C H A P T E R

13

Early to Terminal Classic Maya Diet in the Northern Lowlands of the Yucatán (Mexico)

EUGENIA BROWN MANSELL*, ROBERT H. TYKOT[†], DAVID A. FREIDEL[‡], BRUCE H. DAHLIN[§], AND TRACI ARDREN[¶]

*Department of Anthropology, University of South Florida, Tampa, Florida

[†]Department of Anthropology, University of South Florida, Tampa, Florida

[‡]Department of Anthropology, Southern Methodist University, Dallas, Tyxas

[§]Department of Sociology and Anthropology, Howard University, Washington, D.C.

[¶]Department of Anthropology, University of Miami, Coral Gables, Florida

Introduction 173
Methods 174
Isotopic Studies of the Maya 174
Discussion and Conclusion 180

Glossary

Bone apatite The mineral component of bone that reflects the overall diet.

Bone collagen The fibrous protein component of bone that reflects the protein in the diet.

Chunchucmil Maya site located in the western part of the Yucatán peninsula.

Classic Maya Cultural period ca. AD 250–900. Typically divided into Early Classic (ca. AD 250–550) and Late Classic (ca. AD 550–900).

Stable carbon and nitrogen isotope analysis Used to divide consumed foods into discrete, isotopic groups (i.e., ^{13}C to ^{12}C and ^{15}N to ^{14}N), leading to the understanding of the diet.

Tooth enamel The outer surface of teeth, which reflects the diet at the time of tooth formation.

Yucatán peninsula Peninsula in southeast Mexico that extends into the Gulf of Mexico.

Yaxuná Maya site located in the north central part of the Yucatán peninsula.

For more than a quarter century, **stable isotope analysis** of human skeletal remains has been used to determine the diet of ancient people. For the ancient Maya, the main questions have been focused on the reliance on maize and how it changed over time. Although many areas of the Maya highlands and southern lowlands in Belize, Honduras, and Guatemala have been the subject of isotopic studies, recently the northern lowlands, in particular the **Yucatán peninsula** of Mexico, have been the subject of such research. Twenty-two individuals from **Yaxuná,** in the interior, and five from **Chunchucmil,** on the coastal plain, were specifically selected to provide some data for the Yucatán. Bone and tooth samples were prepared using well-established procedures to ensure integrity and reliability, especially considering the poor preservation of many skeletal remains from this region. Stable carbon and **nitrogen isotope** ratios were then measured for **bone collagen,** and carbon isotope ratios were measured for **bone apatite** and **tooth enamel.** The results suggest significant differences between the two **Classic Maya** sites, with the residents of Yaxuná consistently the most dependent on maize. There was also greater dietary variation among the individuals at Chunchucmil, probably because of the availability of diverse resources and differences related directly to social status.

INTRODUCTION

In 1990, Vogt [20] wrote that maize composes up to 70% of the modern Maya diet, but ethnographic information does not necessarily translate into the diet of the ancient Maya. Although current research tells us that maize was a vital component of their diet, how vital was it? Were there differences in consumption among social groups, between geographic locales, or between genders? This stable isotope study has given us one of our first opportunities to evaluate the importance of maize in the Classic-Period Maya (AD

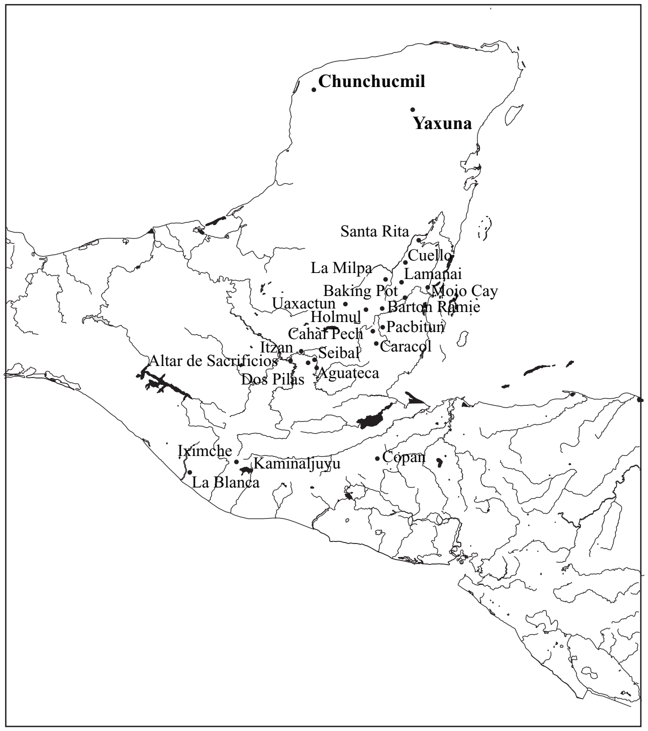

FIGURE 13-1 Map showing sites in the Yucatán and adjacent regions.

250 to AD 1050) of the northern Yucatán peninsula and to study differences among the diets of differing status groups at Yaxuná and Chunchucmil, including elites at Yaxuná and a possible middle class at Chunchucmil (Figure 13-1). The two assemblages also have given us an opportunity to further assess differences in diet among the different geographical areas of Yucatán.

Thanks to the previous stable isotope studies by White and Schwarcz [22], Powis and colleagues [13], Gerry [7], Wright and Schwarz [25], Tykot and colleagues [19], and others we have an increasingly complete picture of the diet of the Southern Lowland Maya in ancient times [17]. However, our knowledge of the Northern Lowland Maya has been lacking. This chapter presents what we hope is the first of many other isotopic studies in the Northern Lowlands. Our study looks specifically at the diet of Early to Late–Terminal Classic people who lived at the sites of Yaxuná and Chunchucmil, both located in the state of Yucatán, Mexico. The purpose of this research is to assess dietary trends and how they reflect social and economic status, gender (at Yaxuná), and access to nourishment within the communities both chronologically and spatially.

METHODS

Because of typical Maya Lowland environmental factors (i.e., humidity and limestone underlying thin soil), the human skeletal material found at both sites was poorly preserved. Collagen was extracted following established procedures [18], including using a dilute hydrochloric acid solution to demineralize the bones, followed by sodium hydroxide to neutralize humic acids, and a defatting solution with methanol and chloroform to remove residual lipids. Powdered bone apatite and tooth enamel samples were treated in sodium hypochlorite to remove organics, and then in an acetic acetate buffer to remove nonbiogenic carbonates. Most samples yielded no collagen at all, with only three individuals each from Yaxuná and from Chunchucmil yielding 1% or more of sample. However, apatite was extracted from all bone samples and most of the teeth available. All samples were run on Finnigan MAT stable isotope ratio mass spectrometers at the University of South Florida, one using a CHN analyzer for collagen samples and the other using a Kiel III device for bone apatite and tooth enamel samples. Collagen yields and C : N ratios were used to confirm the integrity of the collagen isotope results, which are reported in Table 13-1. The analysis of the stable carbon and nitrogen isotopes for collagen yields the percentage of dietary protein in the individual tested, whereas the analysis of the stable carbon isotopes for apatite yields knowledge of the overall diet in the test subject. The analysis of tooth enamel provides information on diet at the age of tooth formation.

ISOTOPIC STUDIES OF THE MAYA

The Maya adapted themselves to a range of ecological zones, including highlands, lowlands, and the coastal plains. In Belize most isotopic studies have been performed at sites on the wide, flat coastal plains, including Lamanai [22], Baking Pot and Barton Ramie [7], Pacbitun [21], Cuello [19], Cahal Pech [13], Colha [23], Altun Ha [23], and on the coast at Mojo Cay [12]. One study has been reported from the west central mountains at Caracol [4]. Elsewhere in Mesoamerica, isotope studies also have been published from the Peten [25]. Research has been done on the Peten area of Belize with a study at La Milpa [11]; this chapter presents a new study that adds the Northern Lowlands to the growing volume of knowledge.

Yaxuná

The site of Yaxuná is located approximately 20 kilometers southwest of Chichén Itzá (Figure 13-1). Its placement in the central northern third of the peninsular has several advantages for subsistence. There is a greater rainfall than the coastal plain for agriculture, low scrub jungle rather than the high tropical rain forest of the Southern Lowlands for ease of seeing prey and clearing land for milpa (maize fields), and a good trade location at a crossroads linking the site

TABLE 13-1 Results of Stable Isotope Analysis at Yaxuná and Chunchucmil

Yaxuná	Sex/Age	$\delta^{13}C_{co}$	$\delta^{15}N_{co}$	$\delta^{13}C_{ap}$	Tooth	$\delta^{13}C_{en}$
Burial 6	F 25–35			–3.3	I	–6.2
Burial 7	F 25–35			–3.6	I	–2.3
Burial 8	F 30–40	–11.8	6.6	–4.1	I2	–0.1
Burial 9	F ?			–2.9	M	–0.8
Burial 11	F A			–3.3		
Burial 13B	M YA			–4.1	M1	–0.9
Burial 13C	M 40+			–3.4		
Burial 15A	M 40+			–2.9		
Burial 16	M 30–35			–4.2	M	–2.6
Burial 17	M 25–40	–12.9	7.3	–1.2	M1	–1.0
Burial 23	M 40–50			–2.6	M3	–3.7
Burial 24-1	A 22–28			–1.4	M1	–2.8
Burial 24-2	J 12–15			–3.0	PM1	–2.8
Burial 24-3	J 7–9			–2.8	I	–3.4
Burial 24-4	J 10–12			–3.1	I	–3.4
Burial 24-5	F 34–45			–2.3	C	–2.1
Burial 24-6	F 20–25			–3.0	M2	–1.7
Burial 24-7	M 55+			–2.3	PM	–4.0
Burial 24-10	F 20–25			–2.5	PM	–2.4
Burial 24-11	M 50+			–2.5	PM	–2.4
Burial 24-12	J 0–0.5	–12.3	7.3	–8.1		
Burial 24-13	F 40+			–3.5		
ave.		–12.3	7.1	–3.2		–2.5
std. dev.		0.4	0.3	1.4		1.5
Chunchucmil	**Sex/Age**	$\delta^{13}C_{co}$	$\delta^{15}N_{co}$	$\delta^{13}C_{ap}$	**Tooth**	$\delta^{13}C_{en}$
Ka'ab 9D1.4 1999	? J/YA	–14.7	6.4	–8.2		
A'ak 9C1.8 2000	? 12+	–13.4	7.6	–4.5	M2	–6.3
A'ak 9C1.9 1999				–5.2	M1	–7.7
Ka'ab 9D1.2 2000	? A			–5.6	M1	–5.8
Muuch 10A22.9.1 2001	? YA?	–16.0	7.0	–3.4		
ave.		–14.7	7.0	–5.4		–6.6
std. dev.		1.1	0.5	1.6		0.8

with the east coast of the peninsular via a 100-kilometer sacbe (raised causeway) to Cobá. From 1986 to 1996, the Yaxuná Archaeological Project under the direction of David Freidel mapped 1.5 square kilometers of the site center and other portions of the site, and excavated and consolidated several large structures (Figure 13-2). We examined 22 individuals from the site, described in detail by S. Bennett [1–3]. We sampled the entire contents of two royal tombs, dating to the Early Classic (AD 250–550 or 600), and also 10 individuals (five females, five males) recovered from nonelite contexts around the site. These burials were found primarily within crypts in modest house mounds that dated, based on ceramics, to the Late–Terminal Classic period (AD 550/600–1000), probably between AD 700 and 900 (Figure 13-3).

The North Acropolis at Yaxuná is a large centrally located platform 11 meters high with an approximately 300-square-meter plaza. On this plaza are three large buildings, two of which contained tombs. In 1993, excavations were begun on the 16.5-meter building on the north side of the plaza. It was during these excavations that the first undisturbed royal tomb in Yucatán was uncovered. The floor of the tomb was

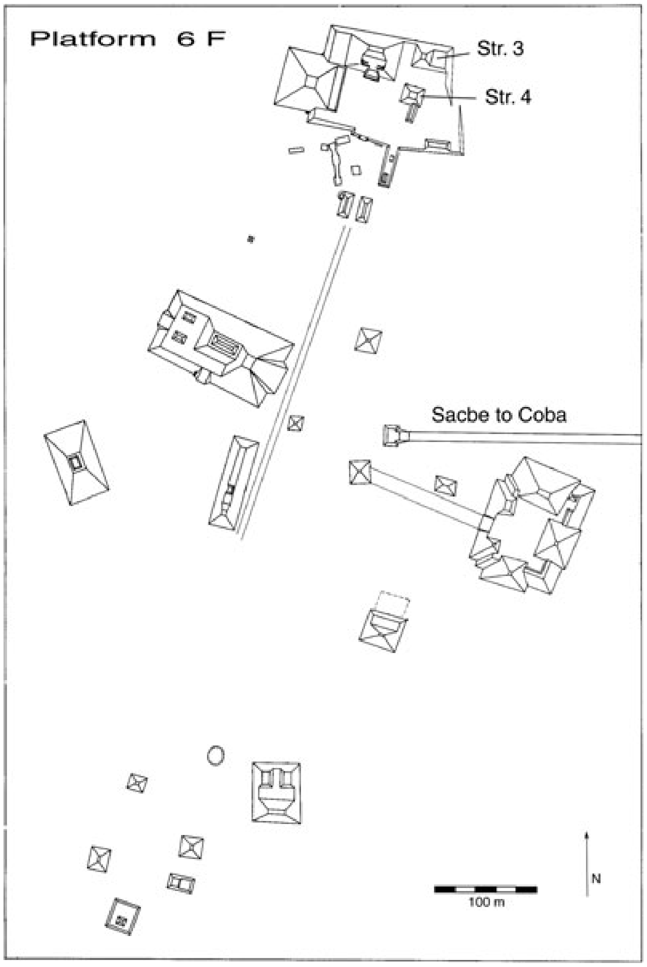

FIGURE 13-2 Map of the central portion of Yaxuná.

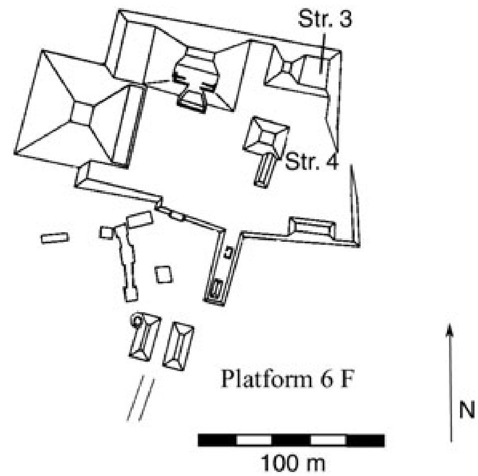

FIGURE 13-3 Map of Platform 6F, showing Structures 3 and 4.

fine, white marl, and the walls were covered in coarse stucco. There were multiple ceramic vessels placed in the tomb, such as four sealed miniature vessels, a polychrome shallow bowl, black bowl with a spout, two cups, and a jar. Also included in the grave goods were a turtle carapace, carved deer bones, three carved jade jewels, a shell pendant carved in the shape of a turtle or frog, and a death head carved from a spondylus shell. The body of one individual (Burial 23) was that of a 40–50-year-old male, who until death had apparently enjoyed good health, with no serious infections or trauma, although there was evidence of arthritis. It was determined by the Yaxuná-Project archaeologists that this individual had been a ruler at Yaxuná [16]. There was no collagen present for this individual; however the $\delta^{13}C$ values obtained for apatite (–2.6‰) and for third molar tooth enamel (–3.7‰) suggest a high dependence on maize or maize-fed animals, both as a youngster and as an adult.

The following year a tomb in an 8-meter structure on the eastern side of the plaza was discovered. It contained the remains of 11 individuals: one male, four females, one individual of undetermined sex, and four children placed around a decapitated adult male who had been centrally placed in the tomb. The excavators believe that the royal people had been terminated, ending their lineage. They were entombed in a terminated elite ceremonial building, which had another structure built over it. As in the previous tomb, there were elite grave goods: ceramics, carved shell, greenstone, and obsidian blades. A description of each individual follows.

A. Burial 24-7 was a centrally placed, older male (55 years old or older), who had been decapitated, and his skull placed in another part of the tomb; all physical data from the Yaxuná burials were taken from the field reports of Sharon Bennett [1–3]. He had an apatite $\delta^{13}C$ value of –2.3‰ and tooth-enamel value of –4.0‰ from a premolar, which were similar values to the older male in Burial 23.

B. Burial 24-1 was an adult between the age of 22 and 28 years; a definite sex assignment was not possible. The apatite signature was –1.4‰, and the tooth-enamel value was –2.8‰ for a first molar.

C. Burial 24-2 was at least 12 years old, but no more than 15 years old, based on dental evidence, and no sex was assigned. The skull had been crushed. The individual was interred with a necklace of jade and shell. The $\delta^{13}C$ value for apatite was –3.0‰, and the value for tooth enamel from a first premolar was –2.8‰.

D. Burial 24-3 was a small child, with the dental and epiphyseal evidence indicating that the child was between 7 and 9 years old. Apatite $\delta^{13}C$ was –2.8‰ whereas the enamel from an incisor yielded –3.6‰.

E. Burial 24-4 was also a child between the age of 10 and 12 with an apatite signature of −3.1‰ and enamel value of −3.4‰, also from an incisor. Both burial 24-3 and 24-4, although they were children, contained a rich array of grave goods.

F. Burial 24-5 was an older female who was between the age of 34 to 45 years, with an apatite $\delta^{13}C$ reading of −2.3‰ and enamel from a bicuspid reading −2.1‰.

G. Burial 24-6 was a female, 20 to 25 years old, with cut marks on the left tibia and the right femur. This woman was interred with many grave goods of jade, shell, and so on, and a unique polychrome ceramic figurine. The apatite $\delta^{13}C$ value was −3.0‰, and the enamel value from a second molar was −1.7‰.

H. Burial 24-10 was a female, 20 to 25 years old. The apatite value was −2.5‰, and tooth-enamel value from a premolar was −2.4‰.

I. Burial 24-11 was a male more than 50 years old. The apatite $\delta^{13}C$ value was −2.5‰, and the tooth-enamel value from a premolar was −2.4‰.

J. Burial 24-12 was an infant, approximately newborn to 6 months. Despite the young age, this was the only individual in the tomb to produce collagen data ($\delta^{13}C$ = −12.3‰; $\delta^{13}C$ = 7.3) along with bone apatite results ($\delta^{13}C$ = −8.1).

K. Burial 24-13 was a decapitated female who was, in all probability, more than 40 years old. Her apatite signature was −3.5‰. There were no teeth associated with this individual.

The centrally placed male and the young female with the figurine were carefully placed in the tomb. All of the other individuals were literally tossed into the crypt, but the richness of the grave goods indicates that they were interred with all of the trappings of royalty. The single collagen result for this tomb, from the infant, is in line with the two other collagen values produced for the Late Classic nonelite individuals. This value most likely represents less dependence on C_4 resources; however, there is a trophic level effect in breastfeeding. The apatite $\delta^{13}C$ value of −8.1‰ for this infant was more negative than any of the other individuals tested, suggesting far less direct dependence on maize and maize products for children of such a young age.

The other 10 individuals tested, five females and five males, were recovered from nonelite contexts around the site. The burials were found primarily within crypts in modest house mounds that date, based on ceramics, to the Late–Terminal Classic Period (AD 550 or 600–1000), probably between AD 700–900.

A. Burial 6 was a 25–35-year-old female recovered from a crypt. She had a Cehpech sphere (Late–Terminal Classic) vessel over her head and another below the femur. The apatite $\delta^{13}C$ value was −3.3‰, and the tooth enamel $\delta^{13}C$ value from an incisor was −6.2‰.

B. Burial 7 was a 25–35-year-old female with a Cehpech sphere vessel and probable deer bones. The apatite reading was −3.6‰, and the tooth enamel $\delta^{13}C$ value from an incisor was −2.3‰.

C. Burial 8 was a 30–40-year-old female with an apatite signature of −4.1‰ and tooth enamel value of −0.1‰ from an incisor. Burial 8 also had a collagen value of −11.8‰. She was interred with Cehpech sphere vessel over the skull.

D. Burial 9 was a female of indeterminate adult age, interred with shell pendants and deer bones. The apatite $\delta^{13}C$ value was −2.9‰, and the tooth-enamel value for a molar was −0.8‰.

E. Burial 11 was an adult female with an apatite $\delta^{13}C$ reading of −3.3‰. There were no teeth associated with this burial. She had three Cehpech sphere vessels interred with her.

F. Burial 13C was a robust male older than 40 years, who was probably a warrior because the decapitated skull of a young adult male (Burial 13B) was interred with him, and he also had multiple grave goods. The ceramics are late Cehpech, suggesting Terminal Classic. The apatite $\delta^{13}C$ for the young adult male (13B) was −4.1‰ and the tooth enamel value was −0.9‰ for a first molar. The warrior (13C) has an apatite signature of −3.4‰, and there were no teeth from this individual.

G. Burial 15A was a male more than 40 years old with a Cehpech vessel over his head. The apatite $\delta^{13}C$ value was −2.9‰. There were no teeth.

H. Burial 16 was a 30–35-year-old male interred in a crypt. His apatite $\delta^{13}C$ signature was −4.2‰, and his tooth-enamel value from a molar yielded a reading of −2.6‰.

I. Burial 17 was a male who was 25–40 years old, and his crypt was disturbed by the construction of the crypt for Burial 16. He had a collagen signature of −12.9‰, an apatite value of −1.2‰, and the results for tooth enamel from a first molar was −1.0‰.

Overall there is a high degree of consistency in stable isotope values for all of these individuals, indicating a great dependence—about 60–70% on average—on maize and maize products for the whole diet (as visible from the apatite). The collagen data, however, suggest that only 50% of dietary protein was represented by C4-based plants (e.g., maize), indicating that the diet was supplemented by C_3 plants (e.g., beans that have a higher protein percentages than maize) and wild animals (e.g., deer).

Chunchucmil

Chunchucmil is located 27 kilometers east of the Gulf of Mexico (Figure 13-4). It is an area of the Yucatán peninsula that has low rainfall and poor soil with little depth. Current

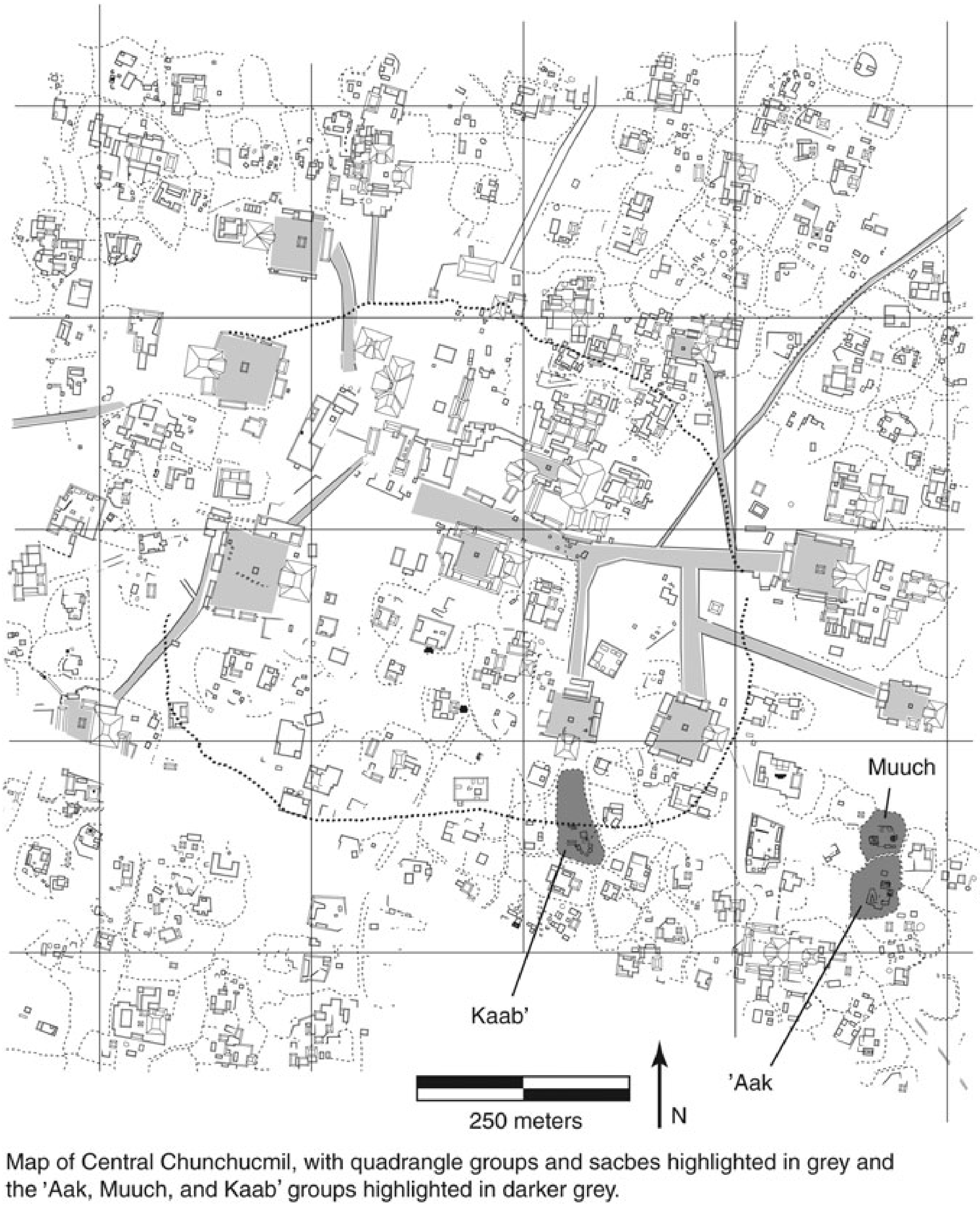

FIGURE 13-4 Map of the site of Chunchucmil (Yucatán) showing residential groups with analyzed human skeletal materials.

estimates state that at its peak during the late Early Classic (ca. AD 400–550 or 600) the population of the site could have reached 29,680 to 46,648 [6]. The estimate is based on the unusually large number of house mounds found at the site. Chunchucmil, with its aridity and thin, impoverished soil, could not have grown enough maize to sustain a population of this size. Chunchucmil residents would have been importing foodstuffs: maize from areas to the east with richer farm lands, marine resources from the nearby coast, and various floral and faunal foodstuffs available in the nearby savanna area.

The five individuals included in this study were found in modest house mounds, in nonelite contexts. At least one individual (Burial 2), however, had grave goods generally associated with higher-status individuals [8]. All residential groups of this period at Chunchucmil are characterized

FIGURE 13-5 Map of Kaab' residential group, Chunchucmil.

by structures arranged around a patio and enclosed by a stone wall [9]. Osteological analyses have been done by Stanley Serafin [14].

Burial 1 was recovered from the Kaab' Group, a residential unit of three medium-sized mounds arranged on three sides of a common patio and several smaller structures arranged around a second southeastern patio (Figure 13-5). The group is located 300 meters from the site center. Burial 1 was a dedicatory burial at the base of the only vaulted structure at the group, Structure 23 (Figure 13-6). It was contained in a cist in the construction fill of the structure under a red painted plaster floor. The skeletal material was in a flexed position. A Teabo-Red vessel was placed over the skull, and a Dzibical vessel was to the east of the long bones [10]. Both vessels date to the Late Classic (AD 550 or 600–800). A complete skeleton was not recovered, but the parts appear to be those of a juvenile or a small adult. The collagen $\delta^{13}C$ value of this individual was −14.7‰, and the apatite value was −8.2‰. There were no teeth.

Burial 5 also was recovered in Structure 32 of the Kaab' Group. It was found on top of the floor in the southeast corner of Room 2. Again, only a partial skeleton was recovered, the skull and long bones of an adult [10]. There was no collagen preserved, although the carbon isotope reading was −5.6‰ for apatite and −5.8‰ for tooth enamel from a first molar.

Burials 2 and 3 were recovered from the 'Aak Group, another residential group of six structures located 600

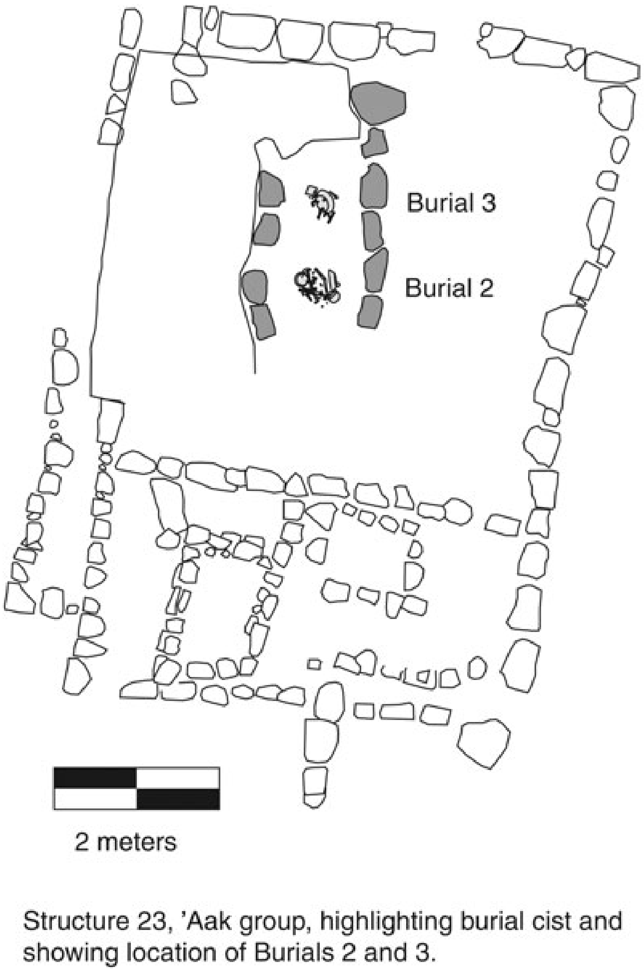

FIGURE 13-6 Map of Structure 23 showing burials, 'Aak residential group, Chunchucmil.

meters from the site center (Figure 13-7). Structure 23, the tallest (2 m) structure at the group, yielded two burials under large stone slabs at a depth of 130 centimeters. Burial 2 consisted of disarticulated bones surrounded by three complete vessels: one was an elaborately carved Acu bowl. In addition, there were numerous jade and greenstone objects, a celt, pendant, and multiple round and tubular beads (Figure 13-8). The individual was at least 12 years of age based on teeth recovered but probably older. The collagen δ^{13}C value was −13.4‰, the apatite value was −4.5‰, and the tooth-enamel value for a second molar was −6.3‰.

Burial 3, on the northern edge of the unit, had fewer remains than Burial 2, only the long bones and a scapula, gathered and perhaps bundled, were recovered under a tripod shallow bowl [8]. There was no collagen recovered. The apatite δ^{13}C value was −5.2‰ and the enamel value for a first molar was −7.7‰. The vessels in both burials date to the late Early Classic (AD 400–550 or 600).

Burial 6, possibly a young adult, was recovered under construction fill while excavating a unit in Structure 16 of the Muuch Group, a small residential albarrada group, just north of 'Aak (Figure 13-9). Burial 6 was a secondary burial; the remains, consisting of a portion of the zygomatic arch, several long bone fragments, and three premolars, had been placed in a large Maxcanu cazuela (basin) (Figure 13-10). Dental evidence indicates that the individual was a young adult. The collagen δ^{13}C value was −16.0‰, and the apatite value was −3.4‰. There was no enamel reading recovered. There were two identical Kanachen dishes and two nearly identical Hunabchen vessels dating to the Early Classic in association with the burial; all were crushed under construction fill [15]. As with Burial 3, these vessels dated to the late Early Classic period; all physical data from the Chunchucmil burials were taken from the field report of Serafin [14].

The burials from Chunchucmil, although not elite, had a large quantity of grave goods. This could represent a "middle class" with a market economy based on trade and exchange, because Chunchucmil probably controlled the second largest salt flats in Mesoamerica and the first salt flats reached when traveling from central Mexico. Even though the sample size is small, it is clear from the stable isotope data that neither maize nor maize-fed animals were quite the critical contributors to the diet as at Yaxuná, and supports the hypothesis that low rainfall and poor soil limited maize production. At the same time, there is no isotopic indication that maize was substituted for by any marine resources, because they likely would have increased δ^{13}C and δ^{15}N values in collagen and δ^{13}C values in bone apatite and tooth enamel. Instead, it appears that there was increased reliance on C3 plants (e.g., squash and beans), whether locally produced or imported, and their consumers.

DISCUSSION AND CONCLUSION

Comparison of the data from Yaxuná and Chunchucmil with published results for Pre-Classic, Classic, and Post-Classic sites across the Maya area indicates that the importance of maize to dietary protein of these two sites from the northern lowlands was similar to many sites in Belize (Figure 13-11) but clearly less important than for sites in the Peten and Guatemala (Figure 13-12). The collagen carbon isotope data for Chunchucmil clearly suggest that maize was far less important in the diet there, when compared with the Belize sites and Yaxuná. The bone apatite carbon isotope data, which measures the whole diet, illustrate the importance of doing isotope analysis on more than collagen samples. Apatite data are especially important when the research is meant to address the significance of plant foods such as maize, which have low protein content. The bone apatite and collagen data produced for Yaxuná strongly suggest that maize (and/or other C4/CAM plants that were directly consumed by humans) was of significance to the

FIGURE 13-7 Map of 'Aak residential group, Chunchucmil.

overall Maya diet in the central portion of the Yucatán peninsula, similar to Belize or other adjacent regions (Figure 13-13). In contrast, in Chunchucmil, which was located in a poor agricultural region and close to a variety of ecological regions and trading routes, people relied less on maize. At the same time, a greater percentage of dietary protein at Yaxuná and Chunchucmil, compared to Belize and elsewhere, must have ultimately come from foods with C3-like carbon isotope values. Although the lower nitrogen isotope ratios for both Chunchucmil and Yaxuná most likely indicate that their more negative collagen carbon isotope values did not result from greater consumption of typical terrestrial or riverine fauna, which are mostly protein and thus have a much greater effect on human collagen values than do plants, fauna in this region need to be isotopically tested, because they could have lower average nitrogen isotope values compared to those from Belize. Another interpretation would be that beans and other legumes were of greater importance in the Yucatán than in Belize.

The isotope data clearly indicate that other sources of information, perhaps faunal isotopic studies, about diet in the Yucatán must be examined to test the hypotheses and potential interpretations presented here. When compared with Chunchucmil, it appears that more rain and deeper soil allowed the people of Yaxuná to grow maize according to their needs; indeed, the people of modern Yaxuná rely on their milpa more than the contemporary people of Chunchucmil (Mansell, personal observation). The skeletal remains of ancient Yaxuná do not evidence a lack of sustenance; the population appears to have been in good health. There appears to be no evidence of gender and status differences in diet or a temporal difference. Their relatively

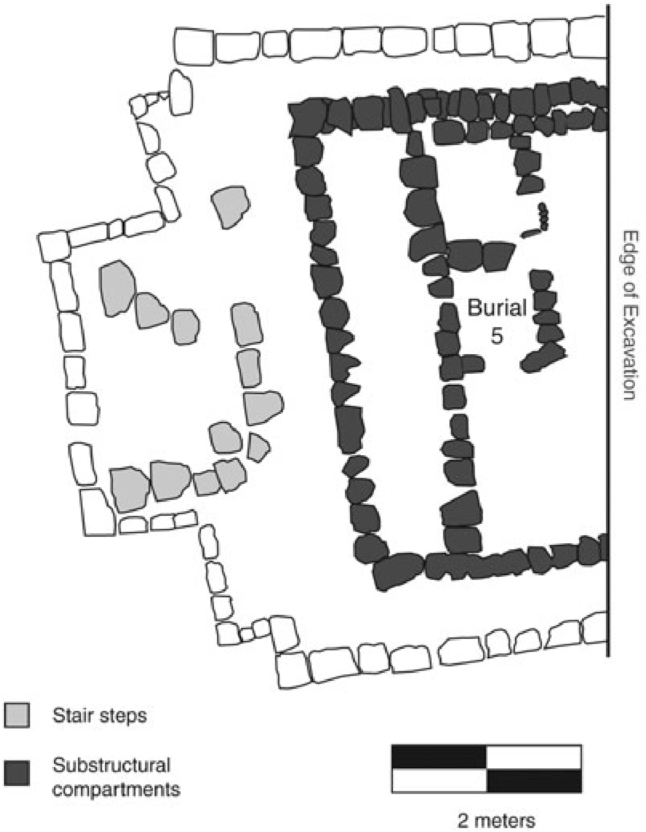

FIGURE 13-8 Map of Structure 22 showing burials, ’Aak residential group, Chunchucmil.

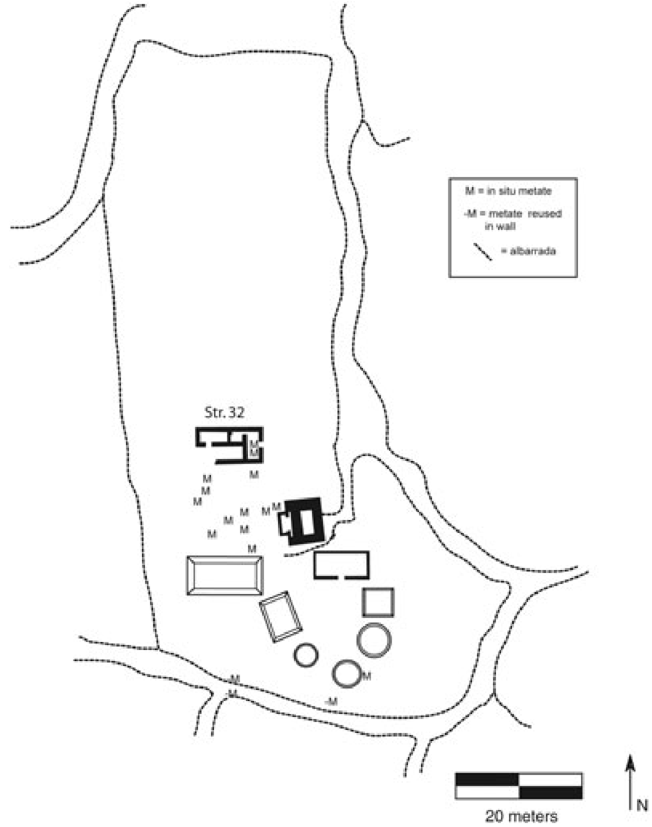

FIGURE 13-9 Map of Muuch residential group, Chunchucmil.

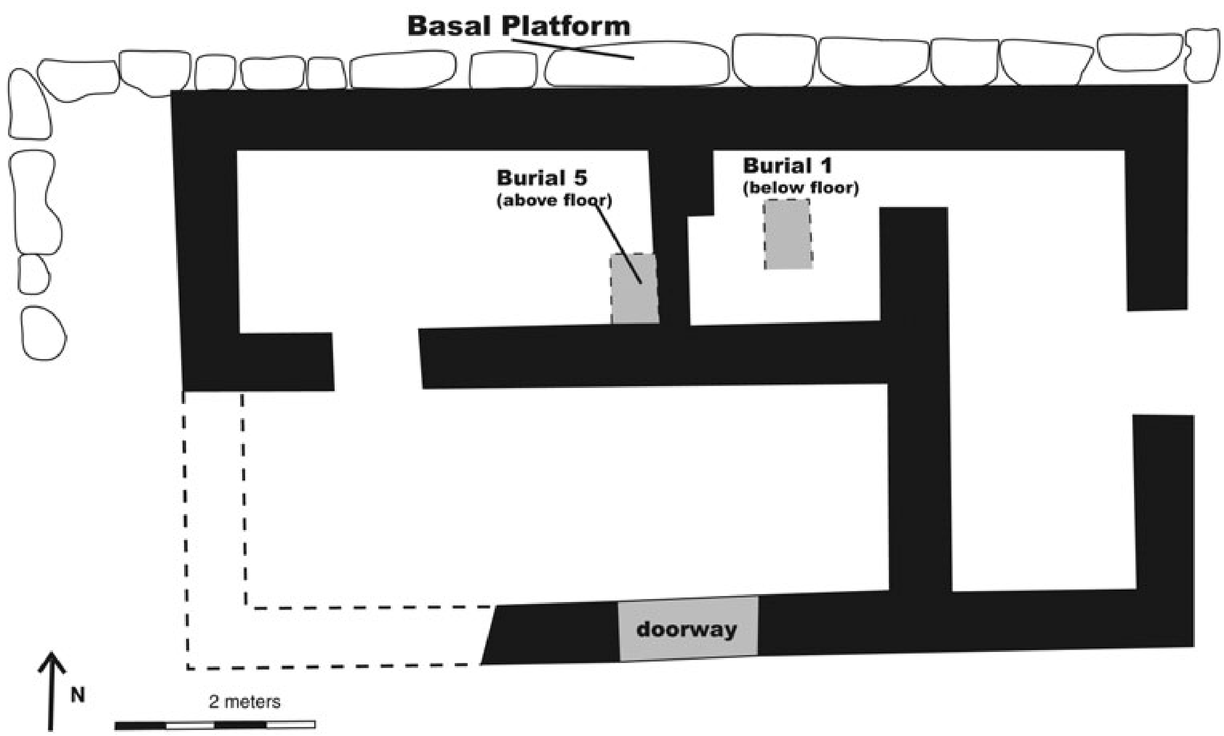

FIGURE 13-10 Map of Structure 16 showing burial, Muuch residential group, Chunchucmil.

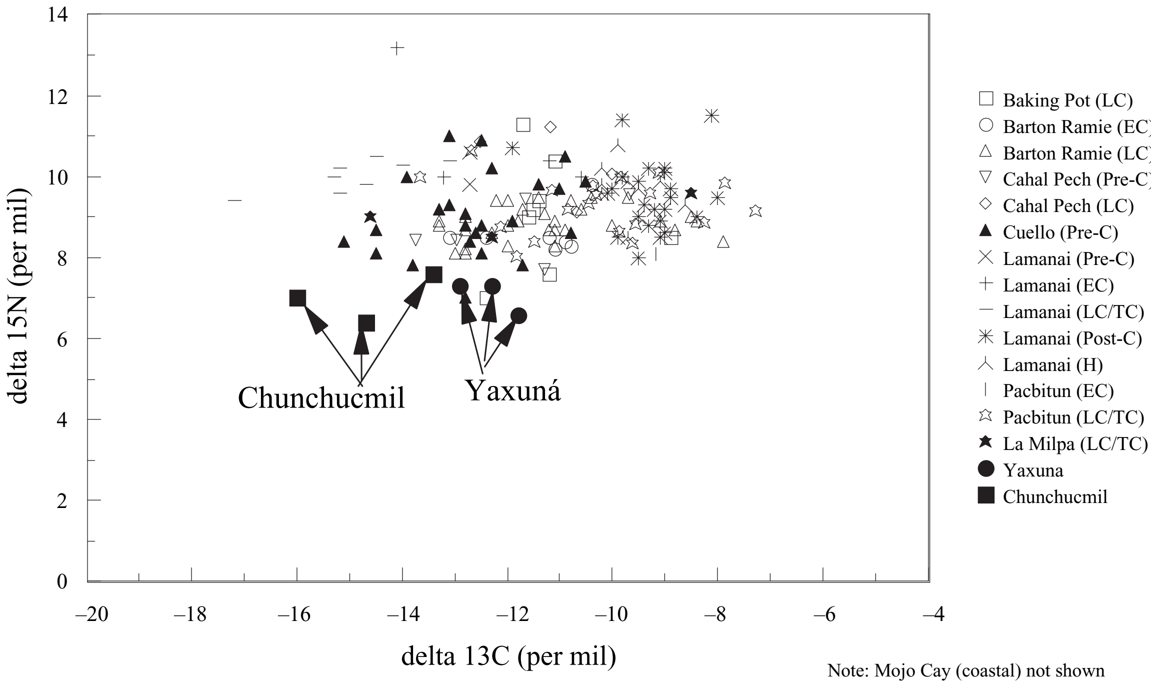

FIGURE 13-11 Collagen stable isotope data for Yucatán sites of Chunchucmil asnd Yaxuná compared with data for sites in Belize.

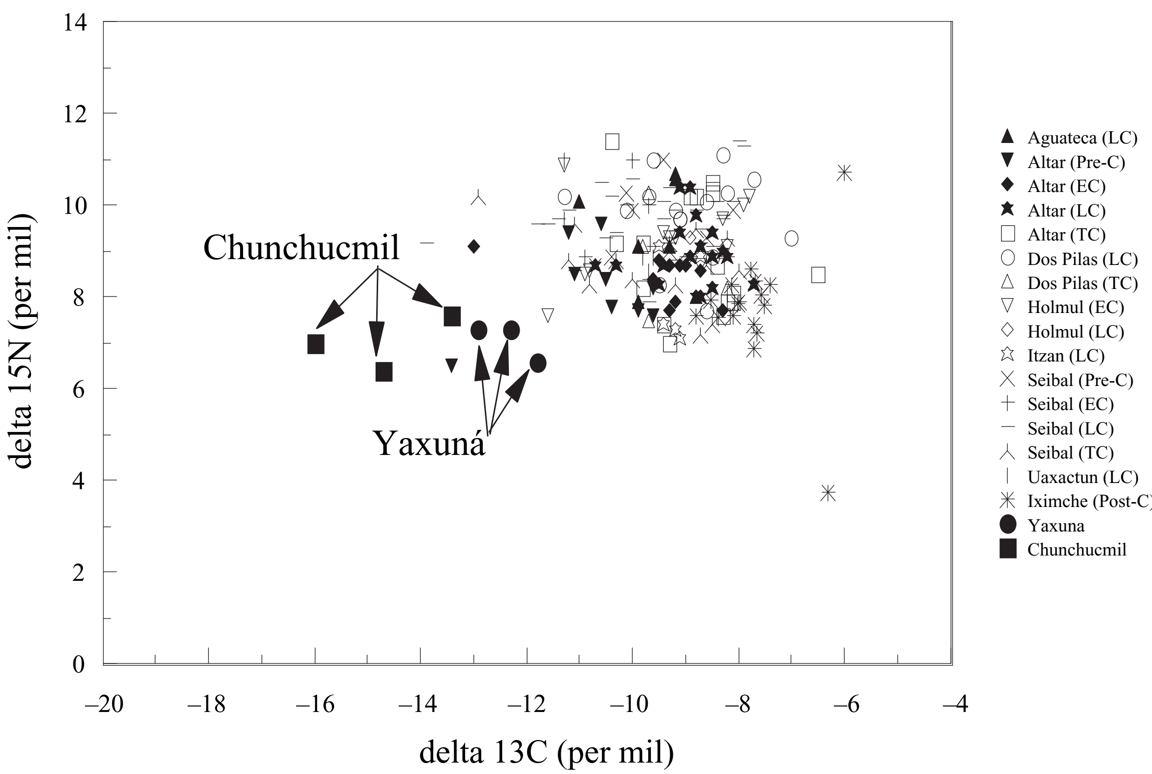

FIGURE 13-12 Collagen data for Yucatán sites of Chunchucmil and Yaxuná compared with data for sites in the Peten and Guatemala.

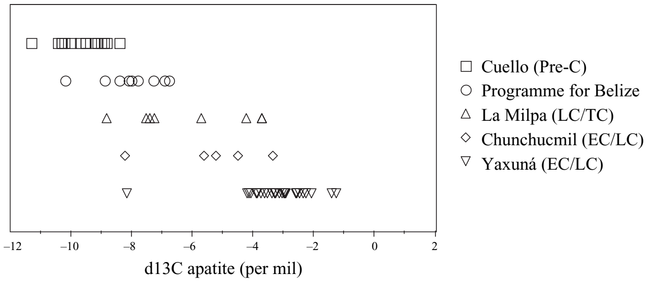

FIGURE 13-13 Bone apatite data for Chunchucmil and Yaxuná compared with selected sites in Belize.

greater reliance on maize, however, may have been directly related to their environment and the lack of diversity in its resources. In contrast, the people of Chunchucmil, unable to grow enough maize to feed their large population on the regionally marginal agricultural resources that the area provided, were probably fortunate that the site occupied a strategic location along a well-established maritime trade route through its port, Punta Canbalam, enabling the site to receive a diversity of subsistence goods. Also, the fact that they abutted an environmentally rich savanna and wetlands greatly improved their ability to provide a variety of nutrients for their population. Dietary gender differences cannot be studied with the Chunchucmil sample because the poorly preserved skeletal material cannot be sexed in most cases. Moreover, because all the burials were from nonelite contexts, we cannot evaluate dietary differences based on social status. Future investigations may possibly reveal whether the Chunchucmil elite and nonelite populations had a similar diet as those from Yaxuná.

From these two small studies, it appears likely that environmental factors are a great determinate to a population's reliance on maize in Northern Yucatán. We await other studies to confirm this conclusion. We feel confident that in the Northern Lowlands, the location of a site and the availability of local and foreign resources was a determining factor in the overall diet of the resident population.

Acknowledgments

We would like to thank Aline Magnoni, Scott Hutson, and Traci Ardren for their help with the illustrations, suggestions, and patience during the writing of the chapter.

References Cited

1. S. Bennett. (1991). Burials at Yaxuná, Yucatán. The Selz Foundation Yaxuná Project. In: D. Freidel, C. Suhler, R. Cobos, (Eds.), *Final report of the 1991 field season.* México: INAH, Mérida, Yucatán.
2. S. Bennett. (1992). Burials from Yaxuná, Yucatán. The Selz Foundation Yaxuná Project. In: C. Suhler, D. Freidel, (Eds.), *Final report of the 1992 field season.* México: INAH, Mérida, Yucatán.
3. S. Bennett. (1993). The burial excavations at Yaxuná in 1993. The Selz Foundation Yaxuná Project. *Final Report of the 1993 Field Season.* México: INAH, Mérida, Yucatán.
4. D. Z. Chase, A. F. Chase, C. D. White, W. Giddens. (1998). Human skeletal remains in archaeological context: Status, diet, and household at Caracol, Belize. Paper presented at the 14th International Congress of Anthropological and Ethnological Sciences, Williamsburg, Virginia, July 27, 1998.
5. B. H. Dahlin, T. Ardren. (2002). Modes of exchange and their effects on regional and urban patterns at Chunchucmil, Yucatán, México. In: M. A. Masson, D. Freidel, (Eds.), *Ancient Maya political economies.* Walnut Creek, CA: Altamira Press. pp. 249–284.
6. B. H. Dahlin, T. Beach, S. Lazzader-Beach, A. Magnoni, S. R. Hutson, E. B. Mansell, D. Mazeau. (In press). Reconstructing agricultural self-sufficiency at Chunchucmil, Yucatán, México. *Ancient Mesoamerica.*
7. J. P. Gerry. (1993). Diet and status among the Classic Maya: An isotopic perspective. Ph.D dissertation. Cambridge, MA: Harvard University.
8. S. Hutson. (2000). Excavations in the 'Aak Group. In: W. Stanton, (Ed.), *Pakbeh regional economy program: Report of the 2000 field season.* México: INAH, Mérida, Yucatán.
9. S. Hutson, A. Magnoni, T. Stanton. (2004). House Rules? The practice of social organization in Classic Period Chunchucmil, Yucatán, Mexico. *Ancient Mesoamerica, 15,* 73–90.
10. A. Magnoni. (2001). Excavations at the Kaab' Group. In: B. H. Dahlin, D. Mazeau, (Eds.), *Pakbeh regional economy program: Report of the 2001 field season.* México: INAH, Mérida, Yucatán.
11. E. B. Mansell, R. H. Tykot, F. Valdes, N. Hammond. (2000). Stable isotope analysis of human remains at La Milpa, Belize. Paper presented at the 65th Annual Meeting of the Society for American Archaeology, Philadelphia, Pennsylvania, April 5–9, 2000.
12. L. C. Norr. (1991). Nutritional consequences of prehistoric subsistence strategies in lower central America. Ph.D. dissertation. Urbana, IL: University of Illinois.
13. T. G. Powis, N. Stanchly, C. D. White, P. F. Healy, J. J. Awe, F. Longstaffe. (1999). A reconstruction of Middle Preclassic Maya subsistence economy at Cahal Pech, Belize. *Antiquity, 73,* 364–376.
14. S. Serafin. (2004). Osteological analyses of the human skeletal remains. In: S. R. Hutson, (Ed.), *Pakbeh regional economy program: Report of the 2004 field season.* México: INAH, Mérida, Yucatán.
15. T. W. Stanton. (2001). Horizontal excavations at the Muuch Group. In: B. H. Dahlin, D. Mazeau, (Eds.), *Pakbeh regional economy program: Report of the 2001 field season.* México: INAH, Mérida, Yucatán.
16. C. K. Suhler. (1996). Excavations at the North Acropolis, Yaxuná, Yucatán, México. Ph.D. dissertation. Dallas, TX: Southern Methodist University.
17. R. H. Tykot. (2002). Contribution of stable isotope analysis to understanding dietary variation among the Maya. In: K. Jakes, (Ed.), *Archaeological chemistry. Materials, methods, and meaning.* ACS Symposium Series 831. Washington, D.C.: American Chemical Society. pp. 214–230.
18. R. H. Tykot. (2004). Stable isotopes and diet: You are what you eat. In: M. Martini, M. Milazzo, M. Piacentini, (Eds.), *Physics methods in archaeometry.* Bologna, Italy: Società Italiana di Fisica. pp. 433–444.
19. R. H. Tykot, N. J. van der Merwe, N. Hammond. (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: Organic, inorganic, and biochemical analysis.* ACS Symposium Series 625. Washington, D.C.: American Chemical Society. pp. 355–365.
20. E. Z. Vogt. (1990). *The Zinacantecos of Mexico: A modern Maya way of life.* New York: Harcourt Brace Jovanovich.
21. C. D. White, P. F. Healy, H. P. Schwarcz. (1993). Intensive agriculture, social status, and Maya diet at Pacbitun, Belize. *Journal of Anthropological Research, 49,* 347–375.

22. C. D. White, H. P. Schwarcz. (1989). Ancient Maya diet: As inferred from isotopic and elemental analysis of human bone. *Journal of Archaeological Science, 16,* 451–474.
23. C. D. White, D. M. Pendergast, F. J. Longstaffe, K. R. Law. (2001). Social complexity and food systems at Altun Ha, Belize: The isotopic evidence. *Latin American Antiquity, 12,* 371–393.
24. C. D. White, M. E. D. Pohl, H. P. Schwarcz, F. J. Longstaffe. (2001). Isotopic evidence for Maya patterns of deer and dog use at Preclassic Colha. *Journal of Archaeological Science, 28,* 89–107.
25. L. E. Wright, H. P. Schwarcz. (1996). Infrared and isotopic evidence for diagenesis of bone apatite at Dos Pilas, Guatemala: Paleodietary implications. *Journal of Archaeological Science, 23,* 933–944.