ARCHAEOLOGY/ANTHROPOLOGY

"An important and timely contribution to both the bioarchaeology of Mesoamerica and the deployment of osteobiography within the field of bioarchaeology."
—**Lauren Hosek**, University of Colorado, Boulder

"The authors of this volume take a challenging approach to understanding the lived experience of people in the past in a novel and interesting way."
—**Corey Ragsdale**, Southern Illinois University

DRAWING FROM A VARIETY of sites throughout Mesoamerica, this volume presents a collection of osteobiographies, which analyze skeletons and their surroundings alongside historical, archaeological, ethnographic, and other contextual data to better understand the life experiences of individuals. This approach allows for a focus on the processes by which individual social identities are created, negotiated, and altered.

In these chapters, contributors address what individual bodies reveal about their societies, what burials can tell us about the ways people were remembered, and what information about disease and health indicates about lifestyles. Each case study compiles a range of available data to gain insights into a specific time and place. Re-creating the lives of individuals from locations in Belize, Mexico, Guatemala, and Honduras, the volume includes descriptions of everyday activities, the social roles of priests and merchants, memorial practices, and many other spheres of human life.

Mesoamerican Osteobiographies demonstrates how the diverse, culturally laden, and complex archaeological record of Mesoamerica can uniquely contribute to bioarchaeology, in part due to the region's many unusual and elaborate mortuary contexts. The different contributions in this volume show that the osteobiography approach can be integrated into existing research frameworks, both in Mesoamerica and around the world, to answer meaningful biocultural questions about the lives and deaths of ancient people.

Gabriel D. Wrobel, professor of anthropology at Michigan State University, is the editor of *The Bioarchaeology of Space and Place: Ideology, Power, and Meaning in Maya Mortuary Contexts*. **Andrea Cucina**, professor of bioarchaeology at the Universidad Autónoma de Yucatán in Mérida, Mexico, is editor or coeditor of several volumes, including *Bioarchaeology of Pre-Columbian Mesoamerica: An Interdisciplinary Approach*.

Cover art by and courtesy of Christophe Helmke

University of Florida Press
http://upress.ufl.edu

ISBN 978-1-68340-445-3 $125.00
12500
9 781683 404453

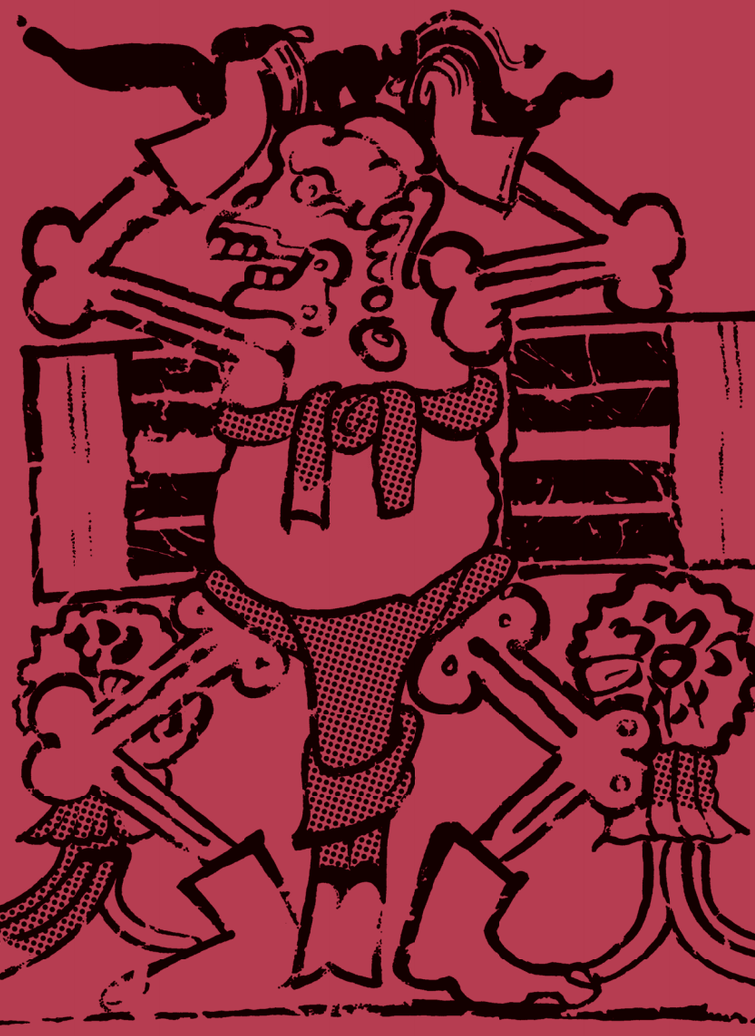
Mesoamerican Osteobiographies

Wrobel and Cucina

UF PRESS

Mesoamerican Osteobiographies

Revealing the Lives and Deaths of Ancient Individuals



EDITED BY
Gabriel D. Wrobel
AND
Andrea Cucina

Cover art by and courtesy of Christophe Helmke

Published in the United States of America

29 28 27 26 25 24 6 5 4 3 2 1

Library of Congress Cataloging-in-Publication Data
Names: Wrobel, Gabriel D., editor. | Cucina, Andrea, 1966– editor.
Title: Mesoamerican osteobiographies : revealing the lives and deaths of ancient individuals / edited by Gabriel D. Wrobel and Andrea Cucina.
Other titles: Revealing the lives and deaths of ancient individuals
Description: 1. | Gainesville : University of Florida Press, [2024] | Includes bibliographical references and index.
Identifiers: LCCN 2023051891 (print) | LCCN 2023051892 (ebook) | ISBN 9781683404453 (hardback) | ISBN 9781683404538 (pdf) | ISBN 9781683404651 (ebook)
Subjects: LCSH: Human remains (Archaeology)—Central America. | Human remains (Archaeology)—Mexico. | Indians of Mexico—Antiquities. | Indians of Central America—Antiquities. | BISAC: SOCIAL SCIENCE / Anthropology / Cultural & Social | SOCIAL SCIENCE / Archaeology
Classification: LCC CC79.5.H85 M47 2024 (print) | LCC CC79.5.H85 (ebook) | DDC 972/.01—dc23/eng/20240213
LC record available at https://lccn.loc.gov/2023051891
LC ebook record available at https://lccn.loc.gov/2023051892

UF PRESS
UNIVERSITY OF FLORIDA

University of Florida Press
2046 NE Waldo Road
Suite 2100
Gainesville, FL 32609
http://upress.ufl.edu

CONTENTS

3

Life into Old Age

A Female Forager-Horticulturalist from the Middle Holocene in Belize

Emily Moes, Lexi O'Donnell, Ethan C. Hill, Mark Robinson, Douglas J. Kennett, and Keith Prufer

Bioarchaeological research focusing on elderly individuals is rare relative to their young or middle adult counterparts. This is partly due to differential patterns of recovery in archaeological assemblages. The skeletons of old adults, especially those of females, are often lighter or osteoporotic, making them less likely to preserve well when buried (Hoppa and Vaupel 2002). Those that are recovered are given age estimations that can span almost half a lifetime since traditional methods of skeletal age estimation group older individuals into a broad category of "50± years." As a result, empirical evidence of the lives of the eldest members of a society are often overlooked in favor of those classified as middle-aged adults and those with remarkable evidence of disease or status. In this chapter, we detail the skeletal biology of a preagriculturalist old adult female excavated from a rock-shelter in southern Belize. We estimate her age to be 81 years (confidence interval 64–93 years) using updated age estimation techniques (Milner and Boldsen 2016). We contextualize this osteobiography based on the environmental and geographic characteristics of the landscape around the burial site, located in the rugged karst terrain of the Maya Mountains during the Middle Holocene.

Ethics Statement

The individual included in this chapter was excavated by the Bladen Paleoindian and Archaic Archaeological Project (BPAAP) in the Bladen Nature Reserve (BNR) under permits issued by the Belize Institute of Archaeology (IA) and the Belize Forest Department. Skeletons recovered by the BPAAP

were exported under permits issued by the IA to Keith M. Prufer in accordance with the laws of Belize, with permission to conduct molecular analyses on skeletal tissues. Research was conducted in close collaboration with the Ya'axché Conservation Trust, an internationally recognized Belizean NGO that comanages the BNR with the government of Belize. Ya'axché is locally managed and staffed by members of descendant Maya communities. As part of this collaboration, BPAAP research proposals are reviewed annually by the Ya'axché administrative and scientific staff. In 2016 and 2018, KMP gave consultation presentations to the local staff of Ya'axché and other interested community members on our research, including isotopic and genomic studies on ancient humans from Belize. In 2020, in coordination with Ya'axché, KMP invited Indigenous leaders and community members from villages proximate to the BNR to consult on this research. KMP delivered a presentation detailing the fieldwork, laboratory work, and research results, followed by a question-and-answer session for attending members from five villages. Community members requested future public consultations to update them on additional research results as well as copies of all study results in English with translations into Mopan and Q'eqchi' languages.

Environmental Context

The focal individual of this chapter was excavated from a rock-shelter in a remote valley in the southern Maya Mountains. Located in Southern Belize, these mountains serve as the formidable western boundary of this geographically diverse region, which is bounded by swampy wetlands to the south, the Caribbean Sea to the east, and pine savannas to the north. These varied landscapes have been continuously inhabited by people since the Late Pleistocene due to their economic importance to foraging and farming populations.

Despite receiving up to 4,000 mm of rainfall annually, southern Belize is considered a seasonal desert in which there is little rain for several months of the year and evaporation exceeds precipitation. The wettest area in the region is that of the southern Maya Mountains, the largest relief feature in the Maya Lowlands. They are remnants of an ancient volcanic range that was subsequently submerged, and they are flanked by a limestone apron. High precipitation during the Quaternary has carved out a network of caves and cockpit karst. Geologically, the mountains are composed of steep, craggy limestone hills and alluvial valleys in which eroding volcanic rock and decaying limestone form rich soils. The high diversity of tropical plant and animal life were exploited for 12 millennia by people living in these valleys, surrounded by near-vertical mountains (Prufer et al. 2021). For early populations, the Maya

Mountains hosted a range of edible plants, including tree fruits, nuts, roots, and seeds, and a wide range of palms that served as sources of fiber, thatch, and food. Their diets also included deer, tapir, and peccary, in addition to freshwater snails, crabs, and fish.

Saki Tzul Rock-Shelter

In an interior valley of the Maya Mountains, Saki Tzul is a rock-shelter located 70 m above the Ek Xux Creek in the Bladen Nature Reserve (BNR) (Figure 1.1), a protected wilderness that has seen little modern human disturbance of archaeological sites. Saki Tzul, meaning "white cliff" in Mopan Maya, is formed by a massive (80 m high, 145 m long) limestone overhang sheltering approximately 1700 m^2. The cliff protects the soils below from the elements, so the rock-shelter's interior receives little to no direct rainfall. As a result, the sediment within the rock-shelter is very dry, facilitating excellent skeletal preservation relative to other burials at most sites in the tropics. Generally, the recovery of skeletal remains prior to approximately 3000 cal. BP is exceedingly rare in Central America, so the fact that we found such intact burials at Saki Tzul is critical for the advancement of our understanding of human lives prior to the development of sedentary agricultural communities in the Neotropics.

Excavations between 2016 and 2022 documented the cultural use of this rock-shelter spanning approximately 11,500 years. These excavations revealed both primary and secondary human burials as well as faunal bone, riverine shellfish, stone tools, and carbonized plant material. Many stratigraphic levels included isolated human bones, some of which resulted from intrusions into earlier contexts, while others were intentional deposits of individual or multiple elements. The primary burials exhibited a wide range of mortuary practices, although individuals in varying degrees of flexure were the most common and were found in all time periods. It was not uncommon for isolated elements to be recovered with primary or secondary burials, and it is unknown if these were intentional or accidental inclusions.

Mortuary Context

Burial ST.18.11.8 (hereafter ST.8) consists of the primary interment of an old adult female (see Skeletal Biology below) directly dated on XAD extracted amino acids from bone collagen to 5040–4860 cal. BP (PSUAMS-5896; 4390 BP ± 20). She was buried in a flexed position on her right side, with her head to the south, facing east (Figure 3.1). Approximately 85% of her skeleton was

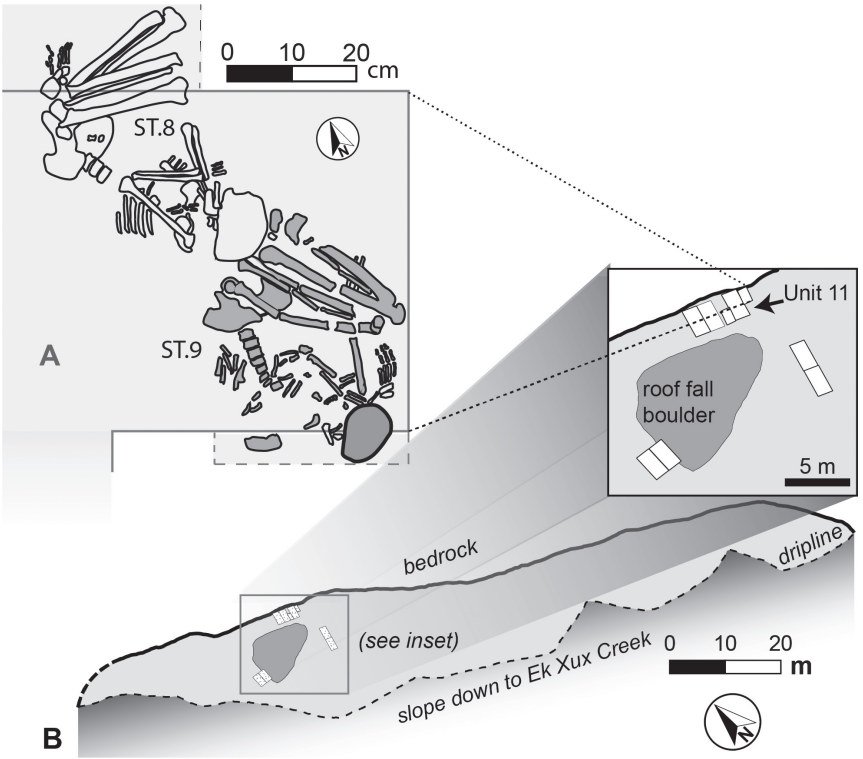


Figure 3.1. Burial sketch of ST.8 and ST.9 in situ, with inset (*A*) denoting burial location within a plan view of Saki Tzul (*B*), Map by K. Prufer.

present and in fair condition, considering that almost every bone was fragmented. In death, she was covered by one course of three flat river stones (approximately 30–50 cm in diameter) placed above her head, thorax, and abdomen. ST.8 was found directly north of another individual, burial ST.18.11.9 (ST.9), who was interred around the same time, albeit earlier, at 4960–4820 cal. BP (PSUAMS-5987, 4300 BP ± 30), but who was later partially disturbed by the interment of ST.8 (Figure 3.1). Analyses of aDNA indicate that these two individuals are unrelated (Kennett, Lipson, et al. 2022). ST.8 did not have any associated grave goods, and her mortuary treatment was consistent with other preagricultural burials we have excavated in that she was interred in a shallow pit and covered with loosely packed sediments and large, flat rocks.

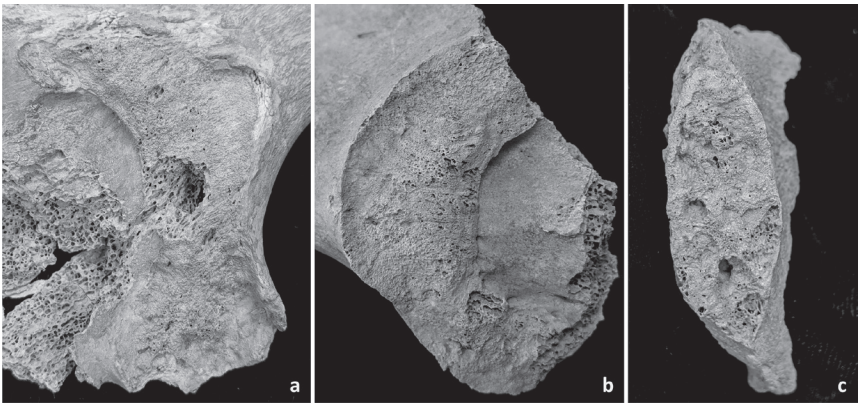


Figure 3.2. Surfaces used for age estimation of ST.8: (*a*) left iliac auricular surface; (*b*) right iliac auricular surface; (*c*) right pubic symphysis. Photographs by E. Moes.

Skeletal Biology

Osteological Analysis

Morphological features of the pelvis indicate that ST.8 is a female, a finding confirmed through aDNA (Kennett, Lipson, et al. 2022). During skeletal analysis, traditional methods of adult age estimation were used (Table 3.1; Buikstra and Ubelaker 1994), but these methods introduce issues such as age mimicry, fixed age intervals (i.e., older adults are categorized as 50± years), and typically underestimate the ages of older adults (Hoppa and Vaupel 2002). To address these issues, we also estimated ST.8's age using transition analysis (Milner and Boldsen 2016), a Bayesian method created using samples of known age and sex using indicators from the auricular surface, pubic symphysis, and cranial sutures. Unlike traditional methods, transition analysis estimates the probability of transitioning from one age stage into the next, therefore providing less biased estimations for older adults rather than grouping them into one category. Due to taphonomic damage, we could not use all features typically recorded in transition analysis. Instead, we scored characteristics on the right pubic symphysis and both iliac auricular surfaces (Figure 3.2; Table 3.1). Using ADBOU software 2.1 (Ousley 2016), we derived an age estimate of 81 years.

Consistent with an individual of advanced age (Waldron 2019), primary osteoarthritis is evident to varying degrees in regions of her skeleton. Although there are at least minimal arthritic changes in all her joints, the most severely affected areas are her neck, lower back, and knees. Two of her cer-

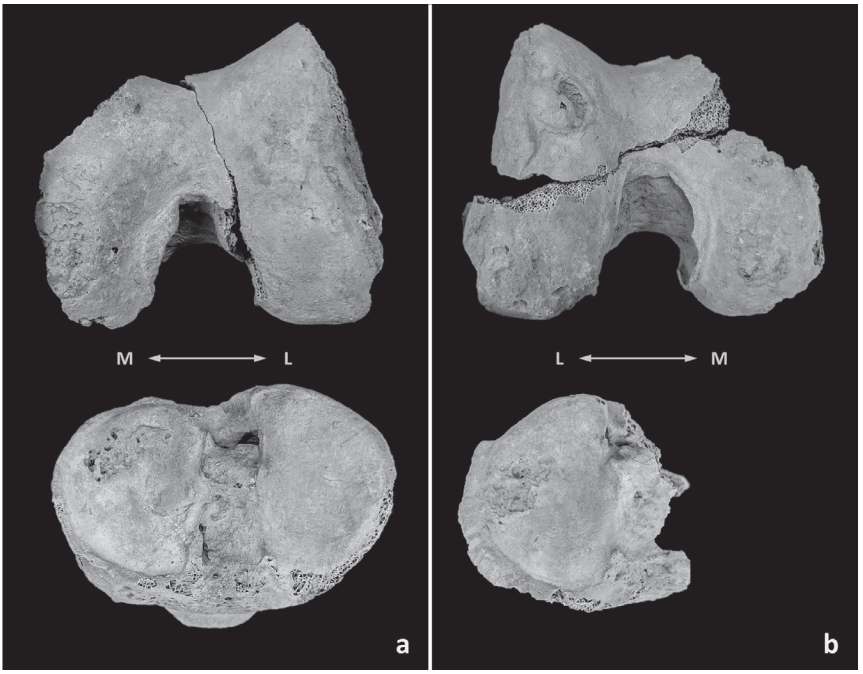


Figure 3.3. Osteoarthritic changes in the (*a*) left distal femur and proximal tibia, and (*b*) right distal femur and proximal tibia. Note the cyst-like lesion on the right femur and subchondral bone exposure throughout. Photographs by E. Moes.

vical vertebrae had completely fused together. Arthritis in her back is especially pronounced in the lumbar vertebrae and sacrum, which have extensive lipping, osteophytic spicules, and actively resorbing annular rings. Figure 3.3 shows the active and sclerotic degeneration in both of her knees, which is particularly remarkable due to the subchondral bone exposed in several places on the joint surfaces. Similar lesions in longitudinal clinical studies are associated with extensive cartilage loss in the adjacent areas of the joint caused by carrying heavy loads (Yuan et al. 2014), suggesting that ST.8's knees were subjected to substantial and frequent load bearing. The erosion in the right femur is much more pronounced than in the left, such that it has severe marginal lipping, more areas of osteochondral lesions, and actively resorbing condylar margins. The differences between the left and right femora may be due to preferential use of one side over the other (such as from handedness), or due to chronic asymmetry in ST.8's gait caused by, for example, trauma earlier in her life. The plateaus of both tibiae mirror the changes observed in the distal femora. Evidence of arthritis is mild to moderate throughout the other areas of her skeleton.

Table 3.1. Age estimation methods used in the analysis of ST.18.11.8

Method	Elements used[a]	Score (L)	Score (R)	Age estimate (yrs)	Range
Buckberry and Chamberlain (2002)	AS	14	15	59.94, 66.7	29–88, 39–91
Lovejoy et al.*	AS	7	5	—	50–59, 40–44
Suchey-Brooks*	PS	—	5	49	25+
Todd*	PS	—	10	—	50+
Milner and Boldsen (2016)	PS: relief	—	6	81	64.4–92.7
	PS: texture	—	4		
	PS: superior apex	—	4		
	PS: ventral margin	—	7		
	PS: dorsal margin	—	5		
	AS: superior topography	2	3		
	AS: inferior topography	3	2		
	AS: superior morphology	4	4		
	AS: middle morphology	4	4		
	AS: inferior morphology	4	4		
	AS: inferior texture	3	2		
	AS: superior exostoses	—	—		
	AS: inferior exostoses	—	—		
	AS: posterior exostoses	—	—		

[a] AS: auricular surface; PS: pubic symphysis; * as cited in Buikstra and Ubelaker 1994.

ST.8 has fractures on her left fifth metatarsal, left clavicle, and left ulna. The fractures on both the metatarsal and ulna occurred at the distal third of the diaphysis. Both are well-healed and well-aligned. Fractures on the distal diaphysis of fifth metatarsals are most commonly sustained through inversion injuries or falls from height (Cakir et al. 2011). The clavicular fracture occurred on the acromial end and resulted in the distal-most portion deviating anteriorly, creating an almost 90° angle, but it is also well-healed. Injuries of the acromial end of the clavicle most commonly occur in accidental circumstances, specifically in falls (Nowak et al. 2000). Additionally, all injuries are restricted to the left side and show the same degrees of healing. It is possible that they occurred in the same accident. Injuries like these would be consistent with living and foraging in the Maya Mountains where foot travel can be arduous and sometimes dangerous.

Since all her fractures are well-healed and display cortical remodeling continuous with the rest of the bone, they represent remote instances of trauma (Maat 2008:246). Using estimates from the clinical literature, we can speculate on the amount of time it would have taken ST.8 to recover from her injuries. Metatarsal fractures typically heal in 4 to 6 weeks, with modern medical intervention (Cakir et al. 2011). Clavicular fractures, treated using figure-eight bandages, take 8 to 12 weeks to heal. Ulnar fractures can take 4 to 12 weeks to reunite when the arm is immobilized (du Toit and Grabe 1979). Due to the nature of her injuries, it is likely that all ST.8's fractures required splints or other immobilization to heal, evidence of which have been identified by archaeologists in other contexts (Ellis 2011). Even with immobilization, ST.8 would have needed at least several weeks to months to heal completely. As such, she likely spent a considerable amount of time unable to conduct many daily activities, such as heavy lifting or walking. Further, her need for medical treatment and her subsequent recovery indicates that the people she lived with provided some amount of care (Stodder 2017). We also infer, based on the amount of remodeling at each fracture site, that these injuries likely occurred at least several years before ST.8 died, possibly well before she transitioned into old age.

Dental pathology is characterized by antemortem tooth loss (14/32 teeth), and moderate to severe occlusal wear on all remaining teeth. Considering her advanced age, ST.8 retained a considerable number of her teeth. It is evident that she was affected by periodontal disease since the observable alveolar margins have receded, and there are lines of dental calculus on the tooth roots, 2–3 mm removed from the crowns. Soft tissue recession would have exposed her tooth roots, and extensive dental attrition could have worn away enamel to the pulp chamber. Tooth roots and pulp chambers are more easily affected by carious lesions than tooth crowns, due to their softer structures. Therefore, a combination of periodontal disease, caries, and attrition was likely responsible for the underlying etiology of ST.8's antemortem tooth loss. Later in her life, occlusal wear may have lessened, perhaps due to a change in her diet. Specifically, the presence of calculus across the occlusal surfaces of many of ST.8's remaining molars indicates that her diet was possibly specialized to consist of foods processed to the point of not requiring additional mastication.

Stress indicators throughout her skeleton are largely absent or unobservable, possibly due to the effects of bone remodeling throughout life. The amount of dental wear and tooth loss rendered unobservable the presence of linear enamel hypoplasia, a commonly studied indicator of early life stress. However, a cranial vault fragment exhibits evidence of healed porotic hyperostosis near the lambdoidal suture. Unfortunately, much of the cranium

was not preserved, restricting observations of the extent of this pathological change. Since there are no other signs of active or healed infection throughout the skeleton, the presence of porotic hyperostosis indicates that ST.8 likely suffered nonspecific infection during her childhood (O'Donnell et al. 2020).

Molecular Analyses

ST.8 lived at a time where all available evidence suggests people in the Neotropics were increasingly relying on cultivated plants (Iriarte et al. 2020) and were likely semisedentary, although likely not yet living in permanent villages. We analyzed dietary isotopes of carbon and nitrogen from bone collagen to better understand ST.8's diet in the context of the time and place where she lived. Her $\delta^{13}C$ value is −21.4‰ suggesting that the plants she ate were almost entirely C_3, and the animals she ate were consuming only C_3 foods. $\delta^{13}C$ of collagen measures food sources from the protein fraction of the diet; therefore, this value indicates the generally low protein fraction of plants as well as the diet of the animals she was consuming. This is consistent with the diet of other individuals we have studied from this time. Specifically, we analyzed the carbon and nitrogen isotopes from bone collagen in a sample of 52 skeletons, including ST.8, from Saki Tzul and Mayahak Cab Pek, another nearby mortuary rock-shelter with a similar span of human use (Kennett, Prufer, et al. 2020). Results show that all individuals dating before 4700 cal. BP had diets consisting mostly of C_3 plants and terrestrial animals from lowland tropical environments. There is no evidence of maize consumption. Although the data do not preclude freshwater protein sources, such as snails or crabs, there is no evidence that humans were consuming marine resources as any significant portion of their diet. Isotopic values indicate that people were eating locally available plants and animals consistent with life in a tropical rainforest.

Because the shift to maize agriculture in the Maya Lowlands occurred after ST.8's lifetime (Kennett, Prufer, et al. 2020), we might expect that her diet included a significant portion of meat and C_3 tropical plants since people were not noticeably relying on domesticated plants. However, the $\delta^{15}N$ value is 6.9‰, indicating that her diet did not include large quantities of meat relative to her contemporaries in our total data set, which have an average $\delta^{15}N$ value of 8.5‰. Since the isotopic signatures of consumed carbon and nitrogen in adulthood originate from skeletal tissue, these values reflect the diet of ST.8 in the last 10–15 years of her life, an estimate based on the slower rate of bone turnover in older adults (Recker et al. 2009). This suggests that she was consuming either less animal protein relative to her contemporaries or protein sources of lower trophic position in the latter years of her life.

Analysis of aDNA extracted from her right petrous pyramid reveals that

ST.8 belongs to the C1c haplogroup, a very common matriline that is exclusive to Native Americans and that is indicative of an early arrival from Beringia with Paleoindians (Perego et al. 2010). She shares ancestry with the earliest foraging population in the region for whom we have data (Posth et al. 2018) as well as with the groups of more recent arrivals to Belize who likely migrated from the Isthmo-Colombian home of proto- or early-Chibchan speaking people sometime between 7400 and 5000 cal. BP (Kennett, Lipson, et al. 2022). Therefore, ST.8 was part of growing population of people who shared ancestry with a diaspora who migrated into the Maya Lowlands from lower Central America, probably bringing with them new technologies and varieties of cultivated plants in the millennia before farming became the primary economic occupation in the region.

Discussion

Without comparative skeletal assemblages from the Middle Holocene Neotropics, we cannot know if the lived experiences of ST.8 were typical of her contemporaries, let alone her community. We cannot make any assumptions regarding the lives of other women or, more generally, other older adults. There are no direct markers of status associated with the burial of ST.8, which is typical for the individuals recovered from this site. However, we do not know what may constitute markers of status for early forager-horticulturalists living in residentially mobile societies. Social inequality is more often associated with agricultural economies, although it is likely that achieved status and prestige were conferred on some individuals in preagricultural populations, which could result in buffering effects against certain facets of daily life. While not observable through artifacts, other aspects of ST.8's mortuary treatment may provide clues about her status.

Interment at Saki Tzul likely held significance for multiple groups inhabiting the region through time. While use of the rock-shelter spanned approximately 11,500 years, individuals were not continuously buried there, nor was it likely the exclusive burial location for any one community (Kennett, Prufer, et al. 2020). Instead, mortuary use seems episodic, but persistent, across the Holocene. Saki Tzul and neighboring Mayahak Cab Pek contain over 40 burials dating to the Early and Middle Holocene, suggesting that these sites were known and sometimes preferred locations for burying the dead for thousands of years. While we might assume that interment at Saki Tzul was reserved for certain individuals, the significance to the groups who used it may have varied over time.

Regardless, Saki Tzul could not have been considered a convenient burial

location, even for individuals residing in the nearby Ek Xux valley. Surviving members of the group would have had to carry the deceased as much as 70 m up a near-vertical slope in a very rugged karstic mountain range in order to bury them at Saki Tzul. As such, ST.8 may have been regarded preferentially, or at least differently, by the members of her community to warrant this type of mortuary treatment, indicating that some aspects of her life may not be representative of the rest of her population. Perhaps her old age, achieved life status, or other characteristics would have rendered this treatment necessary. Regardless of the specific reason, burial in this rock-shelter may have served a special purpose for ST.8's people, perhaps a place to revisit since it was relatively undisturbed by rain or vegetation.

When examining her skeleton for clues about ST.8's life, a notable feature is the extensive degeneration evident in her knees. The osteochondral lesions and marginal resorption of her distal femora may be due to subchondral insufficiency fractures (SIFs) (Gorbachova et al. 2018). Commonly seen in women older than 50 years, SIFs are thought to result from mechanical or physiological stresses applied to weakened trabeculae in the knees, often associated with osteopenia, leading to fractures along the subchondral areas of the femur. Alternatively, these changes may be due to bone contusions associated with osteoarthritis, and the observed lesions the result from subchondral cysts. We cannot confirm either of these diagnoses without advanced imaging techniques (Gorbachova et al. 2018), although it is reasonable to suppose, based on evidence from clinical cases, that either condition would have been painful to ST.8. However, pain is a personal experience that cannot be measured from skeletal remains. Since we cannot speculate on the amount of pain ST.8 endured (Waldron, 2019), it is impossible to infer how the degeneration in her knees impacted her movement or daily activities.

The overall pattern of severe degenerative joint disease in the lower back and knees of ST.8 is likely associated with habitual activities during her life. In a large-scale meta-analysis, Elisa Canetti and colleagues (2020) found a significant relationship, independent of age, between knee osteoarthritis and occupations that involved kneeling, squatting, climbing stairs, and lifting or carrying heavy loads. The relationship between joint degeneration and occupation is weaker for the lumbar spine (Muraki et al. 2009). However, lumbar osteoarthritis tends to be more common in women who regularly lift and carry heavy loads (Muraki et al. 2009). Among hunter-gatherer societies, women often travel shorter distances than men while foraging, but they typically have to carry significantly heavier burdens than men, who usually travel with minimal encumbrances (Kelly 2013). For example, among the Pumé foragers of Venezuela, women routinely transport food baskets weighing up

to 70% of their body weight (Hilton and Greaves 2008). Besides food items, women foragers also frequently carry young children, water, tools, crafting materials, and firewood during their foraging trips (Hilton and Greaves 2008; Kelly 2013). Thus, we might assume that the daily tasks of ST.8 involved burden carrying (e.g., food, water, young children, firewood) while traversing the variable, rugged terrain of the Maya Mountains, since the osteoarthritic changes observed in her body are most severe in her lower back and legs. The degeneration in her knees as well as the extensions of the articular facets onto the necks of both tali also indicate habitual squatting or kneeling (Boulle 2001; Canetti et al. 2020). These positions are commonly associated with foragers and preindustrial farmers as preferred postures while processing foods or resting, likely due to the absence of tables and chairs (Dlamini and Morris 2005).

There are few markers of systemic stress or disease on ST.8's skeleton. This may be because she did not endure any adverse health effects during her life that would have led to changes on her skeleton. Another possibility is that any previously existing evidence became obscured over time due to continual bone remodeling throughout her life. Likely, a combination of both is responsible for the lack of health indicators on her skeleton. Instead, we may infer details about her later years via insights from her oral health. Across modern and archaeological contexts, periodontal disease is a risk factor for a myriad of other diseases including cardiovascular disease, cancers, osteoporosis, and respiratory disease (DeWitte 2012; Kuo et al. 2008). Therefore, it is possible that ST.8 suffered from an illness that acted in concert with her periodontal disease that had not yet impacted her skeleton before she died. The notable existence of dental calculus on the occlusal surfaces of many of her molars indicates ST.8 had limited mastication abilities, precluding the inclusion of many forms of fibrous or tough foods in her diet. Her low $\delta^{15}N$ value indicates that there was less animal protein in her diet relative to others during her time, possibly due to the specialized diet necessitated by her tooth loss.

Conclusions

In this chapter, we discuss the evidence of the life and mortuary treatment of an old adult female from a preagricultural society in the Maya Mountains. Her skeleton shows evidence of age-related changes that are not uncommon among the elderly in other societies around the world. We rarely get a glimpse of the aging process of individuals who lived during the Middle Holocene and who were not reliant on maize agriculture. Our work with ST.8 is unique in this way. Additionally, aging is not identical across contexts because it re-

sults from an interplay between genetics, biology, culture, and society (Appleby 2018). Therefore, it is important to consider individuals of advanced ages within their own settings. That ST.8's estimated age is between 64 and 93 years is especially remarkable considering the multitude of health hazards, including the diseases and parasites, she may have been exposed to, and possibly overcame, even before reaching old age. These include conditions such as Chagas disease, leishmaniasis, hookworm, schistosomiasis, and malaria. Although her remains do not show unequivocal evidence of being affected by a specific illness, these conditions are not outside the realm of possibility. Overall, by incorporating context-specific details when studying individuals from the past, we can infer aspects of their lives that would otherwise be hidden by the anonymizing effect of population-based studies. Moving forward, information from ST.8's life may open the door to additional avenues of bioarchaeological research on preagriculturalists in the tropics including care of the elderly, activity during life, biomechanical limitations from muscle decline and joint degeneration, age-related differences in diet and nutrition, and status or prestige.

Acknowledgments

We thank the Belize Institute of Archaeology, and the Forest Department for issuing permits to conduct fieldwork. We also thank our collaborators from the Ya'axché Conservation Trust, and the members of the Mopan and Q'eqchi' communities of Southern Belize, especially Jose Mes, Raymundo Sho, Oligario Sho, Mateo Rash, and Sylvestre Rash. The work presented here is part of a larger effort funded by the National Science Foundation (SBE1632061: KMP; SBE1632144: DJK) and the Alphawood Foundation (KMP) supporting the work of the Belize Paleoindian and Archaic Archaeology Project. This research would not have been possible without our collaborators at Harvard University (David Reich Lab), Pennsylvania State University (Institute for Energy and the Environment), the University of New Mexico (Laboratory of Human Osteology; Center for Stable Isotopes), and the field and lab-based excavation teams. We also thank Dr. Heather Edgar for her comments on an earlier draft of this chapter.

References

Appleby, Joe
2018 Ageing and the Body in Archaeology. *Cambridge Archaeology Journal* 28:145–163.

Boulle, E.
2001 Evolution of Two Human Skeletal Markers of the Squatting Position: A Diachronic Study from Antiquity to the Modern Age. *American Journal of Physical Anthropology* 115:50–56.

Buckberry, J. L., and A. T. Chamberlain
2002 Age Estimation from the Auricular Surface of the Ilium: A Revised Method. *American Journal of Physical Anthropology* 119:231–239.

Buikstra, Jane E., and Douglas Ubelaker
1994 *Standards for Data Collection from Human Skeletal Remains.* Arkansas Archaeological Survey Research Series No. 44. Arkansas Archaeological Survey, Fayetteville.

Cakir, H., S. T. Van Vliet-Koppert, E. M. M. Van Lieshout, M. R. De Vries, M. Van Der Elst, and T. Schepers
2011 Demographics and Outcome of Metatarsal Fractures. *Archives of Orthopaedic Trauma and Surgery* 131:241–245.

Canetti, Elisa F. D., Ben Schram, Robin M. Orr, Joseph Knapik, and Rodney Pope
2020 Risk Factors for Development of Lower Limb Osteoarthritis in Physically Demanding Occupations: A Systemic Review and Meta-analysis. *Applied Ergonomics* 86:103097.

DeWitte, Sharon N.
2012 Sex Differences in Periodontal Disease in Catastrophic and Attritional Assemblages from Medieval London. *American Journal of Physical Anthropology* 149:405–416.

Dlamini, N., and A. G. Morris
2005 An Investigation of the Frequency of Squatting Facets in Later Stone Age Foragers from South Africa. *International Journal of Osteoarchaeology* 15:371–376.

du Toit, F. P., and R. Grabe
1979 Isolated Fractures of the Shaft of the Ulna. *South African Medical Journal* 56(1):21–25.

Ellis, H.
2011 The Early Days of Splints and Splinting. *Journal of Perioperative Practice* 21(7):251–252.

Gorbachova, Tetyana, Yulia Melenevsky, Micah Cohen, and Brett W. Cerniglia
2018 Osteochondral Lesions of the Knee: Differentiating the Most Common Entities at MRI. *Radiographics* 38:1478–1495.

Hilton, Charles E., and Russell D. Greaves
2008 Seasonality and Sex Differences in Travel Distance and Resource Transport in Venezuelan Foragers. *Current Anthropology* 49:144–153.

Hoppa, Robert D., and James W. Vaupel
2002 The Rostock Manifesto for Paleodemography: The Way from Stage to Age. In *Paleodemography: Age Distributions from Skeletal Samples,* edited by R. D. Hoppa and J. W. Vaupel, pp. 1–8, Cambridge University Press, Cambridge.

Iriarte, Jose, Sarah Elliott, S. Yoshi Maezumi, Daiana Alves, Regina Gonda, Mark Robinson, Jonas G. de Souza, Jennifer Watling, and Josephine Handley
2020 The Origins of Amazonian Landscapes: Plant Cultivation, Domestication and the Spread of Food Production in Tropical South America. *Quaternary Science Reviews* 248(15):106582.

Kelly, Robert L.
2013 *The Lifeways of Hunter-Gatherers: The Foraging Spectrum.* Cambridge University Press, Cambridge.

Kennett, Douglas K., Keith M. Prufer, Brendan J. Culleton, Richard J. George, Mark Robinson, Willa R. Trask, Gina M. Buckley, et al.
2020 Early Isotopic Evidence for Maize as a Staple Grain in the Americas. *Science Advances* 6:eaba3245.

Kennett, Douglas, Mark Lipson, Keith Prufer, David Mora-Marin, Richard George, Nadin Rohland, Mark Robinson, et al.
2022 South-to-North Migration Preceded the Advent of Intensive Farming in the Maya Region. *Nature Communications* 13:1530.

Kuo, Lan-Chen, Alan M. Polson, and Taeheon Kang
2008 Associations between Periodontal Disease and Systemic Diseases: A Review of the Inter-relationships and Interactions with Diabetes, Respiratory Diseases, Cardiovascular Diseases, and Osteoporosis. *Public Health* 122(4):417–433.

Maat, George J. R.
2008 Case Study 5.3: Dating of Fractures in Human Dry Bone Tissue—The Berisha Case. In *Skeletal Trauma Identification of Injuries Resulting from Human Rights Abuse and Armed Conflict,* edited by E. Kimmerle and J. Baraybar, pp. 245–254. CRC Press, Boca Raton.

Milner, George R., and Jesper L. Boldsen
2016 Transitional Analysis Age Estimation: Skeletal Scoring Manual. Fordisc Version 1.02. Available at https://www.statsmachine.net/software/ADBOU2/.

Muraki, Shigeyuki, Toru Akune, Hiroyuki Oka, Akihiko Mabuchi, Yoshio En-Yo, Munehito Yoshida, Akihiko Saika, Kozo Nakamura, and Hiroshi Kawaguchi
2009 Association of Occupational Activity with Radiographic Knee Osteoarthritis and Lumbar Spondylosis in Elderly Patients of Population-Based Cohorts: A Large-Scale Population-Based Study. *Arthritis Care and Research* 61:779–786.

Nowak, J., H. Mallmin, and S. Larsson
2000 The Aetiology and Epidemiology of Clavicular Fractures: A Prospective Study during a Two-Year Period in Uppsala, Sweden. *Injury* 31:353–358.

O'Donnell, Lexi, Ethan C. Hill, Amy S. Anderson, and Heather J. H. Edgar
2020 Cribra Orbitalia and Porotic Hyperostosis Are Associated with Respiratory Infections in a Contemporary Mortality Sample from New Mexico. *American Journal of Physical Anthropology* 173(4):721–733.

Ousley, Stephen
2016 Anthropological Database, Odense University (ADBOU). Vol. 2.1.046.

Perego, Ugo A., Normal Angerhofer, Maria Pala, Anna Olivieri, Hovirag Lancioni, Baharak H. Kashani, Valeria Carossa, et al.
2010 The Initial Peopling of the Americas: A Growing Number of Founding Mitochondrial Genomes from Beringia. *Genome Research* 20:1174–1179.
Piperno, Dolores R., and Deborah M. Pearsall
1998 *The Origins of Agriculture in the Lowland Neotropics.* Academic Press, San Diego.
Posth, Cosimo, Nathan Nakatsuka, Iosif Lazaridis, Pontus Skoglund, Swapan Mallick, Thiseas C. Lamnidis, Nadin Rohland, et al.
2018 Reconstructing the Deep Population History of Central and South America. *Cell* 175:1185–1197.e22.
Prufer, Keith M., Mark Robinson, and Douglas J. Kennett
2021 Terminal Pleistocene through Middle Holocene Occupations in Southeastern Mesoamerica: Linking Ecology and Culture in the Context of Neotropical Foragers and Early Farmers. *Ancient Mesoamerica* 32(3): 439–460.
Recker, Robert, Joan Lappe, K. Michael Davies, and Robert Heaney
2009 Bone Remodeling Increases Substantially in the Years after Menopause and Remains Increased in Older Osteoporosis Patients. *Journal of Bone and Mineral Research* 19:1628–1633.
Stodder, Ann L.
2017 Quantifying Impairment and Disability in Bioarchaeological Assemblages. In *Bioarchaeology of Impairment and Disability,* edited by J. F. Byrnes and J. L. Muller, pp. 183–200. Springer, New York.
Waldron, Tony
2019 Joint Disease. In *Ortner's Identification of Pathological Conditions in Human Skeletal Remains,* edited by Jane E. Buikstra, pp. 719–748. Academic Press, London.
Yuan, X. L., H. Y. Meng, Y. C. Wang, J. Peng, Q. Y. Guo, A. Y. Want, and S. B. Lu
2014 Bone-Cartilage Interface Crosstalk in Osteoarthritis: Potential Pathways and Future Therapeutic Strategies. *Osteoarthritis and Cartilage* 22:1077–1089.