CHAPTER 10

Cuisine from Hun-Nal-Ye

DAVID MILLARD REED

Intrasocial patterns of food preparation, distribution, and consumption reflect status distinctions and social distance within societies. Burials excavated from over a decade of research at Copán, Honduras, by the Pennsylvania State University’s Copán Archaeological Project provide a resource for the analysis of human dietary variability along the dimensions of age, sex, social position, and residential zone within a complexly organized ancient polity. The stable carbon and nitrogen isotopic composition of bone collagen from 82 humans (9 subadults, 70 adults, and 3 probable adults), 7 deer, and 1 jaguar contribute evidence for a principally maize diet at Copán. Inferred diet varied by age and sex with clear differences between male adults and female adults. A greater range of diets is inferred for urban residents relative to their nonurban counterparts. These intrasocial patterns assist us in our quest to reconstruct ancient Maya social structure at the household, community, and polity levels.

Copán

In the Copán Valley of western Honduras, Maya settlement began with sedentary farmers circa 1000 B.C. (Fash 1991; Freter 1992; Rue 1987, 1989). Population was sparse until A.D. 400, and both population size and density increased rapidly after A.D. 600. At the zenith of Copán kingship (circa A.D. 820), population size has been estimated at a maximum of 27,500 (Webster and Freter 1990a; Webster et al. 1992). Afterward population size remained stable for another century with a rapid demographic decline and an abandonment of the valley from A.D. 900 through 1250 (Webster et al. 1992).

In the Copán ceramic sequence, Coner ceramics date from A.D. 600 to 1250, with a subphase division between early and late Coner at A.D. 900 (Freter 1992; Webster and Freter 1990b). Therefore, the Coner period encompasses the growth, centralization, and collapse of elite control of the Late Classic and Postclassic Copán polity.

Seven types of residential sites have been identified at Copán, and examples of each have been excavated (Freter 1992, 1994; Webster and Freter 1990a). Architecture, energy expenditure for construction, and richness measures of artifact diversity have proved more practical at distinguishing social rank at Copán than other measures (Abrams 1994; Gonlin 1994; Reed et al. 1993). Site ranking ranges from the ruling elite royal compounds (the Main Group) to the few, but impressive, Type IV residences of the subroyal, through the less impressive Type III, down to the more numerous Type I, Type II, single-mound,

1. Maize has been identified as present before 1700 B.C. in recently analyzed pollen cores (Webster, personal communication 1996).
and nonmound sites of the commoners (Fash 1991; Freter 1994; Webster and Freter 1990b; Webster and Gonlin 1988). Residential artifact assemblages at all social levels are similar; therefore, domestic artifacts alone are poor discriminators of status at Copán (Gonlin 1993; Webster et al. 1997).

Although all individuals interred at the lower-ranked Type I, Type II, and smaller sites were undoubtedly commoners, it cannot be inferred that all people buried at higher-ranked sites were members of royal and subroyal groups (e.g., kin or lineage occupants of the patio complexes). Some interments at the higher-ranked sites probably included lower-ranked individuals (e.g., retainers and servants).

Demographic patterns can be distinguished based on the location of residential units relative to the urban core of occupation. The longest-occupied sites lie in the alluvial pocket near the Main Group. This core of settlement has the highest structure density of all Classic Maya centers (Webster and Freter 1990a). An intrapopulation distinction between the urban and nonurban sectors may provide discrimination between privileged and commoner members of Copán society better than associated site type.

Stable Isotopes in Paleodietary Research

Because categories of food resources have distinct stable carbon and nitrogen isotopic ratios and dietary isotopic composition is reflected in bone collagen, it is possible to reconstruct diet from osseous remains (DeNiro and Epstein 1978, 1981). Extensive reviews of stable isotope paleodietary research have been presented by Ambrose (1993), DeNiro (1987), Katzenberg (1992), Keegan (1989), Norr (1995), Schoeninger and Moore (1992), Pate (1994), Schwarcz and Schoeninger (1991), and van der Merwe (1982).

The stable isotope ratios of carbon ($^{13}$C to $^{12}$C) and nitrogen ($^{15}$N to $^{14}$N) are measured in units per mil ($\%$) as deviations of the isotope ratio in the sample from a reference. The carbon reference is the rostrum from the Cretaceous Pee Dee belemnite formation (PDB), and the nitrogen reference is ambient air (AIR). The notation is expressed in per mil ($\%$) for carbon as $\delta^{13}$C$_{PDB} = ([^{13}$C$/^{12}$C]_{SAMPLE}/[^{13}$C$/^{12}$C]_{PDB} - 1)1000$, and for nitrogen as $\delta^{15}$N$_{AIR} = ([^{15}$N$/^{14}$N]_{SAMPLE}/[^{15}$N$/^{14}$N]_{AIR} - 1)1000$.

Terrestrial plants can be categorized by their carbon isotope composition and photosynthetic type as either Calvin (C3-based), Hatch-Slack (C4-based), or Crassulacean acid metabolism (CAM) (Bender 1968, 1971; Bender et al. 1973; Calvin and Bassham 1962; Hatch 1976). On average, C3 plants have a $\delta^{13}$C$_{PDB}$ value of $-27\%$, C4 plants have a $\delta^{13}$C$_{PDB}$ value of $-12.5\%$, and CAM plants have $\delta^{13}$C$_{PDB}$ values between C3 and C4 plants. Maize, a C4 plant, has a $\delta^{13}$C$_{PDB}$ value near $-11.5\%$ (O'Leary 1988; DeNiro and Hasting 1985); most other plants consumed by the Maya, such as ramón ($-27.4\%$), beans ($-25.5\%$), squash ($-24.5\%$), cacao ($-34.1\%$), chile pepper ($-29.0\%$), and manioc ($-25.7\%$), are C3–based (DeNiro and Hasting 1985; Norr 1990; Wright 1994; Yoshinaga et al. 1991).

Nitrogen isotopes have been used to distinguish between marine animals,
most of which have $\delta^{15}N_{\text{AIR}}$ values greater than 12%, and terrestrial plant sources, which have values between 0% and 10%. Stable nitrogen isotope ratios have also been used to separate legumes, all of which are C3-based, and nonlegumes (DeNiro 1987; Keegan 1989). A stepwise increase of $\delta^{15}N_{\text{AIR}}$ by 1% to 5% with successively higher trophic levels has been observed (Minagawa and Wada 1984). In humans, nursing infants have shown a 2% to 4% more positive $\delta^{15}N_{\text{AIR}}$ value than weaned children and adults (Fogel et al. 1997; Fogel et al. 1989; Katzenberg et al. 1993; Tuross and Fogel 1994).

Determining the specific dietary source signaled by the isotopic composition of various bone fractions has become a leading issue in stable isotope paleodietary research. In the prevailing view, the carbon isotopic composition of dietary protein is represented to a higher degree in collagen than other diet fractions, whereas the whole diet is best reflected in the carbon isotopic value of bioapatite (Ambrose and Norr 1993; Krueger and Sullivan 1984; Tieszen and Fagre 1993).

Previous Studies of Ancient Maya Diet and Health

Most previous isotopic research in Mesoamerica has focused on temporal or ecological variation. Other Late Classic Maya sites have been studied by Coyston (1995), Gerry (1993), White and Schwarcz (1989), White, Healy, and Schwarcz (1993), and Wright (1994). Few samples from individual sites or polities have been large enough for intrapopulation pattern analysis. Results of my previous Copán research highlight the importance of sample size when addressing questions of intrapopulation and interpopulation variances. In my initial presentation of 25 specimens, no differences were discerned, except for a juvenile of nursing age (Reed 1991). That analysis of 12 male and 7 female adults yielded results that were interpreted as equal male and female diets (Reed 1991). In further studies, patterns of sex differences and social status variability emerged with an increase in sample size (Reed 1992, 1994).

Archaeobotanical research at Copán has furnished evidence for the C4 plant maize (Zea mays) and the C3 plants bean (Phaseolus vulgaris), squash (Cucurbita moschata), nance (Byrsonima crassifolia), and wild grape (Vitis sp.) (Lentz 1991). Other archaeobotanic remains identified from Copán included chayote (Sechium edule), bottle gourd (Lagenaria sp.), palm or coyol (Acrocomia mexicana), ciruela (Spondias sp.), avocado (Persea americana), zapote (Pouteria sp.), hackberry (Celtis sp.), and frijolillo (Cassia occidentalis). Many of these plants were likely to have been supplemental or famine foods (Marcus 1982). None of the Neotropical C3 cultivars—yam (Dioscorea trifida), manioc (Manihot esculenta), malanga (Xanthosoma sp.), sweet potato (Ipomoea batatas), breadnut or ramón (Brosimum alicastrum), chile peppers (Capsicum annuum), or cacao (Theobroma cacao)—have been identified among the archaeobotanical remains from Copán, although chile pepper, cacao, and palm have been identified at other ancient Maya sites (Lentz 1991, this volume). In addition, tools for processing maize, mostly rhyolite manos and metates, are ubiquitous throughout the Copán Valley in Coner phase contexts (Spink 1983).
Table 10.1. Sample Sizes for Categories of Sites and Individuals from Copán.

<table>
<thead>
<tr>
<th>Group</th>
<th>Totals</th>
<th>F</th>
<th>M</th>
<th>U</th>
<th>I</th>
<th>J</th>
<th>D</th>
<th>YA</th>
<th>MA</th>
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<tr>
<td>Type I</td>
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<td>4</td>
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<td>—</td>
<td>1</td>
<td>4</td>
<td>6</td>
<td>—</td>
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<td>—</td>
</tr>
<tr>
<td>Type II</td>
<td>15</td>
<td>6</td>
<td>9</td>
<td>—</td>
<td>—</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td>4</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>Type III</td>
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<td>4</td>
<td>5</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<td>4</td>
<td>10</td>
<td>15</td>
<td>14</td>
<td>1</td>
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<tr>
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</tr>
<tr>
<td>Urban</td>
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<td>28</td>
<td>6</td>
<td>1</td>
<td>1</td>
<td>5</td>
<td>15</td>
<td>18</td>
<td>19</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Nonurban</td>
<td>19</td>
<td>8</td>
<td>9</td>
<td>2</td>
<td>—</td>
<td>2</td>
<td>—</td>
<td>2</td>
<td>6</td>
<td>1</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>82</td>
<td>37</td>
<td>37</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>17</td>
<td>26</td>
<td>25</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>


Bones or shells from several animals have been identified: deer (*Odocoileus virginianus*), peccary (*Tayassu sp.*), dog (*Canis familiaris*), puma or cougar (*Felis concolor*), jaguar (*Felis onca*), paca (*Cuniculus paca*), freshwater snail (*Pachychilus corvinus* or *P. largillierti*), sea urchin, and mussel (Feldman 1994; Gurry 1993; Pohl 1994; Zeleznik, personal communication 1996).

Whittington (1989, 1992) and Storey (1992, this volume) report indications of physiological stress among the elite and low-status subpopulations of Copán, particularly during the Coner phase. Subadults suffered extended chronic illnesses and experienced episodes of acute stress as inferred from porotic hyperostosis and enamel hypoplasia. Based on an association between high enamel hypoplasia frequencies and high mortality, Whittington (1989) suggests that the age of weaning extended until children were nearly four years old. Nutritionally related stress was experienced by all members of society regardless of social status or sex.

**Materials**

For analysis, the human bone specimens were grouped by sex, age at death, urban or nonurban site location, and social status inferred from associated site type (Table 10.1). The typology of residential architecture serves as an index of coresidential wealth and social status. It is assumed that coresidents shared relative wealth in terms of living conditions, socioeconomic ties, and access to resources, including food. Age and sex assignments were based on information provided by Rebecca Storey (personal communication 1995) and Stephen Whittington (1989). Age categories were defined as infant (ages 0 to 1 years), juvenile (2 to 14), adolescent (15 to 19), young adult (20 to 34), middle adult (35 to 50), and old adult (over 50).

From a collection of more than 600 individuals, 350 human bone specimens were taken from ribs when available. Deer long-bone fragments were
taken from remains excavated at site 9M.22-A, and jaguar long-bone fragments were obtained from a cache in the Main Group. One hundred thirty-two Coner phase human samples with reliable age and sex identifications were analyzed for the stable carbon and nitrogen isotopic composition of their collagen. Approximately one-third of the specimens yielded poorly preserved collagen and were therefore excluded from the isotopic analysis. Well-preserved collagen was obtained from 82 humans, 7 deer, and 1 jaguar, a larger sample than presented in Reed (1992, 1994) and Whittington and Reed (1997). In fact, it is the largest published Maya sample from a single polity.

Methods

A collagen preparation protocol for isotopic and preservation analyses was developed based on the widely used acid and base washing procedure (Ambrose 1990; DeNiro and Weiner 1988; Schoeninger and DeNiro 1984). Approximately 1 g of crushed bone was treated with 1 N HCl for 20 minutes and .125 N NaOH for 20 hours to remove acid and base soluble contaminants. An extract was produced from the washed bone by solubilizing collagen at 90°C for 15 hours and lyophilizing the filtered solution.

Collagen preservation for each specimen extract was assessed by infrared spectral analysis and dry weight percent of the extract. Only specimens with an infrared spectrum similar to a modern collagen standard and a dry weight greater than 2 percent were used for isotopic analysis (Ambrose 1990; DeNiro and Weiner 1988; Goldberg 1993).

A gas mixture was produced by combustion of approximately 8 mg of collagen extract in a sealed, evacuated quartz tube with cupric oxide, granular copper, and silver for 3 hours at 900°C. Dinitrogen and carbon dioxide were cryogenically separated for mass spectrometric analysis of nitrogen, carbon, and oxygen stable isotopes. The analytical reproducibility for the isotopic measurements, based on 13 samples of a collagen standard, was ±.04 ‰ for δ¹³CPD and ±.12 ‰ for δ¹⁵NAIR.

Results

Carbon and nitrogen isotopic measurements were made on 44 individuals associated with the nine patio groups of site 9N-8, 38 interments associated with another 14 sites throughout the Copán polity, 7 deer, and 1 jaguar. In Figure 10.1 these isotopic values are illustrated along with those from Gerry 1993. Nitrogen values from both studies indicate that people at Copán were eating a terrestrial diet. Carbon values indicate a maize staple diet. Lack of evidence for processing tools and archaeobotanical remains for root crops, ramón, or staple cultivars other than maize further supports the inference of a maize-based diet (Lentz 1991).

As shown in Figure 10.1, dogs, pacas, and peccaries were eating C₄-based diets. These animals could have contributed to the C₄ signature in human bone. Too little faunal evidence exists to predict more than a minor contribu-
tion of meat to the diets of the Copán Late Classic human population. For all social levels, deer have been reported as the most common faunal remains and dogs as the second most frequent (Pohl 1994). The 41 deer analyzed by myself and Gerry (1993) were C3 browsers. If deer were a major food source, as inferred from the faunal assemblage by Pohl (1994), then humans should show a stronger C3 signature than observed through isotopic analysis.

One infant and one young child show more positive nitrogen isotope ratios than the other individuals in my study (Figure 10.1). They were probably nursing before death, and their isotopic values correspond to a 2%o to 4%o trophic-related isotopic shift observed in nursing infants relative to weaned children (Fogel et al. 1997; Fogel et al. 1989). The juvenile was 2 to 3 years old, whereas the older two juveniles in this study, with nitrogen values similar to those of the adults, were 12 to 15 years old. These isotopic measurements indicate a dietary transition after 3 years of age, consistent with Whittington’s (1992) estimate of weaning between 3.5 and 4.5 years of age.

For adults of ages 35 to 50 years (MA) and over 50 years old (OA), a Student’s t-test yields a statistically significant difference between the carbon isotope means of male and female adults (Table 10.2). Average carbon isotope values become increasingly negative from youngest to oldest for female adults; that is, these women ate progressively less maize (Figure 10.2). In the young adult category, three of the four female adults 25 years of age or younger have 1%o or more positive carbon isotope ratios than the two female adults older than 25 years of age. Thus, the trend for female adults toward more negative carbon isotope values with increasing age holds within the young adult category. The more positive mean for female young adults can be accounted for by the more positive values for the youngest ones (Figure 10.2).

In Figure 10.3 the urban–nonurban dichotomy is illustrated with divisions by male and female. Although no statistically significant difference between the urban and nonurban sectors in mean carbon values exists (\( t = 1.942, p = .06 \)), a
Table 10.2. Stable Carbon and Nitrogen Isotope Means and One Standard Deviation for Sex and Age at Death Categories with Pooled Two-Sample Student's T-Test Results (total α = .05) for the Mean Differences between Male and Female Results within Age at Death Categories.

<table>
<thead>
<tr>
<th>Ageb</th>
<th>Male Mean ± 1 sd</th>
<th>Female Mean ± 1 sd</th>
<th>Sample Sizea</th>
<th>Difference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>YA</td>
<td>-8.9 ± .5</td>
<td>-9.0 ± .8</td>
<td>11</td>
<td>6</td>
<td>.1</td>
</tr>
<tr>
<td>MA</td>
<td>-8.9 ± .6</td>
<td>-9.5 ± .6</td>
<td>13</td>
<td>12</td>
<td>.6</td>
</tr>
<tr>
<td>OA</td>
<td>-9.0 ± .6</td>
<td>-9.7 ± .5</td>
<td>9</td>
<td>16</td>
<td>.7</td>
</tr>
</tbody>
</table>

|      |                  |                    |                  |            |     |
| YA   | 7.7 ± .4         | 7.2 ± .3           | 11   | 6       | .5              | .02* |
| MA   | 7.5 ± .6         | 7.5 ± .5           | 13   | 12      | 0               | .90  |
| OA   | 7.6 ± .4         | 7.4 ± .6           | 9    | 16      | .2              | .40  |

*The exclusion of missing and extreme values makes some sample sizes smaller than those found in Table 10.1.

bAge at death. YA: young adult (20–34 years), MA: middle adult (35–50 years), and OA: old adult (over 50 years).

*Statistically significant difference at a .05 level.

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difference in spread is apparent in the scatter plots. Several individuals from the urban portion show more positive carbon values. The difference in carbon isotope values between male adults is statistically significant for urban sites (Table 10.3) but not for either sex at nonurban sites.

In Figure 10.4 male and female adults from each site type are displayed in
Table 10.3. Stable Carbon and Nitrogen Isotope Means and One Standard Deviation for Urban and Nonurban Categories with Pooled Two-Sample Student’s T-Test Results (total α = 0.05) for the Mean Differences between Male and Female Results within Locale Types.

<table>
<thead>
<tr>
<th>Locale</th>
<th>Male Mean ±1 sd</th>
<th>Female Mean ±1 sd</th>
<th>Sample Size</th>
<th>Difference</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>δ13C PDB</td>
<td>urban</td>
<td>8.9 ± .6</td>
<td>9.4 ± .6</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>nonurban</td>
<td>9.2 ± .5</td>
<td>9.6 ± .3</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>within sex difference</td>
<td>.3</td>
<td>.2</td>
<td></td>
<td></td>
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<tr>
<td>p-value</td>
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<td>.07</td>
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<td></td>
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<tr>
<td>δ15N AIR</td>
<td>urban</td>
<td>7.6 ± .4</td>
<td>7.4 ± .5</td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>nonurban</td>
<td>7.3 ± .7</td>
<td>7.4 ± .5</td>
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<tr>
<td>within sex difference</td>
<td>.3</td>
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<tr>
<td>p-value</td>
<td></td>
<td>.20</td>
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</table>

*The exclusion of missing and extreme values makes some sample sizes smaller than those found in Table 10.1.
*Statistically significant difference at a .05 level.

Figure 10.3. Stable carbon and nitrogen isotopic values and means with one standard deviation bars for male and female adults from urban and nonurban sites.
Table 10.4. Stable Carbon and Nitrogen Isotope Means and One Standard Deviation for Sex and Site Type Categories with Pooled Two-Sample Student’s T-Test Results (total $a = 0.05$) for the Mean Differences between Male and Female Results within Site Types.

<table>
<thead>
<tr>
<th>Type^b</th>
<th>Male Mean ± 1 sd</th>
<th>Female Mean ± 1 sd</th>
<th>Sample Size^a</th>
<th>Difference</th>
<th>p</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Male</td>
<td>Female</td>
<td></td>
</tr>
<tr>
<td>δ^13C_PDB (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>−9.0 ± .2</td>
<td>−9.6 ± .3</td>
<td>4</td>
<td>7</td>
<td>.6</td>
</tr>
<tr>
<td>II</td>
<td>−9.2 ± .6</td>
<td>−9.2 ± .4</td>
<td>8</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>III</td>
<td>−9.5 ± .9</td>
<td>−9.0</td>
<td>3</td>
<td>1</td>
<td>.5</td>
</tr>
<tr>
<td>IV</td>
<td>−8.7 ± .4</td>
<td>−9.5 ± .7</td>
<td>17</td>
<td>21</td>
<td>.8</td>
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<tr>
<td>δ^15N_AIR(%)</td>
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<tr>
<td>I</td>
<td>7.5 ± .3</td>
<td>7.4 ± .6</td>
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<td>7.4 ± .5</td>
<td>17</td>
<td>21</td>
<td>.2</td>
</tr>
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</table>

*The exclusion of missing and extreme values makes some sample sizes smaller than those found in Table 10.1.

^bSocial rank associated with site type from lowest Type I to highest Type IV.

*Statistically significant difference at a .05 level.

scatter plots, and mean values with standard deviations are shown in the adjacent plots. The difference between male and female adults in carbon isotope values is most distinct and statistically significant in individuals from Type I and Type IV sites. Type II sites show a statistically significant difference in nitrogen isotope values. Category statistics are listed in Table 10.4 with statistical test results for male and female mean differences.

Conclusions

People in the Copán Valley during the Late Classic consumed a terrestrial, primarily vegetarian, maize–based diet, an inference supported by the material remains for maize processing, archaeobotanical remains, ecological reconstructions, and the stable isotopic composition of bone collagen. The dental caries rate for those of low status at Copán is high and correlates with other populations relying on a horticultural diet (Whittington, this volume). Many of the edible fauna were C3 browsers and were unlikely contributors to the C4 signature of the humans. Animals with C4 signatures have been found only in small quantities, were poor meat sources, and therefore were unlikely contributors to the positive carbon values. Supplements from deer and other meat sources evidently were irregular and minimal during the Coner phase for the vast majority of people. Deer, the most likely meat source, appear to have been C3–plant eaters, as no C4–plant-eating deer have been noted by myself or Gerry (1993).

Dietary differences are most marked in subgroups with larger sample sizes. Average isotopic subgroup differences were typically small, up to 0.8‰ for carbon and 0.6‰ for nitrogen. Statistically significant differences in the carbon isotope ratios between male and female adults exist for those over the age of 35 (Table 10.2), for the urban location (Table 10.3), and for the lowest- and highest-
ranked social groups (Table 10.4). Diet for female adults shifts toward more negative carbon isotope values, or less maize consumption, with increasing age, whereas male adults maintain similar diets for all age categories. For female adults, increasing age translated into fewer C4 foods, or reduced maize consumption. Presumably, some aspect of the social system at Copán led to age- and sex-based differences, which may represent differential social behavior, a result undetected from other archaeological data.
Future Directions

Future studies should incorporate more samples from the poorly represented lower-status and rural (nonurban) sectors of Late Classic Copán society. Alternative measures of the social status of individuals would allow for additional, and possibly more refined, analysis of intrasocial dietary variability. An isotopic study of specimens from earlier and later settlements at Copán should be undertaken to examine trends relative to agricultural intensification and demographic changes.

Intrasocial differences in diet reflect patterns in aspects of stratified societies. Archaeological reconstructions of ancient societies need to incorporate large, comprehensive skeletal studies that are founded on extensive knowledge of settlement systems, ecological reconstructions, and household excavations. Small samples, although often representative of the basic diet, fail to capture the variability in social behavior and organization observed in larger samples because of the narrow separations for group differences in isotopic values.

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