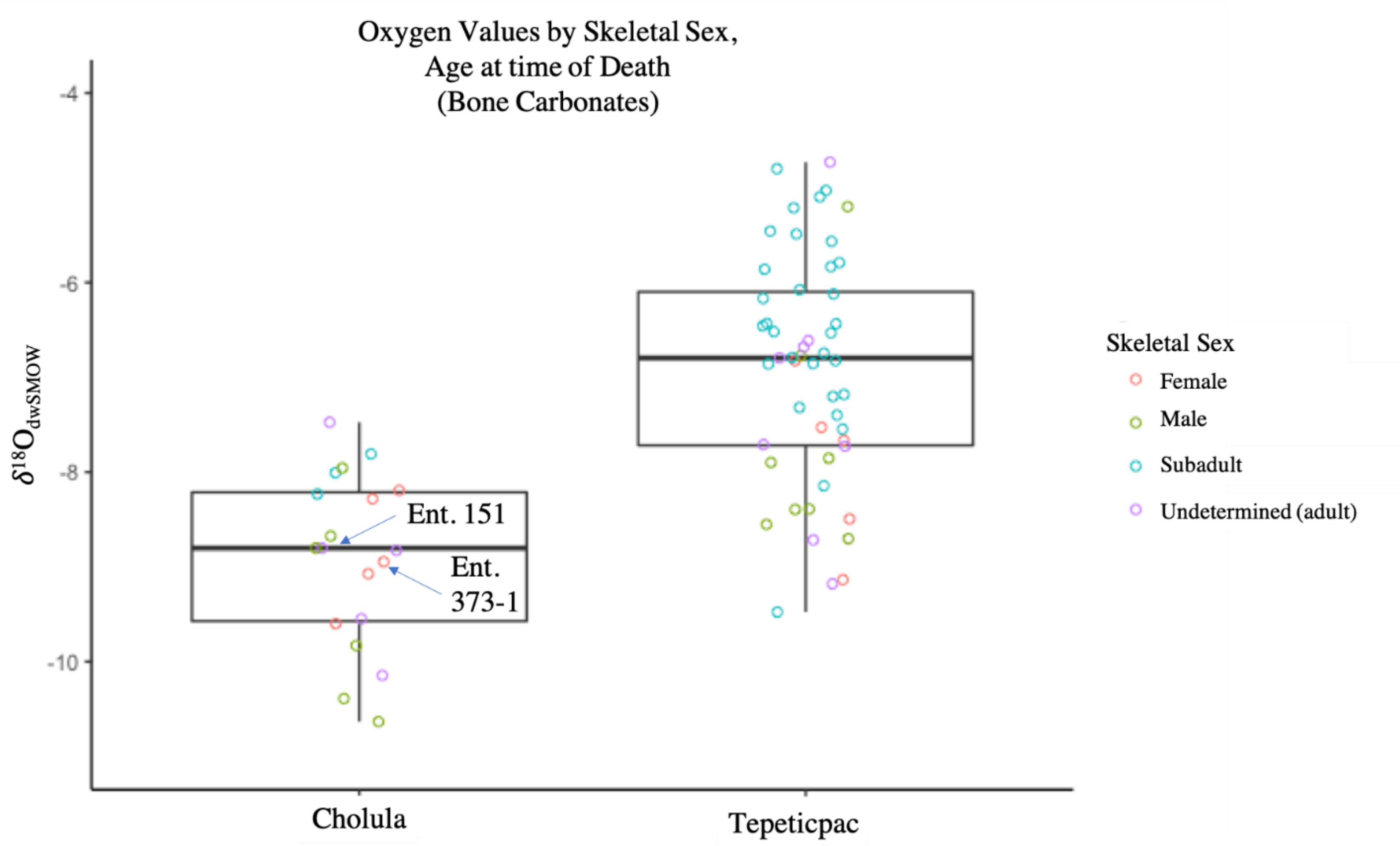


Figure 0.8: Sex-patterned variations in population oxygen sources[27].

---

[27] Based on age at death (18OdwSMOW from bone carbonates). Note: bone carbonates were not recovered from outlier burials Ent. 190 or 81.

Interpretation of locality at Tepeticpac

The population of Tepeticpac clusters more tightly (range = 3.1‰) than at sites where extensive immigration has been documented, such as at Teotihuacan[28] (range of -14.6‰ to -6.41‰ $\delta^{18}O_{bonedwSMOW}$, or 8.2‰ variation) suggesting that at least during childhood, individuals were born and remained within this region. When looking at bone carbonate values, the range decreases slightly from childhood values (from 4.6‰ with enamel carbonate, to 3.1‰ with bone carbonate). Once the breastfeeding enrichment effect is taken into account (**Fig. 6.7**), the population changes little from childhood to adulthood, suggesting very limited migration during childhood and adulthood. This aligns with a scenario in which this urban core was not a key site for immigration, perhaps because the external borders were carefully protected.

Examining sex-based differences in stable oxygen isotope values at Tepeticpac

The small number of females represented in enamel carbonates (n=5 individuals, representing 15 of the samples) and bone carbonates (n=5) does not allow for a statistical comparison of $\delta^{18}O$ values between the skeletal sexes. However, it can be noted that while little girls (**Fig. 6.8**) have $\delta^{18}O_{enamelcarbdwSMOW}$ values that span across all but the most enriched quadrant of the population oxygen values, once those same little girls reach adulthood (**Fig. 6.7**), their $\delta^{18}O_{bonecarbdwSMOW}$ values only appear within the bottom two quadrants of the population range. This suggests that both males and females had similar migration and residential mobility histories in childhood (and/or access to similar water sources, or water consumption practices), but in adulthood women's patterns of water consumption are more similar to one another's than

---

[28] Original values reported by White et al. 2004 in bone phosphates as 11.3 to 17.7‰ $\delta^{18}O_{bonephos}$

to the population as a whole. Despite these small differences, overall males and females consumed the same (or very similar) water sources, in the same (or very similar) manner. If the burial population at Tepeticpac included warriors or other individuals who spent part of their adult lives in another geographic zone, the $\delta^{18}\mathrm{O}_{\mathrm{bonecarbdwSMOW}}$ values might display a broader range of oxygen values. However, this is not observed within the analyzed population sample.

Interpretation of locality at Cholula

At Cholula, there is a similar clustering of enamel carbonate values when the four outliers are removed (range = 3.8‰), suggesting that while there are more individuals with non-local mobility in childhood than at Tepeticpac, both sites have a core majority of the population local to the Puebla-Tlaxcala valley. The four individuals (Ent. 190, Ent. 373-1, Ent. 151, Ent.81) with outlier stable oxygen isotope values from enamel (**See Figs. 6.4 through 6.8**) may have spent their infancy/childhood years elsewhere. The fact that three of the four outliers are female raises interesting questions about gendered patterns of migration and hints at the possibility of greater mobility by females, either due to involvement in trade, pilgrimage, difficult situations in their original homeland, or marriage practices (e.g., patrilocality), among other explanations. More broadly, sex-based comparisons at Cholula show that there are no statistically significant differences for enamel carbonates (Mann Whitney U=85; $n_1 = 19$, $n_2=11$; p=.41222 [two-tailed]), though this may be due to the small sample size. No sex-based comparisons could be completed for bone carbonates due to the small sample size.

Bullock-Kreger's (2010) analysis of strontium isotopes aligns with what the stable oxygen isotope data show in this current study. That is, within a sampled population of 309 individuals, Bullock-Kreger identified three individuals with potentially nonlocal Sr signatures (skeletons 151, 245, and 292), likely coming from the Oaxaca Valley to the south of the Puebla-Tlaxcala Valley. While burials 292 and 371-1 did not have distinct Sr signatures, Bullock-Kreger also designates them as outliers, and potential immigrants. As a metropolitan religious center, Cholula likely experienced the influx of relatively more individuals from distant lands: religious pilgrims, traders attending the central markets, and permanent migrants settling at Cholula in the pursuit of greater economic and social opportunities. The analyzed burials came from a peripheral, "commoner" area outside of the city core, perhaps representing a settlement with less population flux—yet the presence of non-local individuals demonstrates that boundaries of this community were permeable, incorporating individuals from outside the immediate area.

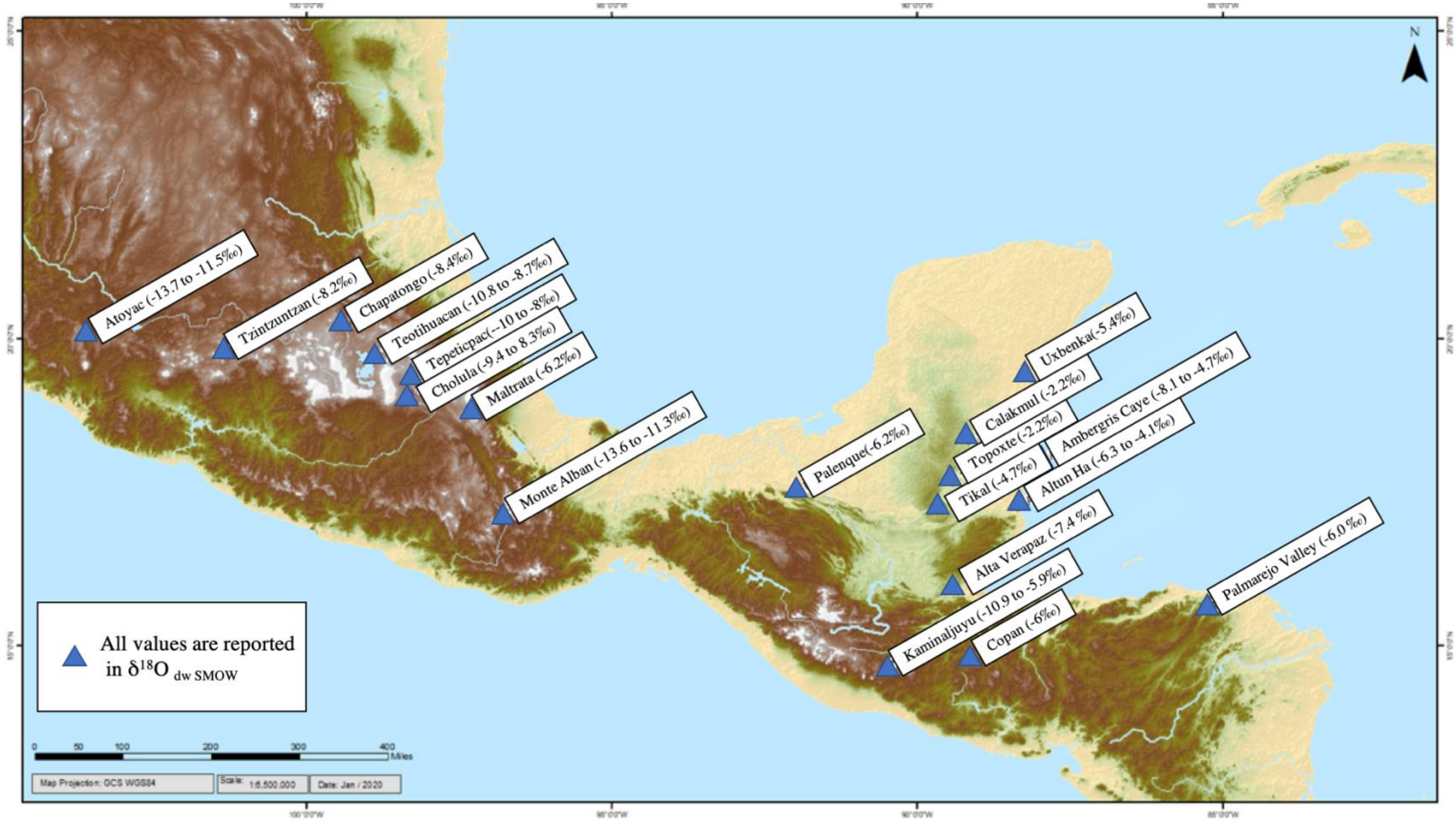


Figure 0.9: Map of ^{18}O ranges across Mesoamerica . Map by Gabriela Oré.

Discussion – What “Community” is This?

General trends

Comparative oxygen values within the region of the Puebla-Tlaxcala Valley and Valley of Mexico fall within a range approximately between -10‰ and -8‰ $\delta^{18}O_{dwSMOW}$. Thus, it is unlikely that population movement *within* the Puebla-Tlaxcala Valley, nor in the neighboring, climatically similar Valley of Mexico will be identifiable through oxygen values. These values do differ from neighboring climatic zones, such as the Guatemalan highlands and lowlands (approx. -6‰ to -2‰), the Pacific Coast (approx. -8‰ to -4‰) and the Oaxaca Valley (approx. -13‰ to -11‰) potentially allowing for the identification of immigrants from these more distant areas (**Fig. 6.9**).

Population movement, as understood through $\delta^{18}O_{\text{enamel carbonate}}$ and $\delta^{18}O_{\text{bonecarbonate}}$ values, do not show any significant difference between enamel (childhood) values between the Tepeticpac and Cholula (enamel carbonate: t = +4.56, p-value =.337948). This suggests that the patterns of childhood mobility captured by enamel were broadly similar between the two populations, and that they likely consumed water with similar stable oxygen isotope ratios, making it difficult to detect any migrants between the two regions. Bone carbonates, in contrast, approached significance with a t-test, (t=+7.39, p-value=.078382), and when run through a Mann Whitney U test had a significant difference (Mann Whitney U=96, z-score 5.12426, p-value < .00001). Thus, oxygen values captured by bone tissue formed in the period directly preceding death may signal differences in drinking water consumption practices. Looking at the demographic differences between individuals for whom bone carbonate was sampled at each site, Tepeticpac has a much higher proportion of infant/toddler/subadult individuals (**Fig. 6.7**), so perhaps this difference comes not from mobility, but from variations between water consumption in infants and toddlers (e.g. breastfeeding), and children (e.g. consuming prepared water, such as atole).

Population outliers: "But where are you really from?"

The four outlier individuals from Cholula (Ent. 81, 151, 190, and 373-1, visible in **Figs. 6.6-6.8**) align with strontium findings by Bullock Kreger (2010) that designate Cholula as a metropolitan center with a notable immigrant population. Yet, immigration is not a monolith, and population movement can stem from many distinct causes and result in a variety of relationships to place. To better understand the nature of immigration within this sample population, I present detailed life-histories of each individual as evidenced by enduring markers of lived experiences found on the skeletal remains.

Entierro 81 was found associated with materials dating to the later Cholulteca III phase. This burial was of a woman, 40-50 years of age. After middle childhood, she made the journey from a region depleted in $\delta^{18}O$ (M2 $\delta^{18}O_{enameldwSMOW} = -11.6‰$). Given recorded values for regions around Mexico, it is possible that these values reflect an area such as Northern Mexico or the Oaxaca Valley. Our storyline for this individual stops here, as the remains housed in the Dirección de Antropología Física were too fragmentary to observe much more than her age and sex, and no additional samples were collected.

Entierro 190 was another gracile individual, interpreted as female, slightly older at 50-60 years of age. From the same Cholulteca III phase, she had been very worn from life—nearly all of her teeth, save the incisors and canines, had been lost long ago, the bone of her jaw remodeling to erase all evidence that the rear teeth had existed. A single rear molar remained, rotted to a half-moon shape by a large carious lesion and the pock marked signs of abscesses in the surrounding bone tissue. Of the teeth that remained in the front of her mouth, all were heavily lined with the striations of linear enamel hypoplasia—evidence of a childhood punctuated by moments of biological stress. This stress, which could have been illness, or nutritional deficiency, was so severe that physiological systems diverted energy from the laying of enamel on her forming adult teeth—triage aimed as survival rather than forming perfect smooth enamel. These incisors would have begun forming when she was about a year old, capturing multiple stress events until their completion at 4 years old (see **Table 4.3**). In this period of early girlhood, this individual lived outside of the Puebla-Tlaxcala valley (M1, $\delta^{18}O_{enameldwSMOW}$ = -5‰) with oxygen values similar to those found in the Maya area to the south of Central Mexico. She also appeared to have a possible modification of her mandibular incisors—perhaps a nod to her non-local origins, as dental modification is common among the Maya (Geller 2009; Williams and White 2006). Again, the story is cut short, due to the fragmented state of these remains.

The final immigrant female is Entierro 373-1, again from the Cholulteca III phase. This individual was 60-70 years old, and she also suffered from extreme dental wear, and the loss of their premolars through molars, with alveolar bone completely resorbed. In addition, the remaining incisors were heavily coated in dental calculus, a record of her past meals. While she did not display a record of childhood stresses on her teeth, her skull was covered in healed porous bone, evidence of porotic hyporostosis—another physiological response to childhood stressors. Her oxygen values come from a single premolar (middle childhood), and show that like Ent. 190, she also came from an area with highly enriched water sources (PM, $\delta^{18}O_{enameldwSMOW}$ = -6.1‰). While there is not enough data to say at what point she came to Cholula, she spent at least the final years of her life there, long enough for her bone tissue to replace its oxygen enriched cells with those with values "average" for a Cholula resident.

The final outlier is Entierro 151, from the earlier Cholulteca II period. This is the sole male outlier, approximately 40-50 years of age. Like the previous burial he also demonstrated healed porotic hyperostosis as well as cribra orbitalia—a similar porous response found inside the eye orbital bones. His teeth were pock-marked with multiple severe carious lesions, though they did not reach the point of complete loss of dentition. His oxygen history shows that in early childhood, he resided in a place with water sources depleted in $^{18}\mathrm{O}$ (M1, $\delta^{18}\mathrm{O}_{\mathrm{enameldwSMOW}} = -11.4‰$). Yet, like Entierro 373-1, by the time of his death, his tissues were constructed of oxygen sources in line with those of a Cholula “local.”

Together, these stories show a trend of childhood origins outside of Cholula, with adolescence, adulthood and/or old age spent in the sacred city. As mentioned previously, it is notable that three of four outliers are female, particularly since females account for only 25% of the sample, a reflection of the larger burial area demography. It is also of note that all three are from the same time period, while the sole male is from the earlier Cholulteca II. Unfortunately, none of these individuals were directly analyzed for radiocarbon dates, but data from other burials in this burial area shows that two individuals from Cholulteca II were dated to a period between A.D. 778-1155, while two individuals from Cholulteca III were dated to a period between A.D. 1030-1255. Following the collapse of the city of Teotihuacan (see **Ch. 3**), there was large-scale population movement throughout Mesoamerica. Could Entierro 190 and 373-1 have been a part of the flow of immigrants shifting away from the Classic-period Maya “collapse”? Did they come with their families, or is the lack of males with enriched values evidence of patrilocal social systems in which females were more likely to marry into families abroad? Could the Cholulteca II Entierro 151 and the Cholulteca III Entierro 81 serve as evidence of longstanding population flow between the Puebla-Tlaxcala Valley and the Oaxaca

Valley to the south, as suggested by Bullock-Kreger (2010)? While the details of these stories remain nebulous, these questions will shape dietary analysis in the following chapter (**Ch.7**).

Beyond geographic community: Intergenerational change

Chronologically, Tepeticpac is clustered within about 200 years in the Terminal Postclassic and Early Colonial period, representing up to eight generations within the cemetery. Even within this chronological range, there is overall homogeneity in oxygen values, suggesting low mobility, though it is possible movement occurred between isotopically similar regions. This homogeneity holds strong across age and sex. Evidence of age-based differences is notable among nursing and weaning-age subadults, yet as will be explored in **Ch. 7**, even at their earliest ages, individuals at Tepeticpac are becoming incorporated into food traditions that carry on into adulthood. The following chapter will explore how this stability in carbon and nitrogen values emphasizes Tepeticpac's continuity in food knowledge and food practices across generational shifts. While the radiocarbon dates suggest that this population perhaps overlaps with the period of intense cultural rupture that is the early colonial period, the material record does not reflect this shift. In the next chapter (**Ch. 7**), I will turn to diet to explore whether foodways, and their continuity or rupture, can also help to reveal what this transitional period looked like at Tepeticpac.

In contrast, radiocarbon dates for Cholula show that this subsample represents a much earlier and more broadly dispersed chronological period, spanning approximately 400 years, or twice the span of Tepeticpac's sample. Four non-local individuals were identified, within a much smaller sample size than at Tepeticpac. While this might suggest that more population movement was occurring in Cholula, this may also be due to the larger amount of time separating sampled individuals. As discussed in **Ch. 5**, the Early Postclassic was a period of constant political shifts and social upheaval, not unlike the Late Postclassic, albeit with different perpetrators. It is possible that given the broader time span of the Cholula sample, the four non-locals did not co-exist (e.g. a single migration event), but rather show the persistence of small-scale migration across time.

In the following chapter (**Ch. 7**) I will use foodways to explore continuity or disjuncture in knowledge systems, comparing Cholula to Tepeticpac to understand community responses to external political influence. While the population at Cholula represents a looser definition of "community," with a low likelihood of individual chronological coexistence, it does represent the possibility of exploring "imagined community" and how identities constructed through foodways might persist across generations.

7

SUBSISTENCE AND COMMUNITY RELATIONSHIPS OF TWO PUEBLA-TLAXCALA CENTERS

In this chapter I present Cholula and Tepeticpac results from carbon, nitrogen and oxygen isotope analysis as well as data on plant microfossils from dental calculus. I begin this chapter by analyzing stable carbon and nitrogen isotope ratios from bone collagen, positioning individual diets from Tepeticpac and Cholula within the food web established in Ch. 5 to establish the local diets for each site. I incorporate results from paleobotanical analyses from dental calculus to identify specific plant components in the diet at Tepeticpac. I then explore within-group dietary patterns to evaluate whether there is dietary heterogeneity within the community. I also explore age-based changes in diet and water source as assessed through carbon and oxygen isotopes in dental enamel, and when available, through comparisons to the carbon and oxygen ratios in bone collagen and carbonates. In sum, this chapter explores the recursive relationship of the individual and the group in shaping foodways that reflect ideological beliefs about social organization.

Introduction

The Puebla-Tlaxcala Valley was one of the last areas of Aztec expansion and remained independent from the empire until Spanish arrival. Examining the dietary isotopes of individuals who lived through the changes of this period (Tepeticpac), and those that lived just prior (Cholula), provides a unique insight into the individual experiences that shaped this political moment. By clearly defining what types of foods are being consumed, what portions of the diet they represent, and how individuals vary in dietary behavior, this chapter examines patterns of food consumption as a component of identity construction at the individual and group level. These insights then permit an exploration of social organization before and during the time of Aztec rule (and attempts to rule). Dietary isotopes can help repopulate the past with individual experiences, filling in the silent gaps of those whose daily lives remained undocumented in imperial and colonial records. These particular case studies focus on a group from the urban core of Tepeticpac in Tlaxcala and a group from commoner households at Cholula. Taking into account the temporal and contextual differences in which these individuals existed, this chapter presents isotopic and paleobotanical data to explore the following questions:

1. *In what ways do Macrosystemic beliefs shape food decisions?*
2. *How do dietary behaviors change over time and through the Chronosystem?*
3. *How do Micro and Mesosystems interact to sustain social structures and/or shape change?*
4. *How do Exosystemic factors shape relationships to food?*
5. *How might internal structures of food distribution and access influence capacities for imperial resistance?*

The Bioecological Model in Action

Drawing from the bioecological model set forth in **Ch. 2 (**and represented here as **Fig. 7.1)**, I demonstrate how dietary goods and the way they are incorporated into the body are markers of multitiered systems of influence and agency. At the level of **Microsystem and Mesosystem**, the distribution of particular types of foods, such as meat and fish reflect both individual decision strategies (microsystem) and networks of household and community exchange and distribution (mesosystem). While official trade patterns and food distribution systems may have been enacted by political powers, or household leaders, individual dietary practices can emphasize the many different, perhaps private or lesser known dietary acts that took place at the individual level (such as decisions based on allergies, taste preferences, ingredient substitutions). Individual decisions about food could have slowly but surely maintained traditions and trends or created new ones.

At the level of the **Exosystem** (external events), I consider how imperial expansion and other concurrent (or in the case of Cholula, antecedent) political events shape what foods were available within two sites that shared an ecological zone. In particular, I explore how shifting networks of trade or relationships with external ecological food production zones (namely, marine areas) shape what foods were chosen, and how they were distributed. Hand in hand with the exosystem, the **Macrosystem** (beliefs and ideologies), while Mesoamerica-wide to a certain extent, was adapted and reinterpreted for local political ends. In the case of Tlaxcala and Cholula, which foods were eaten, and clues as to how and by whom they were eaten helps to emphasize unique interpretations of identity as a state-level marker, serving the political goals of the time.

At the **Microsystemic level**, I explore how idealized markers of state-define identity are negotiated, and often countered, at the individual level. Finally, by comparing Cholula (Early Postclassic) and Tlaxcala (Late Postclassic), I explore the **Chronosystem** (changes through time) of foodways at the site-level to explore how the changing politics and alliances of the Early Postclassic through the Late Postclassic influenced food choices. At a finer level, I examine chronological changes through the lifetime of the individual through comparative isotope values in childhood and adulthood, to understand how social structure at Cholula and Tlaxcallan is enacted through food rules learned throughout the life course.

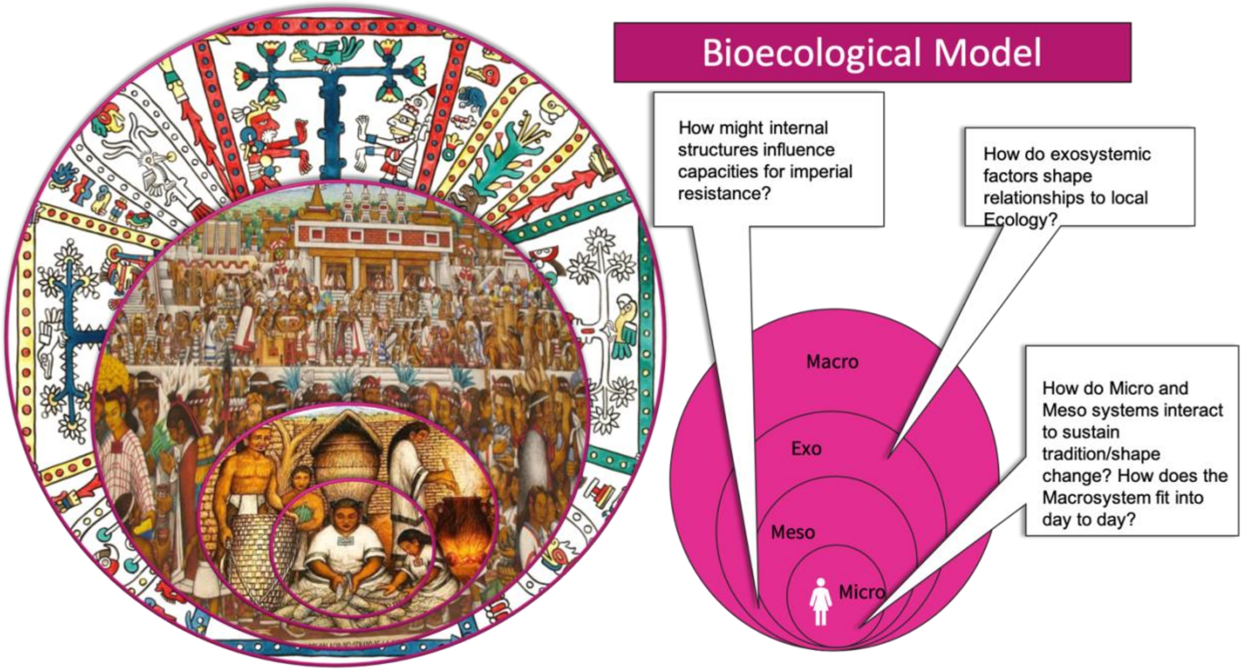


Figure 0.1: The Bioecological Model applied to Tepeticpac and Cholula[29]*..*

Sample Preservation

Tepeticpac

The samples from Tepeticpac were well-preserved, and yielded results from **59/59 collagen samples**, **51/51 bone carbonate samples**, and **76/90 enamel samples**. Bone collagen samples were assessed for postmortem degradation by establishing the ratio of carbon to nitrogen (atomic C:N), which should fall between 2.9-3.6 if the samples are not degraded (Ambrose 1990; DeNiro 1985; Schoeninger and Moore 1992). Tepeticpac atomic C:N ratios produced an average of 3.21 (SD .06). A single Tepeticpac sample (#2328) fell slightly below the threshold (C/N=2.8), though it was still considered for this study. Various analyses have shown that

---

[29] Imagery from artist Desiderio Xochitiotzin's murals at the Tlaxcala National Palace, depicting daily life in Prehispanic Tlaxcallan (inner 3 circles), and Codex Féjervary-Mayer, f.1, depicting the axis mundi of the Mesoamerican world (outer circle).

enamel is less prone to diagenesis than bone (Turner et al. 2005, 2010), yet at Tepeticpac, enamel samples produced the lowest yield of viable samples, likely due to the insufficient quantity of enamel powder that was drilled from each tooth. Non-viable enamel samples predominantly occurred in deciduous dentition or teeth in the process of formation (M2, M3), thus, in the former, the small teeth prevented sufficient enamel powder collection, and in the latter, diagenesis was likely due to incomplete mineralization.

Cholula

In contrast to samples from Tepeticpac, those from Cholula suffered severe diagenesis, likely due to being stored and handled in museum collections for the past 50 years. Of 100 bone samples, 54 produced insufficient collagen during collagen prep, and were not sent for analysis. Of the remaining bone samples, 21/46 produced amounts of collagen too small to be detected by the mass spectrometer. Of the remaining 25 collagen samples, 21 were analyzed at the Yale Analytical and Stable Isotope Center and produced atomic C:N ratios between 3.2 and 3.3 (mean = 3.2, s.d. =.04). The remaining four samples were analyzed by the Pennsylvania State Institute of Energy and Environment (six were sent, but only four yielded results). The atomic C:N ratios of those four samples also ranged from 3.2-3.3 (mean = 3.3, s.d. -.06). Thus, collagen samples yielded a 75% no data rate, with **25 valid collagen samples**. Remaining bone fragments were used to analyze **19 samples for bone carbonates**, all of which produced viable data. As mentioned above, the crystalline structure of dental enamel protects enamel apatite from diagenesis.

Within the Cholula sample, **43/50 enamel samples yielded viable data**; with 14% of samples producing no data, enamel was clearly also impacted by diagenesis, though to a lesser extent. Thus, bone collagen, carbonate and enamel apatite values reported for individuals at Cholula are interpreted cautiously.

Table 0.1: Mean values of preservation

Burial Area	%C	%N	Atomic C:N mean	Collagen % valid	Carbonates % valid	Apatite % valid
Cholula	23.0	8.3	3.2	25% (n=100)	25% (n=100)	64% (n=50)
Tepeticpac Op 3	36.5	13.27	3.2	100% (n=30)	100% (n=26)	76% (n=32)
Tepeticpac Op 13	31.28	11.27	3.2	100% (n=29)	100% (n=25)	93% (n=44)
Tepeticpac Total	33.93	12.28	3.2	100% (n=59)	100% (n=51)	85% (n=77)

Diet in the Puebla-Tlaxcala Valley: The Meso/Exo/Macrosystems

Bone collagen results

The results discussed in **Ch. 5** represent the collagen values of local flora and fauna. Results from collagen in human bone are reported as raw $\delta^{15}N_{AIR}$ and $\delta^{13}C_{VPDB\ coll}$. Converting these collagen values to adjust for fractionation effects, allows them to be compared to the collagen of flora and fauna in the diet. For $\delta^{13}C_{VPDB\ coll}$ values this adjustment is approximately -5‰ . For bone carbonates, this adjustment follows the formula from Ambrose and Norr (1993): (1.04 x $\delta^{13}C_{bone\ carbonate}$ – 9.2‰). $\delta^{15}N_{col}$ was converted by subtracting -3‰ following estimates from Ambrose (2002), Bocherens and Drucker (2003) and Hedges and Reynard (2007). The resulting adjusted values are reported as $\delta^{15}N_{diet}$, $\delta^{13}C_{collagen\ diet}$, and $\delta^{13}C_{carb\ diet}$, in order to understand the relationship between the local food web and the values represented in human collagen and carbonates from Tepeticpac and Cholula.

This section will begin with an overview of collagen values for each site, to establish a **Macro**-level range of Puebla-Tlaxcala diets within Mesoamerican foodways. Then, by looking at intra-site variation, I will explore how comparing diets at Cholula and Tepeticpac might emphasize **Exo**systemic and **Chrono**systemic differences (e.g. relationship to trade networks, chronologically-specific political economic relationships) and **Meso**systemic social structures that shape food access and distribution. Finally, I turn to inter-site variation at the **Micro**-level range to understand how internal variations between members of the same site correlate to certain social identifiers (age, skeletal sex, burial location), as well as identifying individual adherence to or departure from site-specific foodways.

Collagen summary

At Tepeticpac, bone collagen was collected from 59 samples representing 59 individuals. The mean $\delta^{13}\mathrm{C}_{\mathrm{VPDB\ coll}}$ was -6.5‰ (s.d. = .7, range = -8 to -4.6). The mean $\delta^{15}\mathrm{N}_{\mathrm{AIR}}$ was 10.4‰ (s.d. = 0.7, range= 7.7 to 13.4) (**Tables 7.2 and 7.3**). At Cholula, bone collagen was collected from 25 samples representing 25 individuals. The mean $\delta^{13}\mathrm{C}_{\mathrm{VPDB\ coll}}$ was -7.9‰ (s.d. = .6, range = -8.9 to –6.4). The mean $\delta^{15}\mathrm{N}_{\mathrm{AIR}}$ was 8.3‰ (s.d. = 1.0, range= 6.6 to 11.1) (**Tables 7.2 and 7.3**).

To compare diets between the two sites, isotope values were compared using a two-tailed student t-test because they did not exhibit significantly different variances. The two populations show significantly different isotope values in both carbon in collagen ($\delta^{13}\mathrm{C}_{\mathrm{col}}$ t=7.89, p<.00001) and nitrogen in collagen ($\delta^{15}\mathrm{N}_{\mathrm{col}}$ t=-7.18, p=<.00001) (**Fig. 7.2**). While both sites fall within $\delta^{13}\mathrm{C}$

values characteristic of C_4-based diets, Tepeticpac populations are even more enriched in $\delta^{13}C$. As I will argue in this chapter, this aligns with food practices that incorporate additional C_4 and CAM ingredients, as well as nixtamalized maize. As was found in Ch. 6, the populations of Cholula and Tepeticpac are both predominantly local to the region. Thus, individuals are from the same geographical area and in theory have access to the same local resources. However, as this chapter explores, dietary differences both *between* Cholula and Tepeticpac and *within* each site emphasizes that access to the same resources does not mean they will be consumed in the same ways. The following sections explore these differences in detail, to understand in what ways and for whom diets differed at Tepeticpac and Cholula.

Table 0.2: Descriptive statistics for bone collagen and bone carbonate values

	$\delta^{13}C_{VPDB\ coll}$				$\delta^{13}C_{carb}$				$\delta^{15}N_{AIR}$			
Site	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Tepeticpac	-6.5	.7	-8.0	-4.6	-2.7	.6	-3.8	-1.6	10.4	1.3	7.6	13.4
Cholula	-7.9	.6	-8.9	-6.4	-3.1	.5	-4.5	-2.1	8.3	1.0	6.6	11.1

Table 0.3: Stable carbon and nitrogen isotope results from human bone

Site	Isotope Lab Code	Burial Code	Age	Sex	Sample Material	$\delta^{15}N_{AIR}$	$\delta^{13}C_{VPDB\ coll}$	$\delta^{13}C_{carb}$
Tepeticpac	2091	13.1.CRAN1	30-40	M	M2			1.2
Tepeticpac	2092	13.1.CRAN1	30-40	M	M1			0.9
Tepeticpac	BLG7	13.1.CRAN1	30-40	M	Cran frag	10.0	-7.4	
Tepeticpac	2093	13.1.CRAN2	30-40	M	M1			0.0
Tepeticpac	2094	13.1.CRAN2	30-40	M	M2			0.8
Tepeticpac	3117	13.1.CRAN2	30-40	M	Cran frag			-2.2
Tepeticpac	2371	13.1.CRAN2	30-40	M	Cran frag	9.6	-7.0	
Tepeticpac	2100	13.1.CRAN3	40+	M	M1			0.7
Tepeticpac	3113	13.1.CRAN3	40+	M	Cran frag			-2.5
Tepeticpac	2389	13.1.CRAN3	40+	M	Cran frag	10.9	-6.2	
Tepeticpac	2753	13.1.CRAN4	40+	M	Cran frag			-2.1
Tepeticpac	2394	13.1.CRAN4	40+	M	Cran frag	9.1	-5.7	
Tepeticpac	2098	13.1.CRAN5	18-25?	F?	M1			0.9
Tepeticpac	2099	13.1.CRAN5	18-25?	F?	M2			0.6
Tepeticpac	2754	13.1.CRAN5	18-25?	F?	Cran frag			-1.7
Tepeticpac	2393	13.1.CRAN5	18-25?	F?	Cran frag	8.3	-6.4	
Tepeticpac	2106	13.1.DS1	SA	SA	M1			0.3
Tepeticpac	2105	13.1.DS2	A	U	M3			0.1
Tepeticpac	2104	13.1.DS3	A	U	M3			1.7
Tepeticpac	2095	13.1.MAND1	A	U	M3			1.1
Tepeticpac	2096	13.1.MAND1	A	U	M2			0.6

Tepeticpac	2097	13.1.MAND1	A	U	M1			0.4
Tepeticpac	2101	13.1.MAND2	A	U	M1			0.1
Tepeticpac	2102	13.1.MAND2	A	U	M3			0.8
Tepeticpac	2103	13.1.MAND3	A	U	M2			1.0
Tepeticpac	2755	13.10.8.1	4-5 years	SA	Cran frag			-3.1
Tepeticpac	2342	13.10.8.1	4-5 years	SA	Cran frag	10.4	-6.4	
Tepeticpac	1996	13.11.9.1	20-30	F	M2			0.9
Tepeticpac	1997	13.11.9.1	20-30	F	M3			1.0
Tepeticpac	1998	13.11.9.1	20-30	F	M1			0.8
Tepeticpac	2742	13.11.9.1	20-30	F	rib			-2.5
Tepeticpac	2372	13.11.9.1	20-30	F	rib	9.5	-7.2	
Tepeticpac	1999	13.13.10.1	25-30	F	M1			-0.5
Tepeticpac	2000	13.13.10.1	25-30	F	M2			0.2
Tepeticpac	2001	13.13.10.1	25-30	F	M3			0.1
Tepeticpac	3119	13.13.10.1	25-30	F	Cran frag			-2.3
Tepeticpac	2386	13.13.10.1	25-30	F	Cran frag	9.4	-7.0	
Tepeticpac	2090	13.13.10.2	A	U	C			0.0
Tepeticpac	3108	13.14.11.1	30-40	M	rib			-2.6
Tepeticpac	2387	13.14.11.1	30-40	M	rib	8.2	-5.8	
Tepeticpac	2089	13.17.ES3	SA	SA	M1			0.2
Tepeticpac	2370	13.17.ES3	SA	SA	Cran frag	10.2	-4.6	
Tepeticpac	3118	13.17.ES3	SA	SA	Cran frag			-3.4
Tepeticpac	2077	13.19.14.1	30-40	M	M2			0.6
Tepeticpac	2078	13.19.14.1	30-40	M	M3			0.4
Tepeticpac	3069	13.19.14.1	30-40	M	rib	9.2	-7.1	
Tepeticpac	3151	13.19.14.1	30-40	M	rib			-2.1
Tepeticpac	2377	13.19.14.2	SA	SA	Cran frag	11.7	-5.5	
Tepeticpac	3112	13.19.14.2	SA	SA	Cran frag			-2.8
Tepeticpac	2085	13.20.15.1	40-50	M	M1			1.3
Tepeticpac	2086	13.20.15.1	40-50	M	M2			-0.2
Tepeticpac	2087	13.20.15.1	40-50	M	M3			1.4

Tepeticpac	BLG6	13.20.15.1	40-50	M	Cran frag	11.2	-6.8	
Tepeticpac	2373	13.20.15.2	SA	SA	rib	11.4	-5.7	
Tepeticpac	2725	13.20.15.2	SA	SA	rib			-1.7
Tepeticpac	2395	13.20.15.3	SA	SA	rib	9.1	-6.3	
Tepeticpac	3114	13.20.15.3	SA	SA	rib			-2.2
Tepeticpac	2088	13.20.15.4	A	U	PM3			1.4
Tepeticpac	2079	13.22.17.1	40-50	M	M1			0.5
Tepeticpac	2080	13.22.17.1	40-50	M	M2			-0.9
Tepeticpac	2081	13.22.17.1	40-50	M	M3			-1.4
Tepeticpac	2368	13.22.17.1	40-50	M	rib	7.6	-6.7	
Tepeticpac	2723	13.22.17.1	40-50	M	rib			-3.8
Tepeticpac	2082	13.23.18.1	44052	SA	M1			0.5
Tepeticpac	2083	13.23.18.1	44052	SA	M2			0.6
Tepeticpac	2392	13.23.18.1	44052	SA	Cran frag	9.5	-6.3	
Tepeticpac	3109	13.23.18.1	44052	SA	Cran frag			-1.8
Tepeticpac	2084	13.24.19.1	9-12 months	SA	di1			-0.2
Tepeticpac	2378	13.24.19.1	9-12 months	SA	Cran frag	13.4	-6.0	
Tepeticpac	2772	13.24.19.1	9-12 months	SA	Cran frag			-3.8
Tepeticpac	1986	13.3.1.1	20-25	M?	M1			-0.1
Tepeticpac	1987	13.3.1.1	20-25	M?	M2			1.0
Tepeticpac	1988	13.3.1.1	20-25	M?	M3			1.0
Tepeticpac	BLG5	13.3.1.1	20-25	M?	cran frag	10.2	-6.9	
Tepeticpac	1989	13.3.1.2	SA	SA	m2			0.9
Tepeticpac	2376	13.4.2.1	25-30	M	rib	9.7	-6.5	
Tepeticpac	3115	13.4.2.1	25-30	M	rib			-2.4
Tepeticpac	2388	13.5.3.1	3-5 years	SA	long bone frag	10.4	-5.9	
Tepeticpac	2726	13.5.3.1	3-5 years	SA	long bone frag			-2.0
Tepeticpac	2369	13.6.4.1	<1 year	SA	long bone frag	10.8	-6.4	
Tepeticpac	3107	13.6.4.1	<1 year	SA	long bone frag			-2.3
Tepeticpac	1990	13.7.5.1	30-40	M	M2			0.1
Tepeticpac	1991	13.7.5.1	30-40	M	M1			0.3

Tepeticpac	2374	13.7.5.1	30-40	M	Cran frag	8.8	-6.5	
Tepeticpac	2757	13.7.5.1	30-40	M	Cran frag			-2.2
Tepeticpac	1992	13.7.5.2	A	U	C			0.5
Tepeticpac	2341	13.7.5.3	SA	SA	SA long bone	11.9	-5.0	
Tepeticpac	3116	13.7.5.3	SA	SA	SA long bone			-2.4
Tepeticpac	2375	13.7.5.4	SA	SA	Vert	10.6	-6.5	
Tepeticpac	2391	13.7.5.5	A	U	Radius	10.0	-5.7	
Tepeticpac	3085	13.7.5.5	A	U	Radius			-1.9
Tepeticpac	2396	13.7.5.6	A	U	rib	10.8	-6.6	
Tepeticpac	3110	13.7.5.6	A	U	rib			-3.0
Tepeticpac	2343	13.8.6.1	1-3 years	SA	long bone frag	12.4	-5.4	
Tepeticpac	3111	13.8.6.1	1-3 years	SA	long bone frag			-3.5
Tepeticpac	1995	13.8.6.2	SA	SA	dm1			1.3
Tepeticpac	2390	13.9.7.1	6-9 months	SA	Cran frag	11.4	-4.6	
Tepeticpac	2743	13.9.7.1	6-9 months	SA	Cran frag			-2.9
Tepeticpac	448	3.21.1.1	30-40	M	M1			-0.5
Tepeticpac	449	3.21.1.1	30-40	M	M1			0.3
Tepeticpac	450	3.21.1.1	30-40	M	M2			0.2
Tepeticpac	451	3.21.1.1	30-40	M	M2			1.1
Tepeticpac	452	3.21.1.1	30-40	M	M3			0.4
Tepeticpac	BLG8	3.21.1.1	30-40	M	Cran frag	9.5	-6.6	
Tepeticpac	2339	3.21.1.2	SA	SA	rib	11.1	-7.2	
Tepeticpac	3093	3.21.1.2	SA	SA	rib			-3.3
Tepeticpac	2296	3.21.1.3	A	U	MT2	10.8	-7.2	
Tepeticpac	2724	3.21.1.3	A	U	MT2			-2.6
Tepeticpac	455	3.22.ES1	1-2	SA	dc			0.6
Tepeticpac	2337	3.22.ES1	1-2	SA	MC	11.8	-6.2	
Tepeticpac	3094	3.22.ES1	1-2	SA	MC			-1.6
Tepeticpac	2332	3.22.ES1.2	SA	SA	carpal- capitate	9.9	-6.9	
Tepeticpac	3082	3.22.ES1.2	SA	SA	carpal- capitate			-3.4
Tepeticpac	468	3.23.2.1	20-30	F	M2			-0.7

Tepeticpac	469	3.23.2.1	20-30	F	M2			-0.3
Tepeticpac	478	3.23.2.1	20-30	F	M3			0.5
Tepeticpac	479	3.23.2.1	20-30	F	M1			0.3
Tepeticpac	480	3.23.2.1	20-30	F	M1			0.9
Tepeticpac	2254	3.23.2.1	20-30	F	rib	9.1	-6.8	
Tepeticpac	2722	3.23.2.1	20-30	F	rib			-3.4
Tepeticpac	2326	3.23.2.2	SA	SA	Phalanx	11.0	-6.8	
Tepeticpac	3092	3.23.2.2	SA	SA	Phalanx			-1.6
Tepeticpac	1983	3.23.2.3	A	U	C			0.8
Tepeticpac	2333	3.23.2.4	1-2	SA	Vert	12.2	-6.0	
Tepeticpac	3086	3.23.2.4	1-2	SA	Vert			-3.0
Tepeticpac	2253	3.23.5.1	12-15	SA	rib	10.9	-7.0	
Tepeticpac	2727	3.23.5.1	12-15	SA	rib			-1.8
Tepeticpac	2330	3.23.5.2	A	U	Fibula frag	9.7	-6.3	
Tepeticpac	3089	3.23.5.2	A	U	Fibula frag			-3.3
Tepeticpac	2336	3.23.5.3	SA	SA	MC	12.2	-5.9	
Tepeticpac	3083	3.23.5.3	SA	SA	MC			-2.8
Tepeticpac	466	3.23.6.1	40-50	F	I1			-1.1
Tepeticpac	467	3.23.6.1	40-50	F	I1			0.0
Tepeticpac	2255	3.23.6.1	40-50	F	rib	10.3	-6.4	
Tepeticpac	2741	3.23.6.1	40-51	F	rib			-2.6
Tepeticpac	472	3.24.3.1	1-2	SA	di1			0.3
Tepeticpac	2256	3.24.3.1	1-2	SA	rib	10.3	-7.6	
Tepeticpac	3090	3.24.3.1	1-2	SA	rib			-2.9
Tepeticpac	470	3.24.4.1	4-5	SA	dc			0.4
Tepeticpac	2329	3.24.4.1	4-5	SA	rib	9.9	-7.8	
Tepeticpac	3084	3.24.4.1	4-5	SA	rib			-2.6
Tepeticpac	2340	3.24.4.2	SA	SA	Radius	10.1	-7.7	
Tepeticpac	2745	3.24.4.2	SA	SA	Radius			-2.1
Tepeticpac	BLG9	3.26.8.1	2-3	SA	Cran frag	11.7	-7.3	

Tepeticpac	1982	3.26.8.2	SA	SA	M1			-0.3
Tepeticpac	2251	3.27.7.1	1-2	SA	rib	12.0	-5.8	
Tepeticpac	2728	3.27.7.1	1-2	SA	rib			-2.2
Tepeticpac	1985	3.27.7.2	A	U	M2			-1.1
Tepeticpac	2335	3.27.7.2	A	U	Phalanx	9.4	-8.0	
Tepeticpac	3091	3.27.7.2	A	U	Phalanx			-2.5
Tepeticpac	2252	3.27.9.1	1-2	SA	Tibia frag	13.2	-6.0	
Tepeticpac	2729	3.27.9.1	1-2	SA	Tibia frag			-3.8
Tepeticpac	473	3.28.ES2	5-6	SA	M1			-0.1
Tepeticpac	474	3.28.ES2	5-6	SA	M1			0.5
Tepeticpac	476	3.28.ES2	5-6	SA	dm1			0.3
Tepeticpac	2298	3.28.ES2	5-6	SA	Cran frag	11.7	-6.2	
Tepeticpac	2771	3.28.ES2	5-6	SA	Cran frag			-3.3
Tepeticpac	2327	3.28.ES2.2	A	U	Phalanx	9.7	-7.2	
Tepeticpac	3088	3.28.ES2.2	A	U	Phalanx			-3.0
Tepeticpac	457	3.28.ES2.3	SA	SA	M2			0.7
Tepeticpac	1984	3.30.10.1	SA	SA	PM3			1.0
Tepeticpac	2331	3.30.10.1	SA	SA	Pelvis frag	9.5	-6.3	
Tepeticpac	2775	3.30.10.1	SA	SA	Pelvis frag			-2.7
Tepeticpac	2301	3.30.10.2	SA	SA	rib	13.1	-6.1	
Tepeticpac	2756	3.30.10.2	SA	SA	rib			-2.7
Tepeticpac	2300	3.30.10.3	A	U	MC5	9.7	-6.3	
Tepeticpac	3087	3.30.10.3	A	U	MC5			-3.03
Tepeticpac	2334	3.31.11.1	1-2	SA	Fibula frag	12.7	-5.7	
Tepeticpac	2744	3.31.11.1	1-2	SA	Fibula frag			-3.6
Tepeticpac	2297	3.31.12.4	A	U	Fibula Frag	8.5	-6.7	
Tepeticpac	446	3.32.12.1	20-25	M	M2			0.3
Tepeticpac	462	3.32.12.1	20-25	M	M1			-0.2
Tepeticpac	463	3.32.12.1	20-25	M	M2			0.8
Tepeticpac	464	3.32.12.1	20-25	M	M3			0.5
Tepeticpac	465	3.32.12.1	20-25	M	M3			0.8

Tepeticpac	1980	3.32.12.1	20-25	M	c			1.2
Tepeticpac	BLG2	3.32.12.1	20-25	M	rib	9.7	-6.1	
Tepeticpac	2328	3.32.12.2	A	U	Fibula frag	9.3	-7.2	
Tepeticpac	2776	3.32.12.2	A	U	Fibula frag			-2.4
Tepeticpac	2338	3.32.12.3	SA	SA	Cran frag	10.5	-6.4	
Tepeticpac	2773	3.32.12.3	SA	SA	Cran frag			-3.4
Tepeticpac	3081	3.32.12.4	A	U	Fibula frag			-2.8
Tepeticpac	459	3.33.13.1	5-7	SA	C			0.6
Tepeticpac	460	3.33.13.1	5-7	SA	M1			-0.5
Tepeticpac	461	3.33.13.1	5-7	SA	M1			0.2
Tepeticpac	2299	3.33.13.1	5-7	SA	Cran frag	9.6	-7.7	
Tepeticpac	2774	3.33.13.1	5-7	SA	Cran frag			-3.2
Cholula	2397	Ent68-A U 21-7H/75	50-60	F	Rib frag	8.0	-8.6	
Cholula	3122	Ent68-A U 21-7H/75	50-60	F	rib frag			-2.8
Cholula	1925	Ent69A-1, U 21L-14G	20-30	M	M1			-1.2
Cholula	1926	Ent81, U 21L-2C-2D	40-51	F	M2			-3.3
Cholula	BLG13	Ent83-c, U 21L-11G	50-60	M	rib frag	8.5	-7.6	
Cholula	2409	Ent86A U21L-11E	30-35	F	Rib frag	8.1	-8.1	
Cholula	3136	Ent86A U21L-11E	30-35	F	rib frag			-2.9
Cholula	BLG14	Ent100-1, U 19J Cuad1	18-20	F	rib frag	8.1	-8.9	
Cholula	2420	Ent101 U7A-7Z	43990	SA	Phalanx	6.6	-6.8	

Cholula	3128	Ent101 U7A-7Z	43990	U	Phalanx			-2.1
Cholula	1927	Ent127, U 21L-27M	20-25	M	M2			-0.9
Cholula	2427	Ent131 U21L-32A	43864	SA	long bone frag	11.1	-7.2	
Cholula	3124	Ent131 U21L-32A	43865	SA	bone frag			-3.3
Cholula	1928	Ent134, U 21L-32A	8-9	U	M1			-0.7
Cholula	2685	Ent149 U19J-Cuad1	0-0.3	SA	Cran frag	9.2	-8.8	
Cholula	3127	Ent149 U19J-Cuad1	0-0.3	SA	Cran frag			-4.5
Cholula	BLG15	Ent150, U19J Cuad7	4-5	SA	rib frag	8.6	-8.2	
Cholula	2684	Ent151 U19J-Cuad6	40-50	M	Rib frag	6.7	-7.9	
Cholula	3126	Ent151 U19J-Cuad6	40-50	M	rib frag			-2.9
Cholula	1929	Ent151, U 19J-Cuadro 6	40-50	M	M1			-0.7
Cholula	1930	Ent153, U 21K-38V	60-70	M	M3			0.5
Cholula	2665	Ent155 U21L-9L	30-40	F	Rib frag	7.1	-8.2	
Cholula	3121	Ent155 U21L-9L	30-40	F	rib frag			-2.8
Cholula	3138	Ent156 U?	50-60	M?	rib frag			-2.6
Cholula	2664	Ent156 U?-196B	50-60	M?	Rib frag	8.9	-7.7	

Cholula	1931	Ent157, U ?	60-70	M	M3			-1.9
Cholula	3123	Ent163 U21K-36C	A	U	rib frag			-3.1
Cholula	2660	Ent163 U21K-38U?	A	U	Rib frag	9.3	-7.1	
Cholula	2544	Ent164 U21K-36S	60-70	M	Rib frag	8.7	-8.4	
Cholula	2659	Ent182-1 U21K-36S	5-7	SA	Rib frag	8.4	-8.6	
Cholula	3131	Ent182-1 U21K-36S	5-7	U	rib frag			-3.6
Cholula	1932	Ent182-1, U 21K-36S	5-7	U	M1			-0.9
Cholula	1933	Ent183, U21K-32T	15-18	U	M2			0.1
Cholula	1934	Ent185-1, U 21K-32T	50-60	M	M2			0.2
Cholula	2548	Ent186 U21K-24H	40-50	F	Rib frag	9.2	-8.2	
Cholula	3130	Ent186 U21K-24H	40-50	F	rib frag			-2.7
Cholula	1936	Ent186, U 21K-24H	40-50	F	M1			-1.6
Cholula	1937	Ent190, U21K-36S	50-60	F?	I1			-3.7
Cholula	1938	Ent193, U21K-35S	50-60	F?	M1			-0.6
Cholula	2545	Ent204 U21K-35S	50-60	U	Rib frag	9.0	-8.0	
Cholula	3129	Ent204 U21K-35S	50-60	U	rib frag			-3.4

Cholula	1939	Ent204, U21K-35S	60-70	U	M1 or 2			-0.1
Cholula	1940	Ent206, U21K-33Q	60-70	M	C			-1.0
Cholula	1941	Ent208, U 21K-23R	40-50	M	P3 or 4			-0.6
Cholula	1942	Ent210-1, U21K-36S	40-50	M	M1			-0.6
Cholula	1943	Ent213, U21K-24G	7-8	U	M1			-0.7
Cholula	2546	Ent214 U21K-24H	15-18	SA	Cran frag	9.9	-6.4	
Cholula	3125	Ent214 U21K-24H	15-18	U	Cran frag			-2.8
Cholula	1944	Ent214, U21K-24H	15-18	U	M1			-1.6
Cholula	1945	Ent216, U21L-4W	15-18	U	M2			-2.2
Cholula	2595	Ent226 U19J-30D	50-60	M	Phalanx	6.8	-7.5	
Cholula	3137	Ent226 U19J-30D	50-60	M	Phalanx			-3.3
Cholula	1946	Ent232, U21K-19M	5-7	U	M1			-0.3
Cholula	1948	Ent245, U21K-29F	40-50	F	M1			-1.1
Cholula	2569	Ent246-2 U21K-8U	60-70	M	Phalanx	8.2	-8.1	
Cholula	3134	Ent246-2 U21K-8V	60-70	M	Phalanx			-2.6

Cholula	2567	Ent259 U21K-41D	30-40	M	Rib frag	8.3	-8.4	
Cholula	3133	Ent259 U21K-41D	30-40	M	rib frag			-3.3
Cholula	1949	Ent263, U21K-40F	17-18	SA	M3			-1.5
Cholula	BLG17	Ent291, U21K-14Y	60-70	F	rib frag	8	-8.6	
Cholula	2601	Ent295 U21K-39Y	14-16	SA	Rib frag	7.4	-7.8	
Cholula	3120	Ent295 U21K-39Y	14-16	SA	rib frag			-3.4
Cholula	1958	Ent295, U 21K-39Y	14-16	SA	M1			-1.5
Cholula	1959	Ent299, U 21K-39Y	20-30	M	C			-0.3
Cholula	1960	Ent301, U 21K-40Z	30-40	M	M1			-1.0
Cholula	1962	Ent328, U 21K-32Z	20-25	F	M2 or M3			0.6
Cholula	1964	Ent370A, U?	49	M	M2?			-0.5
Cholula	1965	Ent370B, U?	40-50	M	M1 or M2			0.2
Cholula	1966	Ent372-2, U 20J-34X	60-70	F	C			0.2
Cholula	2663	Ent373-1 U20K-17U	60-70	F	Rib frag	8.4	-7.9	
Cholula	3132	Ent373-1 U20K-17U	60-70	F	rib frag			-3.1
Cholula	1967	Ent373-1, U 20K-17U	60-70	F	P3			-4.3
Cholula	1935	Ent385-1, U?	A	U	P4			0.4

Cholula	2632	Ent396 U21K-1N	50-60	F?	Phalanx	7.8	-8.1	
Cholula	1968	Ent397-1, U 21L-1N	20-30	F	I2			-0.6
Cholula	1970	Ent398, U21K-1O	30-40	F	M2			-1.2
Cholula	1972	Ent414 1&2A, U 20J-40P	9-10	SA	M3			-0.9
Cholula	1974	Ent417, U20J-42K	30-40	M	M1			0.2
Cholula	2626	Ent420 U20J-38L	60-70	M	Rib frag	8.1	-7.8	
Cholula	3135	Ent420 U20J-38L	60-70	M	rib frag			-2.9
Cholula	1975	Ent420, U 20J-38L	60-70	M	M2			-1.3
Cholula	1976	Ent424, U20J-39F	40-50	M	M1			-0.8
Cholula	1973	Ent426-1, U?	40-50	M	M1			-1.2
Cholula	1979	Ent428, U?	60-70	M	M1 Or M2			-0.5
Cholula	1977	Ent432, U20J-39P	30-50	M	M2			-0.4
Cholula	1978	Ent433, U 29J-39O	44084	SA	M1			-0.7

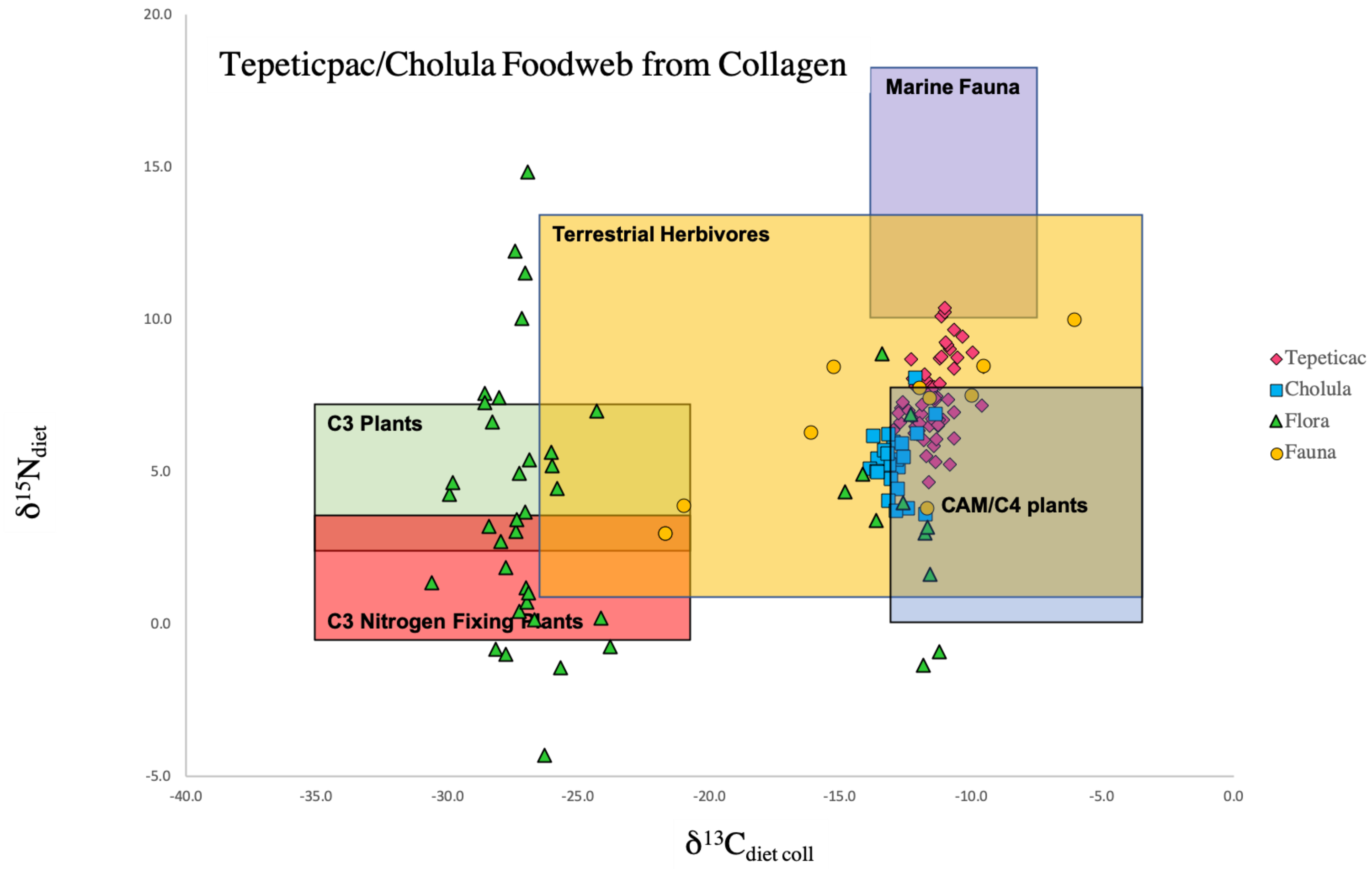


Figure 0.2: Carbon and nitrogen isotope values from collagen in Tlaxcala food web.

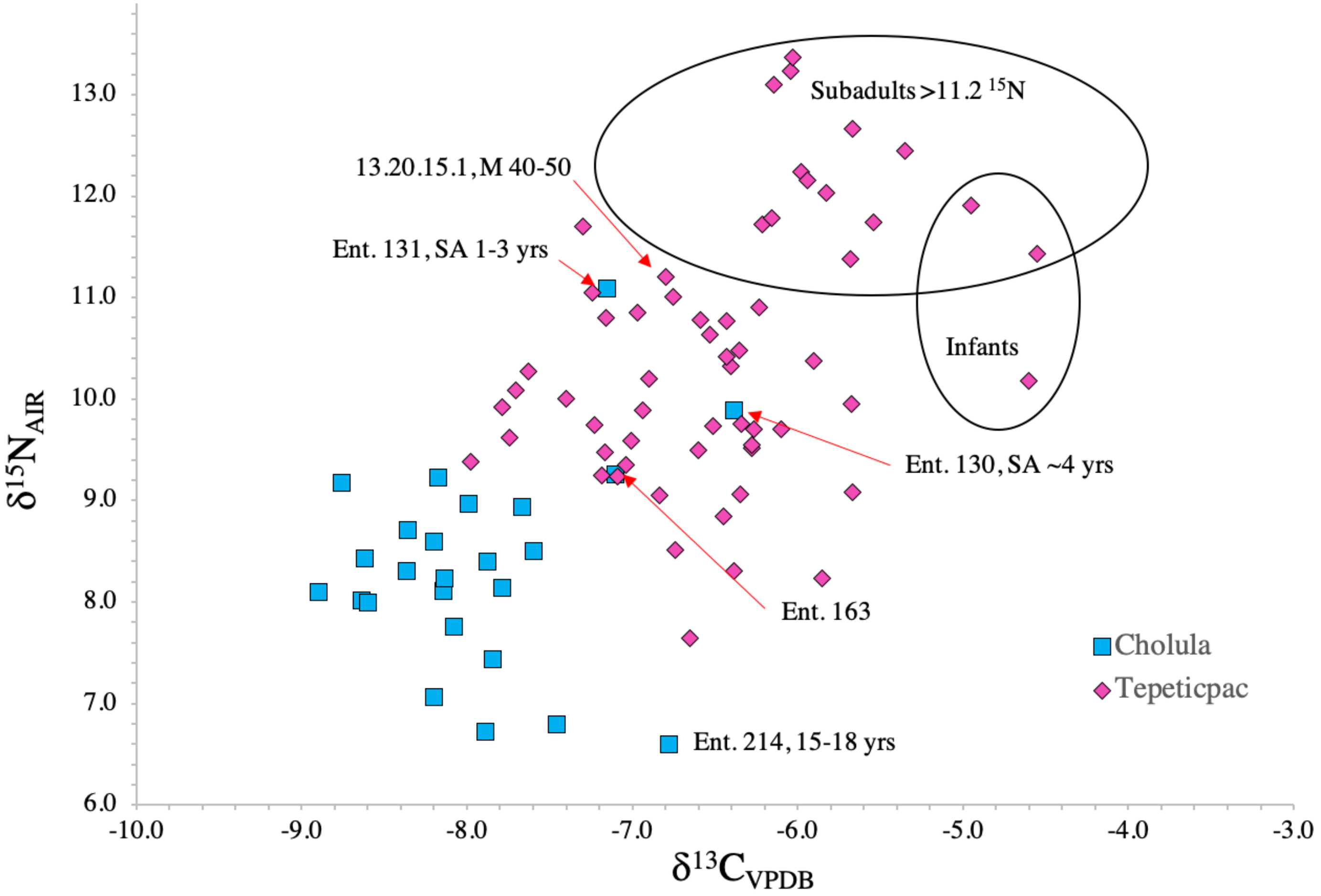


Figure 0.3: Details of dietary variability at Tepeticpac and Cholula[30]*..*

---

[30] Note that individuals with the most enriched δ_{15}N are subadults, except for individual 13.20.15.1. Infants at Tepeticpac are the most enriched in δ_{13}C. Tepeticpac and Cholula have distinct diets, except for three individuals from Cholula, all subadults, who fall within Tepeticpac ranges. Additionally, Ent. 214 is an adolescent aged 15-18 whose carbon values align with averages from Tepeticpac rather than Cholula

Patterns in nitrogen isotope values

Despite overall inter-site differences, there are a few individuals from Cholula that overlap with Tepeticpac values and vice versa (**Fig. 7.3**). When looking at outlying individuals, a few patterns emerge. First, all individuals δ^{15}N above 11.2‰ are subadults from Tepeticpac. This enrichment in ^{15}N is likely due to the trophic effect of breastfeeding (**Fig. 7.3, 7.4**). One adult male, 40-50 years of age (Tepeticpac burial 13.20.15.1) exhibits a δ^{15}N value of 11.2‰ , approaching these levels(**Fig. 7.3**). This is likely a result of consumption of a trophically enriched diet, perhaps including riverine fish, turtles, and amphibians or lesser studied food resources such as insects and algaes such as those described by Parsons (1979). I will further explore dietary reconstruction to determine protein sources in the section "Dietary carbon at Tepeticpac and Cholula". The remaining adults and adolescents exhibit δ^{15}N below 11‰, grouping primarily between 9-11‰, which indicates dietary protein coming from a source other than plants. It is clear that by adolescence, individuals consume an "adult" diet distinct from childhood.

In contrast to Tepeticpac, Cholula δ^{15}N values begin at a much lower range, with the majority of individuals demonstrating δ^{15}N values around 9.2‰ (**Fig. 7.3, 7.5**). Three individuals, two of which are weaning-age subadults, overlap with Tepeticpac values (**Fig. 7.3**: Ent. 131, 2-3 years of age; Ent. 130, ~4 years of age; Ent. 163, age unknown). Only one infant value (Ent. 149, <1 year of age) was collected from Cholula due to poor preservation among more fragile infant bones, but it is among the more enriched values at Cholula (9.2‰). With a greater representation of infants perhaps we would see a greater overlap between Cholula and Tepeticpac values at the δ^{15}N 10-11‰ level. Without this pre-weaning age subgroup, Cholula individuals within the categories of Children, Adolescent and Adults all group within the δ^{15}N 5-

9‰ range. This range is broader than at Tepeticpac, indicating that there is more diversity in access and consumption within this Cholula population. Additionally, the diets at Cholula are approximately 2-5‰ less enriched than at Tepeticpac, indicating diets that rely more heavily on herbivorous meat sources or terrestrial proteins, or perhaps that baseline plant values differ.

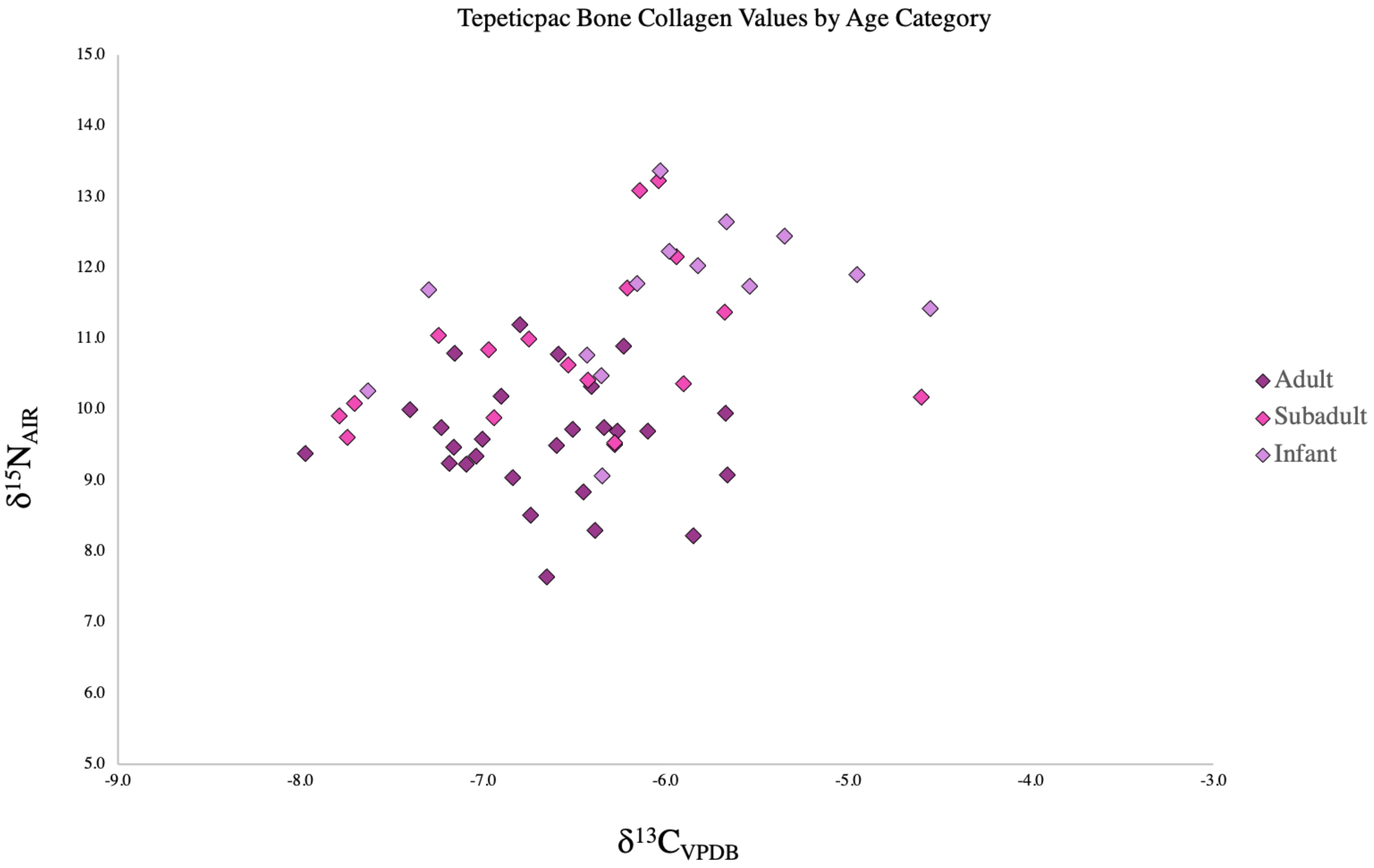


Figure 0.4: Tepeticpac Bone Collagen Values by Age Category

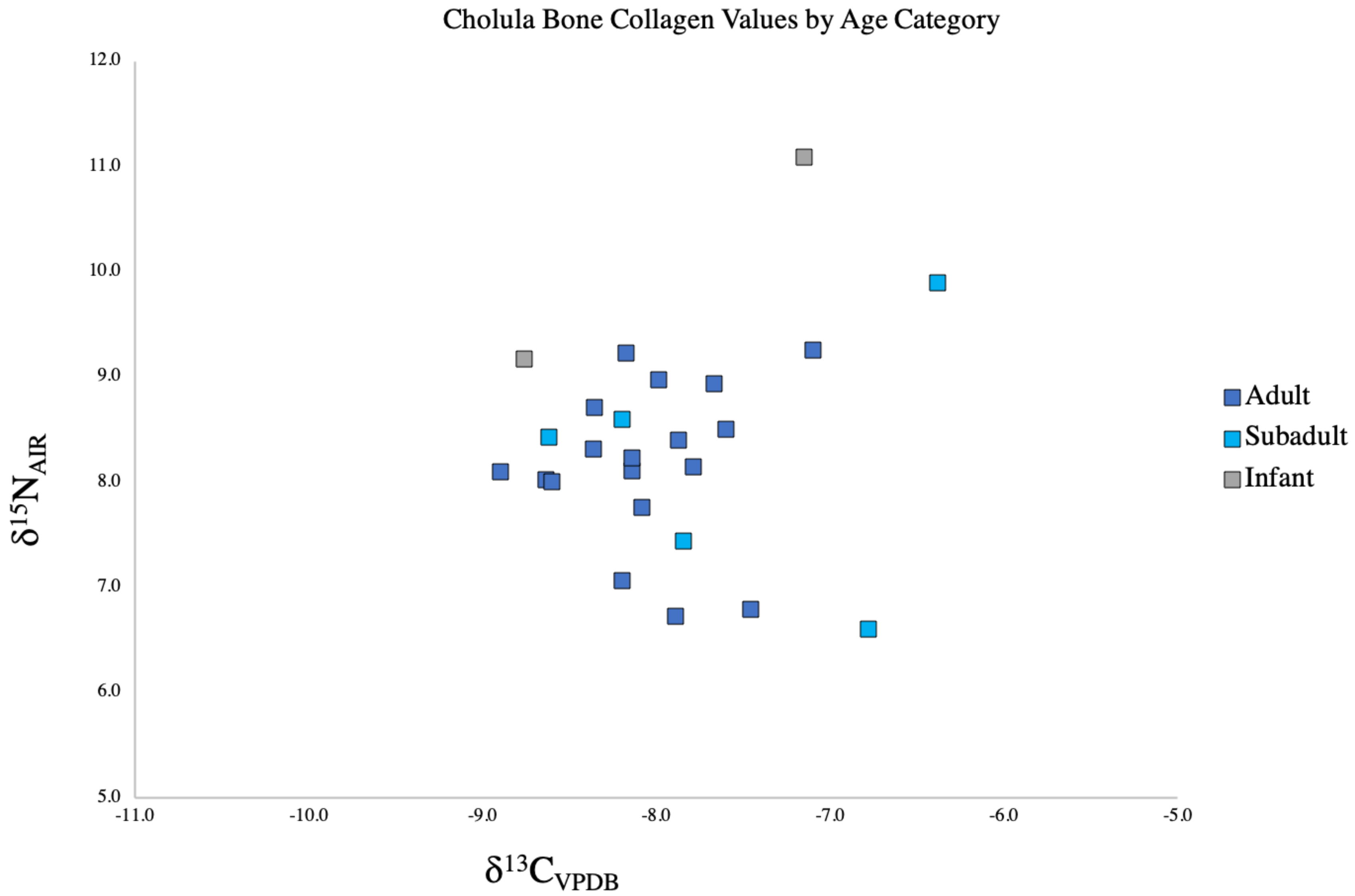


Figure 0.5: Cholula bone collagen values by age category.

Patterns in carbon isotope values

Again, a difference emerges between Cholula and Tepeticpac carbon consumption with Tepeticpac individuals consuming a more $_{13}$C-enriched diet (**Fig. 7.3**). Contrary to patterns described by Wright and Schwarcz (1999), where $_{13}$C is seen to become more enriched in age as individuals incorporate more maize-based foods into the diet, the most enriched individuals at Tepeticpac are infants (13.9.7.1, 6-9 months; 13.7.5.3, subadult infant; 13.8.6.1, subadult infant; 13.17.ES3, subadult age unknown), who exhibit $\delta_{13}C_{VPDB\ coll}$ values within the -4.6‰ to -6.2‰ range. A group of four adults (13.1.CRAN4, M 40+ years; 13.7.5.5, Young Adult; 13.14.11.1, M 30-40 years; 3.32.12.1, M 20-25 years) appears at the more negative end of this range (-5.7‰ to -6.1‰ $\delta_{13}C_{VPDB\ coll}$), while the range of -6.2‰ to -8‰ is admixed with subadults, young adults, adolescents and adults. Clearly, C_4 plants contribute strongly to diets at Tepeticpac; yet what is most interesting is that this contribution is so strong in infancy and early childhood—an age group that wouldn't be expected to eat maize staples like tortillas or tamales. To explain this unexpected peak, it is necessary to consider the mother's diet and the weaning diet, which will be discussed in more detail in the section "Identifying weaning."

Cholula, in contrast, has a less δ_{13}C-enriched diet—still within the range for C_4-reliance, though not to the extent seen at Tepeticpac. Four individuals (Ent. 214, 15-18 years; Ent. 101, 6-8 years; Ent. 163 age unknown; Ent. 131, 2-3 years) overlap with the depleted end of Tepeticpac values. While Ent. 131 and 101 could be considered weaning individuals, an observation enforced by their comparatively elevated nitrogen values, Ent. 214 and Ent. 101 are older (adolescent and child, respectively), and thus it is unclear what specific factors would lead to more enriched δ_{13}C signatures. The majority of the population falls outside of the Tepeticpac cluster, with a range of -7.5‰ to -8.8‰ $\delta_{13}C_{VPDB\ coll}$. Additionally, unlike at Tepeticpac, Cholula does not appear to have age-based patterning of ^{13}C enrichment, with adults, teens, subadults and even infants falling within this range. Age-based patterning will be explored in more detail in the section "Childhood Diets."

From flora and fauna, to meals, to individual food histories

While collagen reflects the protein portion of diet, bone apatite, like enamel, reflects a composite of lipid, protein and carbohydrate portions of diet incorporating carbon into bone from blood plasma. Because this carbon is coming from multiple macronutrients, carbon values from apatite reflect the average values from lipid, protein *and* carbohydrate portions of diet, weighted by their importance to the diet at any given time (Leatherdale 2014). These values are related to the energy expenditure available to an individual (Lee Thorpe et al. 1989). Studies of isotope routing, or the way ingested nutrients are incorporated into consumers' tissues have helped to understand how different animals derive protein, carbohydrates, and lipids from different sources depending on their position on the food chain (herbivore, carnivore, omnivore) (DeNiro and Epstein 1978; Sullivan and Kreuger 1981; Kreuger and Sullivan 1984; Lee Thorpe and van der Merwe 1987; Lee Thorpe 1989). For example, sheep (herbivores) obtain protein directly from plants, in part due to a metabolic system that has the capacity to extract proteins directly from plant cells (Kim et al. 2016). Carnivores, in contrast, cannot extract nutrients directly from plants, instead relying on the consumption of the prey who has metabolized plant material for them.

The human capacity to process ingredients means that both plant-based proteins and meat-based proteins are available for metabolization. Yet, while both plant-based and meat-based diets are possible, the relative contribution of meat vs. plant proteins to diets is widely variable given the preferences and/or foodways of individuals and communities. Several studies on fractionation processes (DeNiro and Epstein 1978; Sullivan and Kreuger 1981; Kreuger and Sullivan 1984; Lee Thorp and Van der Merwe 1987; Lee Thorp 1989) found that because bone collagen differentially draws from proteins in diet, while enamel and bone carbonates draw from the whole diet, the difference between the two can be used to understand which foods were consumed as the primary protein source, and which foods became fuel for energy production (whole diet, but particularly carbohydrates). Different types of diets incorporate energy in different ways (for example, carnivores get protein directly from meat, whereas herbivores get protein from plants). In addition, different tissues of the body have variable rates of turnover, and incorporate different components of diet (protein, lipid, carbohydrates).

A comparison of the difference between $\delta^{13}C$ from bone collagen ($\delta^{13}C_{coll}$) and bone structural carbonate ($\delta^{13}C_{carb}$) can help determine whether proteins are being directly incorporated from meat or from plants and synthesized carbohydrates. Carnivorous diets, which tend to be depleted in $\delta^{13}C$ to start with, become further depleted as meat lipids become used for energy. Herbivorous diets are enriched in $\delta^{13}C$ to start with, and rely on carbohydrates for energy (Lee Thorpe et al. 1989; De Niro and Epstein 1978; Ambrose and Norr 1993). In summary, the difference between carbonates and collagen in the same bone sample ($\Delta^{13}C_{carb\text{-}coll}$) shows whether meat protein is being used to fuel energy, leaving the individual more depleted in $\delta^{13}C$ as is the case for carnivores. If, in contrast, an individual is deriving their $\delta^{13}C$ values from low-protein plant foods, bone collagen may misrepresent the proportion of ^{13}C-enriched foods in the diet, as it only reflections the proportion of protein this food-type is contributing, rather than all nutrients.

In a study of human burials from the Mariana Islands, Ambrose et al. (1997) show that within their sample, when values of $\Delta_{13}C_{coll\text{-}carb}$ value fall higher than 4.4‰, this is due to dietary proteins having a less enriched value than the whole diet. They argue that this reflects a C_4-based plant diet, but with proteins coming from C_3 (likely terrestrial animals). When values were lower than 4.4‰, they interpreted this as dietary proteins that were more enriched than the diet overall (for example, as would happen with marine proteins, and C_3 carbohydrates).

Dietary carbon at Tepeticpac and Cholula

For Tepeticpac the mean $\delta_{13}C_{bone\ carb}$ was -2.7, (s.d. = 0.6, range = -3.3 to -1.6). The mean $\delta_{13}C_{carb\text{-}col}$ was 3.81, which falls within Ambrose et al.'s (1997) expected range for dietary proteins coming from C_3 carbohydrates and marine proteins. At Cholula, the mean $\delta_{13}C_{bone\ carb}$ was -3.07 (s.d. = 0.5, range = -4.50 to -2.14). Interestingly, at Cholula the mean $\delta_{13}C_{carb\text{-}col}$ was 4.77 (s.d.= 0.6, range 3.59 to 5.80), which aligns with Ambrose et al.'s classification of a C_4-based plant diet with proteins from terrestrial animals. So, even though Tepeticpac is more enriched in $\delta_{13}C$ than Cholula in enamel apatite, bone collagen, and bone carbonate, this is not the source of dietary proteins. $\delta_{15}N$ ranges show that marine foods were not a central component of diet at either site. Future research will explore the influence that riverine proteins and/or insects might have on dietary carbon. What is clear is that the two populations show significantly different diets across structural carbonate content ($\delta_{13}C_{carb}$ t=-2.56, p=0.013), and in the difference between collagen-apatite ($\Delta_{13}C_{carb\text{-}col}$ t=4.92, p<.00001). Thus, while maize and other C4 plants are a central component of diets at both sites, the Ambrose et al. model leads to a conclusion where Tepeticpac C_4 foods are supplemented by more enriched proteins.

The Froehle Model

Since the 1990s, researchers have developed several models for projecting likely diet based on differences between collagen and apatite values (Ambrose and Norr 1993; Ambrose et al. 1997; Kellner and Schoeninger 2007; Froehle et al. 2010; Warinner and Tuross 2009). In this study, I use the model by Froehle et al. (2012) , which expands on previous models (Kellner and Schoeninger 2007; Froehle 2010) to include nitrogen as well, using trophic level as another line of evidence for identifying diet source. Using cluster analysis and discriminant function analysis, they identified two discriminant functions that classify isotope values to a set of 5 dietary models. The functions used to evaluate Tepeticpac and Cholula data within this model are given below, producing the relationship visible in **Fig. 7.4**.

Carbon: $F1 = (0.322 * \delta^{13}C_{apatite}) + (0.727 * \delta^{13}C_{collagen}) + (0.219 * \delta^{15}N_{AIR}) + 9.354$

Nitrogen: $F2 = (-0.393 * \delta^{13}C_{apatite}) + (0.133 * \delta^{13}C_{collagen}) + (0.622 * \delta^{15}N_{AIR}) – 8.7$

This model is based on data sets outside of Mesoamerica, and both Tepeticpac and Cholula fall mostly outside of the given dietary blocks (**Fig. 7.4**). However, projecting from the given dietary patterns, Tepeticpac diets fall much higher than 70% C_4 diet, while some Cholula individuals fall within the 30:70 C_3:C_4 diet box, and on the y-axis, approach values for >65% C_3 proteins on the y-axis. In a study of how alkaline cooking affects carbon and oxygen isotopes in bone and enamel, Warinner and Tuross (2009) found that the process of nixtamalization enriches dietary carbon in collagen by +0.9‰ but does not enrich apatite. Because nixtamalization chemically alters the bioavailability of protein in maize (Bressani 1990; Bressani et al. 1997; Sefa-Dadeh 2004; Rong and Kang-Ning 2009), and collagen is a reflection of consumed proteins, this is likely why such a significant difference from the Froehle's 50% C_4 protein diet is noted.

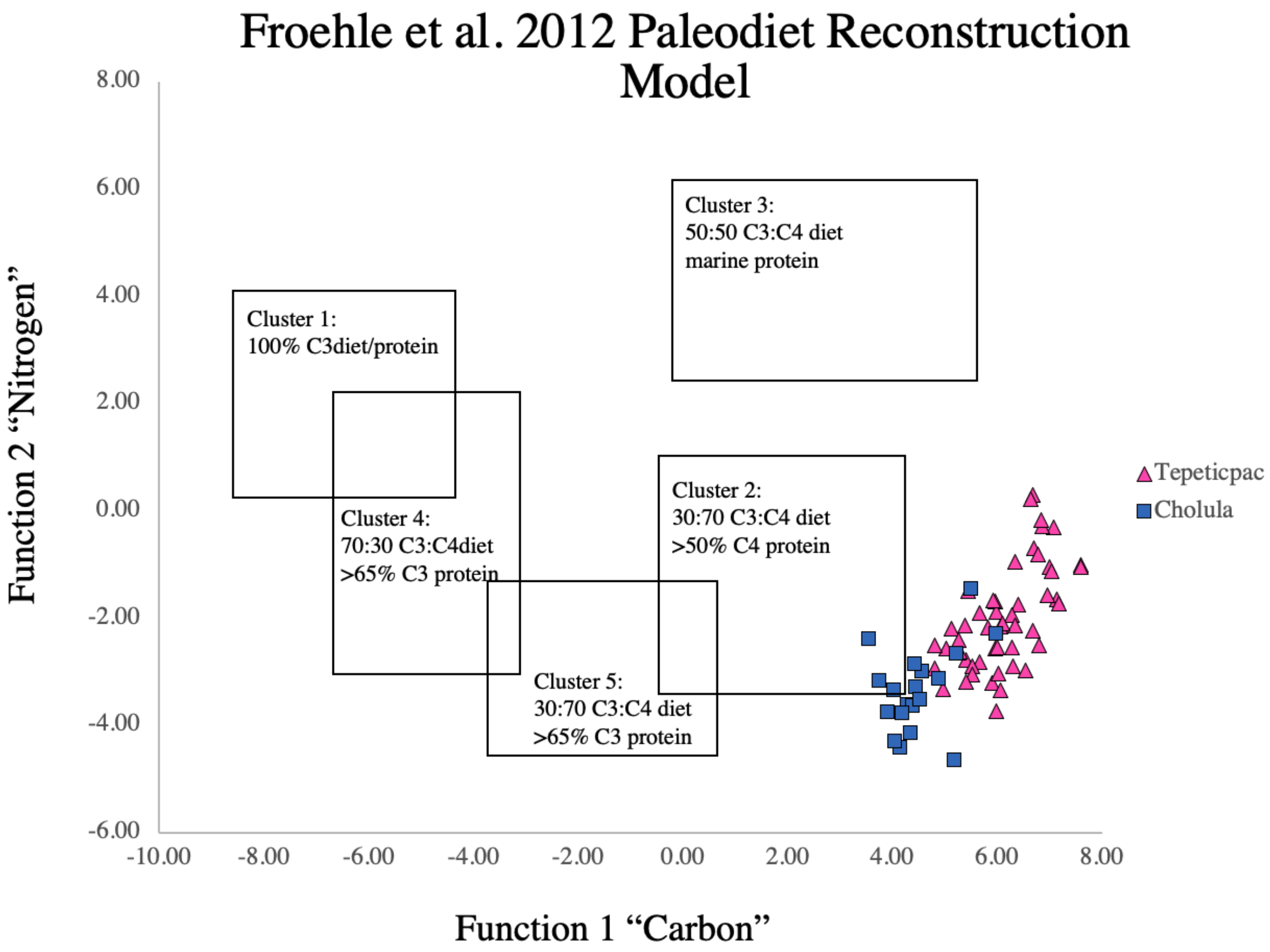


Figure 0.6: Froehle et al. 2012 Paleodiet model of potential diets.

Within Froehle et al.'s (2012) sample of analysis, Cluster 2 was occupied by individuals from an Ontario post-agriculturalist society who relied heavily on maize. Additionally, Froehle associates the nitrogen values for clusters 2, 4 and 5 with populations that consumed terrestrial game, waterfowl and freshwater fish as the main source of protein. For both of these populations, C_4 plants are the dominant food source, with most protein coming from C_4 sources (either the plants themselves, or animals that eat predominantly C_4 plants). The results of this analysis thus confirm that C_4 plants played a large part in the whole diet of Tepeticpac and Cholula populations. Yet they also align with a Tepeticpac food tradition where protein is coming from riverine animals.

While this reliance on similar C_4-rich diets could be considered a Puebla-Tlaxcala Valley food tradition, Tepeticpac and Cholula also demonstrate differences in their relationships to C_4 foods and the trophic levels of protein sources across all isotopic measurements (**Fig. 7.3, Fig. 7.7**). I suggest that Tepeticpac's $\delta_{13}C$ enrichment is due to the incorporation of additional C_4 ingredients, the consumption of a larger amount of nixtamalized goods, animals reliant on C_4 foods, and/or animals from riverine or lacustrine sources.

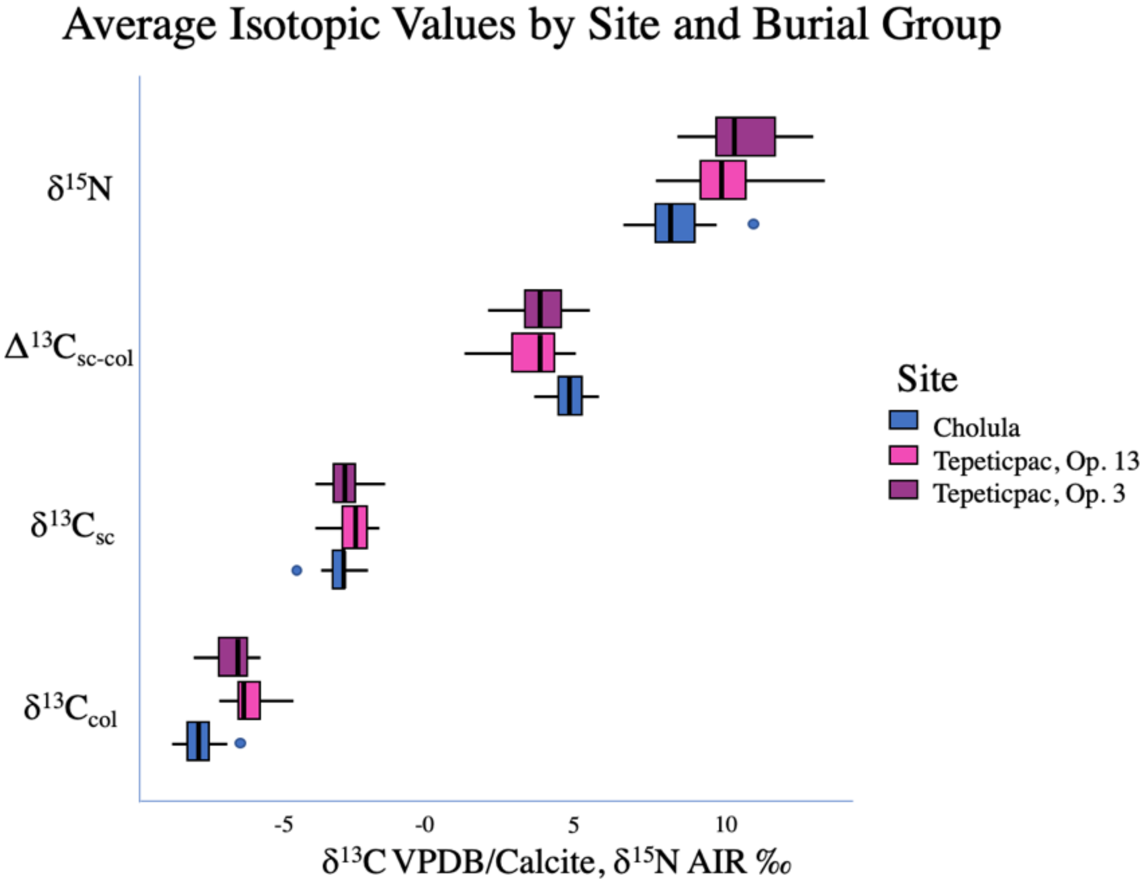


Figure 0.7: Average isotopic values for sites/burial areas at Tepeticpac and Cholula.

Tradition Keepers and Tradition Breakers: The Micro and Meso Dietary Patterns

The isotope data reveal a maize-heavy "Mesoamerican" food tradition across the two populations, but one that is interpreted in different ways at Cholula and Tepeticpac (**Fig. 7.4**). At Tepeticpac, diets of all members are highly enriched in ^{13}C, a pattern likely associated with consumption of nixtamalized maize and additional C_4 and CAM plant resources (and the animals who eat these plants). At Cholula, diets are also heavy in ^{13}C, likely due to maize-heavy diets, yet the mean is 1.4‰ less negative than Tepeticpac, suggesting that people at Cholula consumed relatively less maize (and other ^{13}C-enriched foods) relative to the Tepeticpac community.

Both sites also show different population-level patterns of δ^{15}N, with Tepeticpac generally consuming resources more enriched in ^{15}N. This section takes a closer look at the differences between Tepeticpac and Cholula individuals, to understand how age, sex, and burial area (at Tepeticpac) correspond to individual dietary trends. As discussed in **Ch. 4**, standard bioarchaeological methods were used to determine age-at-death and skeletal sex of individuals when possible. Due to the sample size, individuals who were identified as "probable male" and "probable female" were grouped into male and female categories, respectively. For generalized adult/subadult comparisons, subadults from 0-20 years of age were grouped into one category, while adults 20 years+ were grouped into another (see **Table 4.2**). The subadult category is explored in more detail within the section "Childhood Diet."

Similar diets between males and females

The sample sizes for bone collagen among males and females were too small for meaningful statistical analysis (13 males : 5 females : 9 adults of undetermined sex at Tepeticpac; 8 males : 8 females : 2 adults of undetermined sex at Cholula). However, a qualitative analysis of the data (**Fig.7.8**) suggests that sex (as identified by skeletal features) were not associated with differential access to foods among adults. This absence of significance may be related to the small sample size, particularly at Cholula. Nonetheless, based on data at hand, this sex-based similarity in diet is an important finding because it suggests that social differences based on sex may not have shaped differential access to foodstuffs.

Age-Based Differences in Diet at Tepeticpac

When looking at broad age categories of Adult and Subadult at Tepeticpac, there is a significant difference within dietary protein ($\delta^{13}\mathrm{C}_{\mathrm{coll}}$ $t = -3.78718$; $p = .000953$) and carbonate-collagen ($\delta^{13}\mathrm{C}_{\mathrm{carb\text{-}col}}$ $t = 2.74266$; $p = .011597$) within Operation 13, but *not* Operation 3. At *both* sites, there is a significant age-based difference within nitrogen ($\delta^{15}\mathrm{N}$ Op. 13 $t = -3.85634$; $p = .000803$; Op. 3 $t = -3.35037$, $p = .002663$). Thus, while both dietary proteins and trophic level consumption differ by age groups within Op. 13, only trophic levels differ at Op. 3. This trophic level difference is explained by enriched nitrogen among breastfeeding infants (discussed in the section "Childhood Diets") – with a larger proportion of the population . A significant difference in $\delta^{13}\mathrm{C}_{\mathrm{coll}}$ between adults and subadults at Op. 13 may signal a particular protein-rich, plant-based (and thus, not trophically-enriched) weaning food that was unique to the subgroup buried there.

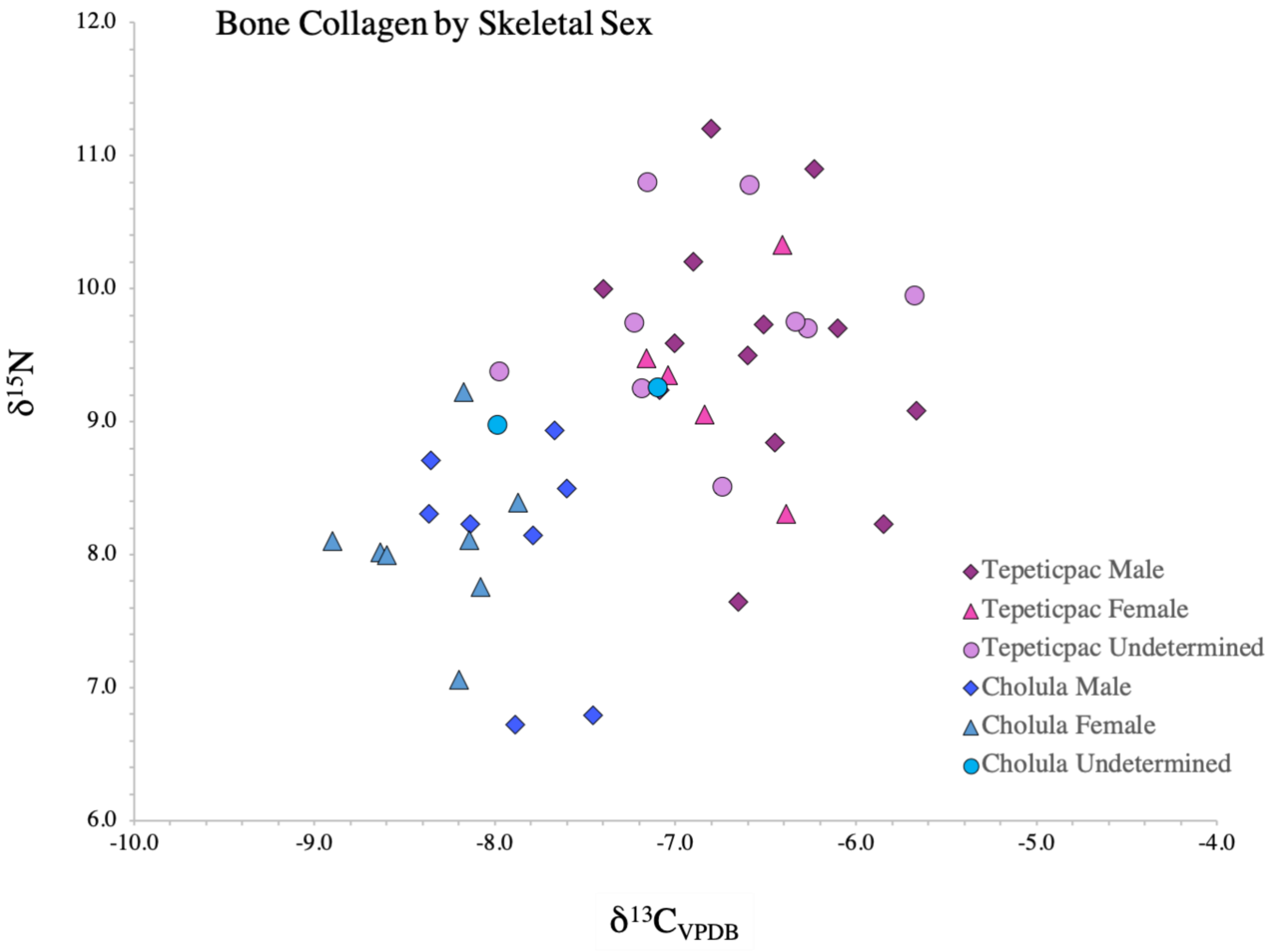


Figure 0.8: Bone collagen values by sex at Tepeticpac and Cholula.

Childhood diets

During their first three years, children experience the vast majority of their growth and cognitive development, relying on a nutritionally rich diet to supplement their physiological needs (Trawick Smith 2013). Food studies have shown that the lack of nutritionally rich foods can lead to developmental delays, increased childhood mortality, and biological frailty in adulthood (de Onis 2017). In addition to exploring the nature of childhood diets, and the ways in which skeletal sex reveals information about childhood and gender, this section will also explore the timing of weaning. Infant diets are a reflection of food consumed by the mother, transferred through umbilical cord to fetus, and then after birth, through mother's milk. The period of weaning is culturally variable, but is defined by the transition from nursing to consuming solid foods. It is a nutritionally risky period where insufficient access to appropriate foods can lead to an increase in parasites, food borne illness, malnutrition, associated pathologies, and even death (León-Kava et al. 2002; Kramer and Kakuma 2004). While survival through the weaning process can signal an infant or child's developmental ability to survive independent of its mother's milk, the age at which weaning occurs, the population-level weaning-age mortality rates, and the availability and accessibility of nutritional weaning foods signal society's capacity to protect one of its most vulnerable groups (Cucina 2011; Wright 1997; Wright and Schwarcz 1999), as well as individual variations in weaning practices.

Diets among boys and girls at Tepeticpac?

Like the data from bone collagen, the sample of individuals of determinate sex is too small to make a statistically significant analysis of enamel carbonates (29 samples representing 10 males: 15 samples representing 5 females at Tepeticpac; 18 samples representing 9 males : 11

samples representing 11 females at Cholula). However, a qualitative analysis shows that while most diets are similar among boys and girls, values for Cholula girls show distinct diets for the two non-local outlier females. This insight into childhood diets permits an exploration into the sociopolitical structures that shaped food access and food choice, which in turn provide avenues for exploring the role food played in shaping the futures of this vulnerable subset of the population, and how this in turn may have related to larger practices of sovereignty and resistance to external threats.

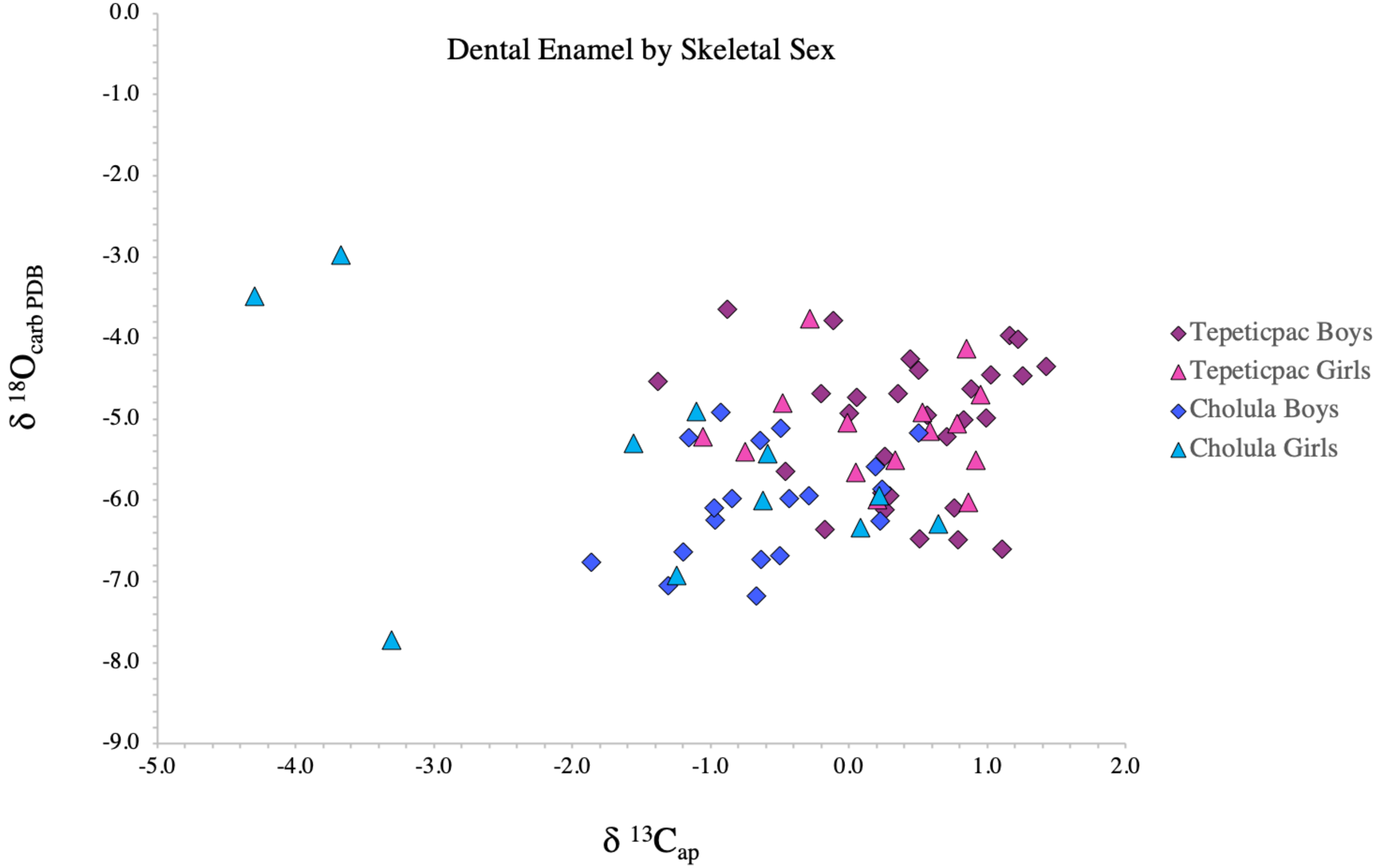


Figure 0.9: Dental enamel carbonate values among boys and girls at Tepeticpac and Cholula

Carbon and oxygen isotopes from enamel

Carbon isotopes found in dental enamel reflect diet at time of tooth formation (Early Childhood, Middle Childhood and Adolescence) (**Table 4.3**). As discussed in the methods chapter (**Ch. 4**), carbon isotopes are most often used to identify the relative proportion of C_4 plants - typically assumed to be maize in Mesoamerica—in the diet. Understanding the nature of childhood diets (*what* foods were being eaten) and their variety and/or homogeneity (*who* was eating what) will be used to understand the role food played in protecting or exposing children from exosystemic threats at Cholula and Tepeticpac.

C4 resource consumption in childhood

At Tepeticpac, enamel results from 77 samples representing 39 individuals had an average $^{13}C_{enamelcarb}$ value of 0.4‰ (s.d.= 0.6, range = -1.1 to 1.7‰). The narrow range of enamel carbonate results shows a population with very homogeneous childhood diets, at least as revealed by the stable carbon isotope data. The heavily positive carbon values also indicate a diet predominantly based in C_4 plants. As samples come from individuals from fetal to late childhood ages, this indicates that C_4 plants played a large part in maternal diets (and thus was transferred through breastmilk) and in nutritional supplementation at all stages of development. Each childhood stage will be examined in detail in the following section on weaning.

At Cholula, enamel results from 32 samples representing 32 individuals had an average $\delta^{13}C_{enamel\ carb}$ of -0.9‰ (s.d.=1.03, range = -4.30 to 0.65‰). Unlike Tepeticpac, $\delta^{13}C_{enamel\ carb}$ are widely divergent, including values that fall towards a C_4-heavy diet, as well as three outlier individuals (Ent. 373-1, F 60-70; Ent. 190, F 50-60; Ent. 81, F 40-51) that approach the range of a mixed C_3/C_4 diet (**Fig. 7.7**). Interestingly, the three outliers are female individuals. Thus, although sex-based differences are not notable in adults from this sample, three female children experienced unique diets in childhood. In Olivera's (1978) study of 16th century Cholulteca marriage practices in indigenous Puebla communities, he found that it was most often the woman who migrated to the home of her husband. This pattern may indicate instances in which these three females grew up in areas with distinct childhood diets and arrived to Cholula in adulthood, living (and eating) in the community long enough to develop collagen values that reflected local ranges.

A statistical comparison of Cholula and Tepeticpac demonstrates that $^{13}C_{ap}$ value differences are significant ($t=-8.39$, $p < .00001$). The likely sources of these differences will be explored in detail in the following sections.

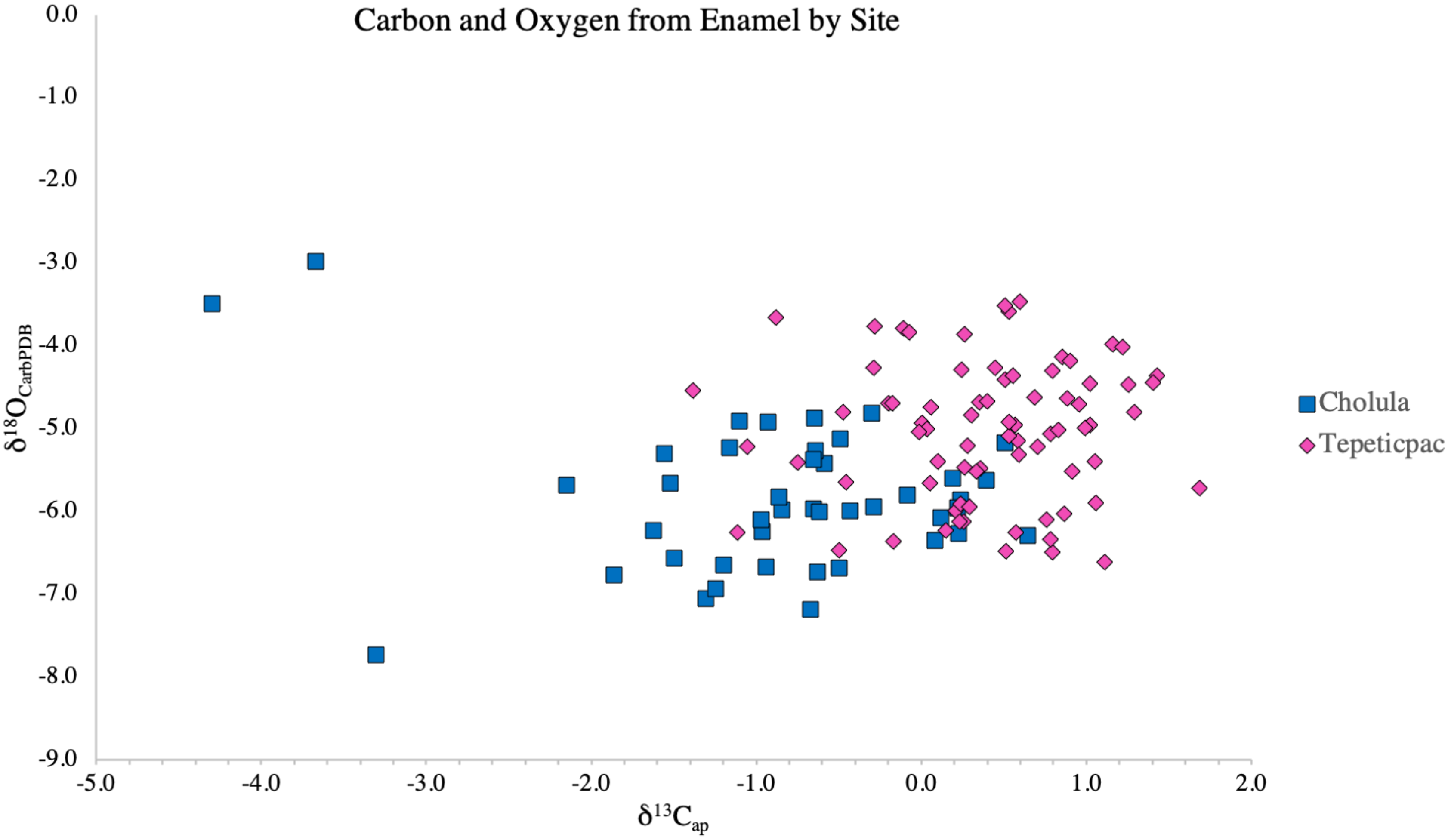


Figure 7.7: Carbon and oxygen isotope data from dental enamel, representing childhood diet

Identifying weaning patterns in dietary isotopes

Oxygen

During the metabolic process of incorporating external water into the body, the lighter isotope (^{16}O) drops out, leaving body water, such as breastmilk, enriched in ^{18}O. Through the process of this enriched body water being consumed by the infant, and going through a second metabolic incorporation, it becomes doubly enriched. Fetal and infant diets that rely on mothers' tissues as a primary source of diet, are thus significantly enriched in ^{18}O in comparison to infants and children who consume solid foods and external sources of water. Studies of the timing of weaning have found that breastfeeding enriches $\delta^{18}O_{PDB}$ in first molars by approximately 0.7‰ when compared to third molars (Turner et al. 2009; Wright and Schwarcz 1998, 1999; White et al. 2001). The shift from breastfeeding to semi-solid foods, or weaning, is observable in the skeleton through more negative values of ^{18}O.

Wright and Schwarcz (1998; 1999) propose a way to identify the effects of weaning by measuring the decline in ^{18}O from the first molar (which captures diet in infancy and early childhood) and the third molar (which captures diet in early adolescence) (see **Table 4.3**). The equation is as follows:

$$\Delta^{18}O = \delta^{18}O_{early} - \delta^{18}O_{late}$$

A negative Δ indicates that the later tooth (in this case, M3) is more enriched, while a positive Δ indicates that the earlier tooth is more enriched. When looking at oxygen, they found that changes lower than .2‰ are not significant signals of weaning, but those that exceed 0.5‰ likely imply the incorporation of water from non-breastmilk sources (either foods or water).

They also found that this transitional period is characterized by a shift of approximately 0.7‰ between the values of M1 and M3.

Carbon

Using the same equation to explore age-based changes to carbon, Wright and Schwarcz (1998) find that the difference between first molars and premolars is about -0.5‰, and first molars and third molars is -0.6‰, meaning teeth get heavier in δ13C with age. However, within their study of the Maya, they found that the majority of this change occurs between the first molar and the premolar, meaning that by three years old, individuals have shifted from milk-based diets to solid foods, and any additional changes in later childhood are much smaller.

Nitrogen

As discussed previously, nitrogen isotopes are used in paleodiet studies to identify the trophic level of protein sources in the diet. Among adults, this was used to identify the presence of terrestrial meat and marine foods in the diet. However, among children and infants, the consumption of mother's milk equates to the consumption of mother's tissue, elevating breastfeeding infants +3‰ relative to their mother's diet. Much in the way carbon and oxygen shift as diets begin to include solid foods, nitrogen values will be expected to decrease as children incorporate less enriched foods into their diets during weaning (Fogel, Tuross and Owsley 1989). While carbon and oxygen reflect diet at the moment of enamel formation, bone collagen turnover rates result in approximately a year of delay between the moment of dietary change and when it appears in collagen isotopes (Wright and Schwarcz 1999).

Comparative patterns of weaning at Cholula and Tepeticpac

Oxygen

The average values for 1st, 2nd, and 3rd molars should demonstrate a slight shift in oxygen values likely associated with the weaning process. At Tepeticpac, a cumulative decline in ^{18}O enrichment is visible as children age (**Fig. 7.8**). Wright and Schwarcz (1998) designate a +.2% shift in ^{18}O values to be considered significant, and a marker of meaningful dietary change (e.g. a shift from breastmilk to non-body water). Interestingly, the shift between M1→M3 is +.7‰, the same change noted among Middle and Late Postclassic Maya populations of Kaminaljuyu, Guatemala (Wright and Schwarcz 1998), perhaps speaking to similarities in weaning traditions.

Within Cholula, oxygen values have a broader range (**Fig. 7.7, 7.8**), suggesting that weaning patterns were more variable within the Cholula population being studied than within the Tepeticpac population. Because of this variation, values at Cholula do not neatly follow the expected decrease in δ^{18}O with age (**Fig. 7.8**). A meaningful shift is visible between M1→M2 (+.57‰), with little change between M2→M3 (-.01‰), and average values for M1→M3 at +.56‰. Due to the small sample size, and lack of multiple teeth from the same individual, the most concrete conclusion that can be made for Cholula is that a dietary shift occurred between M1→M2, or between the ages of 3 to 7, and that this shift was not as great as at Tepeticpac.

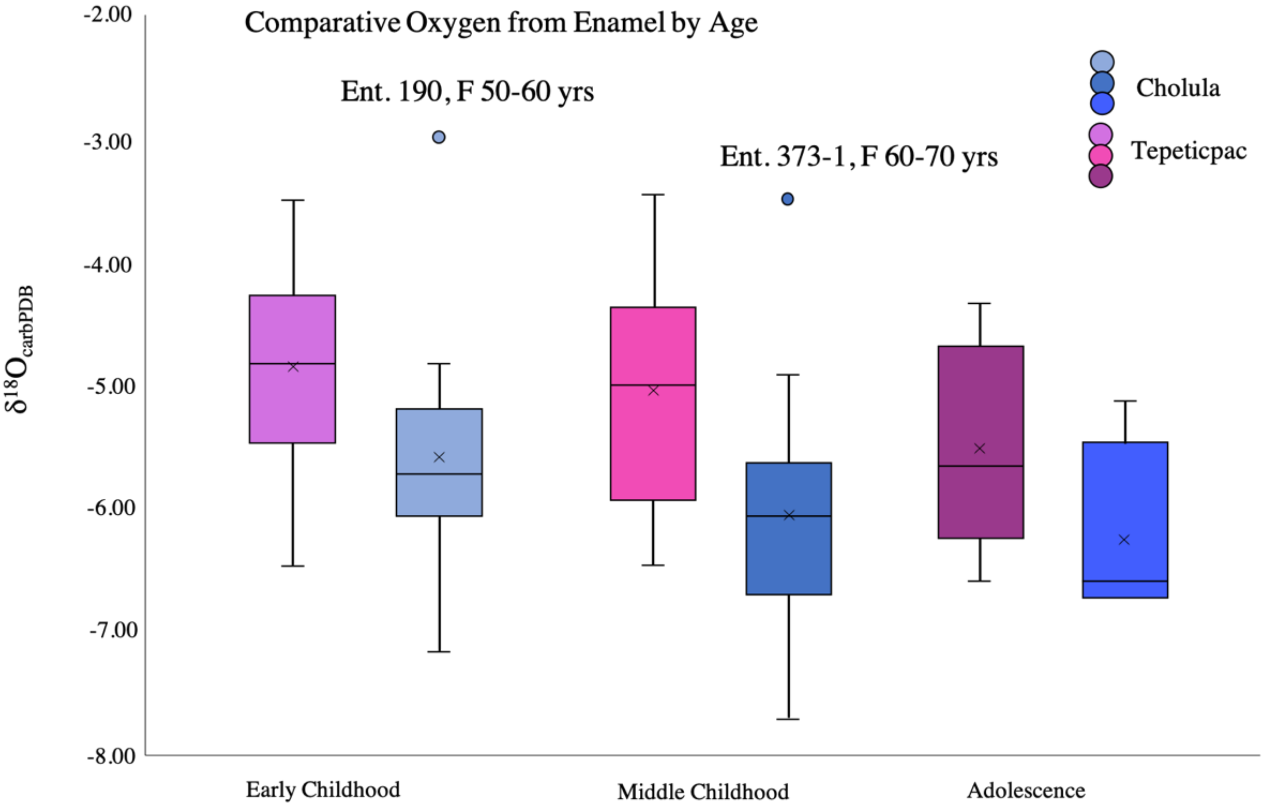


Figure 7.8: Oxygen isotope ratios from enamel apatite[31].

Carbon

As $\delta^{18}O_{PDB}$ are expected to become more negative with age due to the loss of enriched body water, $\delta^{13}C$ will signal the incorporation of C_4 plants into the diet by becoming more enriched in ^{13}C. Wright and Schwarcz (1998) found that the most visible shift in $\delta^{13}C$ was that between M1→PM (a shift of -.5 at about 3 years) with no systematic change to the diet following this indicator of weaning. Tepeticpac shows a similar shift at this age, but starts from a more enriched position of -.89%, indicating a diet *much* heavier in ^{13}C, likely due to the greater role of

---

[31] Tepeticpac oxygen values decrease with age as individuals wean off of oxygen-enriched mother's milk. This shift is less visible at Cholula.

C_4 plants at all stages of development (**Fig. 7.9**). These findings are important because they highlight the influence of maize and other C_4 and CAM plants as likely weaning foods. As those ^{13}C-enriched foods were added to the diet as the infant grew up, the $\delta^{13}C$ values accordingly increased.

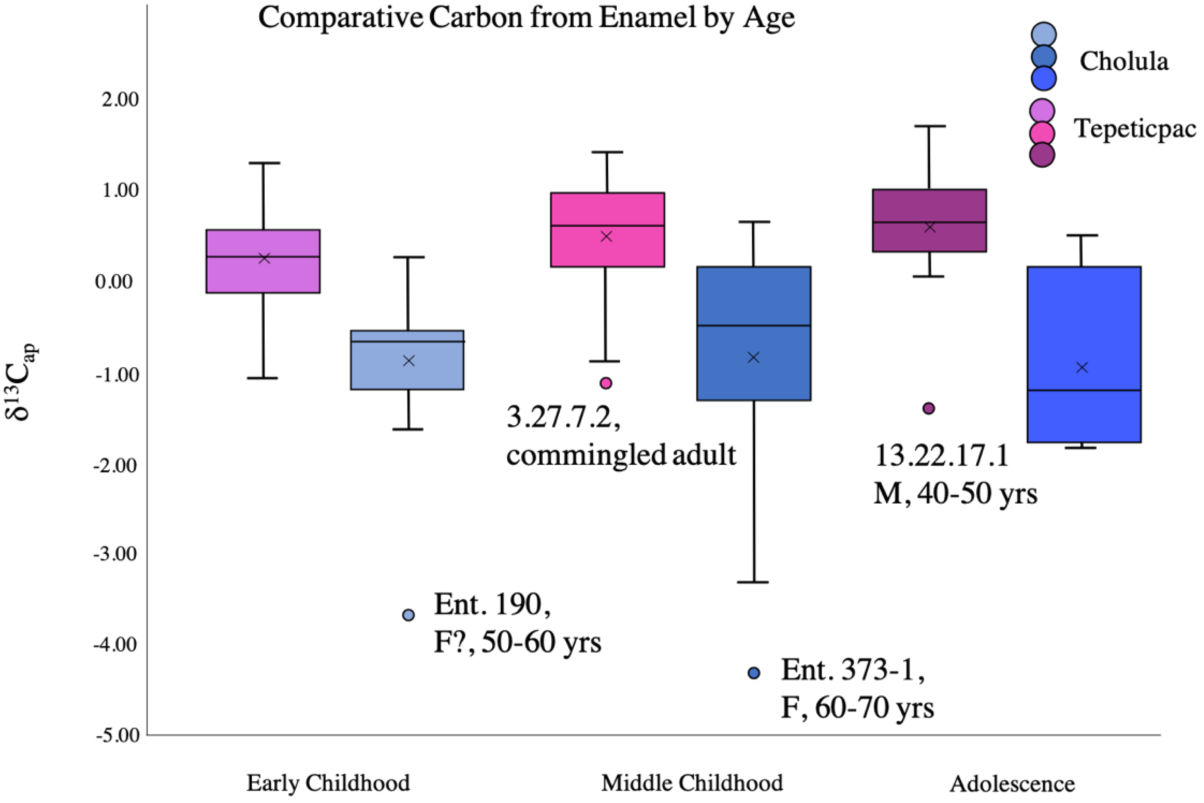


Figure 7.9: Comparative carbon from enamel apatite[32].

When examined as at the population level, carbon and oxygen values are narrowly distributed, suggesting that a population-level cohesion to a specific range of childhood foods enriched in ^{13}C is at play (**Fig. 7.7**). Wright and Schwarcz (1998) discuss the likelihood that

---

[32] Tepeticpac values are more enriched than Cholula at all age groups, with only slight changes through time. Cholula individuals have broader ranges of carbon enrichment with age.

similar patterns among the Postclassic Maya indicated the consumption of atole as a weanling food. This aligns with contemporary Tlaxcalteca practices based on Prehispanic foodways. As foods known to increase breastmilk production, blue maize or amaranth atole is consumed by lactating mothers, and it is also turned into a gruel and given to weaning infants as a calorie and protein-rich food. Additionally, pulque and aguamiel made from agave (a CAM plant) are documented remedies to increase milk flow. The contemporary benefits of atole consumption have been well documented by nutritionists (Pollitt et al. 1995; Martorell et al. 1996; López et al. 2010). If C_4 plants are a primary component of diet introduced to the fetus through the mother's diet and maintained as a staple through adulthood, then enriched $\delta_{13}C$ values should stay relatively stable throughout the life course. I argue that the patterns observed at Tepeticpac are evidence of a C_4-reliant population, integrating a wide variety of C_4 (maize, amaranth) and CAM (agave, nopal) plants into diets from infancy into adulthood.

The $\delta_{13}C$ values at Tepeticpac show a population-wide enrichment in $\delta_{13}C$, yet when examined close-up, within this homogeneity is heterogeneity (**Fig. 7.10**). While a Tepeticpac childhood food tradition existed, it appears likely that individual-level interpretations of this tradition lead to slight differences in timing of weaning, as well as the time at which different foods were incorporated. Wright and Schwarcz (1998) find a similar trend at Kaminaljuyú, noting that while there are overall trends in $\delta_{13}C$ and $\delta_{18}O$ enrichment with age, the range of variability is large.

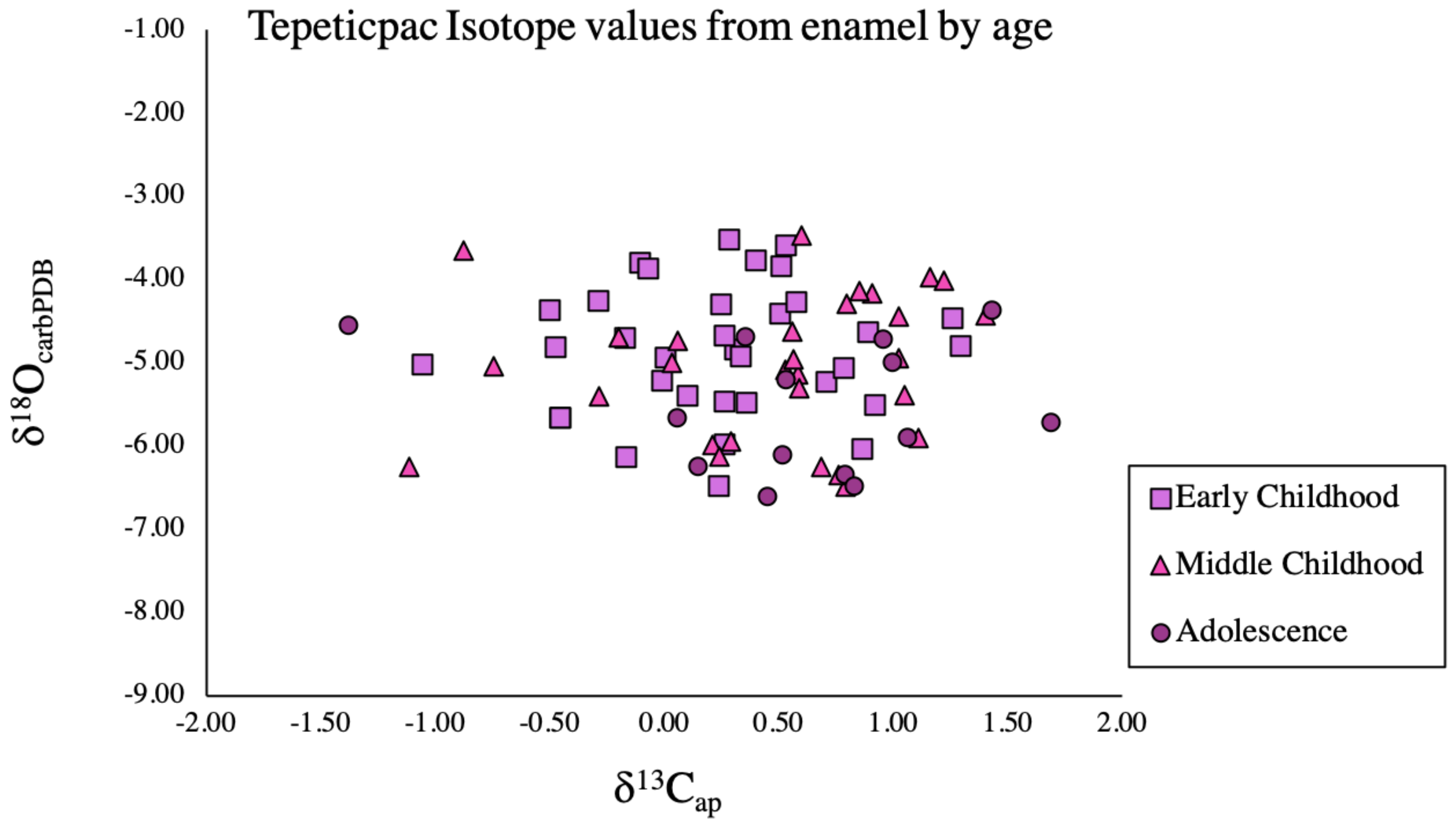


Figure 7.10: Tepeticpac carbon and oxygen isotope values from enamel apatite[33].

---

[33] Note: values do not group distinctly by age group, but rather demonstrate individual variation in timing and nature of weaning, while adhering to a set range of dietary goods.

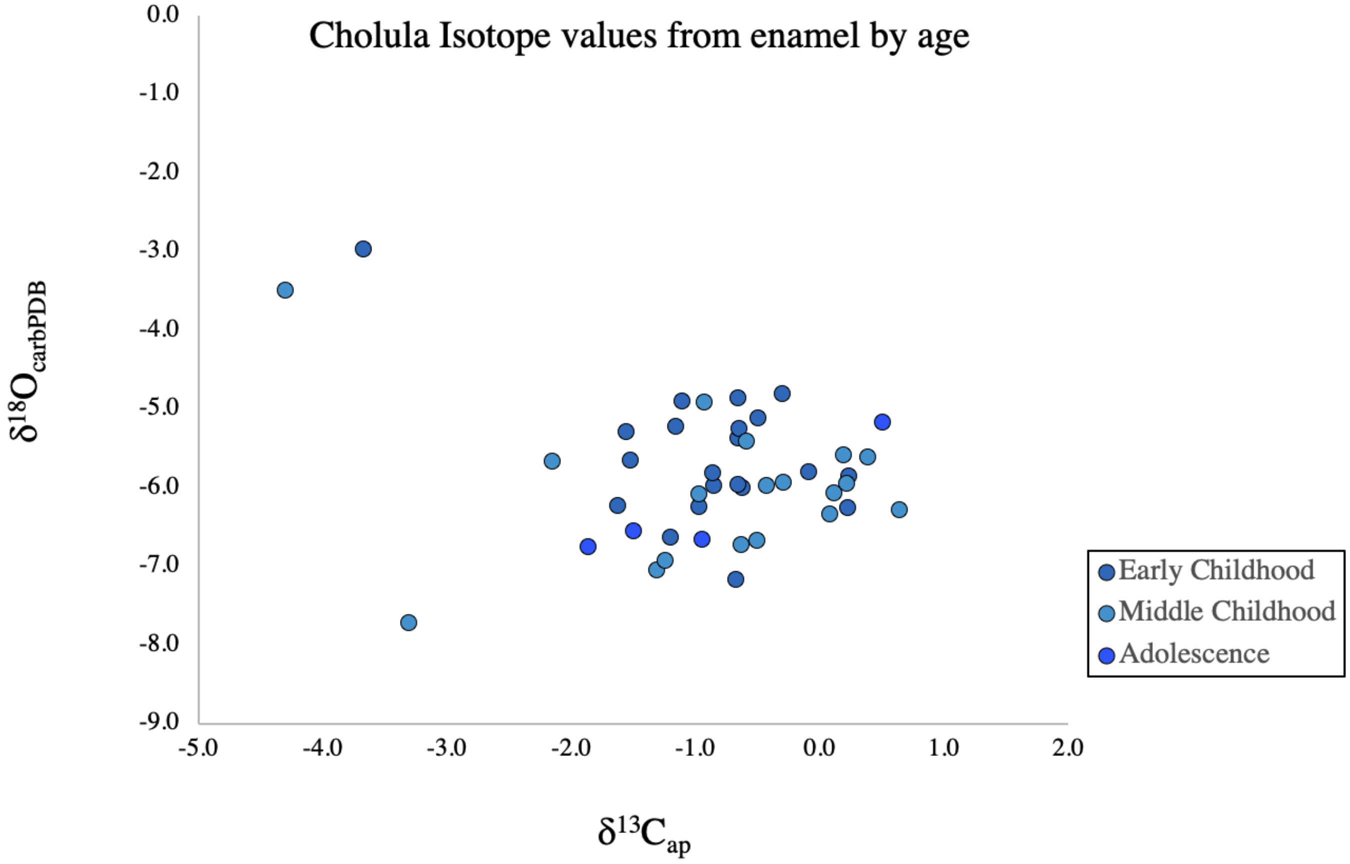


Figure 7.11: Cholula dietary isotope values from enamel[34].

---

[34] Note: values do not group distinctly by age group, but rather demonstrate individual variation in timing and nature of weaning, while adhering to a set range of dietary goods.

Carbon and oxygen isotope patterns at Cholula

Similar to patterns of δ^{18}O variation with age, δ^{13}C at Cholula is also highly varied (**Fig. 7.11**). With only three premolar samples, each with widely ranging values (δ13C$_{ap}$ = -4.30 to 0.39‰; δ^{18}O$_{carbPDB}$ = -6.73 to -3.49‰), change in diet is centered on differences among molars. Interestingly, rather than becoming more enriched in ^{13}C (as maize and other C$_4$ plants become a larger part of diet), later teeth remain fairly stable in values (M1→M2 +.04‰, M2→M3 +.14‰, M1→M3 +.19‰).

Nitrogen isotope patterns

While the most enriched individual at Tepeticpac is an infant (13.24.19.1, 6-9 months), the variety of nitrogen values among infants spans the whole of the childhood population at Tepeticpac, with the least enriched subadult being an infant of approximately the same age (13.20.15.3) (see A&B in **Fig. 7.2**). As this data is from bone collagen, it belongs to individuals who died in infancy, thus perhaps this variation that spans a whole trophic level is the difference between individuals who nursed, and those who died due to lack of milk, or before mother's milk was recorded in their bone tissue.

At Cholula, the sole infant (Ent. 149) falls along the same nitrogen value as the potentially sickly infant at Tepeticpac (13.20.15.3), while the toddler exhibits a higher δ^{15}N value. However, despite an enriched δ^{15}N signature, this Cholula toddler does not reach the values of most other toddlers at Tepeticpac, due to the overall less enriched diet of populations at

Cholula. In the sample of Children and Adolescents for which there are two individuals each (Ent. 182, Ent. 101; Ent. 295 and Ent. 214), they each differ by close to a trophic level in terms of δ^{15}N, again emphasizing the broad variability in diets at Cholula, even among individuals of similar ages.

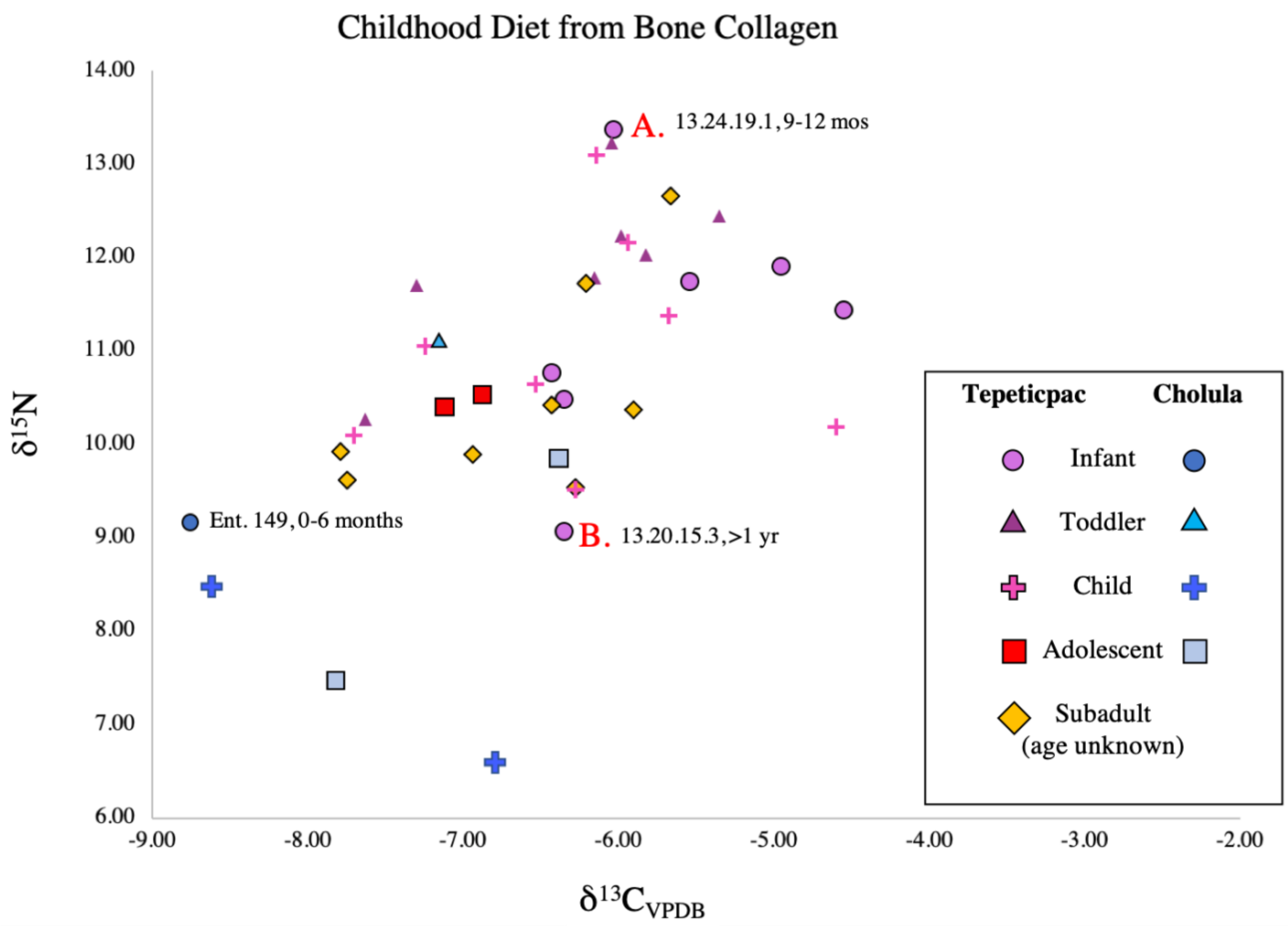


Figure 7.12: Childhood carbon and nitrogen isotope ratios from bone collagen[35].

---

[35] A) Nitrogen-enriched Tepeticpac 6-9 month old infant, Primary Burial 13.24.19.1. B)Nitrogen depleted Tepeticpac Infant, Burial 13.20.15.3, secondary burial.

Table 0.4: Changes to diet with age (enamel carbonate)

	ΔO_{M1-PM}	ΔO_{M1-M2}	ΔO_{M1-M3}	ΔC_{M1-PM}	ΔC_{M1-M2}	ΔC_{M1-M3}
Tepeticpac	+.08	+.32	+.70	-.89	-0.4	-.26
Cholula	nd	+.57	+.56	nd	+.04	+.20

Summary: Weaning and childhood diet in the Puebla-Tlaxcala Valley

Childhood foodways at Tepeticpac differ than those at Cholula in that Cholula is less-enriched in ^{13}C. At neither site are age-group values weaning patterns visible, emphasizing idiosyncratic approaches to weaning practices. As urban centers, this may be the influence of household-level traditions. At Cholula, outliers (Ent. 373, Ent. 190, Ent. 80) hint at greater migration and population flux, or perhaps the presence of more opportunities for exchange, both of edible goods and of food knowledge and traditions. At Tepeticpac, there is also variability in weaning traditions, yet the range of dietary variability is narrower. Thus, while macro-level differences in timing of weaning occur, and types of weaning foods may vary, the population as a whole appears to have similar access to C_4-rich infant and weaning dietary goods.

Table 0.5: Tepeticpac 18O values by age category

Childhood diet by developmental age category										
			$\delta_{18}\mathrm{O}_{\mathrm{carbPDB}}$				$\delta_{13}\mathrm{C}_{\mathrm{ap}}$			
		n	Mean	s.d.	max	Min	Mean	s.d.	max	Min
Tepeticpac	IEC	34	-4.85	.77	-3.51	-6.47	.24	.52	1.29	-1.06
	MC	7	-4.69	.48	-4.01	-5.39	.80	.47	1.40	0.03
	Teen	14	-5.53	.77	-4.35	-6.60	.60	.73	1.68	-1.38
Cholula	IEC	19	-5.56	.87	-2.97	-7.17	-1.00	.78	.24	-3.67
	MC	19	-6.00	.90	-3.49	-7.73	-0.81	.87	.39	-4.30
	Teen	4	-6.29	.65	-5.17	-6.76	-0.63	1.15	.65	-1.86

Paleobotanicals: Starch, Pollen, and Fibers

In order to better interpret plant contributions to diet at Tepeticpac, I submitted 28 dental calculus (calculus) samples from 25 individuals with significant calculus to the Laboratory for Paleoethnobotany and Paleoenvironment at the Institute for Anthropological Research at the Universidad Nacional Autónoma de México, led by Dr. Emily Mc Clung de Tapia. From these samples, Dr. Julia Pérez Perez and C. Cristina Adriano-Morán extracted phytoliths, pollen and fibers. Results from paleobotanical analysis provide a more thorough interpretation of specific plants in the diet.

Starches

Starches are composed of the carbohydrate portion of plants, particularly abundant in fruits, seeds and roots. Recovered starch grains show the presence of maize (*Zea mays*, C_4), sweet potato (*Ipomeoea batatas*, C_3), wild and domesticated beans (*Phaseolus sp*.,C_3).

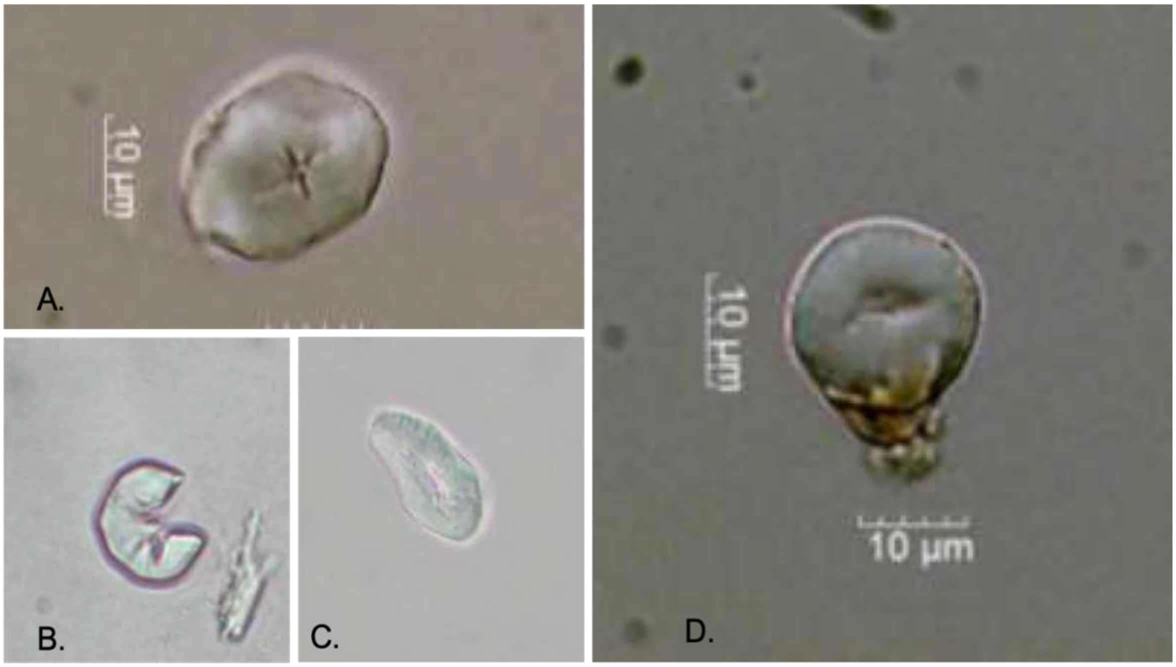


Figure 7.12: All images were taken under white light, at 40x magnification, photos by Julia Pérez Pérez and Jorge E. Cruz Palma. A. Starch grain of Ipomeoea batatas (sweet potato); B. Starch grain of Zea mays (maize); C. Starch grain from Phaseolus sp (wild legume) D. Starch grain from Fabaceae (legume).

Phytoliths

Phytoliths, or microscopic plant silicates, draw primarily from the leaves, shells, peels and fruits of plants (Piperno 2006). The identification of the plant of origin relies upon the identification of cell shape. Within our sample, both bilobed (found in grasses such as maize, and sorghum) and bulliform (found in monocots, or flowering grasses, and root plants which could include sweet potatoes, or amaranth) phytoliths were recovered.

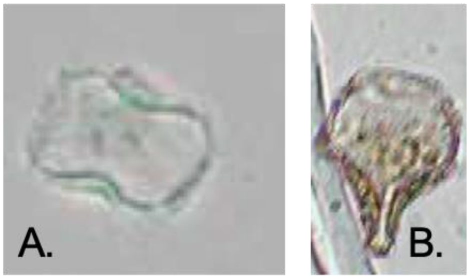


Figure 7.13: Bilobate (A) and buliform (B) phytolith recovered from dental calculus. All images were taken under white light, at 40x magnification, photos by Julia Pérez Pérez and Jorge E. Cruz Palma.

Pollen

Pollen is primarily used by palynologists to identify ecological changes through time, and frequencies of different pollen types ebb and flow (Jarzen and Nichols 1996). When recovered in dental calculus, pollen can aid in interpreting relationships of consumption of plants, but more often is associated with unintentional consumption, such as ingestion via water sources. Thus, this data helps to reconstruct the ecological environment in which Late Postclassic Tlaxcaltecas lived. Within the pollen cells, Alder (*Alnus*), Birch (*Betula*), Cyprus (*Cupressus*), Pine (*Pinus*), Oak (*Quercus*), and Guava trees (*Psidium guajava*)were identified, with Guava and Oak being potential food sources. Additionally pollen came from shrubs and smaller plants such as Arums (*Araceae*), Sedges (*Carex*), Cattails (*Typha*) and Horsetail (*Equisetum*), all of which are associated with bodies of water, confirming interaction with freshwater spaces such as lagoons, rivers and streams, many of which remain in use today (Pérez Pérez pers. Comm 2020), and were sites of water sample collection (Ch. 5). There was also pollen from Watermilfoils (*Myriophyllum*), wild grasses, legumes, Mimosas (*Mimosa pudica*), Madder (*Rubia tinctorum*), and Wild Coffee (*Coffea*). Many of these smaller plants continue to be used for contemporary medicinal uses, perhaps speaking to the time depth of these practices.

Figure 7.14: Pollen from shrubs. (A) Cattail, (B) Legume, (C) Watermilfoils, (D) Mimosa, (E) Arum, (F) Wild Coffee. All images were taken under white light, at 40x magnification, photos by Julia Pérez Pérez and Jorge E. Cruz Palma.

Figure 7.15: Pollen from trees. (A) Alder, (B) Cypress, (D) Guava, (E) Pine, (F)Birch, (G) Oak. All images were taken under white light, at 40x magnification, photos by Julia Pérez Pérez and Jorge E. Cruz Palma.

Plant fibers

As reported by Pérez Pérez (2019), identifiable fibers found within the dental calculus pertain to the *Agave* family, specifically *Agave salmiana*, or “maguey pulquero,” a type of cactus used to make the ritual fermented drink pulque, and the non-fermented aguamiel. Within the site of Tepeticpac, there is abundant evidence of maguey processing for fiber and cloth notable in the quantity of spindle whorls in proportion to other household objects (Ibarra et al. 2018).

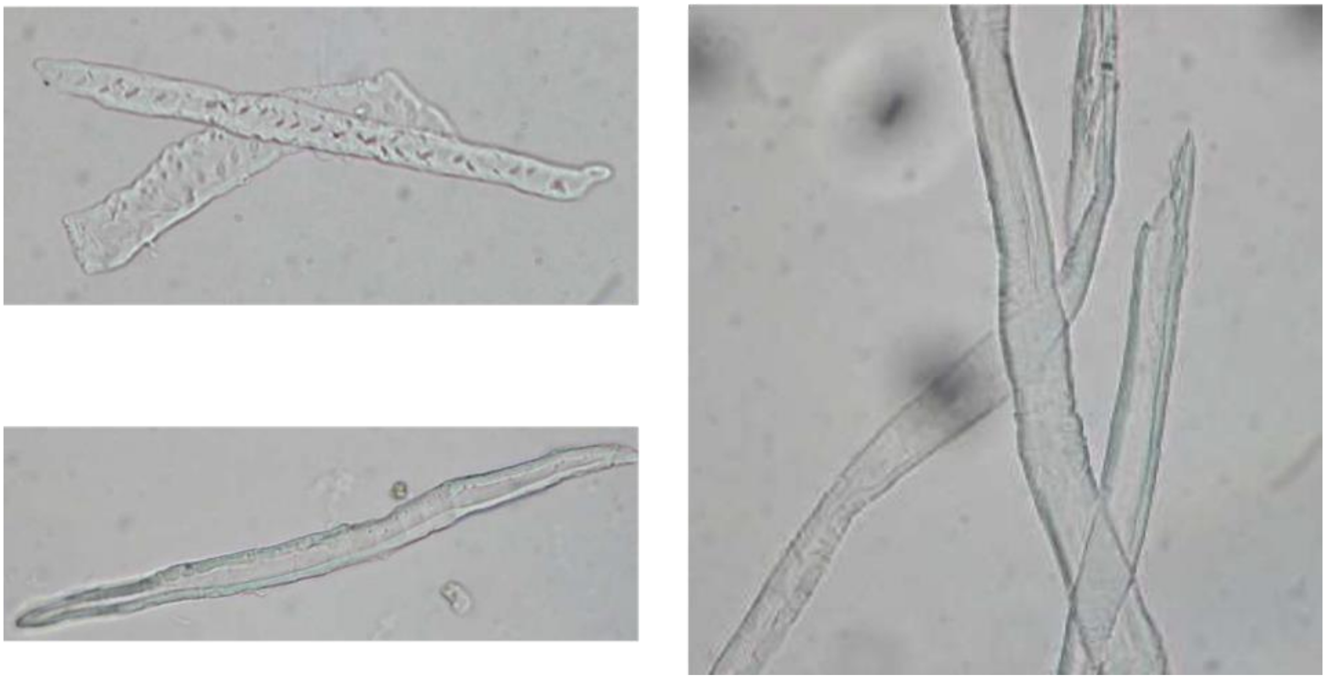


Figure 7.16: Maguey Fibers. All images were taken under white light, at 40x magnification, photos by Julia Pérez Pérez and Jorge E. Cruz Palma.

Summary

Microbotanical results demonstrated the presence of maize, sweet potato, and a variety of wild beans—all plants known to play a key role in Mesoamerican diets more broadly. Pollen grains primarily related to the vegetation of the area, but with the exception of guava, oak, and mimosa these were likely not plants that were consumed; rather, pollens were ingested through drinking water. As pollen came from trees local to the site, this further supports data that individuals were local, drinking local water. Pollen further helps to reconstruct the ecology of the area, and emphasizes local relationship to bodies of water, and edible and medicinal plants in the environment. Of the fibers recovered from the calculus, the majority correspond to the *Agave* family. As discussed in **Ch. 5**, agave is a succulent central to Mesoamerican diets, consumed in liquid form as aguamiel and the fermented drink pulque, or grilled and consumed. The presence of agave fibers confirms its ingestion, and paired with the isotopic results from contemporary plants, emphasizes the likelihood that high $\delta^{13}C$ values may be explained by a diet that includes heavy maize and agave (and other CAM plant) consumption.

Conclusion: Diet and Community Relationships at Tepeticpac and Cholula

To conclude this chapter, I turn to the questions posed in the introduction:

In what ways do Macrosystemic beliefs shape food decisions? How is this shifting and/or stable through time?

Within the populations of Cholula and Tepeticpac, a pattern of Mesoamerican maize-based society is visible through ^{13}C-enriched diets that indicate a reliance on C_4 plants. While the sites share overlap in terms of having both C_4-heavy and terrestrial fauna diets (**Fig. 7.2**), a statistical analysis demonstrates that Cholula and Tepeticpac are significantly different. While Gibson (1967 p. 2), as quoted in **Ch.3**, argues that the Tlaxcalteca may have brought the first maize to the Puebla-Tlaxcala Valley, it is clear that Early Postclassic Cholula had a C_4-heavy diet, a part of which was likely maize. I argue that what the Tlaxcalteca may have brought was a new way of engaging with maize: nixtamalization (Warinner and Tuross 2009). Tlaxcala, translated into Nahuatl is "place of the tortilla." As discussed in previous portions of this chapter, the chemical process of nixtamalization enriches maize in ^{13}C, an explanation for Tepeticpac's more enriched carbon values.

Food is not only a source of nutrition, but holds symbolic value in the ways that it is prepared and presented. Engaging with maize in a new way would allow for a wide array of high-nutrient, storable and easily transportable foods: atole, tamales, tacos, tortillas, tlacoyos to name a few who remain central to everyday Tlaxcalteca life in the current era. Beyond maize, other C_4-rich foods such as amaranth, and CAM resources like pulque and mezcal from the maguey plant share medicinal, nutritional and ritual roles of importance. Amaranth dough figurines took the shape of gods on ritual altars, with a homologue today in amaranth dough skulls that decorate altars at Día de los Muertos. I argue that these foods gave both symbolic, ideological and concrete social structure to the community of Tepeticpac.

Both Cholula and Tepeticpac occupy ecological zones that are adapted to the successful production of these foods, yet the populations of these two cities interacted with them in different ways. I argue that this is not only due to a question of access, edibility and health, but also relates to the symbolism and group identities associated with different types of foods. As the Tlaxcalteca arrived into the unfamiliar Puebla-Tlaxcala Valley in AD 1380, they brought with them traditions and knowledge carried from their home in the Chichimec North. Their task was to effectively and efficiently adapt their knowledge to the surrounding ecosystem, to shape the state of Tlaxcala in little under 150 years. This was done by structuring society around belief systems of food redistribution, which Fargher et al. (2011) argue is visible in the presence of imagery of the Nahua god Tezcatlipoca, god of war and ancestral memory. Motolinia (1950) records numerous public feasts aimed at distributing food—a tradition that continues to be reinterpreted in contemporary Tlaxcala through weekly “moles,” prepared by a different church every week and open to the public on Sundays.

In contrast, Cholula was a well-established ritual center, and possible metropolis as early as AD 150. Rather than group cohesion, Cholula maintained its population through the ebb and flow of adaptation spanning almost 1400 years. While dietary patterns show that maize and other C_4 or CAM plants were a central component of diet, they also show the diverse backgrounds of

Cholula residents—backgrounds drawing from origins both within and outside of the Puebla-Tlaxcala Valley. Cortés (2014) documents that upon Spanish arrival, Cholula hosted over 430 temples, while Rojas (1927 [1581]) speaks of the pilgrimages and tribute from the imperial center to Cholula. In contrast, Tepeticpac was dominated by residential and agricultural terraces. As McCafferty and McCafferty (2000) state,

> In sum, Cholula was a hub of religious and economic activity, with high quality craft production used to communicate ideological messages relating to religion, ethnicity and status (p. 39)

While the outlying individuals show the ways in which food signaled belonging, and perhaps ethnicity, at Tepeticpac food is distributed throughout the population as a means to unify. In contrast, at Cholula, social difference is emphasized through access and consumption patterns.

How do Exosystemic factors shape relationships to food?

Through analysis of nitrogen isotopes, I expected to see some influence of imported marine goods within the two sites, known to be market centers and core nodes on the Gulf-Basin of Mexico trade network. While at Tepeticpac, this could be explained by trade embargoes and economic blockades, Early Postclassic Cholula was also a trade and market center. If the lack of marine foods, known to have been traded in markets (recorded by Spanish chroniclers Hernán Cortés, Bernal Díaz del Castillo, Diego Durán and Bernardino de Sahagún), was related to imperial influence, Early Postclassic Cholula diets would show marine presence. However, since neither site presents marine contribution to diet, this data might indicate that marine foods were not a central component of inland diets regardless of sociopolitical manipulations of the economy. The sole Tepeticpac adult (13.20.15.1, M 40-50 years) with a high nitrogen isotope value (13.3‰) thus perhaps represents a diet enriched from travel and residence in an area where marine or otherwise nitrogen-enriched foods *were* available and accessible components of the diet, rather than an influx of marine goods at Tepeticpac.

In addition, Cholula's position as a ritual center connected it in unique ways to external events. Discussed in **Ch. 3**, the time-depth of Cholula has allowed archaeologists to document its ebb and flow in size as surrounding states like Teotihuacan and Tula rose and fell across time. As hypothesized by Kreger (2010), external warfare as well as the arrival of imperial-driven colonies shaped the immigrant population at Cholula. As is visible in **Figs.7.3, 7.7-7.9,** and **7.11**, Cholula has proportionately more outliers, emphasizing its role as a metropolitan center with more population movement and variation than Tepeticpac.

How do Micro and Mesosystems interact to sustain social structures and/or shape change?

Mesosystem

Interpreting Mesosystem as an interlocking network of Microsystems with every-widening breadth (household, neighborhood, city, state), I argue that the data from Tepeticpac and Cholula show two distinct Mesosystemic networks of social organization. Firstly, the nature of dietary components, while similar in their trend towards C_4-enriched diets, are statistically distinct. Specifically, $\delta_{13}C$ values at Tepeticpac are higher than Cholula at a statistically significant level. Paired with foodweb data from **Ch. 5** and oral history evidence discussed in **Ch. 8**, I argue that this is evidence of dietary practices that include multiple C_4 and CAM plants, and likely the heavy use of nixtamalized maize. At Tepeticpac this enrichment is seen even within the youngest members of the community, which suggests that such ingredients are being consumed in large amounts by breastfeeding mothers, and prepared as a weaning food in a manner that is accessible to young children, such as gruel or drink. This is a pattern unique to Tepeticpac, not visible in its neighbor community of Cholula. Additionally, the tight clustering of diets at Tepeticpac aligns with Fargher et al.'s (2011) argument for a system of "collective action," or a state-controlled system of food distribution. State-level systemization of food distribution is visible in the narrow range of diets at Tepeticpac, and the inclusion of infants and young children within C_4-rich dietary practices that align them with community-level carbon values, even before they are old enough to make decisions for themselves. In contrast, at Cholula, the lack of uniformity in both δ_{13}C and δ_{15}N values by age groups shows that food traditions are not systematized, but rather individually defined.

Collagen values from δ_{15}N and results from collagen-apatite spacing at Tepeticpac also show that difference in diet between Cholula and Tepeticpac is also due to protein sources from terrestrial animals, which potentially consumed large quantities of C_4 plant foods. As we saw in **Ch. 5,** deer, turkey, dog, rabbit and quail from Tepeticpac were highly enriched in $_{13}$C, likely as a result of maize-based diets, either as a result of intentional feeding, or proximity to maize fields and cooking refuse.

At Cholula, only infants and weaning-age subadults exhibit artificially elevated in δ_{15}N values due to the trophic effect of breastfeeding, approach the middle and upper range of Tepeticpac's nitrogen values, indicating that at Cholula, diets rely more heavily on herbivorous meat sources or plant proteins. When comparing collagen and apatite carbon values, this difference is emphasized by Tepeticpac producing values consistent with a heavily carnivorous diet, while Cholula approached values associated with omnivory.

Microsystem

Population-level patterns reflect moments of tradition upkeep—whether through personal preference, custom, or social pressure. However, looking at individual storylines allows for the analysis of where these ripples of difference and change might begin—how individuals who depart from the pack, even slightly, can begin to exert shifts to Mesosystemic structures.

Childhood diets in this study are the site of the most variation among both inter and intra-site comparisons. At Tepeticpac, oxygen values from dental enamel show a shift in diet around 3-4 years. While this is not visible as a clear difference between $_{15}N_{col}$ values of toddlers (age 1-3) and children (age 4-12), this is likely due to the delay between collagen formation and diet change. The majority of isotopic results centered on similarities in dietary practices at Tepeticpac, but analyses of collagen-apatite spacing highlighted an important difference in the source of proteins being consumed by weaning individuals in Op. 3 vs. Op. 13. This site of difference shows that while particular food "traditions" or boundaries of edibility exist at the site-level, there is variety in how they are being applied, in this case, a variation that is visible by what might be defined as a "neighborhood."

Additionally, when the subadult category is analyzed at more specific age-level differences, (**Fig. 7.12**), it becomes clear that within "subadult" trends (e.g. enrichment in nitrogen), averages obscure dramatic differences of individual experience, such as is the case in nitrogen enrichment between Burial 13.24.19.1, a 6-9 month old infant who was a primary burial, and Burial 13.20.15.3, an infant and secondary burial. These differences emphasize how population-level access and equality are exacerbated within vulnerable populations—small differences in access might be related to the distinction between life and death.

In comparison to the seeming homogeneity at Tepeticpac, childhood diets in Cholula are quite varied, making it difficult to pinpoint a particular weaning tradition. What this variation does show is how multiple iterations of unique foodways can result in a population-level dietary tradition that is broad and cross-cutting, without distinct clusters by age, or sex.

Another Micro-level pattern that is visible in Cholula is that of immigration and distinct childhood experiences. Within the data from $^{13}C_{ap}$, three adult Females (Ent. 373-1, F 60-70; Ent. 190, F 50-60; Ent. 81, F 40-51) had outlying values that reflected a childhood diet heavy in C_3 resources that are distinct from either Tepeticpac or Cholula, and thus likely reflecting a childhood upbringing outside of the Puebla-Tlaxcala Valley. Returning to results from **Ch. 6**, Ent. 373-1 and Ent. 190 were both individuals with ^{18}O values outside of local ranges. Within results from $\delta^{13}C_{col}$, Ent. 214 and Ent. 101 (an adolescent and child, respectively) demonstrate carbon values that fall closer to Tepeticpac population averages for C_4 and CAM-heavy diets. Together with records that describe Cholula as a metropolis, I interpret these individuals as representing unique storylines that narrate the many ways in which individuals became a part of the Cholula community, whether in childhood or adulthood, through travel from great distances, or nearby regions.

How might internal structures of food distribution and access influence capacities for imperial resistance?

At Tepeticpac, foodways support archaeological and ethnohistoric accounts of a tightly unified, council-based system of governance, what Fargher et al. (2011) call "collective action." Fargher et al. base their hypothesis on ethnohistoric record, imagery in site murals, and archaeological findings of decentralized city planning. Through this system, food security is reached through community collaboration. Rather than hierarchical relationships of power, a council of rotating elected rulers was selected from among the populace. In return for cooperation, frequent public feasts were used to redistribute goods. The findings from my research support a scenario in which food is used to create and maintain social and political relationships at Tepeticpac.

From these data, I argue that the analyzed Cholula individuals, with their broader dietary variation, represent a lack of state-level cohesion in terms of food distribution, instead relying on household and individual-level systems of access. As discussed in **Ch. 3**, Cholula was a city that had been occupied since the Classic, and experienced a potential population replacement in AD 800. It was a ritual center, and site of religious pilgrimages - population movement was constant. I hypothesize that the analysis of diet at Cholula reflects a city unified by Macrosystemic beliefs, but that this unity is not actively maintained at the smaller macro and micro levels. Rather than the "Tlaxcaltecan" community identity of Tepeticpac, Cholula represented the coming together of people from different places, a metropolis centered around independent networks of food accessibility. Cholula's relationship to the Aztec Empire in the Late Postclassic is unclear, though imperial records document a wavering ally ship, kept alive by consistent pilgrimages by Aztec rulers and elites who would travel from the imperial capital for ceremonies at the religious center. The goal at Tepeticpac was to keep its population strong, while the goal at Cholula was to keep the religious center active.

8

FROM PLANTS, TO INGREDIENTS, TO TRANSGENERATIONAL KNOWLEDGE NETWORKS

In this chapter, I move away from the laboratory and field-based work of archaeology to reflect on the ways my research interacts with the lives of contemporary Tlaxcalteca populations. Drawing from conversations and relationships built upon shared interests in archaeology, food, and plants, I conclude the dissertation with a series of ethnographic interviews of individuals invested in traditional farming practices, and a reimagining of Prehispanic foodways to meet contemporary needs.

Introduction

The foodways that allowed Postclassic Tlaxcallan to remain independent from the Aztec Empire had repercussions that rippled into the present. Food sovereignty put Tlaxcallan in a unique position to ally with the Spanish, a privilege that led to a level of indigenous sovereignty not experienced elsewhere in Colonial Latin America. As a result of this, *cocineras tradicionales*, or traditional indigenous cooks, and small scale farmers continue to maintain practices centuries old. As Mexico increasingly expropriates its economy, bringing in nutritionally-poor agricultural goods from abroad, *cocineras* and farmers protect, maintain, and reinvent practices good for both the body and the land. In both contemporary and ancient Tlaxcala, food sovereignty was not just about getting access to *enough* food, or *nutritionally rich* food, but the right to construct a narrative about identity, and its validity within global discussions of power and authority (Marchione 1979; Marchione and Messner 2010).

By melding bioarchaeology and oral history, I emphasize how politics draw on food as a tool for serving strategic interests. While free trade agreements between the U.S., Mexico and Canada (e.g. NAFTA) flood markets with genetically modified corn, the results of my research run counter to contemporary definitions of what "development" looks like. As Marchione and Messner (2010) argue, food aid can also *undermine* local economies, drowning them in food devoid of cultural meaning and local agency. Data from my research demonstrates that pre-hispanic cultures were "developed" with agricultural methods and foodways that both nutritionally and culturally strengthened the population of Tlaxcallan. The continued work of contemporary community members, who serve as stewards of these foodways, highlight the resilience, financial, social and nutritional value of culturally relevant and historically steeped foodways.

The ethnographic analogies that have added depth to my interpretations were shaped by dialogues between me and the interviewees. In casual conversations across the years of my fieldwork, I shared my work, and listened as others found familiar foodways reflected in the patterns I described. Through discussions of history, food and plants, we began to explore overlaps. I learned that the maize-heavy diets I saw reflected in carbon values in infancy and childhood matched longstanding practices of providing nursing mothers and weaning babies with maize or amaranth-based drink, atole. I learned to deconstruct western narratives of possible protein sources, expanding my interpretations to include insect-heavy and plant-based sources. At the same time, my work supports the sustainability and nourishing effects of these foodways—ecological wisdom visible in diets hundreds of years old. From these conversations with community partners, we began to ask: How could paleodiet studies support the work of sustainable food markets, and ecotourism? How do those same markets and food production spaces help deepen bioarchaeological analyses of the relationships between human bodies, society, and the natural world? I conclude my dissertation by reflecting on these conversations, as a point from which to grow and develop this research and collaborative work.

An Ethnography of Reimagined Food Traditions

For Tlaxcala, a volatile imperial pressure influenced their decision to ally with the Spanish in 1519, facilitating the fall of the Aztec Empire, and the colonization of Mexico. Tlaxcala is the smallest state in Mexico, at $1{,}551_2$ miles—a remnant of its privileged position within the kingdom of New Spain, which led to this state becoming a pocket of self-rule. This "betrayal" by the Tlaxcalteca led to its erasure in dominant Mexican historical sources. Yet *local Tlaxcalteca* oral histories and colonial documents written by Spaniards reflect the resilience of Prehispanic traditions and knowledge. Importantly, indigenous *cocineras tradicionales* (cooks of traditional foods), and agriculturalists have been the stewards of these foodways, yet they have been ignored by Modern Mexican nationalist history and escaped much of the *mestizaje* (cultural mixing) experienced by elites who adapted to Spanish hierarchies. To contextualize the isotopic data from my research within living food traditions and the multigenerational knowledge they contain, I returned in the summer of 2019 to record ethnographic interviews. Drawing from relationships cultivated over five years of field work, I began to interview a selection of small-scale chefs, household cooks, and agriculturalists, several of whom I met through the Alternative Market of Tlaxcala. This weekly farmer's market brings together producers with an interest in the right to sustainable, community-driven food sovereignty through small-scale farming practices.

Figure 0.1: From left to right: atole at the market; the market's welcome sign; a nearby glyph for Tlaxcala, with two hands flattening a tortilla, symbolizing "place of the tortillas."

El mercado alternativo de Tlaxcala

The central market of Tlaxcala bustles seven days a week in a warehouse behind the vast parking lot from which *combis* (small minivan-like public transport) ebb and flow, driving passengers from the city center to the small surrounding towns. A few blocks away in the quiet plaza of the Jardín de San Nicolás, the Mercado Alternativo is a grouping of just 20 stands or so. In one, you can find all kinds of local honey, pollen for allergies, and sprays for throat infections. In another, an ex-butcher displays his wares of vegetarian meats, made of mushrooms and soy. I arrive to the market before 9 am, when the hot sun still isn't infiltrating every corner, and enjoy a tlacoyo breakfast—blue corn masa folded into a teardrop shape, filled with haba bean paste and topped with nopales, onion, tomato, cilantro, salsa roja, and a sprinkle of cheese. If I arrive a bit later, my lunch choice is the deep red pozole swimming with wild mushrooms instead of meat.

A Margaret Mead quote greets visitors to the Mercado's website: "Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has." This co-op was formed in 2004, originally focused on discussion of topics of food rights—their tagline is "*El derecho a una alimentación sana, segura y soberana*," or "The right to healthy, secure, and sovereign food." As reported by their website, the group is formed by "producers and civil society organizations, who care about the environment, unemployment, a lack of opportunities and decline in health" (translation by author). As more people with diverse backgrounds, skills, and products joined the coop, it began to take shape as a market. All items in the market are locally produced, with each member going through a process of application in which they receive training on agroecological production, and are invited to form a part of the Mexican Network of Organic Tianguis and Markets organized by the National Autonomous University of Chapingo.

The members organize democratically, with a rotating membership of leaders, male and female, meeting biweekly on market day to discuss future plans for the market, to share farming and marketing experiences, and to discuss upcoming knowledge shares. For many participants, a shift to agroecological and often plant-based foodways has been a result of health conditions, most often diabetes, a disease that has a disproportionately high impact in Latinx communities. Interestingly, the goals of the market itself do not mention Prehispanic foodways, yet conversations with individual members highlight a theme within food sovereignty of drawing from Prehispanic connections to land. Codices are mentioned often, as is the timelessness of particular food practices, with the phrase "*así se hacía antes*."

Figure 0.2: The larva of an agave snout weevil (left), pulque at Don Jaime's stand (right)

Don Jaime García

Don Jaime greets guests in a white sombrero and plaid flannel shirt, big grey mustache dipping down the sides of his mouth. When I first approached his stand, with its jars of maguey honey, and small cellophane wrapped packets of seasoned grasshoppers, I was a bit intimidated by the lack of a smile. He didn't seem to be interested in my awkward questions about whether he had any fresh insects I might freeze dry to take back to the lab. I bought a jar of honey, and stepped aside amidst the calls for another round of pulque, and a taco de gusano de maguey. The next time I visited, I ran into a neighbor, having a late morning pulque on the long table set up next to the stand. I joined, slowed down to absorb my surroundings. The pulque was served in a tall red clay pint glass, emblazoned with a green painted maguey plant, and the word "Tlaxcala" underneath. Through the ebb and flow of customers, I tried different flavors—*piñón, coco, apio*. I learned that the members of the co-op had weekly taste-tests to see who could come up with the most interesting flavors. As the afternoon wound down, Don Jaime brought over a peace offering of a plate of an array of insects—the bar peanuts of the *pulquería*. We made plans to chat the following week, a more formal conversation.

I arrived the next week at the end of the afternoon. Don Jaime greeted me with the now familiar pint of pulque—strawberry tomato, this time. In addition, he offered me a bowl of pozole, with some tortillas fresh from the comal. As we ate, he told me that he had started to become vegetarian, or plant based, when he found out he had diabetes. His interest in pulque came from the folk knowledge that it is beneficial to those suffering kidney disease and diabetes. Insects as snack foods or toppings is common in Tlaxcala, but as Don Jaime learned more about their protein content, he began to create more complex recipes for tacos and other masa-based foods. And, as is evidenced by his always bustling stand, he found a welcoming audience.

Due to the timing of the insect season, I was unable to include insects in my analyses. Yet, we discussed the wide variety of insects that he kept, frozen or dehydrated in spices—*gusano de maguey*, its fatty white grub body fried to a crisp or fresh and squishy with a dash of lime juice; the more svelte *chinicuil*, or red maguey worm; *jumiles*, known as stink bugs in the Southern U.S., can be ground up or sprinkled on top of dishes; the small crunchy body of the *chicatana* ant; and the grasshoppers- so many kinds of grasshoppers. For Don Jaime, insects and pulque were a familiar, albeit not routine part of his diet until his health led to significant lifestyle changes. Through the market and in collaboration with market colleagues, he works to revive and adapt these foods to the needs and interests of contemporary Tlaxcaltecans.

Figure 0.3: The nopal farm; Don Zeferino cutting a tuna fruit; roasted capulín pits.

Don Zeferino Manoatl Tetlamatzi

I first heard Don Zeferino speak as part of a food tour organized by local chef Irad Santacruz, to showcase the producers of Tlaxcala. The chef is a friend of a friend, and allowed me to tag along as he led a tour of culinary arts students from Mexico City. We met Don Zeferino by the reed gate to his nopal farm, and he led us in past two squat adobe buildings towards the field that opened up in the back. Before us were rows and rows of nopal. As he led us through, Don Zeferino pointed out small differences in the size of the penca, or leaf, the clustering of the thorns, the color of green—what at first looked like hundreds of the same plant was in fact, dozens of different varieties from across Mexico. With his machete, he deftly beheaded a penca, and in a few moves, sliced back its spiky skin, scoring the interior flesh and offering up a tidily cut square of nopal on the end of the blade. Surprisingly, each type of nopal had a different flavor. Some tasted like watermelon rind, others like cucumber; some were thick and succulent while others were woody and hard to chew. Without touching the plant with his hands, he again used the tip of his machete to slice open the tunas, or cactus fruits, revealing the golden, or crimson, or magenta flesh inside. As he told us about the insects that consume the plants, their life cycles, how to identify and dig them out of the nopal leaf, he also waxed philosophical about the world—the importance of plants, human connection to nature, the right to grow your own food, and have access to beautiful plants such as these. Part activist, part scholar, part agriculturalist—we made plans to talk further.

A few weeks later, I took the combi from the center of Tlaxcala to his pueblo of Huitznáhuac. He greeted me at the front of his home, a low adobe building off the main road, amidst the small cluster of buildings that represent the center of town. He opened a wrought iron gate that leads into a small patio. Flowers and small plants nested in old paint buckets and cans dotted the edges, against the bright teal peeling paint on the patio's cement walls. His popularity precedes him, and a second guest—another anthropologist from Mexico City—is also in the patio to share the tour. Don Zeferino is waiting for a third guest to arrive before we head out to the huerta, and as we wait, he gives us a tour of the household nopal fields—smaller than the huerta, but still extensive. As we walk, he muses:

> La nomenclatura, en náhuatl, era tan presente como para definir diferentes terrenos…se definían por sus características. La tuna lo definían por sus características. Pero, entre lo que es la modernidad, hay gente que no quiere… no le *interese* [saber los nombres]…. y los que si les interese no tiene acceso. El tema del nopal es muy grande.
>
> *Their names, in náhuatl, were so distinct as to define different properties… they were defined by their characteristics. The cactus fruit was defined by its characteristics. But, what with modernity, there are people who don't want…aren't* <u>*interested*</u> *in [knowing their names]… and those who are interested don't have access. The topic of the nopal is very big.*

When we walk into his patio, the sound of the local radio station blares from an open walled room off the patio- the kitchen. Our voices echo across the cement. He points to the paint buckets, naming the plants that sprout: cherry tomatoes, tomatillos, calendula, chile, geranium, flor de Santa María, ruda, calabaza, epazote. These are “plantas de lujo,” or luxury plants, he explains—not for selling, or for relying on, but for enjoying. As we continue to wait, he hands us a handful of capulín pits, and teaches us the technique to extract the center.

> Usando lengua, lo acomodas sobre toda en estos dientes para romper. Entonces, intenta acomodarlo, no en comilla sino en estos dientes por se puede romper el diente. Entre los dientes y lengua, se trata de romper. Lo truenas, CRAC, y es probable que se queda entero. Se trata de entre muela y muela, queda así, mira…
>
> *Using the tongue, you place it between these teeth to break. Then, try to place it, not on the point but rather on these teeth because you might break your tooth. Between the teeth and the tongue, you try to break it. You crack it, CRACK, and it will probably stay whole. The point is to keep it between molar and molar, so that it ends up like this, look...*

He shows us the cracked pit, nut-like center now exposed. The whistle of the camote seller fills the street like the anachronistic call of a Prehispanic flute.

When we finally get out to the huerta, without the third guest, who never showed, it is hot, morning sun giving way to the midday rays that pierce through my protective long sleeve shirt. He puts us to work, and our conversation is punctuated by the sounds of the hoe hitting dry dirt, the boom of cohetes in the distance. As we carefully clear the brush between nopal plants, he shows us the vast network of wild greens, instructing us in which to save, which must be removed before they strangle all other life. He looks out at the cacti, and the fruit trees that serve as borders between his property and the rows of maize grown by his neighbor.

> Vean el panorama—hay fruto, hay tunas. Para comer hay capulines. Hay ciruelos. Cuando tu llegaste dijiste ‘hay de todo’, pues casi todo. Hay nopal fresco, que se puede comer, que podemos comer, y hay corazón, que podemos comer. De capulines, la pulpa lo podemos comer…Es decir, hay comida.
>
> *Look at the landscape—there are fruits, there are tunas. To eat, there are capulin fruits. There are plums. When you arrived, you commented ‘there’s some of everything’, well, almost everything. There is fresh nopal, that you can eat, that we can eat, and there is the heart, that we can eat. Of the capulin fruit, we can eat the pulp…. That is to say, there is food.*

He is proud of his work, enjoys the mornings in the misty fields, where he gets to watch the sun rise over the Malinche volcano. His work is a constant exploration of what works and what doesn't. He frequently attends workshops and gatherings with organizations like the Slow Food Movement, and Tijtoca Nemiliztli ("We sow life"), organizations with the goals of creating sustainable and accessible food movements.

> La frase es 'comemos lo que somos' o mas bien 'somos lo que comemos' pero hay mucha gente que no quiere ser. La solución es que…hay que condicionarlas. Una solución es condicionarlas. Otra, es entre lo que es condicionarle y lo que es acondicionar la persona. Parece que es lo mismo, pero no…Es distinto porque yo llego y condiciono las cosas a mi gusto. La otra es, yo llego, y me acondiciono a como están las cosas. Entonces es, o yo llego y destruyo, y levanto. Eso es una. Y la otra es, llego y veo como está, y me acomodo. Y no destruyo tanto. Modifico. Y eso es lo que pasa en muchas partes del mundo. No sé si en Tlaxcala. Destruyen.
>
> *The phrase is 'we eat what we are' or better yet 'we are what we eat' but there are many people who don't want to be. The solution is that… you need to condition them. One solution is to condition them. Another is between conditioning and conditioning the person. It sounds like the same thing, but no… It's distinct because I arrive and I condition things to how I like them. The other is, I arrive, and I condition myself to how things are. So, its, or I arrive and destroy and rebuild. That is one. The other is, I arrive and see how things are, and I accommodate myself. I don't destroy as much. I modify. And that is what happens in many parts of the world. I don't know if in Tlaxcala. They [other parts of the world] destroy.*

This idea is part of so many indigenous food sovereignty movements in the United States—sustainability through adapting to the living systems already in place, rather than destroying them for monocultures, like those of agricultural industries.

I return to interview Don Zeferino over a series of visits that turn into early morning trips to his huerta, where I trade him my far from skilled labor (pulling weeds, planting new seeds, picking off pests) for the stories that flow from his mouth as we work. As we work, we talk about the tour groups that come through, and I mention my discomfort with swooping in in big groups—how it felt like there was no space to get to know people. He gives me new insight into what I thought was simply a product of lack of time, and an overwhelming number of people at once.

> Es una estrategia de conservación, de no decir todo. Algunos organismos tienen mecanismos no solo de defensa sino de ataque. No se si has escuchado el dicho 'corriendo también se gana. Huyendo también se gana'.
>
> *It's a strategy to preserve, to not say everything. Some organisms have mechanisms not just for defense but for attack. I don't know if you've heard the phrase 'you can also win by running. Running away, you also win'.*

I reflect on this as I think about all the ways that knowledge has been passed down, not because it was recorded, but because it wasn't. Because it was passed down in surreptitious ways. Knowledge coded in bowls of soup, in chores done in fields, in stories told under the shade of trees. He starts to tell me about how he came to like plants:

> Cuando yo tenía cuatro, cinco años, andábamos con la familia de mi mama, y yo veía que hacía [la abuela]. Entiendo que ella hablaba con las plantas. Pero el lenguaje no es hablado. Me equivoque en decir hablar—se comunicaba, pues. Y una de las comunicaciones es no necesariamente verbal. Y lo aprendí…y al ver que lo hacia ella, yo también lo hacía. No me acuerdo a cuantos años…. Que fui a la primaria. Así que, en ese lapso, lo que me acuerdo mucho es el surco, los surcos abiertos, y a caminar ahí, a correr. Y algo que también me está llegando es juntar las flores de calabaza…. ¿Mi mamá sembraba quelites, no sé si ya los conoces? Y cuando crecen, ya se los dicen huauzontle…había que más...haba, frijol, ¿que otras plantas? Calabaza…
>
> *When I was four, five years old, we went with my mother's family, and I watched what [my grandmother] did. I understood that she spoke with the plants. But the language wasn't spoken. I made a mistake in saying spoke—she communicated, then. And communication isn't necessarily verbal. And I learned…seeing what she did, I did it also. I don't remember how old I was…. And I went to primary school. And so, in that space of time, what I remember most is the furrows, the open furrows, and walking there, running. And something that is also returning to me is collecting the squash blossoms….My mother planted quelites, do you know those? And when they grow, they're called huauzontle…there was…what else…haba, beans, what other plants? Squash…*

Our conversation is cut off by the blaring speaker of a truck announcing "El paaaaan" to the rhythm of a cumbia song. When it passes, I ask him about how he got involved with the market. He tells me that he tried with other things—ornamental flowers, and fruit. But people would steal his flowers, and birds would steal his fruit. He couldn't find the right market for it. And then an old friend from school told him "el futuro es el nopal." He went to Mexico City to learn a bit more about markets and sales, but kept thinking back to nopales. With time, he came to an agreement with his sister that she would share her land, and he would share his knowledge and labor. As he built up his business, over the years he expanded from her land to his own. Marketing the nopal meant learning how to teach the consumer how to use it, and why they need it, as well as getting certified in the quality of his product. The larger organic market certification was too expensive to join, and to verify. Yet joining the Mercado Alternativo gave him a space to fill a need (no one was yet selling nopales), and a local certification of product value. He explains, about his role in the market:

> Porque la idea es esta: una – generar trabajo. Dos – comer bien. Porque lo mejor que produzco para otro, así puedo comer yo. Y tres – venderles a mis vecinos para que coman rico. Algo sabroso, nutritivo, y rico.
>
> *Because the idea is this: one – generate jobs. Two – eat well. Because the better I produce for others, that is how I will eat. And three – sell to my neighbors so that they eat well. Something tasty, nutritious, and good.*

The recording cuts out a bit but he starts talking about how he can trade with neighbors, meat, eggs, proteins, insects. How being able to live off the land is in many ways the concept of "Paradise."

Between the nopal plants, there exists a biodiverse world of herbs and vegetables—tomatoes, squash, beans, wild greens. And among them all, we spot the infamous maíz ajo—the only version of maize that is self-propagating. He gives me a tour of the plant's morphology:

> La estructura o morfología es milpa. La raíz está abajo, el tallo, lo que llamamos xilote…. Cuando ya calló, murió ya se llama elote. Este es el parte femenino, y este el órgano el masculino. Aquí hay el polen en lo femenino, y se da aquí la fecundación. Entonces el maíz es completo porque tiene toda la información. Y lo llamamos punta. Y cuando ya esta grande lo llamamos mazorca. Y la envoltura, como son hojas lo llamamos el totomoxtli. Y no se manifiesta la parte femenina si no está arriba. Y como no va a intervenir el hombre, la planta dice 'bueno tengo que solucionarlo yo' y entonces la información le manda para decir que aquí nazca la forma femenina, para poder fecundar.
>
> *The structure or morphology is milpa. The root is below, the stem, what we call xilote....When that has fallen, [the plant] has died and it is called elote. This is the female part, and this is the male organ. Here is the female pollen, and here is where it is fertilized. So, the maize is complete because it has all of the information. And we call it punta. And when it is grown, we call it mazorca. And the covering, those are the leaves that we call totomoxtli. And the female part doesn't show unless it is at the top. And since man won't intervene, the plant says, 'ok well I need to solve this myself' and then it sends information to say that the female part should be born so that it can become fertilized.*

Everything I know about corn is that it is completely reliant on humans to become fertilized. I ask him about this, and why this particular strain is different.

> Resulta que el hombre…bueno…los humanos…no voy a decir hombre o mujer. En su afán de control dice esto me gusta, esta me lo llevo, y los demás, muerto. Mátalos. Aunque esta de tal manera, tiene la información original. Entonces se va perfeccionando cada vez más, pero aun así la información está. Cuando vuelvan las condiciones anteriores, se manifiesta. Entonces por eso. Con el maíz ajo dijeron 'como lo voy a desgranar una vez y tener que volver a desgranar otra vez.'
>
> *It turns out that man…well….humans…I won't say man or woman. In their eagerness to control, they say I like this one, I'll take this one, and the rest, dead. Kill them. Even though it is a certain way, it still has the original information. So, it gets more perfect each time, but still has that information. When the previous conditions return, it returns. So that's why. With the maíz ajo they said, 'why would I shuck this and then have to go shuck it again.'*

He is referring to the nature of maíz ajo, where each individual kernel is also surrounded by a tough outer shell, in contrast to the better known versions of corn with only the exterior leaves.

Figure 0.4: Maíz ajo, with each kernel covered in a sheath similar to its namesake of garlic[36].

For Don Zeferino, this knowledge about each plant, about the way it grows, its relationship to the plants around it, the history of its evolution, is key to not only growing quality products, but to protecting the heritage of the state. He explains:

> Decían que Tlaxcala no tenía cocina…Tlaxcala para muchos es negado…la intención es de apoyar al producto, porqué [Irad] llegó a la conclusión que, sin ingredientes, no hay cocina. Por lo tanto, hay que cuidar la producción de las materias primas, de los ingredientes."
>
> *They said Tlaxcala didn't have regional cuisine…Tlaxcala is ignored by many…the goal is to support the product, because [Irad] came to the conclusion that without ingredients, there is no cuisine. Therefore, we have to care for the production of the raw material, the ingredients.*

Don Zeferino now owns and manages one of the largest agroecological nopaleras in Tlaxcala. His knowledge about plants, and traditional foodways came from a mixture of childhood teachings, and his own interests in learning more for the preservation of Tlaxcalteca heritage.

---

[36] Photo from https://www.elsoldetlaxcala.com.mx/local/maiz-ajo-eslabon-perdido-del-maiz-domesticado-3002176.html

Figure 0.5: Maize with epazote de zorillo and quelites; Felipe's home and harvest of squash, with his daughter observing closely; Felipe shows a harvest of garlic.

Arqueólogo Felipe Nava Ahuatzi

I met Felipe during the 2015 archaeological field season, where we would chat during lunch breaks taken in the shade of a nearby tree, catch up on the interesting bugs we had seen, while I asked about the blooming plants of the season. An archaeologist employed by INAH, Felipe is deeply familiar with the landscape, both archaeological and ecological, of Tlaxcala. His family is from Tlaxcala, with the Nahua last name Ahuatzi. Felipe tells me stories about how he grew up curious about the landscape, would spend time after school exploring the hillsides and deep arroyos. It is because of this knowledge that I asked him to help me collect the water samples for this project (see **Ch. 6: Defining Community**). One spring day, he directed me as I drove us to the little chapels dotting the hillside, whose wells of holy water share histories with Prehispanic pozos. For one sample, we pulled off to the shoulder of the busy highway running through Tlaxcala, parked and waded past old tires and highway trash to a well-worn path that led us down to a gully where a small creek runs. Though the highway bustle—semi trucks rumbling, drivers honking—was just steps away, from within the ravine we were suddenly covered by a canopy of trees, birds singing, water flowing. Droplets fell from bedrock walls, into cement channels that led into a rectangular basin. He tells me that this is agua santa, that despite the pollution, construction, nearness to the road, it remains known and used for rituals.

Through conversations with Felipe, released through our shared passion for food, pulque and plants, his stories shaped some of the many pathways that the ancient past reemerges in the present. His family doesn’t consider themselves historians or record keepers, yet his brother is also an archaeologists and his sister-in-law a bioarchaeologist, emphasizing the affirmation of this career trajectory. The Prehispanic knowledge and traditions he carries come from a mix of archaeology school (the Escuela Nacional de Antropología e Historia), experience at sites, curiosity about nature, and bits of teachings passed through family interactions.

My interview with Felipe took place at his home. On a piece of land inherited from his wife’s family, located on the outskirts of Tlaxcala city, they began by building an adobe brick home that is part-Prehispanic-building-part-hobbit-hole-dream. His wife is a therapist, and they share a dedication to living simply, with home-grown vegetables, rain barrels, and furniture designed and built by Felipe. Surrounding his home, an oversized yard is fenced in with stacked cement blocks. As we weave between clusters of plants, birdsong fills the air, punctuated by the yelp of neighbors’ dogs as they protect their designated rooftop. Every so often, the rumble of a semi braking on the highway cuts our conversation off.

In the hour and a half I spend with Felipe, I learn, see, taste, and touch: Ayocote beans “y también, la palabra es náhuatl, ayocotl”; sábila; citronella; colorín; strawberry, calendula “se puede usar para pomadas, infusiones, tés”; dandelion; so many types of nopal cactus, nopalachicle—used instead of a tortilla to make a quesadilla; hinojo to make a tea for digestion; amaranth.

His daughter toddles along in the background, absorbing information about the land, the plants, and her relationship to it. She points to a vine.

"*Ya vienen…estas*" ("Here come…. these ones").

"*Ya vienen esas, pero tienen que crecer, hija*" ("Those are coming, but they need to grow, daughter").

"Cuando ya vienen…Ya me como todas!" ("When they come…I'll eat them all!").

"*Quieres una zanahoria*? *Vamos por una zanahoria…y tenemos que invitar uno a Keit, ¿vale?"* ("Do you want a carrot? Let's go get a carrot…and we have to offer one to Keit, right?").

We continue walking along, taking a roundabout way towards the carrots.

"*Y aquí unos quelites bien frescos*" ("And here are some fresh quelites").

"Se come ese?" ("Do we eat those?").

"Si, se come…los quintoniles, aquí son silvestres" ("Yes, we eat them…the quintoniles, here they are wild").

He hands pieces of leaves to me, to his daughter, for both of us to try.

"Quiero…yo quiero zanahorita…" ("I want…I want a little carrot").

We walk by acelgas, betabeles, cempaxúchitl, lechuga, epazote de zorillo (also good for intense stomach aches).

"Yo quiero YA mi zanahoria…. Mira, un bicho" ("I want my carrot NOW…. Look, a bug*").*

"Son frailes, esos son frailes" ("They're stink bugs, those are stink bugs").

She leads him to the carrots and selects one, together they pull it out and brush off the dirt. His daughter grabs a handful of leaves growing next to it *"Vas a hacer tu ensalada?,"* I joke ("Are you going to make your salad?"). She stares at me straight on and in complete seriousness answers *"no, mi té"* ("no, my tea").

Mandarina; tlaloache para embrujar, pero "hasta la fecha no"; jitomate verde; tomate; lengua de vaca; rúgula; uva; cuetlaxochitl; quintonil; carrizo; mamey; guayaba.

Felipe gives me a recipe for guiso de quintoniles:

"No lleva más que epazote, ajo y cebolla y ya, y se reduce" ("It only needs epazote, garlic and onion, and that's it, and you reduce it").

We move onto the maize: *maíz amarillo, maíz blanco, ojo de gato* (red with stripes), *maíz negro, esmeralda*. He tells me about *maíz ajo*, the only known species of maize that can self-propagate, currently kept by those in the nearby town of Ixtenco, one of the central sites of the non-GMO movement.

I ask him about his method of planting, which is a mismatch of intentionality and watching what comes up in the wild gaps, from the compost pile, changing from one year to the next. I think about the biodiversity of ancient kitchen gardens discussed in academic papers. He explains:

> Cuando es terreno abierto, siempre ayuda mucho [tener variedad], siempre ayuda tener plantas silvestres, atrae más animales a polinizar, hasta el más mínimo animalito que anda por ahí contribuye algo, es parte del mismo organismo…aunque no lo vemos así...y al utilizar fertilizantes y pesticidas…matas todos esos bichitos
>
> *When it is open land, it is always helpful [to have variety], it is always helpful to have wild plants, they attract more animals to pollinate, and even the tiniest little animal that goes around there contributes something, is part of the same organism…even if we don't see it that way…and using fertilizers and pesticides…kills all those little bugs.*
>
> I ask him about how he learned all of these things.
>
> Con el tiempo…es la mejor manera…el tiempo y el interés de recuperar un poco de lo que ya nadie hace…. Tengo algunos amigos que todavía tienen sus huertos…tienen un montón de cosas…. Y ver lo que a mi hija le gusta…pues eso me da ánimos
>
> *With time…it is the best way…the time and an interest in recuperating a bit of what no one does anymore…. I have some friends who still have orchards…they have a ton of things…. And seeing what my daughter likes…well that motivates me*

Even though there are many things he has rediscovered and taught himself, because, in his words, "no one does them anymore," there are echoes of generational knowledge—things he doesn't know directly about, like herbs for "*aires*" or "*espanto.*" Even when he doesn't know how to use them, he still knows that they exist and what they are for.

We move inside to the kitchen, where his daughter is getting a snack from her aunt. The extended family all lives nearby, sharing the fruits from their own gardens among them. As they offer me a bit of mole, the conversation turns to urban legends of the past—*did* mole used to be made of human flesh?

> Seguramente sí había comidas rituales hechas con carne humana. Los tamales, por ejemplo. No en todas las fechas, pero los tamales eran una comida ritual. Hasta la fecha.

> Cuando hay fiesta de la virgencita, pues vamos a hacer tamales. Bueno, para fiestas, ¿no? Y la mole prieta también es comida ritual. También es para fiesta, de los pueblos, para fiestas grandes cuando viene a comer todo el pueblo. Antes no había cerdos, ¿no? Entonces lo que argumentan es que no sacaban tanta carne, ¿no? Si habían sacrificados. Y como eran comidas rituales, pues hasta en los códices no se si has visto imágenes… [de restos humanos] en una olla. Hay varias escenas en los códices. Y sí creo que pudo haber sido…datos concretos, pues quien sabe.
>
> *There were definitely ritual foods made with human flesh. Tamales, for example. Not every day, but tamales were a ritual food. Even today. When there is a festival for the Virgin [Mary], well we go and make tamales. Well, for festivals, right? And the mole prieta is also a ritual food. It is also for festivals, for the pueblos, for the big festivals when everyone comes to eat in the pueblo. Before there were no pigs, right? So, what they argue is that they didn't get so much meat, right? There were sacrifices. And because they were ritual foods, well even in the codices I don't know if you have seen images…[of human remains] in a pot. There are various scenes in the codices. And I think that there could have been…concrete evidence, well who knows.*

While beliefs about the edibility of human flesh have shifted, Felipe's comments about ritual foods stand out. The "moles" of Tlaxcala are well known—weekly events held by a rotating selection of churches. One day a week, a community meal of mole is made public, invitations passed through word of mouth. Mestizaje has reshaped the host as well—in the Late Postclassic, such events were likely hosted by council members that represented each neighborhood, or señorios. Now, each neighborhood is represented by a church. In many ways, elements of the past remain, repurposed, but analogous.

As they offer me a hot mug of atole, I take the opportunity to ask about the data from my dissertation—infants with heavily C_4 diets. I ask what they know about atole, whether it makes sense that mothers would be drinking it, or giving it to young children. Felipe replies with the logic of the ingredient:

> Lo más fácil de conservar es maíz, que lo tuesten, y lo muelen, o el pinole. Y es muy fácil ya de allá hacer un atole, ¿no? ... Es lo que antes hacía, y a lo mejor hasta nosotros…porque no tomamos leche. La leche es una moda, no?

> *The easiest thing to preserve is maize, you toast it, you grind it, or make pinole. And it is very easy from there to make an atole, right?... It's what people used to do, and probably even we do…because we don't drink milk. Milk is a recent trend, right?*

His sister jumps in with her own memories of childhood:

> Siempre el atole. Yo me acuerdo de que mi abuelita molía el nixtamal en el metate. Y ya de ahí nos hacían atole. Porque antes era así. También se usa para mujeres.
>
> *Always atole. I remember that my grandmother would grind the nixtamal[ized corn] on the metate. And from there we would make atole. Because it used to be that way. It is also used for women.*

Felipe, a recent father, expands on this:

> Es un estimulante de leche…Es que lo que llaman la bajada de la leche no ocurre inmediatamente sino a los dos, tres días. Y eso hace que se acelera por procesos de fermentación y cosas así. Es una maquina increíble el ser humano, el cerebro manda la información para que baje la leche. E inmediatamente que toman algo, se convierte en leche casi inmediatamente, luego, luego.
>
> *It stimulates milk….What they call the milk coming in doesn't happen right away, but on the second or third day. And that makes it speed up because of the processes of fermentation and things like that. The human body is an incredible machine, the brain sends information so that the milk comes in. And immediately after they drink something, it gets turned into milk almost immediately, bit by bit.*

Atole, still a huge part of day to day life, is both tradition and intentional act of wellbeing, or perhaps it's impossible to separate the two. We end the visit with Felipe giving me herbs to take home to my mother, seeds for planting, a few extra for isotope samples (see Ch. 5: The Tepeticpac Foodweb). We make plans to spend my next visit scaling the Malinche volcano and exploring the mushrooms that grow at its skirts.

Conclusion

Through these interviews, I am able to reimagine the nested nature of the Bioecological System as it exists in everyday life. How foods can normalize macrosystemic structures, and beliefs about the world. In the past, this may have taken the shape of a Mesoamerican pantheon of gods, origin myths stemming from maize. Today, global belief systems revolve around capitalism. Yet in both, food serves as a way to assert local control. For all of the interviewees, growing their own food became a way to challenge capitalism, to create a new structure of relationships with land, with community and with themselves. Though exosystemic economic networks drive policies like NAFTA, push human migration away from homelands and towards the "developed" north, the stories of these three individuals demonstrate how individual foodways (microsystem), nested within communities of support (mesosystem) can challenge and resist external pressures. The growth of the Slow Food movement, and Restorative Tourism in Tlaxcala emphasize the community interest in maintaining food sovereignty as a site of cultural pride and political autonomy.

The point isn't that Tlaxcaltecans haven't changed, or that they remain trapped in an amorphous indigenous caricature. The point is that throughout change, be it the expansion of imperial armies into the Puebla Tlaxcala Valley, the world-shifting changes of Spanish colonialism, indigenous dispossession, revolution, foodways have been a trojan horse, carrying messages of community self-sufficiency, and clues for food sovereignty. In Postclassic Cholula, where these networks of knowledge were further split through migration, urbanization, and social hierarchies, we see diets less uniform, and although not discussed in this dissertation, the prevalence of markers of nutritional stress and disease reported by Kreger (2010) demonstrate the impacts of this difference in population resilience.

Returning to the questions proposed in the introduction: *How do I envision paleodiet studies supporting the work of sustainable food markets, and ecotourism*? Through these interviews, it is clear that ingredients—the values represented by dietary isotopes—mean much more than sources of nutrients. Ingredients and foodways are a site of knowledge production. Isotopes become a record of the way the world was ordered, as well as the way individuals challenged this order. In the present, being able to highlight that ancestral resistance gives depth and value to contemporary battles for food sovereignty, serving as a reminder not only that battles for autonomy are perennial, but that so too, are the quieter more subtle daily acts of defiance. In turn, to answer the question: *How do markets and food production spaces help deepen bioarchaeological analyses of the relationships between human bodies, society, and the natural world?* I think particularly of Felipe's interview—the Bioecological model embodied by his daughter, learning from her father and aunt as she toddles across the Tlaxcalteca landscape, belly filled with an atole that is in many ways different, in others the same as that which fed the children of Tepeticpac. The dance of constant cultural change, within a family whose members fluctuate between a pull towards the ancient past (its archaeology, its agricultural methods, its words), and their position within a structurally different the present. While the narrative of ancient Tlaxcallan was in many ways written out of Mexican history, it is far from lost.

REFERENCES CITED

Acevedo, R., Wright, L. E., Hermes, B., & Schwarcz, H. P. (1996). La Dieta Maya Despues Del Colapso: Estudio Isotópico Del Sitio Topoxte. In J. P. Laporte & H. Escobedo (Eds.), *X Simposio de Investigaciones Arqueológicas En Guatemala* (pp. 640–652). Museo Nacional de Arqueología e Etnología.

Acsadi, G., & Nemeskeri, J. (1970). *History of Human Life Span and Mortality*. Akademiai Kiado.

Agarwal, S. C., & Glencross, B. A. (Eds.). (2011). *Social Bioarchaeology: Agarwal/Social Bioarchaeology*. Wiley-Blackwell.

Alcock, S. E., D’Altroy, T. N., Morrison, K. D., & Sinopoli, C. M. (Eds.). (2001). *Empires: Perspectives from Archaeology and History*. Cambridge University Press.

Alfaro Castro, M. E., Waters-Rist, A. L., & Zborover, D. (2017). An osteobiography of a Oaxacan late adolescent female. *Journal of Archaeological Science: Reports*, *13*, 759–772.

Altieri, M. A., & Trujillo, J. (1987). The agroecology of corn production in Tlaxcala, Mexico. *Human Ecology*, *15*(2), 189–220.

Ambrose, S. H. (1990). Preparation and characterization of bone and tooth collagen for isotopic analysis. *Journal of Archaeological Science*, *17*(4), 431–451.

Ambrose, S. H. (1991). Effects of diet, climate and physiology on nitrogen isotope abundances in terrestrial foodwebs. *Journal of Archaeological Science*, *18*(3), 293–317.

Ambrose, S. H. (2002). Controlled Diet and Climate Experiments on Nitrogen Isotope Ratios of Rats. In S. H. Ambrose & M. A. Katzenberg (Eds.), *Biogeochemical Approaches to Paleodietary Analysis* (Vol. 5, pp. 243–259). Kluwer Academic Publishers.

Ambrose, S. H., Buikstra, J., & Krueger, H. W. (2003). Status and gender differences in diet at Mound 72, Cahokia, revealed by isotopic analysis of bone. *Journal of Anthropological Archaeology*, *22*(3), 217–226.

Ambrose, S. H., Butler, B. M., Hanson, D. B., Hunter-Anderson, R. L., & Krueger, H. W. (1997). Stable isotopic analysis of human diet in the Marianas Archipelago, Western Pacific. *American Journal of Physical Anthropology*, *104*(3), 343–361.

Ambrose, S. H., & DeNiro, M. J. (1986). The isotopic ecology of East African mammals. *Oecologia*, *69*(3), 395–406.

Ambrose, S. H., & Norr, L. (1993). Experimental Evidence for the Relationship of the Carbon Isotope Ratios of Whole Diet and Dietary Protein to Those of Bone Collagen and Carbonate. In J. B. Lambert & G. Grupe (Eds.), *Prehistoric Human Bone* (pp. 1–37). Springer Berlin Heidelberg.

Anderson, B. (2006). *Imagined communities: Reflections on the origin and spread of nationalism* (Rev. ed). Verso.

Appadurai, A. (1988). *The Social Life of Things: Commodities in Cultural Perspective*. Cambridge University Press.

Ashmore, W., & Geller, P. L. (2005). Social dimensions of mortuary space. In G. F. M. Rakita, L. A. Beck, S. R. Williams, & J. E. Buikstra (Eds.), *Interacting with the Dead: Perspectives on Mortuary Archaeology for the New Millennium* (pp. 81–92). University Press of Florida.

Augustine, D. J., & Frank, D. A. (2001). Effects of Migratory Grazers on Spatial Heterogeneity of the Soil Nitrogen Properties in a Grassland Ecosystem. *Ecology*, *82*(11), 3149–3162.

Baracs, A. M. (2014). *Un gobierno de indios: Tlaxcala 1519 - 1750* (2da Ed.). Fondo de Cultura Económica.

Barros, C., & Buenrostro, M. (1997). El maiz, nuestro sustento. *Arqueología Mexicana*, *5*(25), 6–15.

Beasley, M. M., Bartelink, E. J., Taylor, L., & Miller, R. M. (2014). Comparison of transmission FTIR, ATR, and DRIFT spectra: Implications for assessment of bone bioapatite diagenesis. *Journal of Archaeological Science*, *46*, 16–22.

Benton, G., & Gomez, E. T. (2014). Belonging to the nation: Generational change, identity and the Chinese diaspora. *Ethnic and Racial Studies*, *37*(7), 1157–1171.

Berdan, F. (1996). *Aztec Imperial Strategies* (F. F. Berdan, R. E. Blanton, E. H. Boone, M. G. Hodge, M. E. Smith, & E. Umberger, Eds.; First Edition edition). Dumbarton Oaks Research Library and Collection.

Berdan, F. F. (1993). Trade and Tribute in the Aztec Empire. In A. Cordy-Collins & D. Sharon (Eds.), *Current Topics in Aztec Studies: Essays in Honor of Dr. H. B. Nicholson* (pp. 71–84). San Diego Museum.

Berdan, F. F., & Anawalt, P. R. (1997). *The Essential Codex Mendoza* (Vol. 2). University of California Press.

Berry, J. W., Phinney, J. S., Sam, D. L., & Vedder, P. (2006). Immigrant Youth: Acculturation, Identity, and Adaptation. *Applied Psychology*, *55*(3), 303–332.

Bessani, R., Rooney, L. W., Quintero, X., & Serna Saldivar, S. O. (1997). *Fortification of Corn Masa Flour with Iron and/or Other Nutrients: A Literature and Industry Experience Review*.

Binford, L. R. (1971). Mortuary Practices: Their Study and Their Potential. *Memoirs of the Society for American Archaeology*, *25*, 6–29.

Black, C. C., & Osmond, C. B. (2003). Crassulacean Acid Metabolism Photosynthesis: `working the Night Shift’. *Photosynthesis Research*, *76*(1/3), 329–341.

Blanton, R. E. (1996). The Basin of Mexico Market System and the Growth of Empire. In F. F. Berdan, R. E. Blanton, E. H. Boone, M. G. Hodge, M. E. Smith, & E. Umberger (Eds.), *Aztec*

Imperial Strategies (First Edition edition, pp. 47–84). Dumbarton Oaks Research Library and Collection.

Bloch, M. (1971). *Placing the dead: Tombs, ancestral villages and kinship organization in Madagascar* (First Edition edition). Seminar Press Ltd.

Bocherens, H., & Drucker, D. (2003). Trophic level isotopic enrichment of carbon and nitrogen in bone collagen: Case studies from recent and ancient terrestrial ecosystems. *International Journal of Osteoarchaeology*, *13*(1–2), 46–53.

Bocherens, Hervé, Polet, C., & Toussaint, M. (2007). Palaeodiet of Mesolithic and Neolithic populations of Meuse Basin (Belgium): Evidence from stable isotopes. *Journal of Archaeological Science*, *34*(1), 10–27.

Bogaard, A., Heaton, T. H. E., Poulton, P., & Merbach, I. (2007). The impact of manuring on nitrogen isotope ratios in cereals: Archaeological implications for reconstruction of diet and crop management practices. *Journal of Archaeological Science*, *34*(3), 335–343.

Bogaard, Amy, & Outram, A. K. (2013). Palaeodiet and beyond: Stable isotopes in bioarchaeology. *World Archaeology*, *45*(3), 333–337.

Bolger, N., Caspi, A., Downey, G., & Moorehouse, M. (Eds.). (1988). Interacting systems in human development. Research paradigms: Present and future. In *Persons in Context: Developmental Processes* (pp. 25–49). Cambridge University Press.

Borejsza, A. (2013). Village and field abandonment in post-Conquest Tlaxcala: A geoarchaeological perspective. *Anthropocene*, *3*, 9–23.

Bourdieu, P. (1977). *Outline of a Theory of Practice* (R. Nice, Trans.). Cambridge University Press.

Bressani, R. (1990). Chemistry, technology, and nutritive value of maize tortillas. *Food Reviews International*, *6*(2), 225–264.

Bronfenbrenner, U. (1979). *The Ecology of Human Development*. Harvard University Press.

Bronfenbrenner, U., & Evans, G. W. (2000). Developmental Science in the 21st Century: Emerging Questions, Theoretical Models, Research Designs and Empirical Findings. *Social Development*, *9*(1), 115–125.

Brumfiel, E. M. (1992). Distinguished Lecture in Archeology: Breaking and Entering the Ecosystem - Gender, Class, and Faction Steal the Show. *American Anthropologist*, *94*(3), 551–567.

Brumfiel, E. M. (1996). Figurines and the Aztec State: Testing the Effectiveness of Ideological Domination. In R. P. Wright (Ed.), *Gender and Archaeology* (First edition. Full number line. edition, pp. 143–166). University of Pennsylvania Press.

Brumfiel, E. M. (2008). The Multiple Identities of Aztec Craft Specialists. *Archeological Papers of the American Anthropological Association*, *8*(1), 145–152.

Brumfiel, E. M. (2009). El estudio de la clase común: El asentamiento de Xaltocan durante el Posclásico en la cuenca de México. *Cuicuilco*, *16*(47), 59–86.

Brumfiel, E. M., & Robin, C. (2008). Gender, Households, and Society: An Introduction. *Archeological Papers of the American Anthropological Association*, *18*(1), 1–16.

Brumfiel, E. M., Salcedo, T., Schafer, D. K., & Smith, M. E. (1994). The Lip Plugs of Xaltocan Function and Meaning in Aztec Archaeology. In M. G. Hodge & M. E. Smith (Eds.), *Economies and Polities in the Aztec Realm* (pp. 113–131). Institute for Mesoamerican Studies.

Buenaventura Zapata y Mendoza, J. (1995). *Historia cronológica de la noble ciudad de Tlaxcala* (L. Reyes García & A. Martínez Baracs, Trans.; 1. ed edition). Universidad Autonoma de Tlaxcala, Centro de Investigaciones y Estudios Superiores en Antropología Social.

Buikstra, J.E. & Ubelaker, D. H. (1994). *Standards for Data Collection from Human Skeletal Remains: Proceedings of a Seminar at the Field Museum of Natural History*. Arkansas Archeological Survey.

Bullock Kreger, M. M. (2010). *Urban Population Dynamics in a Preindustrial New World City: Morbidity, Mortality, and Immigration in Postclassic Cholula* [Ph.D. in Anthropology]. Pennsylvania State University.

Carballo, D. M., & Pluckhahn, T. (2007). Transportation corridors and political evolution in highland Mesoamerica: Settlement analyses incorporating GIS for northern Tlaxcala, Mexico. *Journal of Anthropological Archaeology*, *26*(4), 607–629.

Cardoza y Aragón, L. (2006). Corazón de maíz. *Artes de México* (79), 10-15.

Casar, I., Morales, P., Manzanilla, L. R., Cienfuegos, E., & Otero, F. (2017). Dietary differences in individuals buried in a multiethnic neighborhood in Teotihuacan: Stable dental isotopes from Teopancazco. *Archaeological and Anthropological Sciences*, *9*(1), 99–115.

Castelló Yturbide, T. (1986). *Presencia de la comida prehispánica*. Fomento Cultural Banamex.

Cevallos-Ferriz, S. R. S., González-Torres, E. A., & Calvillo-Canadell, L. (2012). Perspectiva paleobotánica y geológica de la biodiversidad en México. *Acta Botanica Mexicana*, *100*, 317.

Chavero, A. (1979). *El Lienzo de Tlaxcala*. Editorial Cosmos.

Chinique de Armas, Y., Buhay, W. M., Rodríguez Suárez, R., Bestel, S., Smith, D., Mowat, S. D., & Roksandic, M. (2015). Starch analysis and isotopic evidence of consumption of cultigens among fisher–gatherers in Cuba: The archaeological site of Canímar Abajo, Matanzas. *Journal of Archaeological Science*, *58*, 121–132.

Chisholm, B. S., Nelson, D. E., Hobson, K. A., Schwarcz, H. P., & Knyf, M. (1983). Carbon isotope measurement techniques for bone collagen: Notes for the archaeologist. *Journal of Archaeological Science*, *10*(4), 355–360.

Chisholm, B. S., Nelson, D. E., & Schwarcz, H. P. (1982). Stable-Carbon Isotope Ratios as a Measure of Marine Versus Terrestrial Protein in Ancient Diets. *Science*, *216*(4550), 1131–1132.

Cohen, A. P. (1985). *The symbolic construction of community*. Routledge.

Cohen, M. N., & Armelagos, G. J. (Eds.). (2013). *Paleopathology at the Origins of Agriculture* (2nd Revised ed. edition). University Press of Florida.

Contreras López, E., Jaimez Ordaz, J., Porras Martínez, G., Juárez Santillán, L. F., Añorve Morga, J., & Villanueva Rodríguez, S. (2010). Propiedades Fisicoquímicas y Sensoriales de Harinas Para Preparar Atole de Amaranto. *Archivos Latinoamericanos de Nutrición*, *60*(2), 184.

Cook, S. F., & Borah, W. (1979). Indian food production and consumption in Central Mexico before and after the conquest (1500–1650). In *Essays in Population History: Mexico and California* (pp. 129–176). University of California Press.

Coplen, T. B., Kendall, C., & Hopple, J. (1983). Comparison of stable isotope reference samples. *Nature*, *302*(5905), 236–238.

Correa-Ascencio, M., Robertson, I. G., Cabrera-Cortés, O., Cabrera-Castro, R., & Evershed, R. P. (2014). Pulque production from fermented agave sap as a dietary supplement in Prehispanic Mesoamerica. *Proceedings of the National Academy of Sciences*, *111*(39), 14223–14228.

Cortés, H. (2014). *Five Letters 1519-1526*. Routledge.

Counihan, C. (1999). *The Anthropology of Food and Body: Gender, Meaning, and Power*. Routledge.

Counihan, C., & Van Esterik, P. (Eds.). (2012). *Food and Culture: A Reader* (3rd ed.). Routledge.

Coyston, S., White, C. D., & Schwarcz, H. P. (1999). Dietary Carbonate Analysis of Bone and Enamel for Two Sites in Belize. In C. D. White (Ed.), *Reconstructing Ancient Maya Diet* (pp. 199–220). University of Utah Press.

Crews, T. E., & Gliessman, S. R. (1991). Raised field agriculture in Tlaxcala, Mexico: An ecosystem perspective on maintenance of soil fertility. *American Journal of Alternative Agriculture*, *6*(1), 9–16.

Cucina, A. (2011). Maya Sub Adult Mortality and Individual Physiological Frailty: An Analysis of Infant Stress by Means of Linear Enamel Hypoplasia. *Childhood in the Past*, *4*(1), 105–116.

Cucina, A., & Tiesler, V. (2003). Dental caries and antemortem tooth loss in the Northern Peten area, Mexico: A biocultural perspective on social status differences among the Classic Maya. *American Journal of Physical Anthropology*, *122*(1), 1–10.

Cummings, L. S., & Magennis, A. (1997). A Phytolith and Starch Record of Food and Grti in Mayan Human Tooth Tartar. In M. J. Machado (Ed.), *The State-of-the-Art of Phytoliths in Soils and Plants* (PaleoResearch Institute; pp. 211–218). Monografias del Centro de Ciencias Medioambientales.

Davies, N. (1968). *Los Señorios Independientes del Imperio Azteca*. Instituto Nacional de Antropologia e Historia.

de la Cova, C. (2012). Patterns of trauma and violence in 19th-century-born African American and Euro-American females. *International Journal of Paleopathology*, *2*(2–3), 61–68.

De Lucia, K. (2013). Domestic economies and regional transition: Household multicrafting and lake exploitation in pre-Aztec Central Mexico. *Journal of Anthropological Archaeology*, *32*(4), 353–367.

De Lucia, K., & Overholtzer, L. (2014). Everyday Action and the Rise and Decline of Ancient Polities: Household Strategy and Political Change in Postclassic Xalcotan, Mexico. *Ancient Mesoamerica*, *25*(2), 441–458.

de Onis, M. (2017). Child Growth and Development. In S. de Pee, D. Taren, & M. W. Bloem (Eds.), *Nutrition and Health in a Developing World* (3rd ed. 2017., pp. 119–141). Springer International Publishing.

DeNiro, M. J. (1985). Postmortem preservation and alteration of in vivo bone collagen isotope ratios in relation to palaeodietary reconstruction. *Nature*, *317*(6040), 806–809.

DeNiro, M. J., & Epstein, S. (1978). Influence of diet on the distribution of carbon isotopes in animals. *Geochimica et Cosmochimica Acta*, *42*(5), 495–506.

DeNiro, M. J., & Epstein, S. (1981). Influence of diet on the distribution of nitrogen isotopes in animals. *Geochimica et Cosmochimica Acta*, *45*(3), 341–351.

DeNiro, M. J., & Weiner, S. (1988). Chemical, enzymatic and spectroscopic characterization of “collagen” and other organic fractions from prehistoric bones. *Geochimica et Cosmochimica Acta*, *52*(9), 2197–2206.

Díaz del Castillo, B. (1916). *True History of the Conquest of New Spain* (G. García, Ed.; A. P. Maudslay, Trans.). Hakluyt Society.

Dietler, M. (2001). Theorizing the Feast: Rituals of Consumption, Commensal Politics, and Power in African Contexts. In M. Dietler & B. Hayden (Eds.), *Feasts: Archaeological and ethnographic perspectives on food, politics, and power*. Smithsonian Institution Press.

Dietler, M., & Hayden, B. (2001). Digesting the Feast: Good to Eat, Good to Drink, Good to Think. In M. Dietler & B. Hayden (Eds.), *Feasts: Archaeological and ethnographic perspectives on food, politics, and power*. Smithsonian Institution Press.

Dobberstein, R. C., Collins, M. J., Craig, O. E., Taylor, G., Penkman, K. E. H., & Ritz-Timme, S. (2009). Archaeological collagen: Why worry about collagen diagenesis? *Archaeological and Anthropological Sciences*, *1*(1), 31–42.

Douglas, M. (1966). *Purity and Danger: An Analysis of the Concepts of Pollution and Taboo*. Routledge.

Douglas, M. (1979). *The world of goods*. Basic Books.

Douglas, M. (2012). Deciphering a Meal. In C. Counihan & P. Van Esterik (Eds.), *Food and Culture: A Reader* (3rd ed., pp. 36–54). Routledge.

Durán, D. (1964). *The Aztecs; the history of the Indies of New Spain.* (D. Heyden & F. Horcasitas, Trans.). Orion Press.

Emery, K. F., Wright, L. E., & Schwarcz, H. (2000). Isotopic Analysis of Ancient Deer Bone: Biotic Stability in Collapse Period Maya Land-use. *Journal of Archaeological Science*, *27*(6), 537–550.

Evans, Susan T. (1990). The Productivity of Maguey Terrace Agriculture in Central Mexico during the Aztec Period. *Latin American Antiquity*, *1*(2), 117–132.

Evans, Susan Toby. (2004). *Ancient Mexico and Central America: Archaeology and culture history*. Thames & Hudson.

Fargher, L. F., Blanton, R. E., & Espinoza, V. H. (2016). *The Independent Republic of Tlaxcallan* (D. L. Nichols & E. Rodríguez-Alegría, Eds.; Vol. 1). Oxford University Press.

Fargher, L. F., Blanton, R. E., & Espinoza, V. Y. H. (2010). Egalitarian Ideology and Political Power in Prehispanic Central Mexico: The Case of Tlaxcallan. *Latin American Antiquity*, *21*(3), 227–251.

Farmer, P. (2004). An Anthropology of Structural Violence. *Current Anthropology*, *45*(3), 305–325.

Farnsworth, N. R., Akerele, O., Bingel, A. S., Soejarto, D. D., & Guo, Z. (1985). Medicinal plants in therapy. *Bulletin of the World Health Organization*, *63*(6), 965–981.

Feinman, G. M., & Garraty, C. P. (2010). Preindustrial Markets and Marketing: Archaeological Perspectives. *Annual Review of Anthropology*, *39*(1), 167–191.

Ferguson, L. (1996). Struggling with Pots in Colonial South Carolina. In C. E. Orser (Ed.), *Images of the recent past: Readings in historical archaeology* (pp. 260–271). Alta Mira Press.

Fischler, C. (1988). Food, self and identity. *Social Science Information*, *27*(2), 275–292.

Flannery, K. V. (1986). *Guilá Naquitz: Archaic foraging and early agriculture in Oaxaca, Mexico*. Academic Press.

Flores Hernández, D. I., & Martínez Jerónimo, F. (2016). Detailed chemical composition of tequesquite, a pre-Hispanic and traditional mineral resource used in Mexico for culinary purposes. *Acta Universitaria*, *26*(5), 31–39.

Flores-Márquez, E. L., Jiménez-Suárez, G., Martínez-Serrano, R. G., Chávez, R. E., & Pérez, D. S. (2006). Study of geothermal water intrusion due to groundwater exploitation in the Puebla Valley aquifer system, Mexico. *Hydrogeology Journal*, *14*(7), 1216–1230.

Fogel, M. L., Tuross, N., & Owsley, D. W. (n.d.). Nitrogen Isotope Tracers of Human Lactation in Modern and Archaeological Populations. *Carnegie Institution of Washington Yearbook*, *88*, 111–117.

Forshaw, R. (2014). Dental indicators of ancient dietary patterns: Dental analysis in archaeology. *British Dental Journal*, *216*(9), 529–535.

Frank, D. A., Groffman, P. M., Evans, R. D., & Tracy, B. F. (2000). Ungulate stimulation of nitrogen cycling and retention in Yellowstone Park grasslands. *Oecologia*, *123*(1), 116–121.

Froehle, A. W., Kellner, C. M., & Schoeninger, M. J. (2010). FOCUS: Effect of diet and protein source on carbon stable isotope ratios in collagen: follow up to. *Journal of Archaeological Science*, *37*(10), 2662–2670.

Froehle, A. W., Kellner, C. M., & Schoeninger, M. J. (2012). Multivariate carbon and nitrogen stable isotope model for the reconstruction of prehistoric human diet. *American Journal of Physical Anthropology*, *147*(3), 352–369.

Gagnon, C. M., Andrus, C. F. T., Ida, J., & Richardson, N. (2015). Local water source variation and experimental Chicha de Maíz brewing: Implications for interpreting human hydroxyapatite δ18O values in the Andes. *Journal of Archaeological Science: Reports*, *4*, 174–181.

Galtung, J. (1969). Violence, Peace, and Peace Research. *Journal of Peace Research*, *6*(3), 167–191.

García Cook, A. (1981). The historical importance of Tlaxcala in the cultural development of the Central Highlands. In V. R. Bricker (Ed.), *Supplement to the Handbook of Middle American Indians* (Vol. 1, pp. 244–276). University of Texas Press.

García Cook, A. (2014a). Importancia de la región poblano-tlaxcalteca en el surgimiento de las grandes ciudades del Altiplano central de México. *Arqueología*, *49*, 91–104.

García Cook, A. (2014b). *Tlaxcala a la llegada de los españoles según las evidencias arqueológicas. Instituto Nacional de Antropología e Historia*. CONACULTA-INAH.

García Vega, A., & Noguera, E. (1927). *Ruinas de Tizatlán, Tlaxcala: Antecedentes históricos de Tlaxcala*. Talleres Gráficos de la Nación.

Geller, P. L. (2009). Altering Identities: Body Modifications and the Pre-Columbian Maya. In C. Knüsel & R. Gowland (Eds.), *The social archaeology of funerary remains* (pp. 279–289). Oxford.

Gibson, C. (1967). *Tlaxcala in the 16th Century*. Stanford University Press.

Giddens, A. (1984). *The Constitution of Society*. The University of California Press.

Goldstein, L. (2002). Visible Death: Mortuary Site and Mortuary Landscape in Diachronic Perspective. In H. Silverman & D. B. Small (Eds.), *The Space and Place of Death* (pp. 201–205). Wiley-Blackwell.

Goodman, A., & Leatherman, T. (Eds.). (1998). *Building a New Biocultural Synthesis: Political-Economic Perspectives on Human Biology*. University of Michigan Press.

Gullapalli, P. (2008). Heterogeneous encounters: Colonial histories and archaeological experiences. In M. Liebmann & U. Z. Rizvi (Eds.), *Archaeology and the postcolonial critique* (pp. 52–76). Altamira Press.

Gumerman, G. (1997). Food and complex societies. *Journal of Archaeological Method and Theory*, *4*(2), 105–139.

Halberstein, R. A., Crawford, M. H., & Nutini, H. G. (1973). Historical-demographic analysis of Indian populations in Tlaxcala, Mexico. *Social Biology*, *20*(1), 40–50.

Hallote, R. S., & Joffe, A. H. (2002). The Politics of Israeli Archaeology: Between ?Nationalism? and ?Science? in the Age of the Second Republic. *Israel Studies*, *7*(3), 84–116.

Hassig, R. (1945). *Aztec Warfare: Imperial Expansion and Political Control*. The University of Oklahoma Press.

Hastorf, C. A. (2017). *The Social Archaeology of Food: Thinking about Eating from Prehistory to the Present*. Cambridge University Press.

Hastorf, C. A., & Johannessen, S. (1993). Pre-Hispanic Political Change and the Role of Maize in the Central Andes of Peru. *American Anthropologist*, *95*(1), 115–138.

Healan, D. M. (2012). The Archaeology of Tula, Hidalgo, Mexico. *Journal of Archaeological Research*, *20*(1), 53–115.

Hedges, R. E. M., & Reynard, L. M. (2007). Nitrogen isotopes and the trophic level of humans in archaeology. *Journal of Archaeological Science*, *34*(8), 1240–1251.

Henry, A. G., & Piperno, D. R. (2008). Using plant microfossils from dental calculus to recover human diet: A case study from Tell al-Raqā'i, Syria. *Journal of Archaeological Science*, *35*(7), 1943–1950.

Hernández, F., & Ochoterena, I. (1942). *Historia de las plantas de Nueva España*. Imprenta Universitaria,.

Hernández Espinoza, P.O., & Lagunas Rodríguez, Z. (2015). *Manual de Osteología.* ENAH-INAH.

Hillson, S. (1996). *Dental Anthropology* (1st ed.). Cambridge University Press.

Hirth, K. G. (1996). Political economy and archaeology: Perspectives on exchange and production. *Journal of Archaeological Research*, *4*(3), 203–239.

Hirth, K. G. (2016). *The Aztec Economic World: Merchants and Markets in Ancient Mesoamerica*. Cambridge University Press.

Hirth, K. G., & Pillsbury, J. (Eds.). (2013). *Merchants, Markets and Exchange in the Pre-Columbian World*. Dumbarton Oaks Research Library and Collection.

Hobson, K. A., & Collier, S. (1984). Marine and Terrestrial Protein in Australian Aboriginal Diets. *Current Anthropology*, *25*(2), 238–240.

Hodge, M. G., & Smith, M. E. (1994). Economies and Polities in Aztec-Period Morelos. Ethnohistoric Overview. In M. G. Hodge & M. E. Smith (Eds.), *Economies and Polities in the Aztec Realm (Studies on Culture and Society)* (pp. 313–48). Institute for Mesoamerican Studies.

Hoefs, M., Schouten, S., De Leeuw, J. W., King, L. L., Wakeham, S. G., & Damste, J. (1997). Ether lipids of planktonic archaea in the marine water column. *Applied and Environmental Microbiology*, *63*(8), 3090–3095.

Hutchinson, D. L., & Aragon, L. V. (2002). Collective Burials and Community Memories: Interpreting the Placement of the Dead in the Southeastern and Mid-Atlantic United States with Reference to Ethnographic Cases from Indonesia. In H. Silverman & D. B. Small (Eds.), *The Space and Place of Death*. Wiley-Blackwell.

Iacumin, P., Bocherens, H., Mariotti, A., & Longinelli, A. (1996). Oxygen isotope analyses of co-existing carbonate and phosphate in biogenic apatite: A way to monitor diagenetic alteration of bone phosphate? *Earth and Planetary Science Letters*, *142*(1–2), 1–6.

Ibarra, T., & López Corral, A. (2018). Thread production in Late Postclassic Tepeticpac, Tlaxcala: A technological and experimental study of archaeological spindle whorls. *81st Annual Meeting of the Society for American Archaeology*.

Isaac, B. L. (1983). The Aztec “Flowery War”: A Geopolitical Explanation. *Journal of Anthropological Research*, *39*(4), 415–432.

Isbell, W. H. (2000). What Should We Be Studying: The ‘Imagined Community’ and the ‘Natural Community.’ In M. A. Canuto & J. Yaeger (Eds.), *The Archaeology of Communities: A New World Perspective* (pp. 243–66). Routledge.

Joyce, R. A. (2007). Embodied Subjectivity: Gender, Femininity, Masculinity, Sexuality. In L. Meskell & R. W. Preucel (Eds.), *A Companion to Social Archaeology* (pp. 82–95). Blackwell Publishing Ltd.

Joyce, R. A., & Henderson, J. S. (2007). From Feasting to Cuisine: Implications of Archaeological Research in an Early Honduran Village. *American Anthropologist*, *109*(4), 642–653.

Katzenberg, M. Anne, & Harrison, R. G. (1997). What's in a bone? Recent advances in archaeological bone chemistry. *Journal of Archaeological Research*, *5*(3), 265–293.

Katzenberg, M. Anne, & Saunders, S. R. (Eds.). (2008). *Biological Anthropology of the Human Skeleton*. John Wiley & Sons, Inc.

Katzenberg, Mary Anne. (1989). Stable isotope analysis of archaeological faunal remains from Southern Ontario. *Journal of Archaeological Science*, *16*(3), 319–329.

Katzenberg, Mary Anne. (2000). Stable Isotope Analysis: A Tool for Studying Past Diet, Demography, and Life History. In Mary Anne Katzenberg & S. R. Saunders (Eds.), *Biological Anthropology of the Human Skeleton* (pp. 305–27). Wiley-Liss.

Keenleyside, A., & Panayotova, K. (2006). Cribra orbitalia and porotic hyperostosis in a Greek colonial population (5th to 3rd centuries BC) from the Black Sea. *International Journal of Osteoarchaeology*, *16*(5), 373–384.

Kellner, C. M., & Schoeninger, M. J. (2007). A simple carbon isotope model for reconstructing prehistoric human diet. *American Journal of Physical Anthropology*, *133*(4), 1112–1127.

Kellner, C. M., & Schoeninger, M. J. (2008). Wari's imperial influence on local Nasca diet: The stable isotope evidence. *Journal of Anthropological Archaeology*, *27*(2), 226–243.

Kennedy, B. V. E. (1988). *Variation in 13C values of post-medieval Europeans* [PhD dissertation]. University of Calgary.

Kennedy, B. V., & Krouse, H. R. (1990). Isotope fractionation by plants and animals: Implications for nutrition research. *Canadian Journal of Physiology and Pharmacology*, *68*(7), 960–972.

Kim, S., Cho, Y. S., Kim, H.-M., Chung, O., Kim, H., Jho, S., Seomun, H., Kim, J., Bang, W. Y., Kim, C., An, J., Bae, C. H., Bhak, Y., Jeon, S., Yoon, H., Kim, Y., Jun, J., Lee, H., Cho, S., …

Yeo, J.-H. (2016). Comparison of carnivore, omnivore, and herbivore mammalian genomes with a new leopard assembly. *Genome Biology*, *17*(1), 211.

King, S. M., & Higelin Ponce de León, R. (2017). Postclassic and Early Colonial mortuary practices in the Nejapa region of Oaxaca, Southern Mexico. *Journal of Archaeological Science: Reports*, *13*, 773–782.

Knudson, K. J. (2009). Oxygen isotope analysis in a land of environmental extremes: The complexities of isotopic work in the Andes. *International Journal of Osteoarchaeology*, *19*(2), 171–191.

Koch, P.L., Zachos, J.C., & Dettman, D.L. (1995). Stable isotope stratigraphy and paleoclimatology of the Paleogene Bighorn Basin (Wyoming, USA). *Paleogeography, Paleoclimatology, Palaeoecology* 115, no. 1-4 (1995):61-89.

Koch, P. L., Tuross, N., & Fogel, M. L. (1997). The Effects of Sample Treatment and Diagenesis on the Isotopic Integrity of Carbonate in Biogenic Hydroxylapatite. *Journal of Archaeological Science*, *24*(5), 417–429.

Kohn, M. J. (1999). You Are What You Eat. *Science*, *283*(5400), 335–336.

Kohn, M. J. (2010). Carbon isotope compositions of terrestrial C3 plants as indicators of (paleo)ecology and (paleo)climate. *Proceedings of the National Academy of Sciences*, *107*(46), 19691–19695.

Kramer, M. S., & Kakuma, R. (2013). The Optimal Duration of Exclusive Breastfeeding. In L. K. Pickering, A. L. Morrow, G. M. Ruiz-Palacios, & R. J. Schanler (Eds.), *Protecting Infants through Human Milk: Advancing the Scientific Evidence* (2004 edition, pp. 63–77). Springer.

Krogman, W. M., & Isçan, M. Y. (1986). *The Human Skeleton in Forensic Medicine, Charles C.* Thomas.

Krueger, H. W. (1991). Exchange of carbon with biological apatite. *Journal of Archaeological Science*, *18*(3), 355–361.

Krueger, H. W., & Sullivan, C. H. (1984). Models for Carbon Isotope Fractionation Between Diet and Bone. In J. R. Turnlund & P. E. Johnson (Eds.), *Stable Isotopes in Nutrition* (Vol. 258, pp. 205–220). American Chemical Society.

Lagunas Rodríguez, Z., Serrano Sánchez, C., & López Alonso, S. (1976). *Enterramientos humanos de la zona arqueológica de Cholula, Puebla*. Instituto Nacional de Antropología e Historia, SEP, Departamento de Antropología Física.

Lane, S. D., Keefe, R. H., Rubinstein, R., Levandowski, B. A., Webster, N., Cibula, D. A., Boahene, A. K., Dele-Michael, O., Carter, D., Jones, T., Wojtowycz, M., & Brill, J. (2008). Structural violence, urban retail food markets, and low birth weight. *Health & Place*, *14*(3), 415–423.

Larsen, C. S. (1997). Isotopic and Elemental Signatures of Diet and Nutrition. In C. S. Larsen (Ed.), *Bioarchaeology: Interpreting Behavior from the Human Skeleton* (1st ed., pp. 270–301). Cambridge University Press.

Larsen, C. S., Griffin, M. C., Hutchinson, D. L., Noble, V. E., Norr, L., Pastor, R. F., Ruff, C. B., Russell, K. F., Schoeninger, M. J., Schultz, M., Simpson, S. W., & Teaford, M. F. (2001). Frontiers of contact: Bioarchaeology of Spanish Florida. *Journal of World Prehistory*, *15*(1), 69–123.

Lazcano Arce, J. C. (2003). Estudio Etnoarqueológico Sobre El Modo de Trabajo Mezcalero Durante El Periodo Formativo Medio (400 a. C.) En El Sitio Arqueológico de Xochitécatl-Nativitas, Tlaxcala. *Boletín de Antropología Americana*, *39*, 157–174.

Leatherdale, A. (2014). Dietary and Physiological Contributions to the Relationship between Diet, Bone Collagen, and Structural Carbonate Δ13C Values. *Totem: The University of Western Ontario Journal of Anthropology*, *22*(1), 53–61.

Lee-Thorp, J. A., Sealy, J. C., & van der Merwe, N. J. (1989). Stable carbon isotope ratio differences between bone collagen and bone apatite, and their relationship to diet. *Journal of Archaeological Science*, *16*(6), 585–599.

Lee-Thorp, J. A., & van der Merwe, N. J. (1991). Aspects of the chemistry of modern and fossil biological apatites. *Journal of Archaeological Science*, *18*(3), 343–354.

Lee-Thorp, Julia A., J. A. L., & Merwe, Nikolaas van der, N. J. V. (1987). Carbon Isotope Analysis of Fossil Bone Apatite. *South African Journal of Science*, *83*(11), 712–15.

Lee-Thorp, Julia A., J. A., & Talma, A. S. (2000). Stable Light Isotopes and Environments in the Southern African Quaternary and Late Pliocene. *Oxford Monographs on Geology and Geophysics*, *40*, 236–251.

Lesnik, J. J. (2018). *Edible Insects and Human Evolution* (1st ed.). University Press of Florida.

Lesure, R. G., Borejsza, A., Carballo, J., Frederick, C., Popper, V., & Wake, T. A. (2006). Chronology, Subsistence, and the Earliest Formative of Central Tlaxcala, Mexico. *Latin American Antiquity*, *17*(4), 474–492.

Levinson, A. A., Luz, B., & Kolodny, Y. (1987). Variations in oxygen isotopic compositions of human teeth and urinary stones. *Applied Geochemistry*, *2*(4), 367–371.

Lévi-Strauss, C. (1963). *Structural anthropology*. Basic Books Inc.

Levitt, P., Lucken, K., & Barnett, M. (2011). Beyond Home and Return: Negotiating Religious Identity across Time and Space through the Prism of the American Experience. *Mobilities*, *6*(4), 467–482.

Liebmann, M., & Rizvi, U. Z. (2008). *Archaeology and the postcolonial critique*. AltaMira Press.

Lieverse, A. R. (1999). Diet and the Aetiology of Dental Calculus. *International Journal of Osteoarchaeology*, *9*(4), 219–32.

Lightfoot, K. G. (2005). *Indians, missionaries, and merchants: The legacy of colonial encounters on the California frontiers*. University of California Press.

Lind, M. (2008). La Gran Cuadra de la ciudad: El gobierno prehispánico de Cholula. *Arqueología*, *39*, 65–76.

Longinelli, A. (1984). Oxygen isotopes in mammal bone phosphate: A new tool for palaeohydrological and palaeoclimatological research? *Geochimica et Cosmochimica Acta*, *48*(2), 385–390.

López Alonso, S., Lagunas, Z., & Serrano, C. (1976). *Enterramientos Humanos de La Zona Arqueológica de Cholula, Puebla, México*. SEP, Instituto Nacional de Antropología e Historia.

López Alonso, Sergio, Lagunas Rodríguez, Z., & Serrano Sánchez, C. (2002). *Costumbres Funerarias y Sacrificio Humano En Cholula Prehispánica*. Universidad Autónoma de México.

López Corral, A., Fargher, L. F., & Santacruz Cano, R. (2016). La república de Tlaxcallan. *Arqueología mexicana*, *24*(139), 42–53.

López Corral, A., & Santacruz Cano, R. (2015). *Proyecto Arqueológico Tepeticpac. Informe de la Tercera Temporada de Campo 2014 y Análisis de Materiales*. Documento en Archivo Técnico del INAH.

López Corral, A., & Santacruz Cano, R. (2016). *Proyecto Arqueológico Tepeticpac: Informe de la Cuarta Temporada de Campo 2015 y análisis de materiales*. Documento en Archivo Técnico del INAH.

López Corral, A., & Santacruz Cano, R. (2017). *Proyecto Arqueológico Tepeticpac: Informe de la Quinta Temporada de Campo 2016 y análisis de materiales*. Documento en Archivo Técnico del INAH.

López Corral, A., Serra Puche, M. C., Vicencio Castellanos, G. A., Hirth, K., Dyrdahl, E., & Pérez Castellanos, N. A. (2016). *Changes in Obsidian Supply during the Classic to Postclassic Transition in Prehispanic Puebla-Tlaxcala*. 81st Annual Society for American Archaeology Meeting, Orlando, Florida.

López Corral, A., Velasco Almanza, I., Ibarra Narváez, T. E., & Santacruz Cano, R. (2019). Iconografía y gobierno colectivo durante el posclásico tardío en Tepeticpac y Tlaxcallan, México. *Latin American Antiquity*, *30*(2), 333–353.

Lopez de Gomara, F. (1596). *The pleasant historie of the conquest of the West India, now called new Spaine: Atchieued by the most worthie prince Hernando Cortes, Marques of the valley of Huaxacac, most delectable to reade. Translated out of the Spanish tongue, by T.N. Anno. 1578*. Printed by Thomas Creede.

López-Costas, O., & Müldner, G. (2016). Fringes of the empire: Diet and cultural change at the Roman to post-Roman transition in NW Iberia. *American Journal of Physical Anthropology*, *161*(1), 141–154.

Lukacs, J. R. (1989). Dental paleopathology: Method for reconstructing dietary patterns. In M. Y. İşcan & K. A. R. Kennedy (Eds.), *Reconstruction of life from the skeleton*. Liss.

Luz, B., Cormie, A. B., & Schwarcz, H. P. (1990). Oxygen isotope variations in phosphate of deer bones. *Geochimica et Cosmochimica Acta*, *54*(6), 1723–1728.

MacNeish, R. S. (1992). The Beginning of Agriculture in the New World. *Revista de Arqueología Americana*, 7–34.

Makarewicz, C. A., & Sealy, J. (2015). Dietary reconstruction, mobility, and the analysis of ancient skeletal tissues: Expanding the prospects of stable isotope research in archaeology. *Journal of Archaeological Science*, *56*, 146–158.

Mangelsdorf, P. C., MacNeish, R. S., & Galinat, W. C. (1967). Prehistoric Maize, Teosinte, and Tripsacum from Tamaulipas, Mexico. *Botanical Museum Leaflets, Harvard University*, *22*(2), 33–63.

Mann, R. W. (1987). *Maxillary Suture Obliteration: A Method for Estimating Skeletal Age* [Master's Thesis]. University of Tennessee.

Manzanilla, L. (1996). Corporate Groups and Domestic Activities at Teotihuacan. *Latin American Antiquity*, *7*(3), 228–246.

Manzanilla, L. (2002). Organización sociopolítica de Teotihuacan: Lo que los materiales arqueológicos nos dicen o nos callan. In M. E. Ruiz Gallut (Ed.), *Ideología y política a través de materiales, imágenes y símbolos: Memoria de la Primera Mesa Redonda de Teotihuacan* (pp. 3–21). Smithsonian Libraries.

Marchione, T. J. (1977). Part three: Food and nutrition in self-reliant national development: The impact on child nutrition of Jamaican government policy. *Medical Anthropology*, *1*(1), 57–79.

Marchione, T. J., & Messer, E. (2010). Food Aid and the World Hunger Solution: Why the U.S. Should Use a Human Rights Approach. *Food and Foodways*, *18*(1–2), 10–27.

Marquina, I. (1970). *Proyecto Cholula* (Vol. 19). Instituto Nacional de Antropología e Historia.

Martin, D. L., Harrod, R. P., & Pérez, V. R. (Eds.). (2013). *Bioarchaeology: An Integrated Approach to Working with Human Remains*. Springer.

Martorell, R., Ramakrishnan, U., Schroeder, D. G., & Ruel, M. (2009). Reproductive Performance and Nutrition During Childhood. *Nutrition Reviews*, *54*(4), S15–S21.

Mayes, A. T., & Barber, S. B. (2008). Osteobiography of a high-status burial from the lower Río Verde Valley of Oaxaca, Mexico. *International Journal of Osteoarchaeology*, *18*(6), 573–588.

McCafferty, G. G. (1996a). Reinterpreting the Great Pyramid of Cholula, Mexico. *Ancient Mesoamerica*, *7*(1), 1–17.

McCafferty, G. G. (1996b). The Ceramics and Chronology of Cholula, Mexico. *Ancient Mesoamerica*, *7*(2), 299–323.

McCafferty, G. G. (2018). Mountain of Heaven, Mountain of Earth: The Great Pyramid of Cholula as Sacred Landscape. In R. Koontz, *Landscape and Power in Ancient Mesoamerica* (1st ed., pp. 279–316). Routledge.

McCafferty, G. G., & McCafferty, S. D. (2006). Boys and Girls Interrupted: Mortuary Evidence of Children from Postclassic Cholula, Puebla. In T. Ardren & S. R. Hutson (Eds.), *The Social Experience of Childhood in Ancient Mesoamerica* (pp. 25–52). University Press of Colorado.

McCafferty, S. D., & McCafferty, G. G. (2000). Textile Production in Postclassic Cholula, Mexico. *Ancient Mesoamerica*, *11*(1), 39–54.

McCaffery, H., Tykot, R. H., Durand Gore, K., & DeBoer, B. R. (2014). Stable Isotope Analysis of Turkey (Meleagris Gallopavo) Diet from Pueblo II and Pueblo III Sites, Middle San Juan Region, Northwest New Mexico. *American Antiquity*, *79*(2), 337–352.

McClung de Tapia, E. (1979). *Ecología y cultura en Mesoamérica* (1. ed edition). Universidad Nacional Autónoma de México.

McClung de Tapia, E. (2010). Recientes estudios paleo-etnobotánicos en Teotihuacan, México. *Anales de Antropología*, *14*(1), Article 1.

McClung de Tapia, E., & Aguilar Hernández, B. A. (2001). Vegetation and Plant Use in Postclassic Otumba. *Ancient Mesoamerica*, *12*(1), 113–125.

McClung de Tapia, E., & Martínez Yrizar, D. (2005). Paleoethnobotanical Evidence from Postclassic Xaltocan. In E. M. Brumfiel (Ed.), *Production and power at postclassic Xaltocan* (pp. 207–232). Instituto Nacional de Antropología e Historia.

McClung de Tapia, E., Martínez Yrízar, D., Ibarra Morales, E., & Adriano Morán, C. C. (2014). Los orígenes prehispánicos de una tradición alimentaria en la cuenca de méxico. *Anales de Antropología*, *48*(1), 97–121.

McKern, T. W., & Stewart, T. D. (1957). *Skeletal Age Changes in Young American Males Analyzed from the Standpoint of Age Identification*. Defense Technical Information Center.

McNeil, C. L. (2006). *Chocolate in Mesoamerica: A Cultural History of Cacao*. University Press of Florida.

Meindl, R. S., & Lovejoy, C. O. (1985). Ectocranial suture closure: A revised method for the determination of skeletal age at death based on the lateral-anterior sutures. *American Journal of Physical Anthropology*, *68*(1), 57–66.

Meskell, L. M. (2000). Writing the Body in Archaeology. In A. E. Rautman (Ed.), *Reading the Body: Representations and remains in the archaeological record*. University of Pennsylvania Press.

Meskell, L. M., & Joyce, R. A. (Eds.). (2003). *Embodied Lives: Figuring Ancient Maya and Egyptian Experience*. Routledge.

Messmacher, M. (1967). *Cholula, reporte preliminar*. Editorial Nueva Antropología.

Metcalfe, J. Z., White, C. D., Longstaffe, F. J., Wrobel, G., Cook, D. C., & Pyburn, K. A. (2009). Isotopic Evidence for Diet at Chau Hiix, Belize: Testing Regional Models of Hierarchy and Heterarchy. *Latin American Antiquity*, *20*(1), 15–36.

Millhauser, J. K., Fargher, L. F., Heredia Espinoza, V. Y., & Blanton, R. E. (2015). The geopolitics of obsidian supply in Postclassic Tlaxcallan: A portable X-ray fluorescence study. *Journal of Archaeological Science*, *58*, 133–146.

Milner, G. R., & Boldsen, J. L. (2012). Estimating Age and Sex from the Skeleton, a Paleopathological Perspective. In A. L. Grauer (Ed.), *A Companion to Paleopathology* (pp. 268–284). Wiley-Blackwell.

Minc, L. D. (2009). Style and Substance: Evidence for Regionalism within the Aztec Market System. *Latin American Antiquity*, *20*(2), 343–374.

Monaghan, J. (1998). The Person, Destiny, and the Construction of Difference in Mesoamerica. *Res: Anthropology and Aesthetics*, *33*, 137–146.

Monson, K. D., & Hayes, J. M. (1982a). Biosynthetic Control of the Natural Abundance of Carbon 13 at Specific Positions within Fatty Acids in Saccharomyces Cerevisiae. Isotopic Fractionation in Lipid Synthesis as Evidence for Peroxisomal Regulation. *Journal of Biological Chemistry*, *257*(10), 5568–5575.

Monson, K. D., & Hayes, J. M. (1982b). Carbon isotopic fractionation in the biosynthesis of bacterial fatty acids. Ozonolysis of unsaturated fatty acids as a means of determining the intramolecular distribution of carbon isotopes. *Geochimica et Cosmochimica Acta*, *46*(2), 139–149.

Montagnini, F. (2006). Homegardens of Mesoamerica: Biodiversity, food security, and nutrient management. In B. M. Kumar & P. K. R. Nair (Eds.), *Tropical Homegardens* (Vol. 3, pp. 61–84). Springer Netherlands.

Montoya, A., Hernández-Totomoch, O., Estrada-Torres, A., Kong, A., & Caballero, J. (2003). Traditional knowledge about mushrooms in a Nahua community in the state of Tlaxcala, México. *Mycologia*, *95*(5), 793–806.

Moorees, C.F.A & Fanning, F.A. (1963). Hunt Age variation formation stages for 10 permanent teeth. *Journal of Dental Research*, 1490-1502.

Morrison, K. D., & Sinopoli, C. M. (1992). Economic diversity and integration in a pre-colonial Indian empire. *World Archaeology*, *23*(3), 335–352.

Motolinía, T. (1950). *History of the Indians of New Spain* (E. Foster, Trans.). Cortés Society.

Müldner, G., & Richards, M. P. (2005). Fast or feast: Reconstructing diet in later medieval England by stable isotope analysis. *Journal of Archaeological Science*, *32*(1), 39–48.

Muñoz Camargo, D. (1972). *Historia de Tlaxcala*. Edmundo Avina Levy.

Muñoz Camargo, D., & Acuña, D. R. (2000). *Descripción de La Ciudad y Provincia de Tlaxcala*. El Colegio de San Luís.

Murphy, M. S., & Klaus, H. D. (Eds.). (2017). *Colonized Bodies, Worlds Transformed: Toward a Global Bioarchaeology of Contact and Colonialism* (1st ed.). University Press of Florida.

Nelson, B. K., Deniro, M. J., Schoeninger, M. J., De Paolo, D. J., & Hare, P. E. (1986). Effects of diagenesis on strontium, carbon, nitrogen and oxygen concentration and isotopic composition of bone. *Geochimica et Cosmochimica Acta*, *50*(9), 1941–1949.

Nichols, D. L. (2004). The Rural and Urban Landscape of the Aztec State. In R. Joyce & J. A. Hendon (Eds.), *Mesoamerican Archaeology: Theory and Practice* (pp. 265–295). Blackwell Publishing Ltd.

Nichols, D., & Smith, M. E. (1994). The Organization of Provincial Craft Production and the Aztec City-State of Otumba. In M. G. Hodge (Ed.), *Economies and Polities in the Aztec Realm* (pp. 175–193). The University of Texas Press.

Nixon, G. T., Demant, A., Armstrong, R. L., & Harakal, J. E. (1987). K-Ar and geologic data bearing on the age and evolution of the Trans-Mexican Volcanic Belt. *Geofísica Internacional*, *26*(1), 109–158.

Noguera, E., & Vega, A. G. (1927). Ruinas de Tizatlán, Tlaxcala. In A. G. V. T. Nación (Ed.), *Antecedentes históricos de Tlaxcala*.

O'Hara, S. L., & Metcalfe, S. E. (1997). The climate of Mexico since the Aztec period. *Quaternary International*, *43–44*, 25–31.

Olivera, M. (1978). *Pillis y macehuales: Las formaciones sociales y los modos de producción de Tecali del siglo XII al XVI*. Centro de Investigaciones Superiores del INAH.

Olivier, G. (2003). *Mockeries and Metamorphoses of an Aztec God: Tezcatlipoca Lord of the Smoking Mirror*. University Press of Colorado.

Ortner, S. B. (1984). Theory in Anthropology since the Sixties. *Comparative Studies in Society and History*, *26*(1), 126–126.

Ortner, S. B. (1989). Expanding Practice Theory. In *High Religion: A Cultural and Political History of Sherpa Buddhism Princeton* (pp. 11–18). Princeton University Press.

Osmond, C. B., Allaway, W. G., Sutton, B. G., Troughton, J. H., Queiroz, O., Lüttge, U., & Winter, K. (1973). Carbon Isotope Discrimination in Photosynthesis of CAM Plants. *Nature*, *246*(5427), 41–42.

Pagán Jiménez, J. R., & Rodríguez Ramos, R. (2008). Sobre arqueologías de liberación en una 'colonia postcolonial. *Revista de Ciencias Sociales*, *19*, 8–41.

Parsons, J. R. (1968). Teotihuacan, Mexico, and Its Impact on Regional Demography. *Science*, *162*(3856), 872–877.

Parsons, Jeffrey R. (2008). Beyond Santley and Rose (1979): The Role of Aquatic Resources in the Prehispanic Economy of the Basin of Mexico. *Journal of Anthropological Research*, *64*(3), 351–366.

Pauketat, T. R. (2000). Tragedy of the Commoners. In M.-A. Dobres & J. E. Robb (Eds.), *Agency in Archaeology* (pp. 113–129). Routledge.

Pearson, S. F., Levey, D. J., Greenberg, C. H., & Martínez del Rio, C. (2003). Effects of elemental composition on the incorporation of dietary nitrogen and carbon isotopic signatures in an omnivorous songbird. *Oecologia*, *135*(4), 516–523.

Pérez Perez, J., & Adriano-Morán, C.C. (2018). Informe preliminar del análisis de cálculo dental de 28 muestras procedentes del sitio arqueológico de Tepeticpac, Tlaxcala.

Pestle, W. J., Crowley, B. E., & Weirauch, M. T. (2014). Quantifying Inter-Laboratory Variability in Stable Isotope Analysis of Ancient Skeletal Remains. *PLoS ONE*, *9*(7), e102844.

Piperno, D. R. (2006). *Phytoliths: A comprehensive guide for archaeologists and paleoecologists*. AltaMira Press.

Piperno, Dolores R., D. R., & Flannery, Kent V., K. V. (2001). The earliest archaeological maize (Zea mays L.) from highland Mexico: New accelerator mass spectrometry dates and their implications. *Proceedings of the National Academy of Sciences*, *98*(4), 2101–2103.

Plunket, P., & Uruñuela, G. (2008). Mountain of sustenance, mountain of destruction: The prehispanic experience with Popocatépetl Volcano. *Journal of Volcanology and Geothermal Research*, *170*(1–2), 111–120.

Plunket, Patricia, & Uruñuela, G. (2000). The Quick and the Dead: Decision-Making in the Abandonment of Tetimpa. *Mayab*, *13*, 78–87.

Plunket, Patricia, & Uruñuela, G. (2005). Recent Research in Puebla Prehistory. *Journal of Archaeological Research*, *13*(2), 89–127.

Pohl, J. (1994). Mexican Codices, Maps, and Lienzos as Social Contracts. In E. H. Boone & W. D. Mignolo (Eds.), *Writing Without Words: Alternative Literacies in Mesoamerica and the Andes* (pp. 137–160). Duke University Press.

Pohl, M. (1981). Ritual Continuity and Transformation in Mesoamerica: Reconstructing the Ancient Maya Cuch Ritual. *American Antiquity*, *46*(3), 513–529.

Pollitt, E., Gorman, K. S., Engle, P. L., Rivera, J. A., & Martorell, R. (1995). Nutrition in Early Life and the Fulfillment of Intellectual Potential. *The Journal of Nutrition*, *125*(suppl_4), 1111 –1118.

Polyani, K. (2001). *The Great Transformation: The Political and Economic Origins of Our Time* (2nd ed.). Beacon Press Books.

Price, T. D., Burton, J. H., Sharer, R. J., Buikstra, J. E., Wright, L. E., Traxler, L. P., & Miller, K. A. (2010). Kings and commoners at Copan: Isotopic evidence for origins and movement in the Classic Maya period. *Journal of Anthropological Archaeology*, *29*(1), 15–32.

Ramos-Elorduy, J., Huis, A. V., & Pino, J. M. (Eds.). (2015). *Acridofacia y Otros Insectos: En Donde Se Cuenta Sobre La Crianza, Recolección, Preparación y Consumo de Chapulines, Gusanos, Hormigas y Otros Bichos Para Salvar al Mundo*. TRILCE Ediciones, Conaculta, Universidad del Estado de Hidalgo.

Ramos-Elorduy, J., Neto, E. M. C., Santos, J. F. dos, Moreno, J. P. M. P., Landero-Torres, I., Campos, S. C. Á., & Pérez, Á. G. (2006). Estudio comparativo del valor nutritivo de varios coleoptera comestibles de México y pachymerus nucleorum (Fabricius, 1792) (Bruchidae) de Brasil. *Interciencia*, *31*(7), 512–516.

Rawlings, T. A., & Driver, J. C. (2010). Paleodiet of domestic turkey, Shields Pueblo (5MT3807), Colorado: Isotopic analysis and its implications for care of a household domesticate. *Journal of Archaeological Science*, *37*(10), 2433–2441.

Recinos, A. (2010). *Popol Vuh*. Linkgua.

Redfern, R. C., Gröcke, D. R., Millard, A. R., Ridgeway, V., Johnson, L., & Hefner, J. T. (2016). Going south of the river: A multidisciplinary analysis of ancestry, mobility and diet in a population from Roman Southwark, London. *Journal of Archaeological Science*, *74*, 11–22.

Redfield, A. (1970). A new aid to aging immature skeletons: Development of the occipital bone. *American Journal of Physical Anthropology*, *33*(2), 207–220.

Reilly, F. K. (2012). *Mesoamerican Religious Beliefs*. Oxford University Press.

Robles, B., Flores, J., Martínez, J. L., & Herrera, P. (2018). The Chinampa: An Ancient Mexican Sub-Irrigation System. *Irrigation and Drainage*, ird.2310.

Rogers, J. D. (2005). Archaeology and the Interpretation of Colonial Encounters. In G. Stein, Gil J. (Ed.), *The Archaeology of Colonial Encounters* (pp. 331–354). School for Advanced Research Press.

Rojas, G. (1927 [1581]). Descripción de Cholula. *Revista Mexicana de Estudios Históricos* 1(6):158-170.

Rojas, G. (1985). *Relación geográfica de Cholula*.

Rong, L. I., & Kang-Ning, W. (2009). Nixtamalization Effects on the Contents of Phytic Acid in the Varieties of Maize and the Bioavailability of Iron in Nixtamalized Maize to Young Pigs. *Pakistan Journal of Nutrition*, *8*(6), 905–909.

Rosa, E. M., & Tudge, J. (2013). Urie Bronfenbrenner's Theory of Human Development: Its Evolution From Ecology to Bioecology: The Evolution of Urie Bronfenbrenner's Theory. *Journal of Family Theory & Review*, *5*(4), 243–258.

Sage, R. F., Christin, P.-A., & Edwards, E. J. (2011). The C4 plant lineages of planet Earth. *Journal of Experimental Botany*, *62*(9), 3155–3169.

Sage, Rowan F. (2017). A portrait of the C4 photosynthetic family on the 50th anniversary of its discovery: Species number, evolutionary lineages, and Hall of Fame. *Journal of Experimental Botany*, *68*(2), 4039–4056.

Sahagún, B. de. (2012). *Florentine Codex: A general history of the things of New Spain*. University of Utah Press.

Sahlins, M. (1994). Cosmologies of capitalism: The trans-pacific sector of 'The World System.' In N. B. Dirks, G. Eley, & S. B. Ortner (Eds.), *Culture/power/history: A reader in contemporary social theory* (pp. 412–455). Princeton University Press.

Sanders, W. T. (1956). The central Mexican symbiotic region: A study in prehistoric settlement patterns. In G. R. Willey (Ed.), *Prehistoric settlement patterns in the New World.* (pp. 115–127). Wenner-Gren Foundation for Anthropological Research.

Santley, R. S., & Rose, E. K. (1979). Diet, nutrition and population dynamics in the Basin of Mexico. *World Archaeology*, *11*(2), 185–207.

Saxe, A. A. (1970). *Social Dimensions of Mortuary Practices* [Ph.D. dissertation,]. University of Michigan.

Scheuer, L., & Black, S. (2000). Bone Development. In *Developmental Juvenile Osteology* (pp. 18–31). Elsevier.

Schoeninger, Margaret J. (2005). Stable isotope studies in human evolution. *Evolutionary Anthropology: Issues, News, and Reviews*, *4*(3), 83–98.

Schoeninger, Margaret J., & DeNiro, M. J. (1982). Carbon isotope ratios of apatite from fossil bone cannot be used to reconstruct diets of animals. *Nature*, *297*(5867), 577–578.

Schoeninger, Margaret J, & DeNiro, M. J. (1984). Nitrogen and carbon isotopic composition of bone collagen from marine and terrestrial animals. *Geochimica et Cosmochimica Acta*, *48*(4), 625–639.

Schoeninger, Margaret J., & Moore, K. (1992). Bone stable isotope studies in archaeology. *Journal of World Prehistory*, *6*(2), 247–296.

Schoeninger, M.J., Deniro, M. J., & Tauber, H. (1983). N-15/N-14 ratios of bone-collagen reflect marine and terrestrial components of prehistoric human diet. *American Journal of Physical Anthropology*, *60*(2), 252–252.

Schrader, S. A. (2012). Activity patterns in New Kingdom Nubia: An examination of entheseal remodeling and osteoarthritis at Tombos. *American Journal of Physical Anthropology*, *149*(1), 60–70.

Schreiber, K. J. (2005). Imperial Agendas and Local Agency: Wari Colonial Strategies. In G. J. Stein (Ed.), *The archaeology of colonial encounters: Comparative perspectives* (1es ed, pp. 237–262). School of American Research Press; James Currey.

Schwarcz, H. P., & Schoeninger, M. J. (1991). Stable isotope analyses in human nutritional ecology. *American Journal of Physical Anthropology*, *34*(S13), 283–321.

Scott, E. C. (1979). Dental wear scoring technique. *American Journal of Physical Anthropology*, *51*(2), 213–217.

Sealy, J. C., van der Merwe, N. J., Hobson, K. A., Horton, D. R., Lewis, R. B., Parkington, J., Robertshaw, P., & Schwarcz, H. P. (1986). Isotope Assessment and the Seasonal-Mobility Hypothesis in the Southwestern Cape of South Africa [and Comments and Replies]. *Current Anthropology*, *27*(2), 135–150.

Sefa-Dedeh, S., Cornelius, B., Sakyi-Dawson, E., & Afoakwa, E. O. (2004). Effect of nixtamalization on the chemical and functional properties of maize. *Food Chemistry*, *86*(3), 317–324.

Serafin, S., Lope, C. P., & Uc González, E. (2014). Bioarchaeological investigation of ancient Maya violence and warfare in inland northwest Yucatan, Mexico: Maya Violence and Warfare in northwest Yucatan. *American Journal of Physical Anthropology*, *154*(1), 140–151.

Serra Puche, M. C. (2012). La Vida Cotidiana En Xochitécatl-Cacaxtl. *Arqueología Mexicana*, *19*(117), 38–45.

Serra Puche, M. C., Lazcano Arce, J. C., & Hernández Hernández, S. (2000). ¿Hornos para la producción de mezcal en un sitio del Formativo de Tlaxcala. *Arqueología*, *24*, 149–157.

Sewell Jr., William H. (2005). A theory of structure: Duality, agency and transformation. In G. M. Spiegel (Ed.), *Practicing history: New directions in historical writing after the linguistic turn* (pp. 143–162). Routledge.

Slovak, N. M., & Paytan, A. (2011). Fisherfolk and farmers: Carbon and nitrogen isotope evidence from Middle Horizon Ancón, Peru. *International Journal of Osteoarchaeology*, *21*(3), 253–267.

Smalley, J., & Blake, M. (2003). Sweet Beginnings: Stalk Sugar and the Domestication of Maize. *Current Anthropology*, *44*(5), 675–703.

Smith, Michael E. (1984). The Aztlan Migrations of the Nahuatl Chronicles: Myth or History? *Ethnohistory*, *31*(3), 153.

Smith, Michael E. (2001). The Aztec Empire and the Mesoamerican World System. In S. E. Alcock, T. N. D'Altroy, K. D. Morrison, & C. M. Sinopoli (Eds.), *Empires: Perspectives from Archaeology and History* (pp. 128–154). Cambridge University Press.

Smith, Michael E. (2013). *The Aztecs*. John Wiley & Sons.

Smith, Michael E., & Heath-Smith, C. (1994). Rural Economy in Late Postclassic Morelos. In M. G. Hodge & M. E. Smith (Eds.), *Economies and Polities in the Aztec Realm* (pp. 349–76). University of Texas Press.

Smith, Michael Ernest, & Berdan, F. F. (2003). *The postclassic Mesoamerican world*. University of Utah Press.

Smith, Michael E., & Berdan, F. F. (2000). The Postclassic Mesoamerican World System. *Current Anthropology*, *41*(2), 283–286.

Somerville, A. D., Fauvelle, M., & Froehle, A. W. (2013). Applying new approaches to modeling diet and status: Isotopic evidence for commoner resiliency and elite variability in the Classic Maya lowlands. *Journal of Archaeological Science*, *40*(3), 1539–1553.

Somerville, A. D., Nelson, B. A., & Knudson, K. J. (2010). Isotopic investigation of pre-Hispanic macaw breeding in Northwest Mexico. *Journal of Anthropological Archaeology*, *29*(1), 125–135.

Somerville, A. D., Schoeninger, M. J., & Braswell, G. E. (2016). Political alliance, residential mobility, and diet at the ancient Maya city of Pusilha, Belize. *Journal of Anthropological Archaeology*, *41*, 147–158.

Somerville, A. D., Sugiyama, N., Manzanilla, L. R., & Schoeninger, M. J. (2016). Animal Management at the Ancient Metropolis of Teotihuacan, Mexico: Stable Isotope Analysis of Leporid (Cottontail and Jackrabbit) Bone Mineral. *PLOS ONE*, *11*(8), e0159982.

Somerville, A. D., Sugiyama, N., Manzanilla, L. R., & Schoeninger, M. J. (2017). Leporid management and specialized food production at Teotihuacan: Stable isotope data from cottontail and jackrabbit bone collagen. *Archaeological and Anthropological Sciences*, *9*(1), 83–97.

Sponheimer, M., & Lee-Thorp, J. A. (1999). Oxygen Isotopes in Enamel Carbonate and their Ecological Significance. *Journal of Archaeological Science*, *26*(6), 723–728.

Stam, R., & Shohat, E. (2012). The Seismic Shift and the Decolonization of Knowledge. In R. Stam & E. Shohat (Eds.), *Race in Translation: Culture Wars around the Postcolonial Atlantic*. NYU Press.

Steckel, R. H., & Rose, J. C. (Eds.). (2002). *The Backbone of History: Health and Nutrition in the Western Hemisphere* (1st ed.). Cambridge University Press.

Stein, G. J. (2005). Introduction: The Comparative Archaeology of Colonial Encounters. In G. J. Stein (Ed.), *The archaeology of colonial encounters: Comparative perspectives* (1st ed, pp. 3–32). School of American Research Press; James Currey.

Stodder, A. L. W., & Palkovich, A. M. (Eds.). (2012). *The Bioarchaeology of Individuals*. University Press of Florida.

Stone, P. K. (2012). Binding women: Ethnology, skeletal deformations, and violence against women. *International Journal of Paleopathology*, *2*(2–3), 53–60.

Stuart, J. (1990). Maize Use By Rural Mesoamerican Households. *Human Organization*, *49*(2), 135–139.

Stuiver, M., & Pearson, G. W. (1993). High-Precision Bidecadal Calibration of the Radiocarbon Time Scale, AD 1950–500 BC and 2500–6000 BC. *Radiocarbon*, *35*(1), 1–23.

Stuiver, M., & Reimer, P. J. (1993). Extended 14C Data Base and Revised CALIB 3.0 14C Age Calibration Program. *Radiocarbon*, *35*(1), 215–230.

Suchey, J. M., Owings, P. A., Wiseley, D. V., & Noguchi, T. T. (1984). Skeletal Aging of Unidentified Persons. In T. A. Rathbun & J. E. Buikstra (Eds.), *Human Identification: Case Studies in Forensic Anthropology* (pp. 278–297). Charles C. Thomas.

Sugiyama, N., Somerville, A. D., & Schoeninger, M. J. (2015). Stable Isotopes and Zooarchaeology at Teotihuacan, Mexico Reveal Earliest Evidence of Wild Carnivore Management in Mesoamerica. *PLOS ONE*, *10*(9), e0135635.

Sugiyama, N., Valadez Azúa, R., & Rodríguez Galicia, B. (2017). Faunal acquisition, maintenance, and consumption: How the Teotihuacanos got their meat. *Archaeological and Anthropological Sciences*, *9*(1), 61–81.

Sullivan, C. H., & Krueger, H. W. (1981). Carbon isotope analysis of separate chemical phases in modern and fossil bone. *Nature*, *292*(5821), 333–335.

Szpak, P. (2014). Complexities of nitrogen isotope biogeochemistry in plant-soil systems: Implications for the study of ancient agricultural and animal management practices. *Frontiers in Plant Science*, *5*.

Szpak, P., Millaire, J.-F., White, C. D., & Longstaffe, F. J. (2012). Influence of seabird guano and camelid dung fertilization on the nitrogen isotopic composition of field-grown maize (Zea mays). *Journal of Archaeological Science*, *39*(12), 3721–3740.

Tauber, H. (1981). 13C evidence for dietary habits of prehistoric man in Denmark. *Nature*, *292*(5821), 332–333.

Tibbets, T. M., Wheeless, L. A., & del Rio, C. M. (2007). Isotopic enrichment without change in diet: An ontogenetic shift in δ_{15} N during insect metamorphosis. *Functional Ecology*, *22*(1), 109-113.

Tieszen, L. L., Boutton, T. W., Tesdahl, K. G., & Slade, N. A. (1983). Fractionation and turnover of stable carbon isotopes in animal tissues: Implications for 13C analysis of diet. *Oecologia*, *57*(1–2), 32–37.

Tieszen, Larry L., & Fagre, T. (1993). Effect of Diet Quality and Composition on the Isotopic Composition of Respiratory CO2, Bone Collagen, Bioapatite, and Soft Tissues. In J. B. Lambert & G. Grupe (Eds.), *Prehistoric Human Bone* (pp. 121–155). Springer Berlin Heidelberg.

Todd, T. W., & Lyon, D. W. (1924). Endocranial suture closure. Its progress and age relationship. Part I.—Adult males of white stock. *American Journal of Physical Anthropology*, *7*(3), 325–384.

Torquemada, F. J. de. (1995). *Monarquia Indiana*. Universidad Autónoma de México.

Torres-Rouff, C., Knudson, K. J., Pestle, W. J., & Stovel, E. M. (2015). Tiwanaku influence and social inequality: A bioarchaeological, biogeochemical, and contextual analysis of the Larache cemetery, San Pedro de Atacama, Northern Chile: Tiwanaku Influence and Social Inequality. *American Journal of Physical Anthropology*, *158*(4), 592–606.

Toulet Abasolo, L. M. (1996). *Tlaxcala en la conquista de México: El mito de la traición*. Tlaxcallan, Ediciones del Patronato Estatal de Promotores Voluntarios en Tlaxcala.

Toyne, J. M., White, C. D., Verano, J. W., Uceda Castillo, S., Millaire, J. F., & Longstaffe, F. J. (2014). Residential histories of elites and sacrificial victims at Huacas de Moche, Peru, as reconstructed from oxygen isotopes. *Journal of Archaeological Science*, *42*, 15–28.

Tozzer, A. M., & Allen, G. M. (1910). *Animal figures in the Maya codices,*. The Museum,.

Trawick-Smith, J. (2013). *Ages and Stages of Development—Child Development (CA Dept of Education*. California Department of Education.

Trinkaus, K. M. (1995). Mortuary Behavior, Labor Organization, and Social Rank. In L. A. Beck (Ed.), *Regional Approaches to Mortuary Analysis* (pp. 53–75). Springer US.

Tung, T. A. (2012). *Violence, Ritual, and the Wari Empire: A Social Bioarchaeology of Imperialism in the Ancient Andes*. University Press of Florida.

Tung, T. A. (2014). Agency, 'Til Death Do Us Part? Inquiring about the Agency of Dead Bodies from the Ancient Andes. *Cambridge Archaeological Journal*, *24*(3), 437–452.

Tung, T. A., & Knudson, K. J. (2018). Stable isotope analysis of a pre-Hispanic Andean community: Reconstructing pre-Wari and Wari era diets in the hinterland of the Wari empire, Peru. *American Journal of Physical Anthropology*, *165*(1), 149–172.

Tung, T. A., Miller, M., DeSantis, L., Sharp, E. A., & Kelly, J. (2016). Patterns of Violence and Diet Among Children During a Time of Imperial Decline and Climate Change in the Ancient Peruvian Andes. In A. M. VanDerwarker & G. D. Wilson (Eds.), *The Archaeology of Food and Warfare* (pp. 193–228). Springer International Publishing.

Turkon, P. (2007). Food Preparation and Status in Mesoamerica. In K. C. Twiss (Ed.), *The Archaeology of Food and Identity* (pp. 152–70). Center for Archaeological Investigations.

Turner, B. L., Kamenov, G. D., Kingston, J. D., & Armelagos, G. J. (2009). Insights into immigration and social class at Machu Picchu, Peru based on oxygen, strontium, and lead isotopic analysis. *Journal of Archaeological Science*, *36*(2), 317–332.

Turner, B. L., Kingston, J. D., & Armelagos, G. J. (2010). Variation in Dietary Histories Among the Immigrants of Machu Picchu: Carbon and Nitrogen Isotope Evidence. *Chungara, Revista de Antropología Chilena*, *42*(2), 515–534.

Turner, B. L., Kingston, J. D., & Milanich, J. T. (2005). Isotopic Evidence of Immigration Linked to Status during the Weeden Island and Suwannee Valley Periods in North Florida. In *Southeastern Archaeology* (pp. 121–136).

Twiss, K. C. (2007). *The Archaeology of Food and Identity*. Center for Archaeological Investigations.

Twiss, K. C., & Dietler, M. (Eds.). (2007). Culinary Encounters: Food, Identity, and Colonialism. In *The archaeology of food and identity* (pp. 218–242). Center for Archaeological Investigations, Southern Illinois University Carbondale.

Tykot, R. H., van der Merwe, N. J., & Hammond, N. (1996). Stable Isotope Analysis of Bone Collagen, Bone Apatite, and Tooth Enamel in the Reconstruction of Human Diet: A Case Study from Cuello, Belize. In M. V. Orna (Ed.), *Archaeological Chemistry* (Vol. 625, pp. 355–365). American Chemical Society.

Tykot, Robert H. (2002). Contribution of Stable Isotope Analysis to Understanding Dietary Variation among the Maya. In K. A. Jakes (Ed.), *Archaeological Chemistry* (Vol. 831, pp. 214–230). American Chemical Society.

Tykot, Robert H. (2016). Isotope Analyses and the Histories of Maize. In J. E. Staller, R. H. Tykot, & B. F. Benz (Eds.), *Histories of Maize: Multidisciplinary Approaches to the Prehistory, Linguistics, Biogeography, Domestication, and Evolution of Maize* (pp. 131–142). Routledge.

Ubelaker, D. H. (1987). Estimating Age at Death from Immature Human Skeletons: An Overview. *Journal of Forensic Sciences*, *32*(5), 11176J.

Uruñuela, G., & Plunket, P. (2002). Lineages and Ancestors: The Formative Mortuary Assemblage of Tetimpa, Puebla. In Patricia Plunket (Ed.), *Domestic Ritual in Ancient Mesoamerica*. Cotsen Institute of Archaeology Press.

van der Merwe, N. J. (1982). Carbon Isotopes, Photosynthesis, and Archaeology: Different pathways of photosynthesis cause characteristic changes in carbon isotope ratios that make possible the study of prehistoric human diets. *American Scientist*, *70*(6), 596–606. JSTOR.

van der Merwe, N. J., & Tschauner, H. (1999). C4 Plants and the Development of Human Societies. In *C4 Plant Biology* (pp. 509–549). Elsevier.

van Der Merwe, N. J., & Vogel, J. C. (1978). 13C Content of human collagen as a measure of prehistoric diet in woodland North America. *Nature*, *276*(5690), 815–816.

Veen, M. van der. (2007). Food as an Instrument of Social Change: Feasting in Iron Age and Early Roman Southern Britain. In K. C. Twiss (Ed.), *The Archaeology of Food and Identity* (pp. 112–29). Center for Archaeological Investigations.

Vogel, J. C. (1978). Recycling of carbon in a forest environment. *Oecologia Plantarum*, *13*, 89–94.

Walker, P. L., & Deniro, M. J. (1986). Stable nitrogen and carbon isotope ratios in bone collagen as indices of prehistoric dietary dependence on marine and terrestrial resources in Southern California. *American Journal of Physical Anthropology*, *71*(1), 51–61.

Warinner, C., Garcia, N. R., & Tuross, N. (2013). Maize, beans and the floral isotopic diversity of highland Oaxaca, Mexico. *Journal of Archaeological Science*, *40*(2), 868–873.

Warinner, C., & Tuross, N. (2009). Alkaline cooking and stable isotope tissue-diet spacing in swine: Archaeological implications. *Journal of Archaeological Science*, *36*(8), 1690–1697.

Watson, J. L., & Caldwell, M. L. (2005). *The Cultural Politics of Food and Eating: A Reader*. Blackwell Publishing.

Wernke, S. A. (2013). *Negotiated Settlements: Andean Communities and Landscapes under Inka and Spanish Colonialism*. University Press of Florida.

White, C. D. (2005). Gendered food behaviour among the Maya: Time, place, status and ritual. *Journal of Social Archaeology*, *5*(3), 356–382.

White, C. D., Healy, P. F., & Schwarcz, H. P. (1993). Intensive Agriculture, Social Status, and Maya Diet at Pacbitun, Belize. *Journal of Anthropological Research*, *49*(4), 347–375.

White, C. D., Pendergast, D. M., Longstaffe, F. J., & Law, K. R. (2001). Social Complexity and Food Systems at Altun Ha, Belize: The Isotopic Evidence. *Latin American Antiquity*, *12*(4), 371–393.

White, C. D., Price, T. D., & Longstaffe, F. J. (2007). Residential Histories of the Human Sacrifices at the Moon Pyramid, Teotihuacan: Evidence from oxygen and strontium isotopes. *Ancient Mesoamerica*, *18*(1), 159–172.

White, C. D., & Schwarcz, H. P. (1989). Ancient Maya diet: As inferred from isotopic and elemental analysis of human bone. *Journal of Archaeological Science*, *16*(5), 451–474.

White, C. D., & Schwarcz, H. P. (1999). Dietary Carbonate Analysis of Bone and Enamel for Two Sites in Belize. In S. Coyston (Ed.), *Reconstructing Ancient Maya Diet* (pp. 199–220). The University of Utah Press.

White, C. D., Spence, M. W., Le Q. Stuart-Williams, H., & Schwarcz, H. P. (1998). Oxygen Isotopes and the Identification of Geographical Origins: The Valley of Oaxaca versus the Valley of Mexico. *Journal of Archaeological Science*, *25*(7), 643–655.

White, C. D., Spence, M. W., Longstaffe, F. J., & Law, K. R. (2000). Testing the Nature of Teotihuacán Imperialism at Kaminaljuyú Using Phosphate Oxygen-Isotope Ratios. *Journal of Anthropological Research*, *56*(4), 535–558.

White, C.D., Longstaffe, F.J., & Law, K.R. (2001). Revisiting the Teotihuacan connection at Altun Ha: Oxygen isotope analysis of Tomb F-8/1. *Ancient Mesoamerica* 12(1), 65-72.

White, C.D., Pohl, M.E.D., Schwarcz, H.P., & Longstaffe, F.J. (2001). Isotopic Evidence for Maya Patterns of Deer and Dog Use at Preclassic Colha. *Journal of Archaeological Science* 28, 89-107.

White, C. D., Spence, M. W., Longstaffe, F. J., Stuart-Williams, H., & Law, K. R. (2002). Geographic Identities of the Sacrificial Victims from the Feathered Serpent Pyramid, Teotihuacan: Implications for the Nature of State Power. *Latin American Antiquity*, *13*(2), 217–236.

White, C. D., Storey, R., Longstaffe, F. J., & Spence, M. W. (2004). Immigration, Assimilation, and Status in the Ancient City of Teotihuacan: Stable Isotopic Evidence from Tlajinga 33. *Latin American Antiquity*, *15*(2), 176–198.

White, T. D., Black, M. T., & Folkens, P. A. (2011). *Human Osteology*. Academic Press.

Wiessner, P., & Schiefenhövel, W. (1996). *Food and the status quest: An interdisciplinary perspective*. Berghahn Books.

Wiley, S., Perkins, K., & Deaux, K. (2008). Through the looking glass: Ethnic and generational patterns of immigrant identity. *International Journal of Intercultural Relations*, *32*(5), 385–398.

Williams, J. S., Stronge, S. M., Iannone, G., & Longstaffe, F. J. (2017). Examining Chronological Trends in Ancient Maya Diet at Minanha, Belize, Using the Stable Isotopes of Carbon and Nitrogen. *Latin American Antiquity*, *28*(2), 269–287.

Williams, J. S., & White, C. D. (2006). Dental Modification in the Postclassic Population from Lamanai,Belize. *Ancient Mesoamerica*, *17*(1), 139–151.

Williams, J. S., White, C. D., & Longstaffe, F. J. (2009). Maya Marine Subsistence: Isotopic Evidence from Marco Gonzalez and San Pedro, Belize. *Latin American Antiquity*, *20*(1), 37–56.

Wolf, E. R. (1997a). *Europe and the people without history: With a new preface*. University of California Press.

Wolf, E. R. (1997b). Introduction. In *Europe and the people without history: With a new preface* (pp. 3–24). University of California Press.

Woo, E. J., & Sciulli, P. W. (2013). Degenerative Joint Disease and Social Status in the Terminal Late Archaic Period (1000–500 b.c.) of Ohio. *International Journal of Osteoarchaeology*, *23*(5), 529–544.

Wright, L. E. (1997). Intertooth patterns of hypoplasia expression: Implications for childhood health in the classic Maya collapse. *American Journal of Physical Anthropology*, *102*(2), 233–247.

Wright, L. E., & Schwarcz, H. P. (1998). Stable carbon and oxygen isotopes in human tooth enamel: Identifying breastfeeding and weaning in prehistory. *American Journal of Physical Anthropology*, *106*(1), 1–18.

Wright, L. E., & Schwarcz, H. P. (1999). Correspondence Between Stable Carbon, Oxygen and Nitrogen Isotopes in Human Tooth Enamel and Dentine: Infant Diets at Kaminaljuyú. *Journal of Archaeological Science*, *26*(9), 1159–1170.

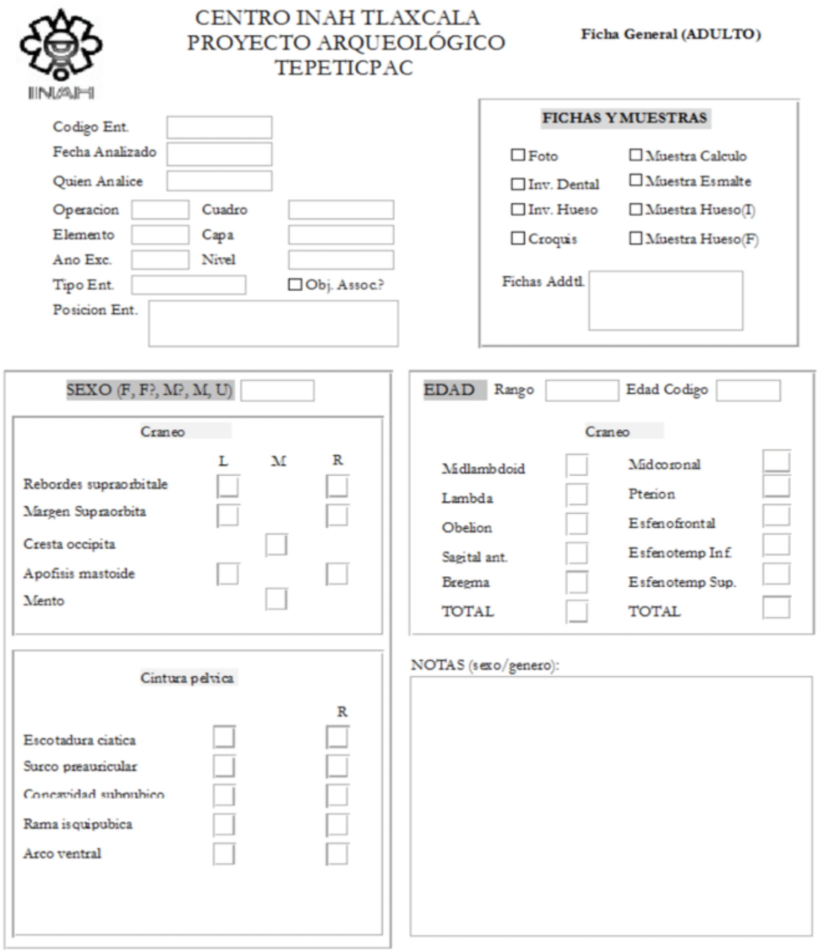
Wright, L. E., Valdés, J. A., Burton, J. H., Douglas Price, T., & Schwarcz, H. P. (2010). The children of Kaminaljuyu: Isotopic insight into diet and long distance interaction in Mesoamerica. *Journal of Anthropological Archaeology*, *29*(2), 155–178.

Wright, L. E., & White, C. D. (1996). Human biology in the Classic Maya collapse: Evidence from paleopathology and paleodiet. *Journal of World Prehistory*, *10*(2), 147–198.

Yilmaz, D., Ersoy, B., Bilgin, E., Gümüşer, G., Onur, E., & Pinar, E. D. (2005). Bone mineral density in girls and boys at different pubertal stages: Relation with gonadal steroids, bone formation markers, and growth parameters. *Journal of Bone and Mineral Metabolism*, *23*(6), 476–482.

Zizumbo-Villarreal, D., & Colunga-GarcíaMarín, P. (2010). Origin of agriculture and plant domestication in West Mesoamerica. *Genetic Resources and Crop Evolution*, *57*(6), 813–825.

APPENDIX A: BIOARCHAEOLOGICAL DATA COLLECTION PROTOCOLS



CENTRO INAH TLAXCALA
PROYECTO ARQUEOLÓGICO
TEPETICPAC

Ficha General (ADULTO)

Codigo Ent.
Fecha Analizado
Quien Analice
Operacion
Cuadro
Elemento
Capa
Ano Exc.
Nivel
Tipo Ent.
☐ Obj. Assoc?
Posicion Ent.

FICHAS Y MUESTRAS

☐ Foto	☐ Muestra Calculo
☐ Inv. Dental	☐ Muestra Esmalte
☐ Inv. Hueso	☐ Muestra Hueso(I)
☐ Croquis	☐ Muestra Hueso(F)

Fichas Addtl.

SEXO (F, F?, M?, M, U)

Craneo

	L	M	R
Rebordes supraorbitale	☐		☐
Margen Supraorbita	☐		☐
Cresta occipita		☐	
Apofisis mastoide	☐		☐
Mento		☐	

Cintura pelvica

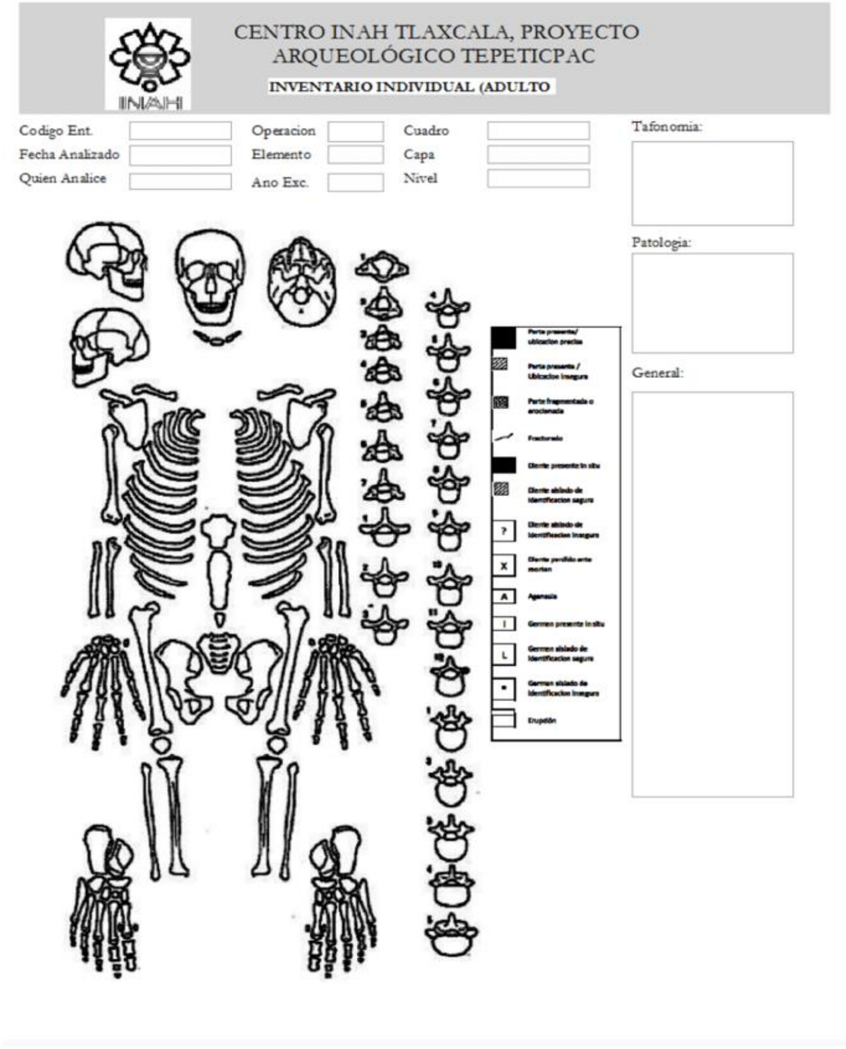
		R
Escotadura ciatica	☐	☐
Surco preauricular	☐	☐
Concavidad subpubico	☐	☐
Rama isquipubica	☐	☐
Arco ventral	☐	☐

EDAD Rango
Edad Codigo

Craneo

Midlambdoid	☐	Midcoronal	☐
Lambda	☐	Pterion	☐
Obelion	☐	Esfenofrontal	☐
Sagital ant.	☐	Esfenotemp Inf.	☐
Bregma	☐	Esfenotemp Sup.	☐
TOTAL	☐	TOTAL	☐

NOTAS (sexo/genero):



CENTRO INAH TLAXCALA, PROYECTO
ARQUEOLÓGICO TEPETICPAC
INVENTARIO INDIVIDUAL (ADULTO

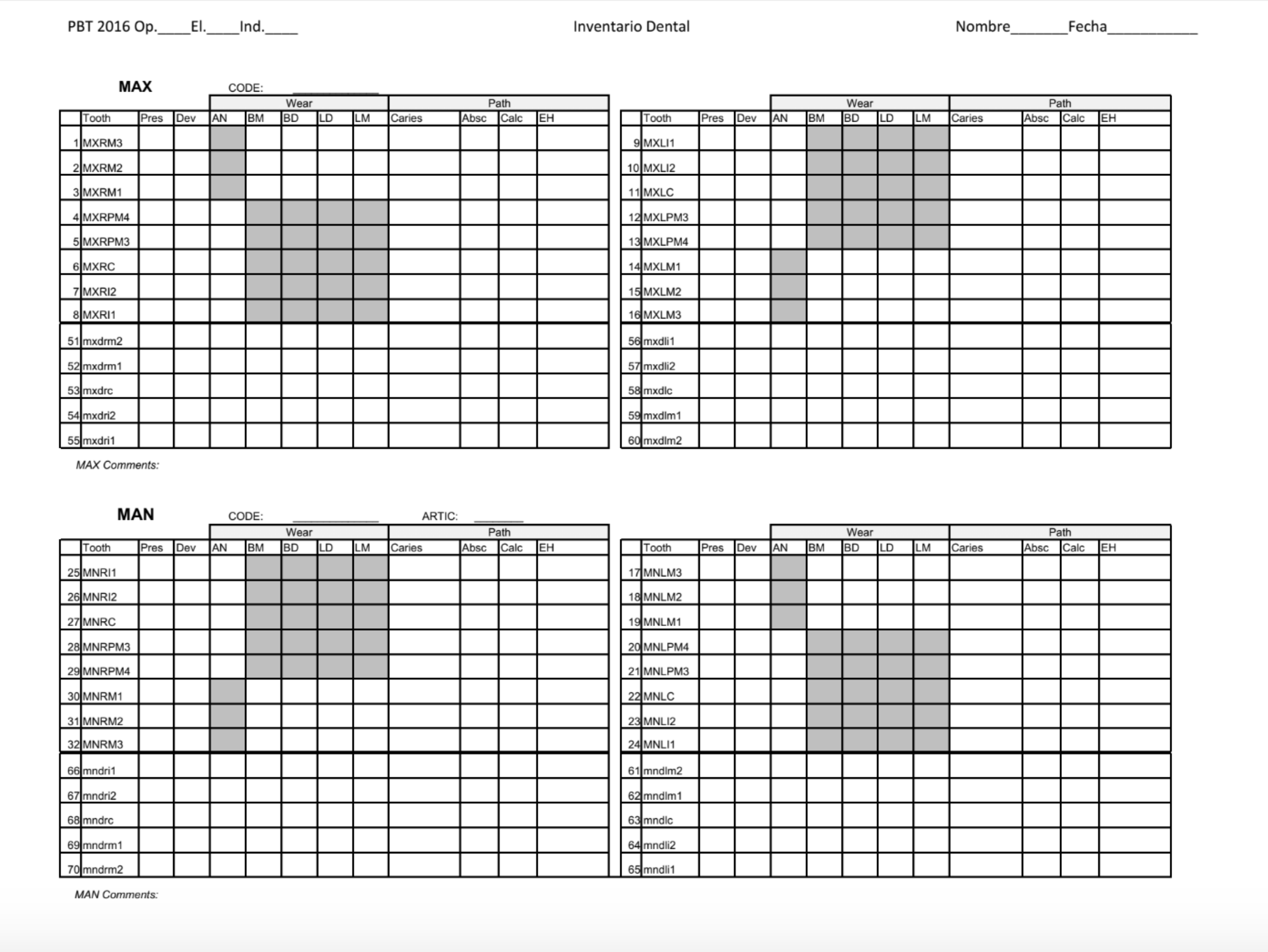
Codigo Ent.
Fecha Analizado
Quien Analice
Operacion
Elemento
Ano Exc.
Cuadro
Capa
Nivel

Tafonomia:

Patologia:

General:

■	Parte presente/ ubicacion precisa
▨	Parte presente / Ubicacion insegura
▩	Parte fragmentada o erosionada
⁄	Fracturado
■	Diente presente in situ
▨	Diente aislado de identificacion segura
?	Diente aislado de identificacion insegura
X	Diente perdido ante mortem
A	Agenesia
I	Germen presente in situ
L	Germen aislado de identificacion segura
•	Germen aislado de identificacion insegura
☐	Erupción



PBT 2016 Op.____El.____Ind.____ Inventario Dental Nombre_______Fecha___________

MAX CODE: ___________

				Wear					Path			
	Tooth	Pres	Dev	AN	BM	BD	LD	LM	Caries	Absc	Calc	EH
1	MXRM3			▨								
2	MXRM2			▨								
3	MXRM1			▨								
4	MXRPM4				▨	▨	▨	▨				
5	MXRPM3				▨	▨	▨	▨				
6	MXRC				▨	▨	▨	▨				
7	MXRI2				▨	▨	▨	▨				
8	MXRI1				▨	▨	▨	▨				
51	mxdrm2											
52	mxdrm1											
53	mxdrc											
54	mxdri2											
55	mxdri1											

				Wear					Path			
	Tooth	Pres	Dev	AN	BM	BD	LD	LM	Caries	Absc	Calc	EH
9	MXLI1				▨	▨	▨	▨				
10	MXLI2				▨	▨	▨	▨				
11	MXLC				▨	▨	▨	▨				
12	MXLPM3				▨	▨	▨	▨				
13	MXLPM4				▨	▨	▨	▨				
14	MXLM1			▨								
15	MXLM2			▨								
16	MXLM3			▨								
56	mxdli1											
57	mxdli2											
58	mxdlc											
59	mxdlm1											
60	mxdlm2											

MAX Comments:

MAN CODE: ___________ ARTIC: _______

				Wear					Path			
	Tooth	Pres	Dev	AN	BM	BD	LD	LM	Caries	Absc	Calc	EH
25	MNRI1				▨	▨	▨	▨				
26	MNRI2				▨	▨	▨	▨				
27	MNRC				▨	▨	▨	▨				
28	MNRPM3				▨	▨	▨	▨				
29	MNRPM4				▨	▨	▨	▨				
30	MNRM1			▨								
31	MNRM2			▨								
32	MNRM3			▨								
66	mndri1											
67	mndri2											
68	mndrc											
69	mndrm1											
70	mndrm2											

				Wear					Path			
	Tooth	Pres	Dev	AN	BM	BD	LD	LM	Caries	Absc	Calc	EH
17	MNLM3			▨								
18	MNLM2			▨								
19	MNLM1			▨								
20	MNLPM4				▨	▨	▨	▨				
21	MNLPM3				▨	▨	▨	▨				
22	MNLC				▨	▨	▨	▨				
23	MNLI2				▨	▨	▨	▨				
24	MNLI1				▨	▨	▨	▨				
61	mndlm2											
62	mndlm1											
63	mndlc											
64	mndli2											
65	mndli1											

MAN Comments:

PAT 2015 Op. ____ El.___ Ind.______

Inventario del esqueleto

Nombre__________ Fecha ________

Inventory							Demography		Cranial				Comments
Bone Code	Bone	Side	Segment	Compl.	Tooth Count	Count	Age	Sex	CD	CO	PH	Trauma	
	Frontal	R											
	Frontal	L											
	Parietal	R											
	Parietal	L											
	Temporal	R											
	Temporal	L											
	Occipital	R											
	Occipital	L											
	Maxilla	R											
	Palatine	L											
	Vomer	U											
	Inf. Nas. Con	R											
	Inf. Nas. Con	L											
	Ethmoid	U											
	Lacrimal	R											
	Lacrimal	L											
	Nasal	R											
	Nasal	L											
	Zygomatic	R											
	Zygomatic	L											
	Sphenoid	U											
	Mandible	U											
	Hyoid	U											
									OA	Loc. OA	Trauma	Periostitis	
	C1	U											
	C2	U											
	C3-7	U											
	T1-12	U											
	L1-5	U											
	Sternum bod	U											
	Manubrium	U											
	Rib 1	L											
	Rib 2	L											
	Rib 3-11	L											
	Rib 12	L											
	Rib 1	R											
	Rib 2	R											
	Rib 3-11	R											
	Rib 12	R											

APPENDIX B: ETHNOGRAPHIC INERVIEW PROTOCOLS

Principal Investigator: Keitlyn Alcantara
Study Title: Foodways in Ancient and Contemporary Tlaxcala, Mexico
Institution: Vanderbilt University

Sample Recruitment Script:
I would like to invite you to participate in a qualitative study about the relationship between ancient Tlaxcalteca foodways, and their adaptations and uses in the present. I am interested in understanding how ancient ingredients continue to be farmed and used in contemporary Tlaxcalteca cuisine, and how food knowledge has come to persist from the past to the present. The answers you provide will be used to help me interpret data about diet recovered from ancient skeletons excavated at Tepeticpac. I will ask questions such as the following: What traditional ingredients do you use (in your home/meals/kitchen)? Where or from whom did you learn to use these ingredients? In what contexts are these ingredients used? You can answer in any way you like. There is no right or wrong answer. The interview will be semi-structured – I have set questions, but we can talk about related subjects as well, at your discretion. The interview will last approximately one hour. You may decide to end the interview at any time. You may also ask to withdraw your information at any time. Participation is completely voluntary. Would you like to participate?

Ejemplo de invitación:
Me gustaría invitarlo a participar en un estudio cualitativo acerca de la relación entre los hábitos alimenticios tlaxcaltecos del pasado y cómo se han ido adaptando para llegar a los usos actuales de ingredientes originarios. La intención es entender cómo es que estos ingredientes de la antigüedad se siguen cultivando y usando en la cocina tlaxcalteca contemporánea, y también cómo ha persistido este conocimiento culinario desde tiempos prehispánicos hasta la actualidad. Las respuestas que me puedan proporcionar también me serán de utilidad para interpretar datos obtenidos de excavaciones de esqueletos antiguos en el sitio de Tepeticpac. Las preguntas que se realicen serán como las siguientes: ¿Qué ingredientes tradicionales utilizas (en tu casa/comida/cocina)? ¿Dónde o de quién aprendiste a usar estos ingredientes? ¿En qué contextos se usan estos ingredientes? Puede responder de la manera que quiera. No hay respuestas correctas ni incorrectas. La entrevista estará media estructurada – es decir, yo traigo ciertas preguntas para que responda, pero también podemos hablar acerca de temas relacionados si así lo desea. La entrevista tendrá una duración de aproximadamente una hora. Sin embargo, puede decidir terminar la entrevista en cualquier momento. También puede pedir que se retire su información del estudio en cualquier momento. La participación es completamente voluntaria. ¿Estaría interesado en participar?

Formato de consentimiento informado

Me gustaría invitarlo a participar en un estudio cualitativo acerca de la relación entre los hábitos alimenticios tlaxcaltecos del pasado y cómo se han ido adaptando para llegar a los usos actuales de ingredientes originarios. La intención es entender cómo es que estos ingredientes de la antigüedad se siguen cultivando y usando en la cocina tlaxcalteca contemporánea, y también cómo ha persistido este conocimiento culinario desde tiempos prehispánicos hasta la actualidad. Las respuestas que me puedan proporcionar también me serán de utilidad para interpretar datos obtenidos de excavaciones de esqueletos antiguos en el sitio de Tepeticpac. Las preguntas que se realicen serán como las siguientes: ¿Qué ingredientes tradicionales utilizas (en tu casa/comida/cocina)? ¿Dónde o de quién aprendiste a usar estos ingredientes? ¿En qué contextos se usan estos ingredientes? Puede responder de la manera que quiera. No hay respuestas correctas ni incorrectas. La entrevista estará media estructurada – es decir, yo traigo ciertas preguntas para que responda, pero también podemos hablar acerca de temas relacionados si así lo desea. La entrevista tendrá una duración de aproximadamente una hora. Sin embargo, puede decidir terminar la entrevista en cualquier momento. También puede pedir que se retire su información del estudio en cualquier momento. La participación es completamente voluntaria. Durante la entrevista, estaré tomando notas a mano para registrar sus respuestas. Le puedo entregar una copia de estas notas si así lo desea, y tendrá la decisión final acerca de qué tanto de la información proporcionada se puede incluir en este estudio. También, con su permiso, me gustaría grabar la entrevista para que pueda regresar y escuchar nuestra conversación en otro momento.

¿Está de acuerdo de que se grabe la entrevista?
CIRCULA SÍ o NO

Los datos de la entrevista serán vinculados a una clave única que identifica su papel de informante acerca de alimentos, su sexo y edad. A menos de que se solicite claramente, no se incluirá su nombre y toda la información que proporcione será vinculada a esta clave única. Posteriormente, estos datos se guardarán en un archivo cifrado que sólo podrán consultar mi tutora y su servidora.

¿Le gustaría que lo identifiquemos por nombre?
CIRCULA SÍ o NO

Puede solicitar los resultados y las publicaciones que se generen con base en esta entrevista sin costo alguno, si así lo desea. Antes de publicar mi trabajo, me contactaré con usted para solicitarle de nuevo su consentimiento acerca de la manera en que presento la información. Le entregaré mi tarjeta con correo electrónico para que se pueda poner en contacto conmigo acerca de la entrevista en cualquier momento.

¿Está usted de acuerdo con estas condiciones y acepta que lo entreviste el día de hoy (fecha)?

Firma: ____

Interviewee Consent Form

I would like to invite you to participate in a qualitative study about the relationship between ancient Tlaxcalteca foodways, and their adaptations and uses in the present. I am interested in understanding how ancient ingredients continue to be farmed and used in contemporary Tlaxcalteca cuisine, and how food knowledge has come to persist from the past to the present. The answers you provide will be used to help me interpret data about diet recovered from ancient skeletons excavated at Tepeticpac. I will ask questions such as the following: What traditional ingredients do you use (in your home/meals/kitchen)? Where or from whom did you learn to use these ingredients? In what contexts are these ingredients used? You can answer in any way you like. There is no right or wrong answer. The interview will be semi-structured – I have set questions, but we can talk about related subjects as well, at your discretion. The interview will last approximately one hour. You may decide to end the interview at any time. You may also ask to withdraw your information at any time. Participation is completely voluntary.
During the interview, I will take written notes to record your answers. I can provide you a copy of these notes upon request, and you will have final say about what information will be included in the study. I would also like to record the interview, so that I can go back and re-listen to it at a later time.

Is it okay if I record this interview?
Circle YES or NO

The interview data will be linked to a unique code that identifies your role as food knowledge holder, gender, and age. Unless you explicitly requested to be referred to by name, the information you provide will be referred to by unique ID in data analysis. This data will be uploaded to an encrypted file, accessible only to myself and my advisor.

Would you like to be referred to by name?
Circle YES or NO

All results and publications from this interview will be made accessible to you upon request at no cost. Prior to publication, I will ask again for your consent regarding the way the information is presented. I will give you a business card with my email address, and you may contact me at any time regarding this interview.

Do you agree to these conditions, and to being interviewed today (date)?

Sign ____________________________________

Sample Interview questions

Household and commercial chefs

1. What traditional ingredients do you use in your recipes?
2. Where or from whom did you learn to use these ingredients?
3. Are there particular social contexts within which these recipes are used?
4. Are there recipes used only for community meals?
5. Are there recipes used only for private, or family meals?
6. How have you adapted traditional recipes?
7. What role did ancestral knowledge play in your use of these recipes (for example, did a grandparent pass this information down?)
8. What knowledge do you have about pre-hispanic Tlaxallan foodways?

Household and commercial farmers

1. What local plants do you sow?
2. Where or from whom did you learn your planting techniques?
3. Can you describe some of the methods of planting you use?
4. Why do you choose these particular plants?
5. In what ways do you use these plants in your daily life?
6. What role did ancestral knowledge play in your use of these plants (for example, did a grandparent pass this information down?)
7. What knowledge do you have about pre-hispanic Tlaxallan foodways?

Preguntas de entrevista

Cocineras en el hogar y comerciales

1. ¿Qué ingredientes tradicionales usa en sus recetas?
2. ¿Dónde o de quién aprendió a usar estos ingredientes?
3. ¿Hay ciertas ocasiones o contextos sociales en las cuales se usan estos ingredientes?
4. ¿Hay platillos que sólo se hacen para eventos comunitarios?
5. ¿Hay platillos que se reservan para comidas familiares?
6. ¿Cómo ha adaptado recetas tradicionales?
7. ¿Qué papel jugaron sus antepasados en su uso de estas recetas? Por ejemplo, ¿es una receta de la abuela o bisabuela?
8. ¿Qué tanto conoce acerca de los hábitos alimenticios de los tlaxcaltecas antes de la llegada de los españoles?

Agricultores individuales y comerciales

1. ¿Qué plantas endémicas o locales siembra en sus parcelas?
2. ¿Dónde o de quién aprendió como sembrar?
3. ¿Me puede explicar algunos de los métodos que utiliza al sembrar?
4. ¿Por qué eligió trabajar con estas plantas específicas?
5. ¿Cómo utiliza estas plantas en su vida cotidiana?
6. ¿Qué papel jugaron sus antepasados en su uso de estas recetas? Por ejemplo, ¿es algo que aprendió de su padre, quien lo aprendió de su padre y así sucesivamente?
7. ¿Qué tanto conoce acerca de los hábitos alimenticios de los tlaxcaltecas antes de la llegada de los españoles