Archaeobiology 1

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Chapter 7

ANIMAL ECONOMIES IN PRE-HISPANIC SOUTHERN MEXICO

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Our research compares and contrasts Zapotec animal-based subsistence practices at seven archaeological sites dating from the Archaic to the Postclassic periods (ca. 8700 BCE to 1100 CE) to explore change and continuity in animal use over time in the Central Valleys of Oaxaca. At each of these settlements, three to four main animals (deer, dog, rabbits, and turkey) constitute the majority of the meat diet consumed by Zapotec peoples, yet each assemblage we examined had its own unique zooarchaeological signature. Variations in the distributions of animal remains reflect status differences as well as household and community specializations that revolved around "producing" animals and animal by-products. This is especially evident during the Classic period when the results of our study indicate that different sites had developed different animal-related specialties and preferences. By utilizing new and existing data we gain a broader diachronic perspective on animal economies in ancient Oaxaca that inform our discussions of community specializations in animal procurement at the Classic and Postclassic sites of El Palmillo and the Mitla Fortress.

Specialized domestic craftwork alongside agricultural pursuits and other subsistence activities economically underpinned pre-Hispanic Mesoamerican households, ensuring their social and economic survival (Feinman 1999; Hirth 2006, 2009a). Utilitarian and luxury goods crafted by skilled artisans were manufactured within one's own residence to be exchanged for necessities and desired goods at local markets and through informal barter (Feinman and Nicholas 2000, 2007b, c). The importance of production for exchange cannot be overstated as it laid the foundation for the Mesoamerican market economy, which formed an important cornerstone of the state-level societies that arose throughout the region (Feinman and Garraty 2010; Feinman and Nicholas 2010; Hirth 2006). In ancient Oaxaca and elsewhere in Mesoamerica, households generally participated in multicrafting in that they produced a number of different kinds of goods (Feinman and Nicholas 2007a; Hirth 2006, 2009a; Shimada 2007); however, what goods were produced and at what volumes

and intensities varied both among households and barrios within the same settlement as well as between different communities (Feinman and Nicholas 2004:114; Feinman, Nicholas, and Haines 2002; Flannery and Winter 1976). Domestic production strategies were flexible over time and across settlements, fostering intra- and intercommunity interdependence. Not surprisingly, specialized production methods in ancient Oaxaca exploited local and regional differences in available resources, but they also were created through human ingenuity and rational choices.

Some families also likely raised animals and produced animal by-products (e.g., meat, fur, feathers, etc.) to be consumed by people living outside their immediate household and residing in neighboring and even distant communities, although this is an uncommon topic in discussions of domestic craft production (see also Emery et al. and Lapham et al., this volume). By late pre-Hispanic times, farther north in the Valley of Mexico, exotic and local bird feathers and colorfully dyed rabbit fur were being sold in markets at the Aztec capital Tenochtitlan along with an astonishing array of other items (Sahagún 1961:61, 77, 92). Vendors also offered wild game and animals raised for meat, including rabbits, turkeys, and dogs in all shapes and sizes (Durán 1967; Sahagún 1954:67; 1961:80). How far back in time and where geographically these practices extended is uncertain. To explore ancient Mesoamerican household economies from this oft-overlooked perspective, we examine animal use and animal-based diet in the Central Valleys of Oaxaca, home to Zapotec-speaking peoples. Were ancient Zapotecs raising animals and producing animal by-products for exchange beyond their own familial needs? What similarities and differences existed in animal use and meat diet among and between different households and communities? What aspects changed over time? What aspects remained the same? And, were animals being incorporated along with other products into a household's multicrafting activities?

Previous zooarchaeological studies in the Oaxaca and Ejutla Valleys have taken a problem-oriented approach focused on one or two specific sites (Drennan 1976b; Flannery and Marcus 2005; Flannery and Wheeler 1986; Haller, Feinman, and Nicholas 2006; Middleton, Feinman, and Nicholas 2002; Whalen 1981). To address the questions posed above, we utilize data produced from these earlier studies to examine animal-based subsistence practices from a broader perspective, comparing and contrasting faunal remains from seven archaeological sites (Guilá Naquitz [Flannery 1986c; Flannery and Wheeler 1986; B. D. Smith 2000], San José Mogote [Flannery and Marcus 2005], Fábrica San José [Drennan 1976b],

Santo Domingo Tomaltepec [Whalen 1981], Ejutla [Feinman and Nicholas 1990, 1993, 2000; Middleton, Feinman, and Nicholas 2002], El Palmillo [Feinman, Nicholas, and Maher 2008; Haller, Feinman, and Nicholas 2006; Lapham 2007, 2008a; Middleton, Feinman, and Nicholas 2002], and the Mitla Fortress [Lapham 2009, 2010]) dating from ca. 8700 BCE to 1100 CE to explore change and continuity in animal use over time. Table 1 lists the sites and Table 2 provides a regional chronology. Prior research has approached meat diet and animal use from a diachronic perspective elsewhere in Mesoamerica (Emery 1999a, 2004a; Emery, Wright, and Schwarcz 2000; Flannery 1967; Hamblin 1984; Henderson and Joyce 2004; Hudson, Walker, and Voorhies 1989; Masson 2004b; Shaw 1999; Wing 1981), but not yet in central Oaxaca. We find that variations in the distributions of animal remains do not simply reflect subsistence procurement, but also provide insights into status as well as household and community specializations, especially by the Classic period.

Background of the Zooarchaeological Samples

The Oaxaca and Ejutla Valleys, a large part of the Central Valleys of Oaxaca, are located in the southern highlands of Mexico (Figure 1). Climate is semiarid, with annual rainfall fluctuating substantially. Six of the seven archaeological sites we discuss in the following section are located in the Etla and Tlacolula Subvalleys of the Valley of Oaxaca. The northern arm of the valley, or Etla Subvalley, is cooler and higher in elevation with the best potential for irrigation to supplement inadequate rainfall and assist the growth of crop plants at sites such as San José Mogote and Fábrica San José (Blanton et al. 1999:34; Kirby 1973). This valley arm also has the most land with potential for high, dependable crop yields in the entire region (Nicholas 1989). The Tlacolula subvalley in the eastern arm is the driest part of the valley. Its low annual rainfall influences and can restrict the growth and productivity of vegetation and crops, ultimately limiting agriculture at sites such as Tomaltepec, El Palmillo, and the Mitla Fortress, among others (Blanton et al. 1999; Kirby 1973). The Ejutla Valley lies south of the southern arm of the Valley of Oaxaca, being separated from it by the southern edge of the upper drainage of the Atoyac River. Ejutla has less irrigation potential than the Valley of Oaxaca, a factors that likely contributed to the lower human population density in Ejutla compared to its larger, northern neighbor (Feinman and Nicholas 1990).

Table 1. Oaxaca and Ejutla Valley sites with animal remains discussed in the text.

Site	Geographic Location	Main Period(s) Represented by Fauna	Phases with Fauna*	Reference(s)
Guilá Naquitz	Piedmont cave, eastern Tlacolula Subvalley	Early Archaic	*Naquitz*	Flannery 1986
San José Mogote	Piedmont spur, Etla Subvalley	Early Formative	Tierras Largas, *San José*, Guadalupe, and Rosario	Flannery and Marcus 2005
Santo Domingo Tomaltepec	Piedmont, western Tlacolula Subvalley	Early Formative	Tierras Largas, *San José*, Rosario, and Monte Albán Early I, Late I, and II	Whalen 1981
Fábrica San José	Piedmont, Etla Subvalley	Middle Formative	*Guadalupe* and *Rosario*	Drennan 1976
Ejutla	Valley floor, Ejutla Valley	Late Classic	mostly *Monte Albán IIIB–IV*	Feinman and Nicholas 1990, 1993, 2000; Middleton, Feinman, and Nicholas 2002
El Palmillo	Piedmontridge, eastern Tlacolula Subvalley	Classic	*Monte Albán IIIA*, *IIIB–IV*, and *V*	Feinman, Nicholas, and Maher 2008; Haller, Feinman, and Nicholas 2006; Lapham 2007, 2008; Middleton, Feinman, and Nicholas 2002
Mitla Fortress	Piedmont mesa, eastern Tlacolula Subvalley	Late Classic and Early Postclassic	Monte Albán IIIA, *IIIB–IV*, and *V*	Lapham 2009, 2010

*Italicized phases are where the majority of animal remains were recovered.

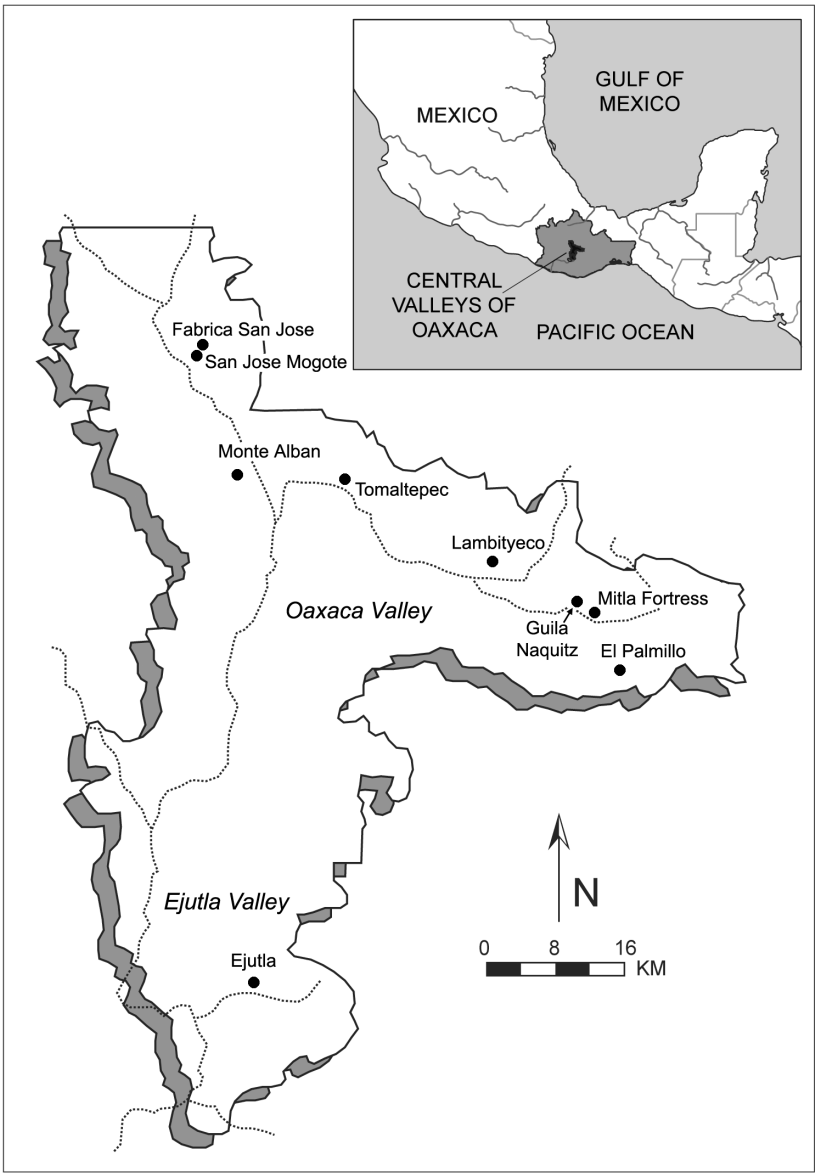

Figure 1. Map of the Oaxaca and Ejutla Valleys showing the location of sites mentioned in the text. Illustrated by Linda Nicholas.

Archaic Sites

The earliest animal remains associated with human occupations in the Valley of Oaxaca were excavated at the preceramic Early Archaic (ca. 8900–5800 BCE) Guilá Naquitz cave site, which lies high above the valley floor at the base of a large canyon in the eastern Tlacolula subregion (Figure 1 and Table 1; Flannery 1986b). Excavations at the small rock shelter revealed the earliest evidence of domesticated squash (*Cucurbita pepo*) and maize (*Zea mays*) in the valley along with a variety of other plants and animals (Benz 2001; Flannery and Wheeler 1986; Kaplan 1986; Piperno and Flannery 2001; B. D. Smith 1997, 2000; C. E. J. Smith 1986; Whitaker and Cutler 1986). Although other Archaic sites produced small amounts of animal remains (Flannery 1970), they were not included in our cross-temporal study due to small sample sizes. Understanding basic Archaic vertebrate fauna subsistence practices provides an important foundation from which to examine animal economies during later periods.

Formative Sites

Information about Formative meat-based diet and animal use comes from three archaeological sites—San José Mogote, Santo Domingo Tomaltepec, and Fábrica San José—excavated along with Guilá Naquitz as part of the University of Michigan Museum of Anthropology's multidisciplinary Prehistory and Human Ecology of the Valley of Oaxaca Project. The animal remains from all three Formative sites as well as Guilá Naquitz were analyzed by Flannery and associates (Drennan 1976a:213; Flannery and Marcus 2005:xxii; Flannery and Wheeler 1986; Whalen 1981:168). Our comparisons of the zooarchaeological assemblages in this chapter rely solely on the number of identified specimens (NISP). We base our comparisons on NISP rather than some other quantitative unit because those are the data that have been collected and published. We discuss the pros and cons of using NISP below. Faunal remains were also recovered at Tierras Largas, a Formative village located several kilometers from the Classic regional capital city of Monte Albán (Winter 1972). The Tierras Largas sample is small and the data are presented in a format that is not directly comparable to the other seven sites, therefore we exclude it from the present study.

San José Mogote, the largest of the three settlements, is an Early and Middle Formative civic-ceremonial center located on a low piedmont spur above the floodplain of the Atoyac River in the northern Etla Sub-

Table 2. Chronological Sequence for Oaxaca and Mesoamerica.

Date	Oaxaca Phase	Mesoamerican Period
1500		
		Late Postclassic
1300		
	Monte Albán V	
1100		Early Postclassic
900		
	Monte Albán IV	
700		Late Classic
	Monte Albán IIIB	
500		
	Monte Albán IIIA	Early Classic
300		
100 CE	Monte Albán II	Terminal Formative or Preclassic
100 BCE		
	Monte Albán Late I	
300		Late Formative or Preclassic
	Monte Albán Early I	
500		
	Rosario	
700		Middle Formative or Preclassic
	Guadalupe	
900		
	San José	
1100		Early Formative or Preclassic
1300	Tierras Largas	
1500		

valley (Figure 1; Flannery and Marcus 2005). Its main occupations date to the Early through Terminal Formative periods, but a few earlier materials were also recovered. The majority of the animal remains come from excavations of Early Formative San José phase deposits (Tables 1 and 2). More than a decade of excavation and research at San José Mogote have produced numerous reports and publications (e.g., Flannery and Marcus 1994; Marcus 1998; Parry 1987; Pires-Ferreira 1975), including a volume focused specifically on domestic households (Flannery and Marcus 2005),

from which the following faunal data have been gathered. The animal remains discussed in this chapter come from an Early San José midden and domestic deposits from 15 households and associated activity areas (10 Middle San José, two Late San José, and three Rosario residences). During the Early Formative, San José Mogote increased substantially in both size and complexity, growing in expanse from about 7 hectare to an estimated 70 hectares (Flannery and Marcus 2005:7, 10). As much as half of the population of the Valley of Oaxaca likely lived at this large community during this time, and many newcomers may have been enticed to immigrate there for reasons such as protection from hostile neighboring polities, elite support of craft specialists, better access to exotic and valued goods, and opportunities to be closer to important religious leaders and ritual specialists (Flannery and Marcus 2005:11–12). Among San José phase households, differences in domestic architecture, residential activities, the distribution of exotic goods, mortuary customs, and the consumption of preferred foodstuffs, indicate that status varied and was both achieved and inherited (Flannery and Marcus 2005:10, 58; Marcus and Flannery 1996:93–110).

The second Formative site with a well-preserved faunal sample is Fábrica San José, a Middle Formative hamlet located in the piedmont region of the Etla Subvalley about 5 km northeast of San José Mogote (Figure 1; Drennan 1976a). Relationships between this satellite village and the large civic-ceremonial center itself are evident in the ceramic assemblages and mortuary record of the two sites (Flannery and Marcus 2005:12, 470; Plog 1976). Springs near the hamlet supported small-scale salt mining (Drennan 1976a). The main occupations date to the Middle Formative Guadalupe and Rosario phases, but earlier Tierras Largas and later Monte Albán Early I materials were recovered in small quantities as well (Drennan 1976a). In contrast to San José Mogote where most of the excavated fauna is associated with the Early Formative, animal remains excavated from Fábrica San José date to the Middle Formative (Tables 1 and 2), having been recovered from residential deposits associated with three Early Guadalupe, nine Late Guadalupe, and eight Rosario households.

The third Formative site we consider is Santo Domingo Tomaltepec, a small civic-ceremonial center located in the piedmont region of the western part of the Tlacolula subvalley about 12 km east of modern Oaxaca City (Figure 1; Whalen 1981). The site spans the entire Formative, with occupations dating from the Early Formative Tierras Largas phase

through the Terminal Formative Monte Albán II phase (Tables 1 and 2). The vast majority of the animal remains come from domestic contexts associated with five Early Formative San José households. Small amounts of fauna were also recovered from two Tierras Largas, two Rosario, three Monte Albán Early I, and three Monte Albán Late I residences. Situated about 23 km southeast of San José Mogote, Tomaltepec lies outside of the most prominent Formative settlement's sphere of most direct influence (Whalen 1981). From its founding in the Early Formative through its peak in the Middle Formative, Tomaltepec grew in size and importance as indicated by an increasing number of domestic structures including elite residences, multiple public buildings (some with elaborate architecture), and an impressive tomb filled with fine offerings. The settlement, which began as a two- to five-household hamlet, expanded to cover an estimated 5–8 hectares by the Late Formative (Whalen 1981:32, 104). Tomaltepec saw a decline in population and subsequent abandonment during the Terminal Formative, correlating with larger demographic changes in the Tlacolula Subvalley and the greater Valley of Oaxaca (Whalen 1981:106).

Classic and Postclassic Sites

Information about animal-based subsistence practices during the Classic and Postclassic is derived from three archaeological sites: Ejutla, El Palmillo, and the Mitla Fortress. Ejutla, located in the Ejutla Valley immediately south of the southern arm of the Valley of Oaxaca, was one of the largest settlements in this smaller valley (Figure 1; Feinman 1999; Feinman and Nicholas 1990). The relationships that developed between communities in the two valleys were dynamic, oscillating in nature and intensity over time. By the Early Classic, however, Ejutla was more fully integrated into the Monte Albán state (Feinman and Nicholas 1990). Following regional surveys of the Ejutla Valley (Feinman and Nicholas 1990), four seasons of excavations were conducted at the eastern edge of the site. These yielded the remains of a single Classic commoner household and domestic-activity areas associated with marine-shell ornament and ceramic production, largely for exchange and likely export (Feinman 1999; Feinman and Nicholas 2000). Ceramic forms manufactured by the residents included figurines and tortilla griddles, among other items. Animal remains were recovered primarily from Late Classic domestic midden deposits (Tables 1 and 2; Middleton, Feinman, and Nicholas 2002).

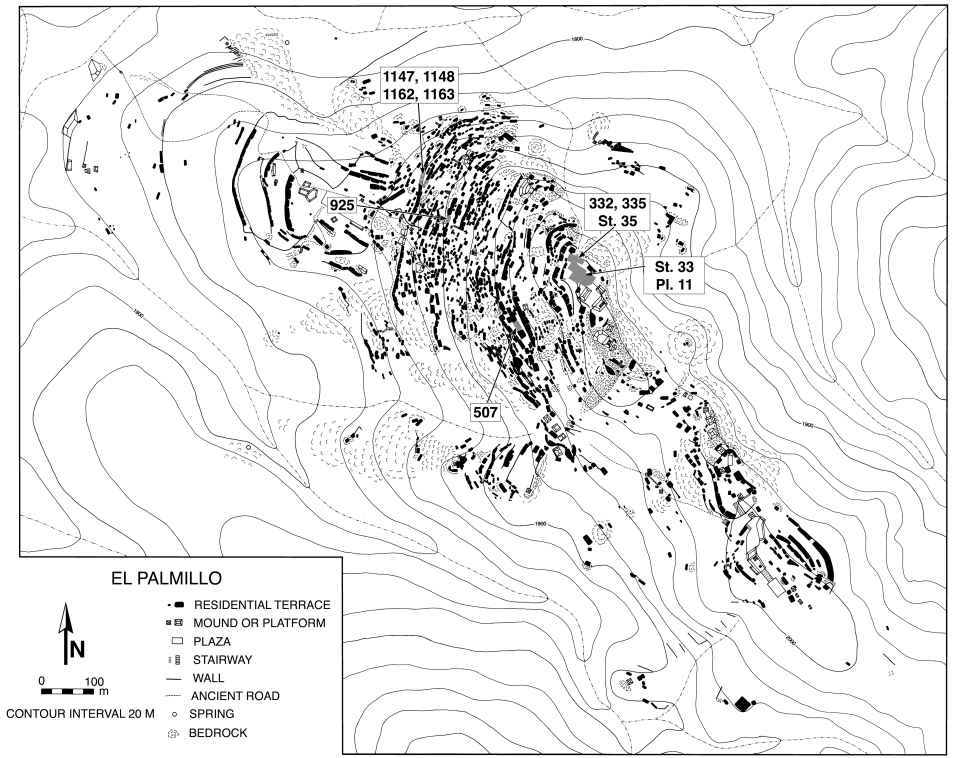

Figure 2. Plan of El Palmillo showing the location of the excavated terraces. Illustration by Linda Nicholas.

El Palmillo lies on a high ridge in the piedmont region of the Tlacolula Subvalley, east of the modern town of Santiago Matatlán and south of the Mitla Fortress (Figure 2; Feinman and Nicholas 2004). Settled during the Late Formative, the community grew quickly during the Classic to more than 90 hectares when it supported thousands of people, making it the largest center in the eastern Tlacolula subregion (Feinman and Nicholas 2004:95, 100). With more than 1,400 residential terraces, El Palmillo was by far the largest Early Classic center in eastern Tlacolula. Its many residents produced ceramics, worked stone, and processed plants (especially maguey) for food and fiber, along with other domestic activities. Craft production both for inhouse consumption and outside exchange varied among households and barrios at the settlement (Feinman and Nicholas 2004:105, 1012). The animal remains discussed here come from eight residential complexes excavated during the 1999–2004 seasons (Haller, Feinman, and Nicholas 2006; Middleton, Feinman, and Nicholas 2002). The lower excavated residences (Terraces 1162, 1163, 1147/1148, 925, 507) were occupied throughout the Classic period, whereas three upper residences date from the Middle Classic to the Late Classic/Early Postclassic transition. Household status is broadly correlated with terrace elevation, with residences located on the upper terraces having held a relatively more privileged status than households located farther down the slope toward the base of the hill (Feinman, Nicholas, and Haines 2002; Haines, Feinman, and Nicholas 2004; Haller, Feinman, and Nicholas 2006).

The Mitla Fortress, like El Palmillo, is located in the eastern Tlacolula Subvalley on a steep, freestanding hill that juts up from the surrounding floodplain near the ancient and modern town of Mitla (Figure 1; Feinman and Nicholas 2004). During the Classic period, the settlement experienced rapid growth, expanding in size to almost 40 hectares and eventually housing a few thousand people. The community continued to be occupied into the Postclassic (Feinman and Nicholas 2004:47, 51). Animal remains come from residential deposits associated with two adjacent commoner households (Terraces 56 and 57) excavated in 2009 and 2010 (Figure 3). Both households worked obsidian and produced maguey fiber, among other domestic activities (Feinman and Nicholas 2012). At the Mitla Fortress and El Palmillo, all archaeofaunal materials were washed and analyzed in the field laboratory using modern comparative skeletons and published reference sources. Some identifications were confirmed using photographs and metric data collected in the field upon returning to

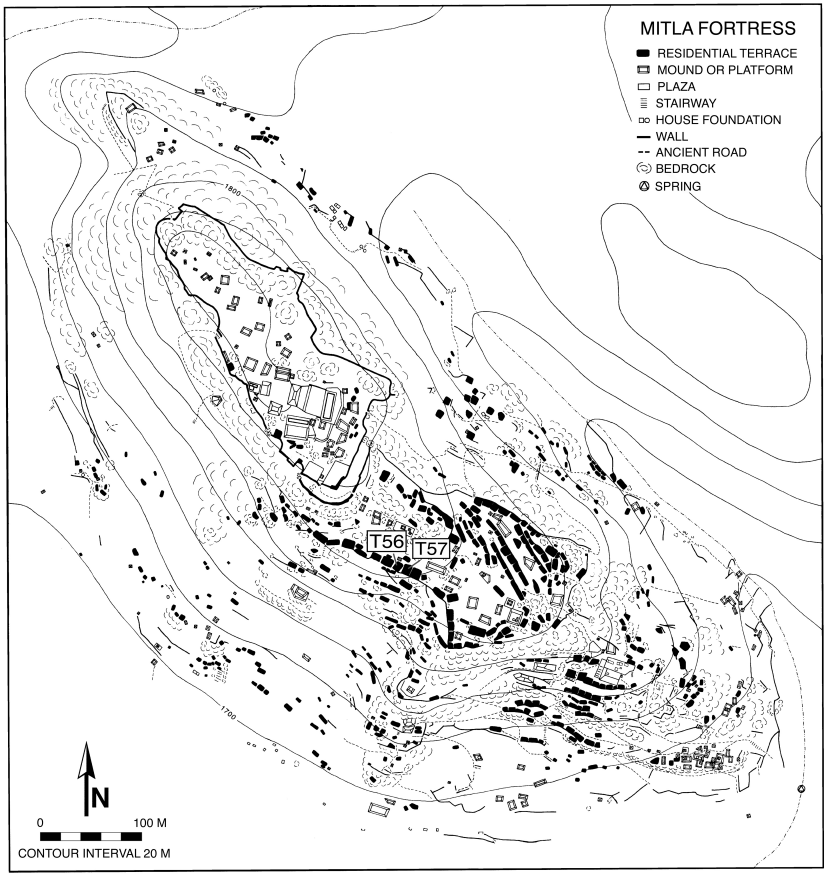

Figure 3. Plan of the Mitla Fortress showing the location of the excavated terraces. Illustrated by Linda Nicholas.

the Center for Archaeological Investigations' Zooarchaeology Laboratory at Southern Illinois University Carbondale, which houses an extensive comparative collection and library.

Sample Limitations

We base our comparisons of the animal remains on the number of identified specimens (NISP) because those are the available data that have been reported consistently for all seven aforementioned sites. NISP, which is the count of the number of specimens and specimen fragments identified per taxon, is one common quantitative unit used to describe

the basic composition and estimate the relative frequency of taxa within zooarchaeological assemblages. This measure has its strengths and weaknesses, which we briefly summarize here because they have been discussed in detail elsewhere (e.g., Grayson 1979; Lyman 1994a; Reitz and Wing 1999:191–202). NISP is easily calculated, can be reproduced by different researchers, and will be the same regardless of how one aggregates the data. Like all measures archaeologists use to quantify data, NISP is affected by past cultural practices (butchering, meal preparation, disposal, etc.), site formation processes, and field and laboratory methods. It is sensitive to bone fragmentation in that it can overrepresent animals with a greater number of skeletal elements or more identifiable elements. NISP can also overemphasize the importance of animals brought back to the occupation site intact versus those butchered in the field. Despite these potential biases, we believe NISP (especially in its proportion form, %NISP) is an appropriate measure to evaluate the relative abundance of different animals exploited by ancient peoples for subsistence and other purposes.

Another limitation of this study is the large differences in sample sizes both within and between archaeological sites. At Fábrica San José, for example, the Middle Formative Early Guadalupe phase contained fewer than 30 specimens, whereas the Late Guadalupe phase yielded more than 200 fragments. Similar sample size disparities are also seen at most of the other sites, and certainly between sites. One reason for the large variation in sample size is differences in area excavated. Again, using Fábrica San José as an example, excavations uncovered three Early Guadalupe phase households, with an estimated occupation area of 0.2–0.3 hectares. By the Late Guadalupe phase, the settlement had grown to eleven households covering an estimated 2 hectares (Drennan 1976a:83, 109). Sample size is also influenced by a household's status and its domestic activities. At San José Mogote, the elite Middle Formative Rosario residences built on top of the southern mound were more thoroughly cleaned than other households, leaving behind smaller bone fragments and less debris than deposits recovered from other domestic areas (Flannery and Marcus 2005:417, 424). At El Palmillo, in contrast, higher-status residences located near the hill's apex show a greater density of animal remains indicative of greater access to meat than do lower-class households farther down the slope (Haller, Feinman, and Nicholas 2006).

Two important similarities exist among all seven sites, both of which enhance the feasibility of intersite comparisons. First, the contexts represented by the animal remains are broadly similar, typically domestic debris

from residential feature and midden contexts. Second, excavation recovery strategies were similar. Archaeologists at San José Mogote, Fábrica San José, and Tomaltepec hand picked visible fauna from *in situ* deposits and then sifted all soil through standard 6 mm mesh screen, with 2 mm mesh likely used as well based on other excavations by this team (Drennan 1976a:13; Flannery and Marcus 2005:35; Spencer 1981:195). The recovery strategy at Guilá Naquitz utilized 2 mm as well as standard 6 mm mesh screens (Flannery, Moser, and Maranca 1986:68–69). At Ejutla, El Palmillo, and the Mitla Fortress, all deposits were screened through 6 mm mesh, with fine mesh used for more delicate contexts.

Meat Diet in the Oaxaca and Ejutla Valleys

To explore change and continuity in animal use and meat diet over time, we compare and contrast faunal assemblages from seven settlements with occupations ranging from the Archaic to the Postclassic (Figure 1 and Tables 1 and 2). We draw on a number of earlier studies to gain a longer temporal perspective on animal-based subsistence practices, including Drennan 1976a; Flannery and Marcus 2005; Flannery and Wheeler 1986; Haller, Feinman, and Nicholas 2006; Middleton, Feinman, and Nicholas 2002; and Whalen 1981. We begin this section by discussing animal diet among Archaic hunters and gatherers in central Oaxaca because understanding early vertebrate fauna subsistence practices provides an important foundation from which to examine animal economies later in time. Next, we examine animal use and meat diet in Formative hamlets and towns and explore continuity and change in these practices during the Classic and Early Postclassic periods. Lastly, we discuss diachronic change in ancient Zapotec animal economies in the Oaxaca and Ejutla Valleys.

Throughout this chapter, scientific and common names of the identified taxa follow standards employed by the Integrated Taxonomic Information System (ITIS; http://www.itis.gov). Yet, we deviate from ITIS standards in our use of *Canis familiaris* as the scientific name for domestic dog, following nomenclature long favored by zooarchaeologists (Gentry, Clutton-Brock, and Groves 1996, 2004; Morey 1986, 1994; Olsen 1985; Reitz and Wing 1999:281–282).

Archaic Hunters and Gatherers

During the Archaic, family-sized groups that temporarily settled at Guilá Naquitz hunted white-tailed deer and collared peccary, trapped

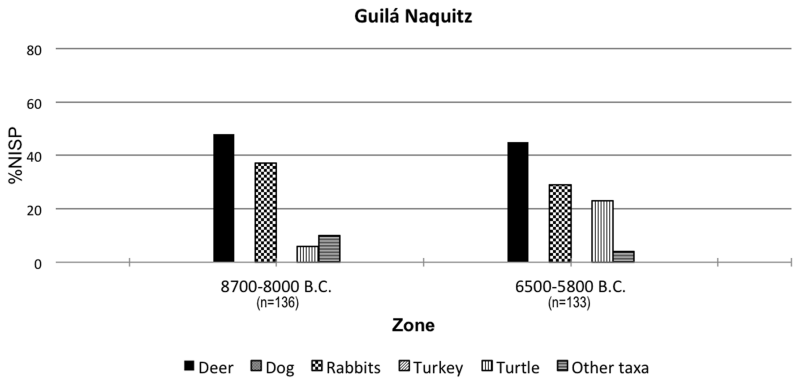

Figure 4. Comparison of the main taxa during the Archaic at Guilá Naquitz. Data from Table 3.

cottontail rabbits and raccoons, and caught mud turtles and various birds (Flannery and Wheeler 1986). Domestic dog, a meat common in Formative and Classic diets, had not yet been incorporated into family meals, at least not at Guilá Naquitz. Despite significant time lapse between the two main occupations (about 3,000 years), the proportion of deer remained strikingly similar through time. In both temporal contexts deer constitutes slightly less than half of the total fauna (48% and 45%, respectively), indicating that deer hunting remained consistent throughout the Archaic at Guilá Naquitz (Figure 4 and Table 3). The same pattern is also apparent when the data are tallied by minimum number of individuals (MNI; see tables in Flannery 1986a:308–312). Archaic deer exploitation was different than what is seen during the later Formative and Classic periods, where deer hunting declined over time as reflected by the proportionate representation of deer remains in the assemblages, as we discuss later in the chapter.

Subsistence in Formative Hamlets and Towns

Early Formative San José Mogote residents consumed meat mainly from domestic dog, white-tailed deer, rabbits (both cottontails and jackrabbits), and giant pocket gopher (classified as "other taxa" in Figure 5a and Table 3). With the exception of pocket gophers, this same trio of taxa constitutes the basic meat diet at other Formative sites in the Valley of Oaxaca. Sometime during the past 5,000 or so years, between the Early Archaic and Early Formative, domestic dog became an important

Table 3. Comparison of Main Taxa by Site, Period, and Phase.

Site, Period, and Phase[1,2]	NISP	Deer NISP (%)	Dog NISP (%)	Rabbit NISP (%)	Turkey NISP (%)	Turtle NISP (%)	Other Taxa NISP (%)	# Taxa
Guilá Naquitz[3]								
A Naquitz, 8700–8000 BC	136	65 (48)	0 (0)	50 (37)	0 (0)	8 (6)	13 (10)	7
A Naquitz, 6500–5800 BCE	133	60 (45)	0 (0)	38 (29)	0 (0)	30 (23)	5 (4)	7
San José Mogote[4]								
EF Early San José	90	22 (24)	28 (31)	14 (16)	2 (2)	8 (9)	16 (18)	12
EF Middle San José	364	36 (10)	125 (34)	85 (23)	2 (1)	18 (5)	98 (27)	21
EF Late San José	470	94 (20)	142 (30)	163 (35)	0 (0)	9 (2)	62 (13)	19
MF Rosario	21	3 (14)	5 (24)	10 (48)	0 (0)	0 (0)	3 (14)	7
Fábrica San José[5]								
MF Early Guadalupe	27	18 (67)	6 (22)	3 (11)	0 (0)	0 (0)	0 (0)	4
MF Late Guadalupe	216	108 (50)	73 (34)	27 (13)	0 (0)	2 (1)	6 (3)	10
MF Rosario	252	75 (30)	138 (55)	19 (8)	0 (0)	1 (1)	19 (8)	17
Santo Domingo Tomaltepec[6]								
EF Tierras Largas	30	9 (30)	0 (0)	15 (50)	0 (0)	1 (3)	5 (17)	5
EF Early San José	449	405 (90)	4 (1)	25 (6)	0 (0)	0 (0)	15 (3)	8
MF Rosario	19	14 (74)	2 (11)	0 (0)	0 (0)	0 (0)	3 (16)	4
MF Monte Albán Early I	47	30 (64)	11 (23)	4 (9)	0 (0)	0 (0)	2 (4)	4
LF Monte Albán Late I	62	39 (63)	21 (34)	1 (2)	0 (0)	0 (0)	1 (2)	4
Ejutla[7]								
LC Monte Albán IIIB–IV	1338	259 (19)	504 (38)	278 (21)	5 (1)	228 (17)	64 (5)	11

El Palmillo[8]								
EC Monte Albán IIIA	426	131 (31)	161 (38)	98 (23)	20 (5)	9 (2)	7 (2)	8
MC Late Monte Albán IIIA & Early IIIB–IV	509	149 (29)	196 (39)	135 (27)	13 (3)	13 (3)	3 (1)	9
LC Monte Albán IIIB–IV	1746	276 (16)	568 (33)	749 (43)	87 (5)	51 (3)	15 (1)	15
LC/EP Late Monte Albán IIIB–IV & Early V	956	159 (17)	267 (28)	411 (43)	80 (8)	30 (3)	9 (1)	13
Mitla Fortress[9]								
MC Late Monte Albán IIIA & IIIB–IV	92	6 (7)	36 (39)	20 (22)	22 (24)	6 (7)	2 (2)	7
LC Monte Albán IIIB–IV	182	23 (13)	52 (29)	29 (16)	45 (25)	9 (5)	24 (13)	18
LC/EP Late Monte Albán IIIB–IV& Early V	375	38 (10)	123 (33)	55 (15)	105 (28)	14 (4)	40 (11)	14
EP Early Monte Albán V	106	11 (10)	36 (34)	14 (13)	35 (33)	3 (3)	7 (7)	10

1. Period abbreviations are as follows: A (Archaic), EF (Early Formative), MF (Middle Formative), LF (Late Formative), EC (Early Classic), MC (Middle Classic), LC (Late Classic), LC/EP (Late Classic/Early Postclassic), and EP (Early Postclassic).

2. This table includes specimens identified to the taxonomic level of infraclass and lower, with the exception of bony fishes (Osteichthyes superclass). It excludes commensal taxa, worked bone, and mortuary and offering contexts.

3. Guilá Naquitz counts and percentages are calculated from individual animal bone counts listed by archaeological context in Flannery and Wheeler 1986:Tables 22.1–22.9. The fauna are grouped into two main occupation periods (Zones C–D and B1–B3; 8,700–8,000 and 6,500–5,800 cal. BCE, respectively) based on the findings from 37 radiocarbon dates by B. D. Smith (2000) that included Flannery's (1986c) original dates as well as 27 more recently dated samples of wood charcoal and plant remains. This table also excludes material from Zone B2+3, an area of mixed contexts, and "songbirds in owl pellets" from Table 22.9.

4. San José Mogote counts and percentages are calculated from individual animal bone counts listed by archaeological context in Flannery and Marcus 2005:108–443.

5. Fábrica San José counts and percentages are calculated from individual animal bone counts listed by archaeological context in Drennan 1976:Appendix VIII.

6. Santo Domingo Tomaltepec counts and percentages are calculated from individual animal bone counts listed by archaeological context in Whalen 1981:Appendix V.

7. Ejutla counts from Middleton et al. 2002:Table 3.

8. Data from Table 4.

9. Data from Table 5

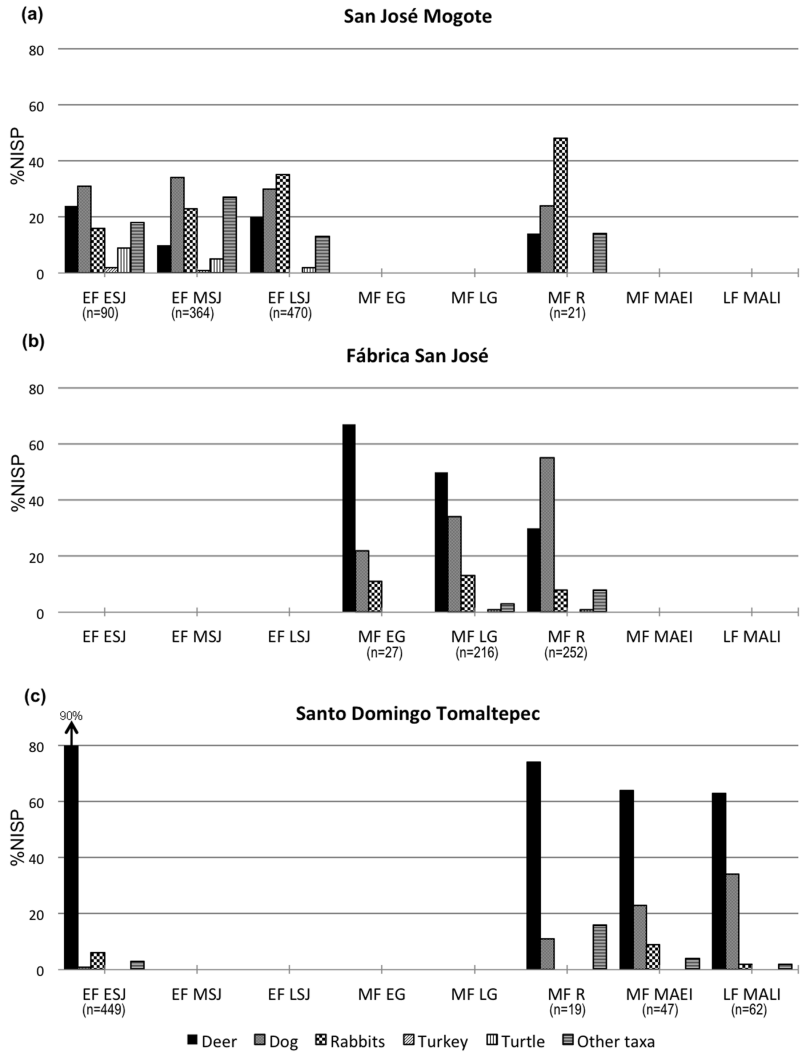

Figure 5. Comparison of the main taxa during the Formative, (a) San José Mogote, (b) Fábrica San José, and (c) Santo Domingo Tomaltepec. Data from Table 3. Period and phase abbreviations are as follows: EF (Early Formative), MF (Middle Formative), LF (Late Formative), ESJ (Early San José), MSJ (Middle San José), LSJ (Late San José), EG (Early Guadalupe), LG (Late Guadalupe), R (Rosario), MAEI (Monte Albán Early I), and MALI (Monte Albán Late I).

meat source. Additional mammals exploited for food and other purposes include collared peccary, gray fox, raccoon, ringtail, spotted skunk, long-tailed weasel, nine-banded armadillo, and opossum (Flannery and Marcus 2005). Birds are represented by a wide variety of local species, although never in great numbers, including lesser scaup and other ducks, band-tailed pigeon, mourning dove, crested guan, Montezuma quail, American coot, common raven, finches, and perching birds. Turkey is rare at San José Mogote, with only four bones identified (Flannery and Marcus 2005:188, 245, 251). Mexican mud turtle is found throughout the Early Formative San José phase, but in frequencies that steadily decreased over time (Figure 5a and Table 3). Three carapace (upper shell) fragments of imported, nonlocal river turtle (possibly *Dermatemys mawii*) also have been identified (Flannery and Marcus 2005:164, 188), perhaps pieces of drums once used in community rituals (Flannery 1976:335; Flannery and Marcus 2005:96) or the remains of ceremonial delicacies eaten by leaders. Nonlocal marine fish represent a small proportion of the faunal assemblage during all Early Formative San José occupations. Fish are absent in the later Middle Formative Rosario phase, although this may be due to sample size (21 NISP) or context represented (elite houses built upon a mound). Taxa include sea trout, drum, grunt, snapper, sea catfish, stingray, and requiem shark. The latter two cartilaginous fish are represented by a complete spine and a single tooth, both items imported from the coast for ceremonial purposes (Flannery 1976:344; Flannery and Marcus 2005:245, 317).

The dietary importance of different animals varies among the occupation phases at San José Mogote, but rabbits, particularly cottontails, are the one main food source that increased steadily during the occupation from the early Formative Early San José phase through the Middle Formative Rosario phase (Figure 5a and Table 3). Some of the variation seen in the proportions of different taxa may be due to sample size (the Rosario sample is much smaller than the other three assemblages), but it is also due in part to differences among the contexts represented by each phase. Animal remains from the Early San José phase, for example, come primarily from two different midden contexts, one associated with lower-status families residing in the southwestern portion of the settlement and the other with a southeastern barrio where families worked shell and magnetite (Flannery and Marcus 2005:136, 241). The Rosario phase, in contrast, contains fauna from several elite residences built on top of a prominent southern mound where during the earlier San José phase a spi-

der monkey (*Ateles geoffroyi*) skull reddened with ochre had been buried as a ritual offering below the floor of a men's house (Flannery and Marcus 2005:396, 409). By untangling the defining factors that coalesced to form individual zooarchaeological assemblages, we gain a better understanding of Formative animal economies at both local and regional levels.

At Fábrica San José, a Middle Formative hamlet located near San José Mogote, residents subsisted mainly on meat from deer, dog, and, to a lesser degree, rabbits. General subsistence trends indicate a decrease in deer meat over time, possibly resulting from declining white-tailed deer populations in the nearby mountains due to cultural and ecological pressures (Drennan 1976a:137–138). Unlike deer, domestic dogs steadily increased in frequency (Figure 5b and Table 3), and dog burials are also more common in later deposits than earlier ones. Increased intervillage raiding and warfare evident in the valley during the Rosario phase (Marcus and Flannery 1996:124–125) may have also influenced subsistence strategies. Local deer populations were likely declining (Drennan 1976a:137–138), but if deer hunting had also become a potentially dangerous activity because hunting parties had to venture into unprotected or unfriendly territories to procure deer, then Fábrica San José's residents may have opted to rely more heavily on locally raised dog meat to ensure they had a safe, and reliable, meat source.

Other mammals exploited for subsistence and other uses by Fábrica San José's residents include collared peccary, gray fox, white-nosed coati, raccoon, ringtail, striped skunk, long-tailed weasel, Mexican gray squirrel, and nine-banded armadillo. Birds, reptiles, and fishes are not particularly common during any occupation at the settlement (Figure 5b and Table 3) but include red-tailed hawk, American kestrel, Montezuma quail, great horned owl, Mexican mud turtle along with Central American river turtle, crocodile, and snapper (a marine fish; Drennan 1976a). These latter three animals are nonlocal to the surrounding environment, indicating their acquisition through trade. In general, however, imported reptile and fish remains are less frequent at Fábrica San José (1%) compared to its more prominent neighbor, San José Mogote (4%). The higher proportion of imported animals at San José Mogote is not unexpected given that the large, civic-ceremonial center wielded much greater power and influence in the valley than smaller, satellite settlements such as Fábrica San José.

Early Formative families residing at Santo Domingo Tomaltepec largely consumed white-tailed deer, especially during the Early Formative San José phase where deer constitute 90 percent of identified remains (Figure

5c and Table 3). The higher numbers of deer throughout the site's occupation may reflect the lower human population densities during the Formative in the Tlacolula subvalley as compared to the Etla Subvalley where San José Mogote and Fábrica San José are located. Other mammals recovered from residential deposits include collared peccary, domestic dog, cottontail, giant pocket gopher, opossum, red-tailed hawk, Mexican mud turtle, Central American river turtle, and grunt (a marine fish; Whalen 1981). Later in time, during the Middle and Late Formative, Tomaltepec's residents consumed similar animals as their predecessors, with deer and dog continuing to be important parts of the diet. The low proportion of dog in Early Formative households is curious given their frequency at other sites in the valley and during later periods at Tomaltepec. Dog is conspicuously absent from the Tierras Largas assemblage, and it is found in surprisingly low numbers during the San José phase, especially considering the size of the sample recovered (ca. 450 identifiable specimens). It is not until the Middle Formative Monte Albán Early I phase that dogs are found in a frequency comparable to other sites in the valley such as San José Mogote and Fábrica San José. At Tomaltepec, like Fábrica San José, the consumption and use of dog increased over time.

Continuity and Change in the Classic and Early Postclassic

Like their Formative predecessors, Classic and Early Postclassic communities relied on the same general trio of taxa—dog, deer, and rabbit—to fulfill their meat-based subsistence needs. Meaningful differences exist, however, among the animal remains from Ejutla, El Palmillo, and the Mitla Fortress, resulting in three unique zooarchaeological signatures that are reflective of slightly different animal economies. At Ejutla, turtles were exploited more heavily than elsewhere in the valley (Figure 6a and Table 3), likely because residents could have procured turtles from nearby alluvial environments since the site is situated on a floodplain in prime mud turtle habitat (Flores Villela 1993; H. M. Smith and R. B. Smith 1979). Fewer turtles are found at either El Palmillo or the Mitla Fortress, which are located in piedmont regions in the Tlacolula subvalley. Ejutla also contains a large number of isolated dog teeth, particularly canine teeth, which may have been collected by the residents for use in ornament production (Middleton, Feinman, and Nicholas 2002).

El Palmillo, more so than Ejutla and the Mitla Fortress, is dominated by the main taxa trio (dog, deer, and rabbits; Figure 6b and Table 3). Sub-

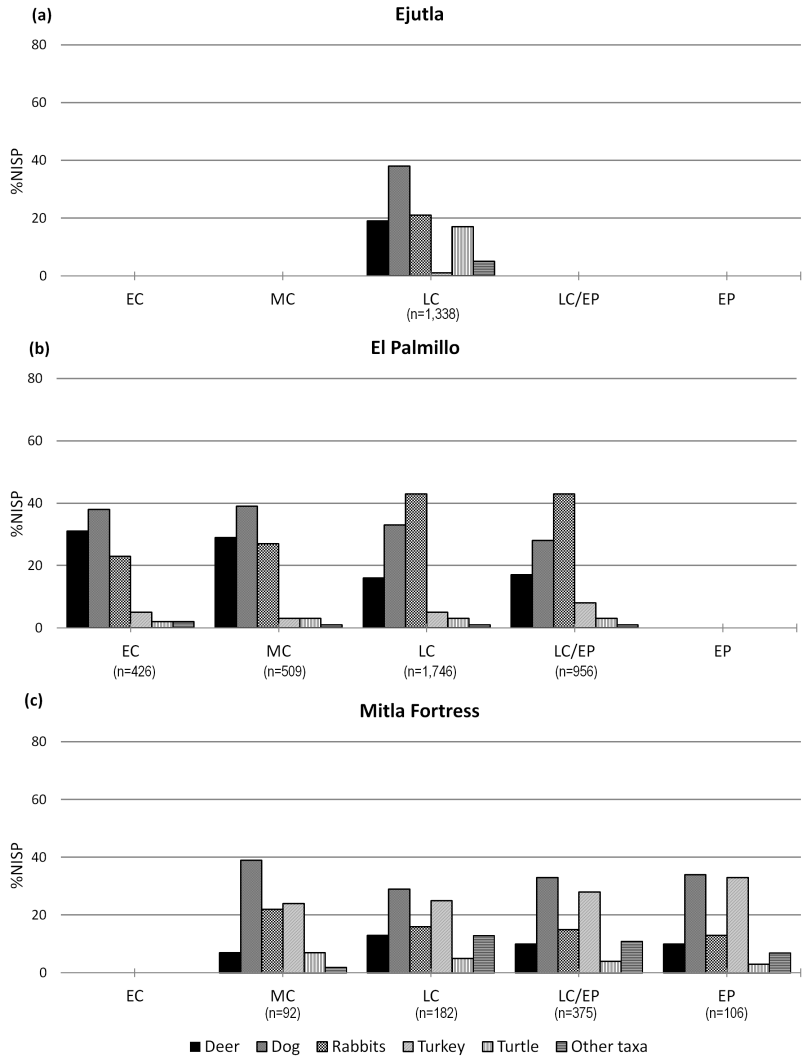

Figure 6. Comparison of the main taxa during the Classic and Early Postclassic, (a) Ejutla, (b) El Palmillo, and (c) the Mitla Fortress. Data from Table 3. Period abbreviations are as follows: EC (Early Classic), MC (Middle Classic), LC (Late Classic), LC/EP (Late Classic/Early Postclassic), and EP (Early Postclassic).

sistence practices exhibit some interesting temporal changes in animal use that cannot be evaluated at either Ejutla or the Mitla Fortress because of the contexts represented (one household and two adjacent households, respectfully). Deer and dogs both decreased in proportion over time as rabbits gained greater importance in the animal economy. We discuss these and other diachronic changes in the next section, following which we explore animal specializations in Classic communities in more depth. A variety of other mostly locally procured animals are found in small amounts in the El Palmillo assemblage, including collared peccary, coyote, gray fox, opossum, giant pocket gopher, Mexican gray squirrel, duck, hawk, white-winged dove, turkey, lineated woodpecker, barn owl, and turtle (likely mud turtle; Table 4).

Residents of the two houses excavated to date at the Mitla Fortress relied heavily throughout the occupation of the site on a more recent addition to central Oaxaca animal economies, domestic turkey. Even though both Tlacolula subvalley sites contain samples from Middle Classic to Early Postclassic deposits, turkey is found in high proportions only at the Mitla Fortress, where this new domesticate represents between 20 percent to 28 percent of the identified fauna (Figure 6c and Table 3). Turkey is rare at Ejutla (5 bones or <1%) and only slightly more common at El Palmillo (3–8%). The best evidence of turkey domestication in the Valley of Oaxaca is found at the Mitla Fortress, as we discuss in the following sections. In addition to dog and deer, mammals exploited for food and other purposes include bobcat, hooded skunk, long-tailed weasel, nine-banded armadillo, jackrabbit, cottontail, opossum, giant pocket gopher, and Mexican gray squirrel (Table 5). Ossified dermal plates from the protective shell of armadillos are uncommon, but expected finds at valley sites, having been imported to the region to be used for ornamental purposes in elite attire and ceremonial regalia (Flannery 1976; Goodwin 1969:121). At the Mitla Fortress, excavations uncovered an armadillo femur and metatarsal, possibly the first examples of postcranial armadillo remains recovered in the valley. Armadillo plates are found in elite deposits at El Palmillo, and they are occasionally reported at earlier Formative sites in the valley, including San José Mogote (Flannery and Marcus 2005:164, 283) and Fábrica San José (Drennan 1976a:217), but neither cranial nor postcranial skeletal elements were recorded. Along with turkey, various other birds and reptiles expand the list of animals exploited by the Mitla Fortress residents to include hawk, zenaida dove, Montezuma quail, great horned owl, barred owl, Mexican mud turtle, and Central American river turtle (Table 5).

Table 4. El Palmillo Fauna by Phase.*

Taxa*	Early Classic		Middle Classic		Late Classic		Late Classic/ Early Postclassic	
	NISP	%	NISP	%	NISP	%	NISP	%
White-tailed deer (*Odocoileus virginianus*)	131	30.8	149	29.3	276	15.8	159	16.6
Collared peccary (*Pecari tajacu*)	–	–	–	–	1	.1	1	.1
Domestic dog (*Canis familiaris*)	161	37.8	196	38.5	568	32.5	267	27.9
Coyote (*Canis latrans*)	–	–	1	.2	–	–	–	–
Gray fox (*Urocyon cinereoargenteus*)	–	–	1	.2	1	.1	1	.1
Small carnivores (Carnivora order)	–	–	–	–	–	–	1	.1
Jackrabbits (*Lepus* spp)	37	8.7	42	8.3	249	14.3	83	8.7
Cottontails (*Sylvilagus* spp)	61	14.3	93	18.3	500	28.6	328	34.3
Opossum (*Didelphis marsupialis*)	6	1.4	1	.2	4	.2	1	.1
Giant pocket gopher (*Orthogeomys grandis*)	1	.2	–	–	4	.2	3	.3
Mexican gray squirrel (*Sciurus aureogaster*)	–	–	–	–	1	.1	–	–
Ducks (Anatinae subfamily)	–	–	–	–	1	.1	–	–
Hawks (Accipitridae family)	–	–	–	–	1	.1	1	.1
White-winged dove (*Zenaida* cf *asiatica*)	–	–	–	–	–	–	1	.1
Turkey (*Meleagris gallopavo*)	20	4.7	13	2.6	87	5.0	80	8.4
Lineated woodpecker (*Dryocopus lineatus*)	–	–	–	–	1	.1	–	–
Barn owl (*Tyto alba*)	–	–	–	–	1	.1	–	–
Unidentified turtles (Testudines order)	9	2.1	13	2.6	51	2.9	30	3.1
Totals	**426**	**100**	**509**	**100**	**1,746**	**100**	**956**	**100**

*Table includes specimens identified to the taxonomic level of infraclass and lower. It excludes commensal taxa, worked bone, mortuary and offering contexts, and mixed deposits. Several taxa are represented only in these excluded contexts, including wolf (*Canis lupus*), jaguar (*Panthera onca*), bobcat (*Lynx rufus*), nine-banded armadillo (*Dasypus novemcinctus*), egret (*Egretta* spp), and great white shark (*Carcharodon carcharias*).

A Diachronic Perspective on Animal Economies

Four broad temporal trends are apparent in Oaxaca Valley meat diet and animal use: the consumption of deer decreased, the consumption of domestic dog and rabbit increased, and turkey domestication began. Whether or not the Ejutla Valley exhibits the same trends cannot be evaluated due to the nature of the sample (one Late Classic household). Because of large differences in sample size among the occupational phases and because not all phases are represented at each site, we consider the following interpretations to be preliminary and subject to revision as future excavations fill in the spatial and temporal gaps. For these reasons, we discuss the trends briefly and then delve more deeply into another pattern we observed in the faunal data, animal specializations during the Classic period.

Deer generally decreased in valley diets through time, beginning in the Early to Middle Formative and continuing through the Postclassic (Figures 5 and 6). This pattern is evident at all three Formative sites, but is most marked at Fábrica San José and Tomaltepec, and also at Classic El Palmillo. Deer procurement declined both over time and at each site throughout the occupation of that site, suggesting deer were heavily exploited when a site was first settled and then as local deer populations declined due to cultural and ecological pressures, such as over hunting and loss of habitat, they became harder to exploit. This general trend is less apparent at San José Mogote, perhaps because some venison was imported to the civic-ceremonial center from outlying settlements such as Fábrica San José, whose residents may have been part-time specialized hunters (Drennan 1976a:137). If some hunters procured venison for other communities, then this relationship should be apparent in deer body-part distributions, especially if the deer were being processed within certain settlements and the meat attached to major limb bones transported elsewhere. Deer skeletal element data were not published in the Fábrica San José site report (this type of detailed information rarely appears in print unless directly related to a focal research question), therefore further inquiry into this topic is unfeasible at present. It is also possible that salt mined by Fábrica San José's residents was used to cure deer meat prior to its exportation, although typically fish, not venison, was salted (see Williams 2010). Declining deer populations (if this was indeed the case) would have made deer hunting uneconomical, but increased warfare during the Middle Formative (Marcus and Flannery 1996:124–125) may

Table 5. Mitla Fortress Fauna by Phase.*

Taxa*	Middle Classic		Late Classic		Late Classic/ Early Postclassic		Early Postclassic	
	NISP	%	NISP	%	NISP	%	NISP	%
White-tailed deer (*Odocoileus virginianus*)	6	6.5	23	12.6	38	10.1	11	10.4
Bobcat (*Lynx rufus*)	–	–	1	.5	–	–	–	–
Domestic dog (*Canis familiaris*)	36	39.1	52	28.6	123	32.8	36	34.0
Hooded skunk (*Mephitis macroura*)	1	1.1	1	.5	15	4.0	–	–
Long-tailed weasel (*Mustela frenata*)	–	–	1	.5	2	.5	1	.9
Small carnivores (Carnivora order)	–	–	1	.5	4	1.1	–	–
Nine-banded armadillo (*Dasypus novemcinctus*)	–	–	1	.5	–	–	1	.9
Jackrabbits (*Lepus* spp)	9	9.8	13	7.1	28	7.5	2	1.9
Cottontails (*Sylvilagus* spp)	11	12.0	15	8.2	24	6.4	11	10.4
Rabbits (Leporidae order)	–	–	1	.5	3	.8	1	.9
Opossum (*Didelphis marsupialis*)	–	–	1	.5	1	.3	–	–
Giant pocket gopher (*Orthogeomys grandis*)	–	–	3	1.6	9	2.4	1	.9
Mexican gray squirrel (*Sciurus aureogaster*)	–	–	3	1.6	1	.3	4	3.8

Hawks (Accipitridae family)	–	–	–	–	1	.3	–	–
Zenaida doves (*Zenaida* spp)	–	–	2	1.1	–	–	–	–
Montezuma quail (*Cyrtonyx montezumae*)	–	–	2	1.1	1	.3	–	–
Turkey (*Meleagris gallopavo*)	18	19.6	39	21.4	79	21.1	30	28.3
Turkey eggs and eggshell	4	4.3	6	3.3	26	6.9	5	4.7
Great horned owl (*Bubo virginianus*)	–	–	1	1.1	–	–	–	–
Barred owl (*Strix varia*)	–	–	1	1.1	1	.3	–	–
Mexican mud turtle (*Kinosternon integrum*)	6	6.5	9	4.9	14	3.7	3	2.8
Central American river turtle (*Dermatemys mawii*)	–	–	1	.5	–	–	–	–
Turtles (Testudines order)	1	1.1	5	2.7	5	1.3	–	–
Totals	**92**	**100**	**182**	**100**	**375**	**100**	**106**	**100**

*Table includes specimens identified to the taxonomic level of infraclass and lower. It excludes commensal taxa, worked bone, mortuary and offering contexts, and mixed deposits. Several taxa are represented only in excluded contexts, including collared peccary (*Pecari tajacu*), jaguar (*Panthera onca*), gray fox (*Urocyon cinereoargenteus*), bittern/egret/heron (Ardeidae family), and finebarbel croakers (*Micropogonias* spp).

have also made it unsafe for hunting parties to venture into the mountains, and even more risky for short-term, seasonal hunting camps. By the Classic period, settlements in the eastern Tlacolula subvalley were certainly concerned about defense against hostile neighbors (Feinman and Nicholas 2004:124–128). The combined effects along with other factors led residents of the valley to rely more heavily on domesticated meat sources, primarily locally raised dogs (and turkeys at the Mitla Fortress) to meet their subsistence needs.

Dogs became a more important dietary resource in the Valley of Oaxaca during the Formative, more than doubling in proportion over time at Fábrica San José and Tomaltepec (Figure 5). At San José Mogote and later Classic sites, dogs were a dietary staple throughout the settlement's occupation. During the Classic period, the proportion of dog remains decreased slightly as other taxa such as rabbits (at El Palmillo) and domestic turkey (at Mitla Fortress) gained importance (Figure 6). The shift to domestic animals is likely associated with the need or desire for a more reliable meat source, and one that could be managed and controlled to feed a growing human population (Drennan 1976a:137; Middleton, Feinman, and Nicholas 2002) As deer hunting became uneconomical or unsafe, perhaps as early as the Middle Formative, the valley's residents turned to more local, accessible, and predictable meat sources.

Rabbits, in general, constitute a small part of valley diets during the Formative. San José Mogote is an exception, where rabbits increased substantially over time (Figure 5a). Greater consumption and use of rabbit at the valley's most powerful Formative settlement appears to be linked to social status, not solely dietary changes over time, although several interrelated factors likely influenced leporid use. The two latest phases (Late San José and Rosario) also represent the most elite excavated contexts at the site. The vast majority of Late San José materials come from San José Mogote's Houses 16/17, a household that enjoyed a higher status than many other families based on findings such as imported stone and marine shell ornaments, a stingray spine bloodletter, and a variety of nonlocal ceramics, including a bowl imported from the Basin of Mexico (Flannery and Marcus 2005:314). The Rosario faunal assemblage comes from ultra elite residences that contained status-marking items such as pearl oyster and jadeite ornaments, bird-bone beads, a ceramic earspool, two ceramic effigy whistles, and three finely flaked obsidian bloodletters, among other items (Flannery and Marcus 2005:411–437). When the zooarchaeological assemblages are compared at the household level, it is apparent that

San José Mogote's elite families ate more rabbit than their lower-status neighbors. This pattern was amplified during the Classic period, at least at some sites such as El Palmillo in the Tlacolula subvalley where Haller, Feinman, and Nicholas (2006) found a strong association between rabbit consumption and household status, with more elite residences containing more rabbit bone refuse than less elite households.

Turkey domestication began or intensified during the Classic period, and the best evidence comes from the Mitla Fortress. Turkey is rare to nonexistent at Formative sites, and it is only slightly more common at Classic Ejutla and El Palmillo (Figures 5 and 6). At the Mitla Fortress, however, turkey increased markedly through time, where it constitutes 20–28 percent of the assemblage (Figure 6c). In addition, excavations at the Mitla Fortress have uncovered eggshell fragments and complete eggs as well as juvenile and adult birds from domestic refuse and offering contexts. The availability of a new domesticate could have had a significant impact on meat diet, a topic we explore in more depth in following section along with the evidence for animal specializations that developed during the Classic period.

Animal Specializations in Classic Communities

Three (to four) main animals—deer, dog, rabbits (and turkey)—constitute the majority of the meat diet in the Oaxaca and Ejutla Valleys, yet each settlement we examined in this study had its own unique zooarchaeological signature. This is especially evident during the Classic period as seen in the high proportions of dogs at Ejutla, rabbits at El Palmillo (particularly in elite contexts), and turkey at the Mitla Fortress. In the following section we explore why these specializations or preferences for certain animals may have developed and their implications for household and regional Classic economies.

Rabbits, Ritual, and Craft Production at El Palmillo

Rabbits played a significant role in El Palmillo's animal economy, as meat consumed in meals, as animals incorporated into ritual practices, and as a source of hair used in textile production. All of these uses are especially evident in, and some possibly restricted to, the elite sectors of the community. In the following section, we lay out the archaeological evidence to support such observations.

Table 6. Comparison of Cottontails and Jackrabbits by Household at El Palmillo.

Terrace and Site Sector		Total NISP	Cottontail		Jackrabbit		Cottontail:Jackrabbit Percentages[1]
			NISP	% NISP	NISP	% NISP	
T. 1162	lower sector	247	20	8.1	15	6.1	57:43
T. 1163	lower sector	113	10	8.8	7	6.2	59:41
T. 1147	lower sector	100	19	19.0	15	15.0	56:44
T. 925	lower-middle sector	200	26	13.0	19	9.5	58:42
T. 507	middle-upper sector	643	55	8.6	18	2.8	75:25
T. 335	top precinct	1,073	339	31.6	132	12.3	72:28
St. 35	top precinct	1,077	403	37.4	160	14.9	72:28
Pl. 11	top precinct	709	263	37.1	35	4.9	88:12
Totals		4,162	1,135	27.3	401	9.6	74:26

*Table includes specimens identified to the taxonomic level of infraclass and lower. It excludes commensal taxa, worked bone, and mortuary and offering contexts.

1. Cottontail to jackrabbit percentages are calculated by summing cottontail NISP and jackrabbit NISP to get the total rabbit NISP, then dividing cottontail NISP and jackrabbit NISP by rabbit NISP, respectively. For example, using the T.1162 data set, 20+15=35, 20/35=57% cottontail and 15/35=43% jackrabbit.

Higher-status houses were located on the upper terraces at El Palmillo contained a greater density of faunal refuse, and their residents consumed more deer, dog, and rabbits (in terms of usable meat weight) than lower-status households located farther down the terraced slopes (Haller, Feinman, and Nicholas 2006). Although the actual proportion of deer and dog varied between upper and lower terrace households, and sometimes substantially so, a perfect rank-order, highly significant correlation between the adjusted density of rabbit bones and terrace elevation was identified, suggesting that rabbits may be a key marker of elite diet in this community (Haller, Feinman, and Nicholas 2006). This pattern is also evident when the proportion of rabbits and other taxa are presented in graph form (Figure 7). Rabbit refuse is found in consistently greater proportions in upper precinct households (42–52%) than in middle- and lower-terrace residences (10–34%). And, although all households participated in domestic rituals in which animals were sacrificed, offerings of rabbits were found only in the upper terrace residences (Feinman, Nicholas, and Maher 2008:Table 2). Rabbit remains found in mortuary contexts are also restricted to the upper terraces (Feinman, Nicholas, and Maher 2008:Table 6). Additionally, three bloodletters or possible bloodletters made from rabbit limb bones were recovered from top precinct contexts, one from an altar in Platform 11 and another from an upper plaza area. A third, red-painted, rabbit bloodletter was interred near the head of an elite female buried on Terrace 335. These data suggest that rabbits not only marked elite diet at El Palmillo but also differentiated elite rituals as being somehow different than ritual practices in commoner households.

Another aspect of the connection between rabbits and household status becomes apparent when we compare the distribution of rabbits by genus. Two different genera of leporids are present in the El Palmillo faunal assemblage: cottontails (*Sylvilagus* spp) and jackrabbits (*Lepus* spp). Cottontails occupy many diverse habitats, from deserts to swamps and grasslands to woodlands, and habitat preference can vary greatly by species (Chapman, Hockman, and Ojeda 1980). The eastern cottontail (*S. floridanus*) is about half the size of a jackrabbit, weighing on average 1.2 kg (Chapman, Hockman, and Ojeda 1980), but the Mexican cottontail (*S. cunicularius*) is larger and can grow to be similar in mass to a small jackrabbit (Cervantes et al. 1992). The white-sided jackrabbit (*L. callotis*) that inhabits the Valley of Oaxaca weighs on average 2.5 kg. It prefers flat open grasslands with few shrubs, avoiding forested slopes and hilltops (Best and Henry 1993; Goodwin 1969:126). Species in both genera coexist

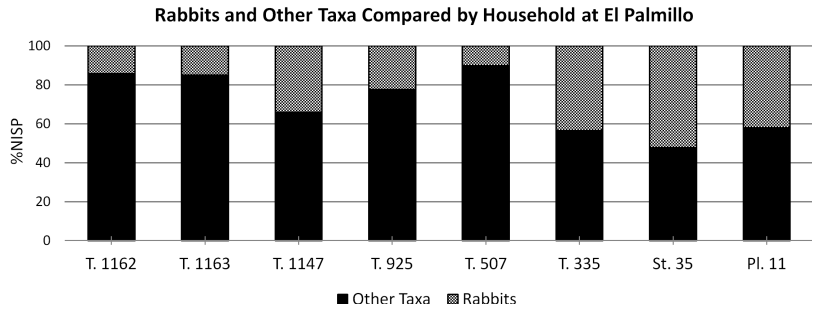

Figure 7. Rabbits and other taxa compared by %NISP among El Palmillo households. Data from Table 6. Households are ordered by terrace elevation: lower sector (T. 1162, T. 1163, and T. 1147), lower-middle sector (T. 925), middle-upper sector (T. 507), and top precinct (T. 335, St. 35, and Pl. 11).

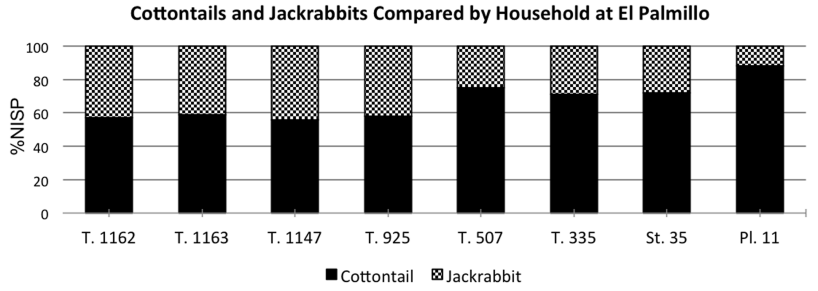

Figure 8. Cottontails and jackrabbits compared by %NISP among El Palmillo households. Data from Table 6. Households are ordered by terrace elevation: lower sector (T. 1162, T. 1163, and T. 1147), lower-middle sector (T. 925), middle-upper sector (T. 507), and top precinct (T. 335, St. 35, and Pl.11).

(Best and Henry 1993; Cervantes et al. 1992; Chapman, Hockman, and Ojeda 1980) and could have been hunted or trapped by El Palmillo's residents in nearby habitats. Contemporary accounts describe young boys hunting rabbits with blowguns and darts (Parsons 1932). At El Palmillo, the remains of cottontail rabbits are found in greater proportions in upper and middle-upper precinct households (71–88%) than in residences located closer to the base of the hill (56–59%), indicating that elite families used and consumed more cottontails (versus jackrabbits) compared to their lower-status neighbors (Figure 8). These data further support the argument that rabbits, specifically cottontails, became an animal resource

favored by high-status families at El Palmillo. This elite preference for rabbits has some time depth associated with it in the Valley of Oaxaca as there is evidence that rabbits also marked elite status at the Formative civic-ceremonial center of San José Mogote, as we discussed previously.

One of the principal craft activities at El Palmillo was the processing of maguey for fiber to be used in textile production as well as for food and pulque, an intoxicating drink made by fermenting the sap of the maguey plant. In some parts of ancient Mesoamerica, rabbits are associated with maguey and its important product pulque. In the central Mexican Aztec calendar, the name of the eighth day is *tochtli*, meaning rabbit in Nahuatl, and the patron deity of that day is Mayahuel, goddess of maguey, whose breast milk has been depicted as pulque (Anawalt 1993). The gods of pulque, known collectively as Centzontotochtin or 400 Rabbits, represent the intoxicating effects and undesirable behaviors of those persons who consume too much of the drink (Anawalt 1993). The image of the rabbit is tentatively correlated with the eighth day in the Zapotec calendar as well (Urcid 2001:204–205). By the arrival of the Spanish, problems with the over indulgence of pulque, and its inebriating effects resulted in age-related restrictions as to who could drink the beverage, limiting its intake to elders (Kicza 1980). In ancient Oaxaca, pulque played a key role in royal marriage ceremonies (Miller and Taube 1993:138), and drinking the alcoholic liquid differentiated elite from commoner (Marcus 1992:223). Pulque is still made today at Santiago Matatlán (Starkman 2011), the modern town closest to El Palmillo, and elsewhere in southern and central Mexico (Parsons and Parsons 1990).

The connection among elites, rabbits, and maguey products at El Palmillo is strengthened by the archaeological data on textile production. Lower-status residents in the community spun course maguey fibers, based on more finds of larger spinning whorls on the lower terraces, whereas higher-status households spun fine maguey, and possibly cotton, threads as indicated by greater numbers of smaller spindle whorls found on the middle and upper terraces (Carpenter, Feinman, and Nicholas 2012; Feinman, Nicholas, and Maher 2008:178–179). Both coarsely and finely woven textiles likely were consumed by the makers themselves, bartered at market, or used as gifts and tribute (Berdan 1987; McCafferty and McCafferty 1991). Rabbit hair was commonly incorporated into textile production in ancient Mesoamerica. Bernardino de Sahagún, a Spanish priest who documented the lifeways, language, and beliefs of central Mexicans in the sixteenth century, described how royal Aztec women kept a basket of

rabbit fur near their looms (Sahagún 1954:49), presumably so they would have it easily accessible to incorporate into their daily craftwork. Spinning and weaving rabbit hair and embroidering with these soft threads was probably carried out mainly in elite households (Berdan 1987:245), which appears to be the pattern at El Palmillo as well. Rabbit hair, along with dog hair and bird feathers, spun into fine maguey and cotton threads was used to construct intricately woven elite apparel, and rabbit fur embellished and fringed high-status clothing (Berdan 1987; McCafferty and McCafferty 1991). Some of the rabbit fur sold in Aztec markets was dyed brilliant colors, such as "red, yellow, sky blue, light green, dark blue, tawny, dark green, flower yellow, blue-green, [carmine], rose, brown" (Sahagún 1961:77), while other merchants bartered unspun rabbit hair plucked from the animal (Sahagún 1959:22).

Even modern weavers note that cottontail hair can be spun with very good results, especially when it is blended with longer fibers, such as cotton and wool (Kroll 1981:35). Fur obtained from rabbits by combining or plucking (rather than cutting or shearing) is preferred so that individual hairs are longer with naturally tapered ends (Kroll 1981:35). Thus, the best continuous, readily available source of rabbit fur would have been from live animals kept near the residence. This begs the question, were some cottontails being raised for fur, food, and ritual purposes by El Palmillo's elite families? The answer to this question requires further research and study; however, evidence of rabbit raising has been identified elsewhere in Mesoamerica. At Oztoyahualco, a multifamily residential compound located in the Classic capital city of Teotihuacán in the Valley of Mexico, it has been argued that the occupants of one household raised rabbits as well as dogs and possibly turkeys (Manzanilla Naim 1996; Valadez Azúa 1993). Regardless of whether or not El Palmillo's residents kept captive and possibly bred rabbits, it is certain that these animals were important sources of meat, fur, and ritual offerings, particularly among elite families in the community.

Raising Turkeys at the Mitla Fortress

Excavations on two residential terraces (Terraces 56 and 57) at the Mitla Fortress have provided evidence that turkeys were raised at the site based on the high proportion of turkey remains and eggshell fragments, the presence of hatched and unhatched eggs, the remains of juvenile and adult birds, and the presence of turkeys and eggs in both refuse and of-

fering contexts. Turkey represents 20–28 percent of the animal remains at the Mitla Fortress, and it increased steadily over time (Figure 6c). Based on differences in cortical-bone development and skeletal element size, three stages of juvenile bones are present: neonatal, very young, and young. More than 500 eggshell fragments along with several complete eggs have been recovered from refuse and offering contexts combined. The occupants of Terraces 56 and 57 also crafted bone tools and ornaments from turkey and large bird (most of which is likely turkey, but the fragments lack the diagnostic characteristics needed to make positive identifications). In addition, the ritual use of turkeys is supported by four offerings laid beneath house floors, containing unhatched eggs and juvenile birds. These factors combined are highly suggestive that turkeys were being raised on or near the two terraces.

Turkey, which is second only to domestic dog in terms of relative dietary importance at the Mitla Fortress, is significantly less common at Classic Ejutla and El Palmillo; it is rare to nonexistent at Formative sites in the region (Figures 5 and 6). One subspecies of wild turkey, the southern Mexican turkey *(Meleagris gallopavo mexicana*), inhabits parts of southern Mexico, but it may not have ranged as far south as Oaxaca (Howell and Webb 1994:225–226; Schorger 1966:48). The ocellated turkey (*M. ocellata*), a smaller relative of the wild turkey, occupies the Yucatán Peninsula in Mexico and parts of northern Belize and northern Guatemala (Steadman, Stull, and Eaton 1979). It was a subspecies of the wild turkey *(M. gallopavo*), not the ocellated turkey, that were eventually domesticated in some regions of North America (Munro 2006). The few turkey remains found on earlier Formative sites in the Valley of Oaxaca suggest these birds were occasionally imported to the region from outside areas (Flannery and Marcus 2005:96, 188). Their beautiful, iridescent feathers would have made fine additions to clothing and ceremonial accouterments (for references to feather artisans, see Sahagún 1959:84–97), not to mention the symbolic and medicinal importance turkeys may have had in pre-Hispanic Oaxaca (Benson 1997:68–113; Corona-Martínez 2008a).

Domestic turkey has also been identified in the Tehuacán Valley, located just north of Oaxaca in the state of Puebla, and the temporal distribution reflects a trend similar to that seen in the Valley of Oaxaca. In the Tehuacan Valley, turkey is rare to nonexistent in Terminal Formative/Classic period Palo Blanco phase (200 BCE–700 CE) deposits, with a single bone found at a single site, Coxcatlán Cave (Flan-

nery 1967:164, Table 116). Turkey increased in proportion during the Late Classic to Late Postclassic Venta Salada phase (ca. 700–1540 CE), where it ranges from 6 to 12 percent NISP of identified animal remains at sites such as Coatepec village, Coxcatlán Cave, and El Riego Cave (Flannery 1967:Tables 20, 16, and 19, respectively). Much farther north, in the American Southwest and northern Mexico, turkeys were being raised at human habitation sites by around 500 CE, with more evidence appearing in the archaeological record after 900 CE (Munro 2006:464). Archaeological signatures of turkey domestication include the presence of eggshell, juvenile skeletal remains, broken and healed bones, feathers, gizzard stones, turkey droppings (waste), and retaining enclosures (Beacham and Durand 2007; Breitburg 1988; Munro 2006). Some of the classic markers of domestication that have been identified in the American Southwest (such as gizzard stones, droppings, and pens) have yet to be recovered in southern Mexico; however, ongoing excavations at the Mitla Fortress will continue to expand our understanding of turkey domestication, its archaeological indicators, and what the introduction of a new domesticate meant to subsistence practices and animal economies in ancient Mesoamerica. Questions for future research include: Were turkeys domesticated in central Oaxaca independent of domestication events taking place in other regions? Or were domestic turkeys introduced to central Oaxaca? Why were turkeys domesticated, or why did domestic turkeys become important in the animal economy during the Classic period? And did all households raise turkeys at the Mitla Fortress or only certain households or barrios?

Conclusions

Ancient Zapotecs in the Central Valleys of Oaxaca relied on a limited number of animals to provide the majority of their animal-based dietary protein and fat. These three to four main animals (deer, dog, rabbits, and turkey) constitute on average between 80 and 97 percent of the proportion of identified taxa at each of the seven archaeological sites we compared in this study. Yet, no single unified animal economy can be defined for the region. Rather, each site has its own zooarchaeological signature, which was influenced by multiple factors, including the local environment and specific contexts represented. And, by the Classic period, not only do we see different households and barrios specializing in different activities,

including those dealing with procuring meat to eat, but different sites had developed different animal-related specialties and preferences (e.g., rabbits at El Palmillo and turkey at the Mitla Fortress). It is possible that such specializations existed earlier in time during the Formative, but that the material markers of such activities were not strong enough to be detected in the zooarchaeological record. Nevertheless, the intensity of craft production activities during the Classic was not only greater than that which occurred earlier in the Formative, but because the regional population was substantially larger in the Classic than in prior times more households would have been participating in craft work (Feinman and Nicholas 2004:123). This, in turn, would result in a higher overall volume of goods produced, which would leave a more pronounced archaeological signature in the ground. The same likely corresponds to animal specializations, in that they become discernable only once they reached a certain magnitude, and such specializations and their magnitudes were greater by the Classic period as compared to earlier.

Ancient animal use and animal-based diet was just as flexible and dynamic as the domestic production of other types of goods. To understand more fully pre-Hispanic Mesoamerican domestic economies in all their inherent complexity and multiplicity, animals should be added to the list of products produced for exchange by multicrafting households. This pattern, evident by the Classic period, illustrates the economic interdependence between pre-Hispanic Oaxacan households. Hunting, gathering, trapping, and raising were all techniques that could have been used to "produce" animal-based products for exchange. Clearly, not every episode of animal procurement resulted in a market product, but some most certainly did.

By utilizing new and existing data from a series of sites dating from the Archaic to the Postclassic periods—a span of almost 10,000 years (ca. 8700 BCE to 1100 CE)—we gained a much longer diachronic perspective on animal economies in pre-Hispanic Oaxaca. This approach informed our discussions not only of ancient animal use through time, but also allowed us to identify community specializations in animal procurement during the Classic and Postclassic periods. Future excavations at other settlements and ongoing excavations at sites such as the Mitla Fortress will continue to expand our knowledge of pre-Hispanic Mesoamerican household economies, and how a household's multicrafting activities incorporated animals into their production repertoire.

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Key Words

Oaxaca, Zapotec, animal by-products, animal specializations, deer, dog, rabbit, turkey

Digital Companion

There is no digital content related to this chapter.