



## Hunting, husbandry, exchange and ritual: animal use and meaning at Moxviquil, Chiapas Mexico



Elizabeth H. PARIS, Roberto LÓPEZ BRAVO,  
Ellen PACHECO & Miranda GEORGE



DIRECTEUR DE LA PUBLICATION : Bruno David,  
Président du Muséum national d'Histoire naturelle

RÉDACTRICE EN CHEF / EDITOR-IN-CHIEF: Joséphine Lesur

RÉDACTRICE / EDITOR: Christine Lefèvre

RESPONSABLE DES ACTUALITÉS SCIENTIFIQUES / RESPONSIBLE FOR SCIENTIFIC NEWS: Rémi Berthon

ASSISTANTE DE RÉDACTION / ASSISTANT EDITOR: Emmanuelle Rocklin (anthropo@mnhn.fr)

MISE EN PAGE / PAGE LAYOUT: Emmanuelle Rocklin, Inist-CNRS

COMITÉ SCIENTIFIQUE / SCIENTIFIC BOARD:

Cornelia Becker (Freie Universität Berlin, Berlin, Allemagne)  
Liliane Bodson (Université de Liège, Liège, Belgique)  
Louis Chaix (Muséum d'Histoire naturelle, Genève, Suisse)  
Jean-Pierre Digard (CNRS, Ivry-sur-Seine, France)  
Allowen Evin (Muséum national d'Histoire naturelle, Paris, France)  
Bernard Faye (Cirad, Montpellier, France)  
Carole Ferret (Laboratoire d'Anthropologie Sociale, Paris, France)  
Giacomo Giacobini (Università di Torino, Turin, Italie)  
Véronique Laroulandie (CNRS, Université de Bordeaux 1, France)  
Marco Masseti (University of Florence, Italy)  
Georges Métaillé (Muséum national d'Histoire naturelle, Paris, France)  
Diego Moreno (Università di Genova, Gènes, Italie)  
François Moutou (Boulogne-Billancourt, France)  
Marcel Otte (Université de Liège, Liège, Belgique)  
Joris Peters (Universität München, Munich, Allemagne)  
François Poplin (Muséum national d'Histoire naturelle, Paris, France)  
Jean Trinquier (École Normale Supérieure, Paris, France)  
Baudouin Van Den Abeele (Université Catholique de Louvain, Louvain, Belgique)  
Christophe Vendries (Université de Rennes 2, Rennes, France)  
Noëlie Vialles (CNRS, Collège de France, Paris, France)  
Denis Vialou (Muséum national d'Histoire naturelle, Paris, France)  
Jean-Denis Vigne (Muséum national d'Histoire naturelle, Paris, France)  
Arnaud Zucker (Université de Nice, Nice, France)

COUVERTURE / COVER:

Canid specimens from Moxviquil, Chiapas, Mexico. Photographs: Elizabeth Paris.

*Anthropozoologica* est indexé dans / *Anthropozoologica* is indexed in:

- Social Sciences Citation Index
- Arts & Humanities Citation Index
- Current Contents - Social & Behavioral Sciences
- Current Contents - Arts & Humanities
- Zoological Record
- BIOSIS Previews
- Initial list de l'European Science Foundation (ESF)
- Norwegian Social Science Data Services (NSD)
- Research Bible

*Anthropozoologica* est distribué en version électronique par / *Anthropozoologica* is distributed electronically by:

- BioOne® (<http://www.bioone.org>)

*Anthropozoologica* est une revue en flux continu publiée par les Publications scientifiques du Muséum, Paris, avec le soutien du CNRS.

*Anthropozoologica* is a fast track journal published by the Museum Science Press, Paris, with the support of the CNRS.

Les Publications scientifiques du Muséum publient aussi / The Museum Science Press also publish:

*Adansonia*, *Zoosystema*, *Geodiversitas*, *European Journal of Taxonomy*, *Naturae*, Cryptogamie sous-sections *Algologie*, *Bryologie*, *Mycologie*.

Diffusion – Publications scientifiques Muséum national d'Histoire naturelle

CP 41 – 57 rue Cuvier F-75231 Paris cedex 05 (France)

Tél.: 33 (0)1 40 79 48 05 / Fax: 33 (0)1 40 79 38 40

diff.pub@mnhn.fr / <http://sciencepress.mnhn.fr>

© Publications scientifiques du Muséum national d'Histoire naturelle, Paris, 2020

ISSN (imprimé / print): 0761-3032 / ISSN (électronique / electronic): 2107-08817

# Hunting, husbandry, exchange and ritual: animal use and meaning at Moxviquil, Chiapas Mexico

**Elizabeth H. PARIS**

Department of Anthropology and Archaeology, Earth Sciences 620,  
University of Calgary, 2500 University Drive NW, Calgary AB T2N 0J6 (Canada)  
elizabeth.paris@ucalgary.ca

**Roberto LÓPEZ BRAVO**

Escuela de Arqueología, Universidad de Ciencias y Artes de Chiapas,  
Camino Antiguo a San Gabriel s/n, Chiapa de Corzo, Chiapas 29160 (Mexico)  
roberto.lopez@unicach.mx

**Ellen PACHECO**

**Miranda GEORGE**

Department of Anthropology and Archaeology, Earth Sciences 620,  
University of Calgary, 2500 University Drive NW, Calgary AB T2N 0J6 (Canada)  
ellen.pacheco@ucalgary.ca  
miranda.george@ucalgary.ca

Submitted on 23 October 2019 | Accepted on 21 January 2020 | Published on 13 March 2020

Paris E. H., López Bravo R., Pacheco E. & George M. 2020. — Hunting, husbandry, exchange and ritual: animal use and meaning at Moxviquil, Chiapas Mexico. *Anthropozoologica* 55 (4): 43-72. <https://doi.org/10.5252/anthropozoologica2020v55a4>. <http://anthropozoologica.com/55/4>

## ABSTRACT

This study investigates the animal use of the ancient inhabitants of Moxviquil, a small urban center in the Jovel Valley of highland Chiapas, Mexico, that was occupied during the Late Classic (AD 600-900) and Early Postclassic periods (AD 900-1250). Zooarchaeological remains were recovered from the monumental zone, from a neighboring hilltop residential group, and from the funerary cave located immediately below the residential group. Rather than a hard boundary between house and wilderness, sacred and profane, the distribution of different species and elements reflect the ways in which animals and animal products were interwoven through the fabric of cultural practice. Domestic spaces reflect the selective husbandry and hunting of animals for everyday living, compared to the high-status crafts and dedicatory contexts of royal residences, and the carefully constructed microcosm of ritual activities represented in the funerary cave. Following Rapoport (1982) and Barthes (2012), we use a framework of low-level, mid-level and high-level meanings to understand everyday hunting and domestication practice, status and exchange relationships, and medicinal and ceremonial uses. Considering the meanings of particular animal species can provide a holistic perspective on the cultural practices that shaped royal, residential and ritual spaces at Moxviquil, and provide a perspective on broader issues of agro-urbanism and resiliency in highland Maya polities.

## KEY WORDS

Maya,  
zooarchaeology,  
hunting,  
husbandry,  
exchange,  
ritual,  
Chiapas.

## RÉSUMÉ

*Chasse, élevage, échange et rituel : exploitation et signification des animaux à Moxviquil, Chiapas, Mexique.*  
 Cet article examine l'exploitation des animaux par les anciens habitants de Moxviquil, un petit centre urbain de la vallée de Jovel, dans les hautes terres du Chiapas, au Mexique, occupé à l'époque Classique ancien (600 à 900 apr. J.-C.) et Postclassique ancien (900 à 1250 apr. J.-C.). Les vestiges archéofauniques ont été retrouvés dans la zone monumentale, dans un groupe résidentiel voisin situé au sommet d'une colline et dans la grotte funéraire située immédiatement en dessous du groupe résidentiel. Plutôt qu'une frontière ferme entre espaces domestiques et nature sauvage, entre sacré et profane, la distribution des différentes espèces et éléments squelettiques reflète la manière dont les animaux et leurs produits ont été imbriqués dans la structure des pratiques culturelles. Les espaces domestiques reflètent l'élevage sélectif et la chasse d'animaux pour la vie quotidienne, qui contrastent avec l'artisanat de haut rang et les contextes dédicatoires des résidences royales, et avec le microcosme soigneusement construit des activités rituelles représentées dans la grotte funéraire. En nous basant sur les travaux de Rapoport (1982) et Barthes (2012), nous utilisons un cadre de significations avec des niveaux bas, intermédiaire et haut pour comprendre les pratiques quotidiennes de chasse et d'élevage, les relations de statut et d'échange, ainsi que les usages médicaux et cérémoniels. Prendre en compte la signification des espèces animales particulières peut fournir une perspective holistique sur les pratiques culturelles qui ont façonné les espaces royaux, résidentiels et rituels à Moxviquil, ainsi qu'une perspective sur des questions plus vastes d'agro-urbanisme et de résilience dans les États Maya des hautes terres.

## MOTS CLÉS

Maya,  
 zooarchéologie,  
 chasse,  
 élevage,  
 échange,  
 rituel,  
 Chiapas.

## INTRODUCTION

This study investigates the animal use of the ancient inhabitants of Moxviquil, a small urban center in highland Chiapas, Mexico, that was occupied during the Late Classic (AD 600-900) and Early Postclassic (AD 900-1250) periods. Studies of ancient Maya ecology and diet often focus on lowland regions, marked by intensive management of tropical forests and their associated animal species; this study will provide a complimentary perspective from the western Maya frontier region, with significantly different ecosystems. The region has been the focus of detailed ethnobiological research over the last 50 years, which provides a detailed perspective on the range of animal species that are integral to both the local economies and spiritual beliefs of the Tzotzil Maya communities of the Central Highlands. Our recent excavations at Moxviquil provide evidence that this pattern can also be observed for the ancient Tzotzil Maya as well. Zooarchaeological remains were recovered from the monumental zone, from a neighboring hilltop residential group, and from the funerary cave located immediately below the residential group.

Scholars since Lévi-Strauss (1969) have recognized that cultural thought shapes the ways in which different animals and animal products are used and perceived by humans. Food, in particular, has been a consistent focus of anthropological inquiry (Hastorf 2017), including cognitive structures (Lévi-Strauss 1969), power dynamics (Bourdieu 1984), and group identity (Barthes 1979; Dietler & Hayden 2001). In the archaeological record, many of these cultural dynamics must be inferred through analogy. However, one of the analytical strengths of archaeology is a concern with materiality, and how artifacts reflexively and actively influence social worlds (Dietler & Herbich 1998), in combination with a concern with the spatial dynamics of activities and built environments (Kent 1990). The variation in the animal species represented in the different assemblages attests to the

complexities in the construction of domestic and ritual space in Early Postclassic period highland Maya polities. Rather than a hard boundary between house and wilderness, sacred and profane, we can observe the ways in which animals and animal products were interwoven through the fabric of cultural practice. Domestic spaces reflect the selective husbandry and hunting of animals for everyday living, compared to the high-status crafts and dedicatory contexts of royal residences, and the carefully constructed microcosm of ritual activities represented in the funerary cave.

Scholars such as Rapoport (1982) and Barthes (2012) and have identified three themes or levels of meaning into which materials, actions and ideas may be framed. Low-level meanings are concerned with everyday practice, tradition, and sensory experience: in a zooarchaeological framework, this would entail the physical navigation of food preparation and serving spaces, hunting practices, and the cultural transmission of dietary practices (e.g. recipes and cooking techniques). It would also include ecological considerations of the native habitats of particular species, and the relationships between communities and their local environments. Mid-level meanings concern hierarchical relationships, including the cultural values that place constraints on particular materials and actions. In a zooarchaeological framework, this could include sumptuary restrictions limiting the use of animal products to particular social contexts: class-based or gendered associations or restrictions on the use of particular species; the selective acquisition of exotic species by elites through trade or taxation; class or gender-based restrictions on hunting particular types of animals or using particular types of weapons. High-level meanings concern symbolic and concept-based behavior. In a zooarchaeological framework, this would include the symbolism of particular animals based in traditional religious beliefs and creation stories, the “hot” or “cold” qualities possessed by different animals, their use in traditional medicine for curing particular diseases, and their association with positive or negative qualities. These frame-



FIG. 1. — Map of the Maya culture area with ▲, archaeological sites and ●, modern towns mentioned in the text. Drafted by Elizabeth Paris, from base map by Wikimedia Commons (commons.wikimedia.org). Abbreviations: **CD**, Central Depression; **CP**, Comitán Plateau; **EH**, Eastern Highlands; **SL**, Sierra Lacandona; **SMC**, Sierra Madre de Chiapas; **WH**, Western Highlands.

works of meaning derived from Barthes and Rapoport are highly compatible with seven emic categories of cultural use derived from ethnozoological studies of fauna use by traditional Maya communities in the north-central Yucatan (Herrera-Flores *et al.* 2019). These include three categories of use related to low-level meaning (food, damage control [prevention of damage to crops, domestic animals, and people] and material for tools); two categories related to mid-level meaning (ornamental use, and pets); and two categories related to high-level meaning (medicinal use, and symbolic and ritual use). A broad consideration of the low-level,

mid-level, and high-level meanings of particular animal species can provide a holistic perspective on the cultural practices that shaped royal, residential and ritual spaces at Moxviquil.

## BACKGROUND

The Jovel Valley is located in the Central Plateau of highland Chiapas (Fig. 1), where the traditional language is Tzotzil Maya (Aubry 2008). Other highland areas to the north and

east include Tzeltal, Tojolabal, and Coxoh Maya-speaking groups in the areas encompassing the Amatenango Valley, Comitán Plateau, and Upper Grijalva River Valley. The region is also bordered by non-Maya speaking groups, including the Chiapanecs of the Central Depression, and the Zoques of the Lower Grijalva River Valley and Rio La Venta areas of north-west Chiapas (Adams 1961; Culbert 1965; Calnek 1988).

The Jovel Valley is one of the largest intermountain valleys in the Central Plateau, bordered on most sides by karstic hills and ridges interspersed by volcanic domes, and is the location of the modern city of San Cristóbal de las Casas. The terrain of the central highlands, referred to as “*tierra fría*”, is extremely rugged, characterized by high elevations (over 2000 masl), steep mountain ridges, and small to medium-sized valleys (Bryant 1988: 1). It is surrounded in all directions by “*tierra caliente*” lowland zones. At the highest elevations of the Central Plateau, such as the Jovel Valley, the climate remains brisk year-round, with daytime temperatures between 20 and 27 degrees Celsius and low temperatures between 10 and 15 degrees Celsius, occasionally dropping below freezing at night in December and January. The region is generally subject to the same broad oscillation between rainy season (mid-May to December) and dry season (January to mid-May) as the rest of Mesoamerica; at 1171 mm annual rainfall, the Jovel Valley receives more rain than the Central Depression to the west, but less rain than areas to the north and east. The region is characterized mostly by pine-oak forest, with small microclimates created by variable altitudes and moisture conditions on steep mountain slopes. North and east slopes from 1050 to 2500 masl are typically more moist and support a wide range of bromeliad species, and are referred to as Pine-Oak-Liquidambar Forest, with wet, temperate Evergreen Cloud Forest characterizing the peaks and ridges between 2000 and 2700 masl; the south and west slopes are a much drier Pine-Oak Forest, with a comparatively poorly developed understory (Berlin *et al.* 1974: 14). Much of highland Chiapas terrain is farmed using the milpa system (Hunn 1977: 12), which involves traditional open-field agricultural plots of polycultured corn, beans and squash, usually located on the outskirts of traditional villages (at a distance of 1 to 5 ha), and often engages slash-and-burn fertilization techniques (De Frece & Poole 2008). An exception is the highest mountain peaks above 2400 masl, which are typically Evergreen Cloud Forest where agricultural returns are marginal (Hunn 1977: 12); this was likely also the case in the pre-Columbian period. The floor of the Jovel Valley sits at 2200 masl, with two small rivers, the Río Amarillo and the Río Fogótico, transecting the valley from northeast to southwest, while numerous springs (*ojos de agua*) provide additional sources of fresh water. The resulting environment houses a range of animal species that is nevertheless specific to temperate and mountainous geoclimates, lacking lowland-adapted species.

Ethnobiology studies provide an important framework for the range of uses of animals and animal products in highland Chiapas. Many of the studies take a folk biology perspective to describe indigenous classificatory systems for flora (Berlin *et al.* 1974: 14), faunal (Acheson 1966; Hunn 1977; Retana & Lorenzo 2002; Rodiles Hernández *et al.* 2005, 2010; Enríquez

Vázquez *et al.* 2006; Barragán *et al.* 2007), and mycological (Lampman 2007) diversity of the Central Plateau region, including the ways that species are hunted, domesticated, and used in traditional ritual practice; while ethnographic studies of traditional communities (Vogt 1969; Gossen 1975, 1999; Guerrero Martínez 2015) tend to focus on everyday practice in traditional communities with regard to cooking, craft production, trade, traditional medicines, religious ceremonies and traditional belief systems. Many of these studies also acknowledge the significant impact of the Columbian exchange and Colonial-period demands on local economies, labor, materials, and belief systems; as such, comparisons with other faunal assemblages from other archaeological studies are an important counterpoint to studies of modern communities.

## ARCHAEOLOGICAL RESEARCH AT MOXVIQUIL

Moxviquil is located on the northern edge of the Jovel Valley, and consists of a small monumental zone containing public architecture and elite residences, with additional residential settlements located on the surrounding hilltops (Fig. 2). The monumental zone of Moxviquil was originally excavated by Frans Blom and Clarence Weiant (in 1952 and 1953), and focused on public architecture, tombs and caches (Blom 1954; Blom & Weiant 1954). More recently, we established the Proyecto Económico de Los Altos de Chiapas (2009-present; directed by Paris & López Bravo) to investigate household economic organization of its previously-undocumented outlying residential settlements, including shovel tests, 1 × 2 m vertical excavations, and horizontal exposures of selected residential structures.

Moxviquil’s monumental zone is built on a tall, defensible hilltop, with a small quadrangle group at the apex of the hill, referred to as the Upper Plaza, which contained elite administrative and residential spaces (Blom & Weiant 1954). On the northern slope of the hill, below the Upper Plaza, were five artificial terraces with fortified masonry walls, connected by a large monumental staircase. The saddle at the base of the hillside housed spaces and structures that probably served important public and religious functions for the population: an I-shaped ballcourt, a large main plaza, and three small temples (Blom & Weiant 1954; see also Paris *et al.* 2015). The monumental zone was likely established in the Late Classic period (AD 600-900), and remained occupied through the Early Postclassic period. During the Early Postclassic period, (c. AD 900), residential settlement expanded onto the hilltops and ridges to its north and west, encompassing an area of at least 5 ha (Paris 2012). Ten different structures have been identified in these outlying residential areas; many others likely exist, as most residential structures are not superficially visible in this region (Paris & López Bravo 2018). The hilltop immediately to the west of the monumental zone (Operation 4) is particularly densely occupied, and supports at least four structures, of which two structures near the apex of the hill (a house, Structure 9; and a small outbuilding, Structure 7) contain two substructures each. A funerary cave (Operation 7) on one of the outlying hilltops contained over 7000 human skeletal elements, along

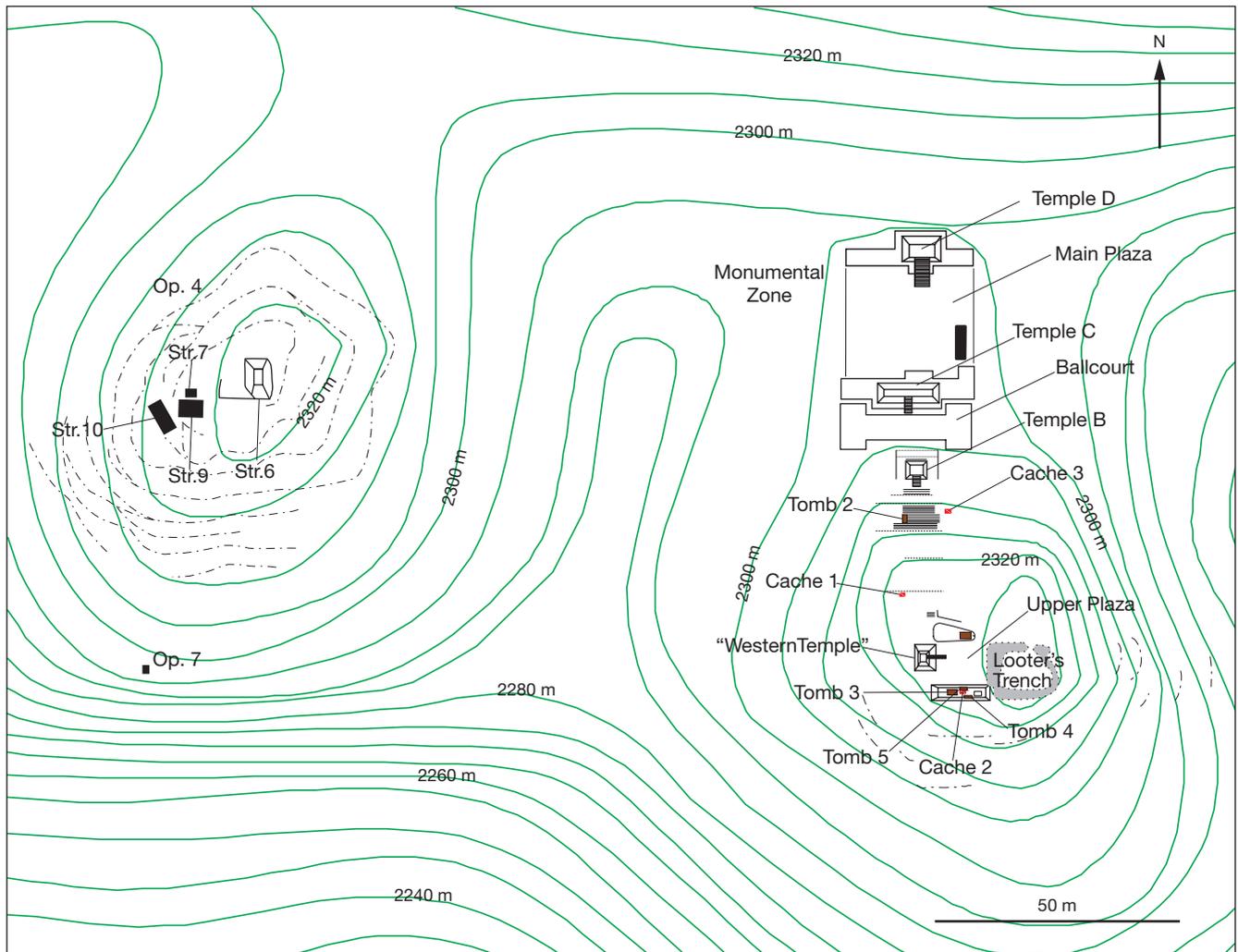


FIG. 2. — Map of Moxviquil, including the locations of the monumental zone, Operation 4, an outlying residential zone, and Operation 7, a funerary cave located on the hillslope below Operation 4. Drafted by Roberto López Bravo & Stephanie Reyes Ibelles, from topographic base map by INEGI (Mexico) and Moxviquil monumental zone map by Frans Blom digitally redrafted by Elizabeth Paris from the unpublished original on file at the Museo Na Bolom. Abbreviations: **Op.**, operation; **Str.**, structure.

with a variety of offerings (Paris *et al.* 2019). Excavations on the valley floor (Operation 5) did not recover evidence of pre-Hispanic occupation, while a small number of artifacts derived from the Colonial or Modern periods.

## METHODS

The faunal remains from the Proyecto Económico de los Altos de Chiapas were recovered through field excavations. All excavations were screened with 1/4" mesh; due to the clayey consistency of the soils, smaller size grades were not feasible. Twenty flotation samples were taken in 2009 on a judgmental basis; while a few small bone fragments were recovered, they were non-diagnostic portions and are thus not considered here. Materials recovered in screen were cleaned using dry brushes and dental picks in the field lab. Faunal elements were separated from human osteological elements by Paris and project bioarchaeologist Stanley Serafin, using morphology, diagnostic features, and the texture

and density of the periosteum and endosteum, taking weathering and other taphonomic processes into account. Human osteological specimens and carved human bone objects are not considered in this publication, and are presented elsewhere (Paris *et al.* 2019). The samples were exported for analysis by Paris to the University at Albany, SUNY Mesoamerican Archaeology Laboratory (2009) and University of Calgary Faunal Laboratory (2015-2016), where they were identified using comparative zooarchaeology collections housed at these institutions. The majority of specimens were identified using these comparative collections, while a small subset was identified using digital photos and comparative literature when comparative specimens were not available, using standard zooarchaeological identification procedures (e.g. Olsen 1973, 1982; Reitz & Wing 1999). Data recorded for each specimen included closest taxonomic identification, common name(s), element, side, portion (including landmarks), taphonomy, anthropogenic modification, age (based on fusion of epiphyses or dental eruption), and skeletal pathologies (Reitz & Wing 1999). Dental measurements were

taken for canids and several rodent and lagomorph species with a calibrated Dino-lite digital microscope, following Holbrook (1970), and tooth size and diagnostic morphology were used to identify rodent/lagomorph species.

The Number of Identified Specimens (NISP) was calculated for each operation and taxonomic class (Table 1). Fragments that could be refitted were counted as one specimen, including juvenile long bones and their epiphyses, and also teeth embedded in their alveoli (tooth sockets). We note that this method can over-represent species with fragile elements, such as rodents, fish and birds (Reitz & Wing 1999). However, most elements were not complete or mostly-complete individuals in primary context; instead most were recovered as isolated fragments in highly mixed midden deposits, rendering other calculations such as MNI (Minimum Number of Individuals) and MNE (Minimum Number of Elements) less useful in this context.

MNI was also calculated for selected species; when making these calculations, we took age and depositional context into account, assuming that elements found in the same unit and lot could plausibly be from the same individual and attempting to match paired elements where possible. We also took skeletal landmarks, element size, and dental measurements into consideration when determining whether particular left and right elements formed a pair. The MNI calculations were made using a middle-of-the-road approach, examining multiple elements from animals of the same age in the same unit and excavated level and without evidence to the contrary, assuming they were from the same individual, but also making the assumption (perhaps unfounded) that there was minimal scattering/portioning of elements from individual animals between multiple contexts. We acknowledge that multiple households could have shared a single deer, or that a portion of a deer eaten at the residential hilltop could also have been used as an offering in the cave; that food remains from a single individual could have been scattered between multiple locations by dogs or scavengers; and that some scattering did occur in the cave through the cultural practice of multiple interments in the cave, and subsequent looting and disturbance (Paris *et al.* 2019).

In addition to the project data, a number of faunal elements were recovered from the monumental zone by Blom and Weiant, and were retained in the collections of the Museo Na Bolom. Blom and Weiant did not screen their deposits, nor is it possible to determine whether all of the recovered specimens were included in the museum collection. Paris re-examined the available specimens in 2008, with the permission of the museum. The museum had on file a hand-written list of unpublished specimen identifications of Moxviquil faunal specimens by Sean Brady, Ignacio J. March & Sven M. Aden, completed at an unknown date; six of the specimens in their study were on display in the museum, and the others were missing. Paris reanalyzed the specimens present in the museum collection in 2008, cross-referencing her observations with those of Brady and colleagues (Table 2). Many of the faunal specimens from the monumental zone were modified into a wide variety of personal ornaments. Blom and Weiant also identified faunal specimens in Cache 1, and their field notebooks and publications record the presence of several white-tailed deer antlers

(Fig. 3A-C) were recovered on Terrace 3 in association with lithic projectile points and debitage (Blom 1954; Weiant 1954; Blom & Weiant 1954). While this data is not directly comparable to the data from systematically sampled and screened deposits, we consider it qualitative data that provides the only currently available evidence from monumental zone deposits.

## RESULTS

The sample includes 598 faunal elements from Moxviquil (Table 1), from test pit excavations in 2009 (N=70) and test pit and horizontal excavations in 2015-2016 (N=528). The majority of specimens were from the residential midden context of Operation 4 (N=222) and the funerary cave of Operation 7 (N=374). The remains included a wide variety of cranial and postcranial elements from a diverse range of taxa. A horse phalanx (*Equus* sp.) and a non-diagnostic large mammal long-bone fragment recovered from Operation 5 (N=2) were not associated with pre-Hispanic archaeological artifacts or features, and were interpreted as Colonial or Modern. An additional 17 elements from Blom and Weiant's excavations in the monumental zone consist of bone tools or ornaments (Table 2). In reporting the results, we incorporate a discussion of the various low-level, mid-level and high-level meanings of the different taxa and elements represented in the assemblage. We consider ethnobiology data from ethnohistorical and ethnographic studies in highland Chiapas, as well as comparative archaeological evidence from the highlands and other sites in the Maya area.

### LOW-LEVEL MEANINGS: ANIMAL HUSBANDRY, HUNTING, AND ENVIRONMENT

Low-level meanings include the role of animals within the local environment, comprising wild animals (many of which were targeted in traditional hunting practices), domesticated animals, and animal products incorporated into daily practice, such as utilitarian bone tools. As with many ancient Maya cities, green space was an important component of urban design (Isendahl 2012). At Moxviquil, our excavations suggest that residential spaces were densely clustered on the upper terraces of modified hilltops, with smaller residences on lower terraces, and a mosaic of managed terraces, semi-terraces, and forested areas on the steep lower slopes. The steepness of terrace retention walls and the quality of construction varied according to the inferred status of the hilltop residents; the monumental zone had the steepest and most well-defined terraces, and outlying residential areas varied greatly in the degree of labor investment, size, and construction strategies apparent in terrace architecture. Poorly-defined semi-terraces bordering outlying residential zones were most likely bordered with maguay plants. Numerous chert maguay scrapers were recovered from the hilltop residences, suggesting that maguay was used as an important source of fiber; the sharp maguay spines would have served as a defense mechanism during times of conflict. The semi-terraces likely supported garden/infield areas, complimenting outfields on neighboring hillslopes which supported large-scale milpa agriculture dominated by corn, beans and squash, similar to the way semi-terraced agriculture in

TABLE 1. — Number of identified specimens (NISP) counts of taxa by species, age, and context (including the proportion of each taxon represented per operation). Counts include specimens from the Proyecto Económico de los Altos de Chiapas, 2009 and 2015-2016 seasons. Abbreviation: **Op.**, operation.

	Op. 4	Op. 5	Op. 7	Total
<b>Mammalia (Mammal Class)</b>				
Artiodactyla (Artiodactyl Order)				
Artiodactyla (species unidentified)	–	–	1 (0.27%)	1
juvenile	–	–	1	1
Cervidae (Deer Family)				
<i>Odocoileus virginianus</i> Zimmermann, 1780 (White-tailed deer)	30 (13.5%)	–	5 (1.4%)	35
adult	26	–	4	30
sub-adult	2	–	–	2
juvenile	2	–	–	2
unidentified	–	–	1	1
<i>Mazama temama</i> Kerr, 1792 (Brocket deer)	1 (0.45%)	–	1 (0.27%)	2
adult	1	–	–	1
juvenile	–	–	1	1
Suidae (Eurasian pig Family)				
<i>Sus scrofa</i> Linnaeus, 1758 (Domestic pig)	–	–	1 (0.27%)	1
juvenile	–	–	1	1
Tayassuidae (Peccary Family)				
Tayassuidae (species unidentified)	–	–	4 (1.1%)	4
adult	–	–	3	3
sub-adult	–	–	1	1
Carnivora (Carnivore Order)				
Carnivora (small, species unidentified)				
adult	–	–	3 (0.80%)	3
adult	–	–	3	3
Canidae (Canine Family)				
<i>Canis lupus familiaris</i> Linnaeus, 1758 (Domestic dog)	57 (25.7%)	–	116 (31%)	173
age undetermined	1	–	1	2
adult	52	–	40	92
juvenile	1	–	52	53
juvenile ( >6 months)	–	–	4	4
sub-adult	1	–	–	1
old adult	2	–	–	2
unidentified	–	–	19	19
<i>Urocyon cinereoargenteus</i> Schreber, 1775 (Gray fox)	–	–	3 (0.80%)	3
adult	–	–	3	3
Felidae (Cat Family)				
Felidae (species unidentified)	–	–	1 (0.27%)	1
adult	–	–	1	1
<i>Panthera onca</i> Linnaeus, 1758 (Jaguar)	–	–	1 (0.27%)	1
adult	–	–	1	1
Mustelidae (Weasel Family)				
<i>Eira barbara</i> Linnaeus, 1758 (Tayra/Viejo de monte)	–	–	19 (5.1%)	19
adult	–	–	19	19
<i>Mustela frenata</i> Lichtenstein, 1831 (Long-tailed weasel)	–	–	1 (0.27%)	1
adult	–	–	1	1
Didelphimorphia (American marsupials Order)				
Didelphidae (Opossum Family)				
<i>Didelphis virginiana</i> Kerr, 1792 (Opossum/Tlacuache)	15 (6.8%)	–	–	15
adult	15	–	–	15
Lagomorpha (Rabbit, Hare, Pika Order)				
Leporidae Family				
<i>Sylvilagus</i> sp. (Rabbit)	–	–	36 (9.6%)	36
adult	–	–	24	24
sub-adult	–	–	1	1
juvenile	–	–	9	9
juvenile?	–	–	2	2
Perissodactyla (Perissodactyl Order)				
Equidae (Horse Family)				
<i>Equus</i> sp. (Horse)	2 (0.90%)	1 (50%)	–	3
adult	2	1	–	3
Rodentia (Rodent Order)				
Cricetidae (New World Rat and Mouse Family)				
Cricetidae (species unidentified)	–	–	1 (0.27%)	1
adult	–	–	1	1
<i>Microtus guatemalensis</i> Merriam, 1898 (Guatemalan vole)	–	–	3 (0.80%)	3
adult	–	–	3	3

TABLE 1. — Continuation.

	Op. 4	Op. 5	Op. 7	Total
<i>Neotoma mexicana</i> Baird, 1855 (Mexican woodrat)	–	–	27 (7.2%)	27
adult	–	–	24	24
juvenile	–	–	3	3
<i>Sigmodon hispidus</i> Say & Ord, 1825 (Hispid's cotton rat)	–	–	21 (5.6%)	21
adult	–	–	17	17
juvenile	–	–	4	4
Sciuridae (Squirrel Family)				
<i>Sciurus aureogaster</i> F. Cuvier, 1829 (Gray squirrel)	–	–	6 (1.6%)	6
adult	–	–	5	5
unidentified	–	–	1	1
Dasyproctidae (Agouti Family)				
<i>Dasyprocta</i> sp. (Agouti/Guaqueque)	1 (0.45%)	–	12 (3.2%)	13
adult	1	–	11	12
juvenile	–	–	1	1
Cuniculidae (Paca Family)				
<i>Cuniculus paca</i> Linnaeus, 1766 (Paca/Tepezcuintle)	–	–	2 (0.54%)	2
adult	–	–	2	2
Mammalia (size and species unidentified)	12 (5.4%)	1 (50%)	1 (0.27%)	14
age undetermined	–	1	–	1
adult	12	–	–	12
unidentified	–	–	1	1
Mammalia (small, species A104)	5 (2.3%)	–	9 (2.4%)	14
age undetermined	2	–	–	2
adult	3	–	7	10
juvenile	–	–	2	2
Mammalia (medium, species unidentified)	12 (5.4%)	–	12 (3.2%)	24
adult	11	–	12	23
juvenile	1	–	–	1
Mammalia (medium or large, species unidentified)	–	–	1 (0.27%)	1
juvenile	–	–	1	1
Mammalia (large, species unidentified)	61 (27.5%)	–	5 (1.3%)	66
age undetermined	1	–	–	1
adult	59	–	2	61
fetal/newborn	1	–	–	1
juvenile	–	–	2	2
unidentified	–	–	1	1
<b>Aves (Bird Class)</b>				
Aves (medium, species unidentified)	–	–	6 (1.6%)	6
adult	–	–	5	5
unidentified	–	–	1	1
Anseriformes (Duck, Geese and Swan Order)				
Anatidae (Wood duck Family)				
Anatidae (species unidentified)	–	–	1 (0.27%)	1
adult	–	–	1	1
Galliformes (Landfowl Order)				
Phasianidae (Gamebird Family)				
<i>Gallus gallus</i> Linnaeus, 1758 (Chicken)	–	–	1 (0.27%)	1
adult	–	–	1	1
<i>Meleagris</i> sp. (Turkey)	–	–	7 (1.9%)	7
adult	–	–	3	3
unidentified	–	–	4	4
Odontophoridae (Quail Family)	–	–	–	–
Odontophoridae (species unidentified)	–	–	2 (0.54%)	2
adult	–	–	2	2
<b>Reptilia (Reptile Class)</b>				
Testudines (Turtle Order)				
Emydidae (Terrapin turtle Family)				
Emydidae (species unidentified)	12 (5.4%)	–	–	12
<b>Actinopterygii (Ray-finned fish Class)</b>				
Actinopterygii (small, species unidentified)	–	–	1 (0.27%)	1
Siluriformes (Catfish Order)				
Siluriformes (species unidentified)	–	–	2 (0.54%)	2
adult	–	–	2	2
<b>Gastropoda (Univalve snail Class)</b>				
Achatinidae (African terrestrial gastropod Family)				
<i>Leptinaria lamellata lamellata</i> Potiez & Michaud, 1838 (Terrestrial gastropod)	–	–	1 (0.27%)	1

TABLE 1. — Continuation.

	Op. 4	Op. 5	Op. 7	Total
Helicinidae (Central American terrestrial gastropod Family)				
<i>Helicina</i> sp. or <i>Lysinoe ghiesbreghtii ghiesbreghtii</i> Nyst, 1841 (Terrestrial gastropod)	2 (0.90%)	–	5 (1.3%)	7
<i>Lucidella lirata</i> L. Pfeiffer, 1847 (Terrestrial gastropod)	–	–	3 (0.80%)	3
Xanthonychidae (Central American terrestrial gastropod Family)				
<i>Lysinoe ghiesbreghtii</i> Nyst, 1841 (Terrestrial gastropod)	–	–	43 (11.5%)	43
Pachychilidae (Freshwater gastropod Family)				
<i>Pachychilus</i> sp. (Jute snail)	7 (3.2%)	–	7 (1.9%)	14
Spiraxidae (Central American terrestrial gastropod Family)				
<i>Streptostyla (Streptostyla) nebulosa</i> Dall, 1896 (Terrestrial gastropod)	–	–	2 (0.54%)	2
Strombidae (Conch Family)				
<i>Strombus</i> sp. (True conch)	1 (0.45%)	–	–	1
<b>Bivalvia (Bivalve Class)</b>				
Venerida (Clam Order)				
Veneridae (Venus clam Family)				
<i>Dosinia</i> sp. or <i>Mercenaria mercenaria</i> Linnaeus, 1758 (Venus clam or Quahog clam)	1 (0.45%)	–	–	1
Ostreida (Oyster Order)				
Ostreidae (True Oyster Family)				
Ostreidae (species unidentified)	1 (0.45%)	–	–	1
<b>Unidentified</b>	7 (3.2%)	–	1 (0.27%)	8
Bird or Rabbit (Aves or Leporidae)	1	–	–	1
Terrestrial gastropod	2	–	–	2
Unidentified	4	–	1	5
<b>Grand Total</b>	<b>222</b>	<b>2</b>	<b>374</b>	<b>598</b>

TABLE 2. — Study of the faunal remains from the Moxviquil monumental zone curated at the Museo Na Bolom, modified by E. H. Paris from study by Sean Brady, Ignacio J. March & Sven M. Aden, unpublished and report on file at the museum. \*, based on size and morphology, this specimen is most likely *Canis lupus familiaris* Linnaeus, 1758 as well; \*\*, based on photos by Frans Blom on file with the Museo Na Bolom, this is one of the two *Puma concolor* Linnaeus, 1771 canines from Cache 1 of the monumental zone; \*\*\*, based on photos by Clarence Weiant on file with the Museo Na Bolom, this carved ornament was recovered on Terrace 3 of the monumental zone.

Species	Bone	Portion	Side	Age	Modification
<i>Odocoileus virginianus</i> Zimmermann, 1780	first phalanx	whole	right	possibly juvenile	perforation
<i>Canis lupus familiaris</i> Linnaeus, 1758	upper canine	whole	–	adult	perforation in root
	inferior canine	whole	–	adult	perforation in root
<i>Canis</i> sp.*	mandible	molar and mandible fragment	right	adult	incising
<i>Puma concolor</i> Linnaeus, 1771**	inferior canine	whole	–	adult	none
Mammalia	long bone	–	–	–	carved awl / pendant
	long bone	shaft	–	adult	carved in shape of maize deity head
	long bone	fragment	–	adult	none
	long bone	shaft	–	adult	carved in shape of deity***
	long bone	shaft	–	adult	none
	long bone	shaft	–	adult	long thin implement
	long bone	shaft	–	adult	long thin implement with incising
	long bone	shaft	–	adult	modified into awl
	long bone	shaft	–	adult	modified into awl
Pelecaniformes, possibly <i>Ardea herodias</i> Linnaeus, 1758	humerus	shaft	–	adult	2 perforations at one end, 1 perforation in center
Pelecaniformes, possibly <i>Ardea alba</i> Linnaeus, 1758	tarsometatarsus	proximal	–	adult	awl-tapered shaft
Unidentified	long bone	shaft	–	adult	incised with cross-hatch pattern

highland Chiapas is practiced today (Vogt 1969). Unoccupied areas at the edges of population centers, steep slopes, high-altitude evergreen cloud forests, and seasonally-flooded valley floor areas would have provided habitat for a wide variety of taxa (Varela Scherrer & Trabanino 2017). Although forest areas may have been managed to some degree (e.g. Ford & Nigh 2009), they would have supported a different range of animal taxa than seasonally cleared milpa areas and cultivated terraces. The slash-and-burn

techniques used to create many milpa spaces themselves likely created a mosaic of secondary forests that permitted a range of species to thrive (Götz 2014).

#### Environment

An examination of the range of terrestrial species at Moxviquil indicates that there is a balance of species that favor secondary and cleared forests, and species that favor mature forests (e.g. Götz



FIG. 3. — *Odocoileus virginianus* Zimmermann, 1780 antler fragments from the monumental zone. Photographs: Elizabeth Paris. Scale bar: 4 cm.

2014; Sharpe & Emery 2015; Varela Scherrer & Trabanino 2017). Many of the species found at Moxviquil are species that prefer secondary forests or may take advantage of planted milpas: white-tailed deer (*Odocoileus virginianus* Zimmermann, 1780), cottontail rabbits (*Sylvilagus* sp.), opossums (*Didelphis virginiana* Kerr, 1792), and turkeys (*Meleagris* sp.), as well as Hispid's cotton rat (*Sigmodon hispidus* Say & Ord, 1825), which prefers grasslands with some shrub overstory. However, the site also includes a range of species that prefer mature forest environments, such as agouti (*guaqueque*; *Dasyprocta* sp.), paca (*tepezcuintle*; *Cuniculus paca* Linnaeus, 1766), peccary (*jabalí*; Tayassuidae Family), tayra (*viejo de monte*; *Eira barbara* Linnaeus, 1758), and Mexican woodrats (*Neotoma mexicana* Baird, 1855), suggesting a landscape where some mature forested areas were conserved; some of these species, such as agouti, paca, and peccary, also consume milpa crops (Varela Scherrer & Trabanino 2017). Mexican woodrats, long-tailed weasels (*Mustela frenata* Lichtenstein, 1831) and gray foxes (*Urocyon cinereoargenteus* Schreber, 1775) also favor brush-covered rocky environments such as caves and rockshelters, and the funerary cave may have served as habitat. While Mexican woodrats often favor cave and rockshelter environments, and could plausibly have been attracted to the cave by food offerings left during funerary rituals, no complete or semi-complete specimens were identified that would suggest natural mortality. Additionally, there is a substantial trade and consumption of rodent species in traditional communities of present-day highland Chiapas, and Mexican woodrats are one of the most popular consumed rodent species (Barragán *et al.* 2007), suggesting that the rats in the cave may have been among the funerary food offerings.

According to Hunn (1977: 13), larger game species such as white-tailed deer, red brocket deer (*Mazama temama* Kerr, 1792), peccary and large predators such as puma (*Puma concolor*, Linnaeus, 1771) are native to highland Chiapas, but had been over-hunted to the point of scarcity by the 1970s; a small number were still present in unoccupied forest areas at that time. Tropical forest species such as jaguar (*Panthera onca* Linnaeus, 1758), ocelot (*Leopardus pardalis* (Linnaeus, 1758)), tapir (*Tapirella bairdii* Gill, 1865), monkeys, and parrots are not local to the highlands, but individuals from modern highland communities who travel to markets in lowland areas, such as Ocosingo, are familiar with them (Hunn 1977: 14). These species are portrayed in decorated pre-Hispanic ceramics found at Moxviquil and other highland Chiapas sites, often on vessels hypothesized to have been imported from lowland areas such as the Central Depression or northeast Chiapas (see Culbert 1965; Paris *et al.* 2015; Paris & López Bravo 2019).

#### Animal husbandry

As in ancient Mesoamerica more broadly, dogs (*Canis lupus familiaris* Linnaeus, 1758) and turkeys (*Meleagris* sp.) were the only known domesticated animals in highland Chiapas during the Early Postclassic period. Both species have been recovered at lowland Maya sites in Guatemala and Belize, dating to the Middle Preclassic period (Wing 1978; Shaw 1991; Clutten-Brock & Hammond 1994; White *et al.* 2001; Thornton *et al.* 2012, 2016; Thornton & Emery 2017; Manin *et al.* 2018a). In pre-Columbian times, domestic dogs in the Maya culture area were eaten (Pohl 1990; Clutten-Brock & Hammond 1994) and used in sacrifices



FIG. 4. — **A-I**, *Canis lupus familiaris* Linnaeus, 1758; **J-L**, *Urocyon cinereoargenteus* Schreber, 1775; **M-X**, *Canis lupus familiaris* Linnaeus, 1758; **A**, adult left mandible with PM2, PM3, PM4, M1; **B**, juvenile left mandible fragment with DPM2, with adult cusp visible below; **C**, **D**, two adult left mandibular PM3; **E**, juvenile right maxillary I3; **F**, **G**, two juvenile left mandibular M1; **H**, adult right maxilla with PM4, M1, M2; **I**, adult right maxillary PM4; **J**, adult right maxillary PM4; **K**, **L**, two right maxillary PM4; **M**, adult maxillary left canine with perforated root; **N**, **O**, standard juvenile right maxillary M1 with cusp mutation; **P**–**R**, standard juvenile left maxillary M1 with cusp mutation; **S**, miniature adult left maxillary M1 with cusp mutation; **T**, miniature adult right maxillary M1 with cusp mutation; **U**, miniature adult left maxillary M1 with cusp mutation; **V**, adult left maxillary PM2 and maxilla fragment; **W**, atlas; **X**, juvenile ribs, including a broken and healed rib (two left and four right fragments). Photographs: Elizabeth Paris. Scale bar: 4 cm.

(Hamblin 1984; Masson & Peraza Lope 2008; see also Landa *in* Tozzer 1941:164, 165); they have been found in cave caches from the Terminal Classic, together with deer (Pendergast 1969; Pendergast & Luther 1974), and in Postclassic period cenote deposits (Pollock & Ray 1957). They also may have been used for hunting and pest control as in modern communities (Hunn 1977). Scholars have also argued that white-tailed deer, white-nosed coatimundi (*Nasua narica* Linnaeus, 1766), and turkey may have been

raised in pens at northern Yucatan sites, based on age-class data (Hamblin 1984; Masson & Peraza Lope 2008; see also Pohl & Feldman 1982; Pohl 1990).

Dogs were the dominant species in the residential and cave assemblages at Moxviquil, and formed just under a third of the specimens in both contexts (Table 1; Fig. 4). Because no articulated specimens were recovered, ages were estimated using different methods for cranial and post-cranial specimens (Table 3). For post-cranial specimens, age categories were

TABLE 3. — Number of identified specimens (NISP) of *Canis lupus familiaris* Linnaeus, 1758 by context, age and element, from the Proyecto Económico de los Altos de Chiapas (2009, 2015-2016). Age categories for postcranial elements were estimated using a combination of element size and epiphyseal fusion, including adult individuals (inferred from fully-fused elements), sub-adults (fusion line visible), and juveniles (unfused elements), with reference to Summer-Smith (1966: table 2). Age categories for teeth were estimated using eruption ages, crown and root development (Wiggs & Lobprise 1997).

Element	Juvenile (very young, likely >6 months)									Total
	Juvenile		Sub-adult		Adult		Old adult		Unknown	
	Op7	Op4	Op7	Op4	Op4	Op7	Op4	Op4	Op7	
cranium	—	—	—	—	—	2	—	—	1	3
cranium-parasphenoid	—	—	—	—	—	—	—	—	1	1
cranium-temporal	—	—	—	—	—	1	—	—	1	2
cranium-zygomatic	—	—	—	—	—	2	—	—	—	2
maxilla fragment with PM4, M1, M2	—	—	—	—	—	1	—	—	—	1
maxillary canine	—	—	—	—	10	3	—	—	—	13
maxillary I13	—	—	1	—	—	—	—	—	—	1
maxillary DPM2 and PM2	—	—	1	—	—	—	—	—	—	1
maxillary DPM3	—	—	1	—	—	—	—	—	—	1
maxillary I2	—	—	—	—	1	—	—	—	—	1
maxillary I3	—	—	1	—	2	2	—	—	—	5
maxillary M1	—	—	4	—	1	4	1	—	—	10
maxillary M2	—	—	—	—	—	0	1	—	—	1
maxillary PM2	—	—	—	—	1	—	—	—	—	1
maxillary PM2 and alveola fragment	—	—	—	—	—	1	—	—	—	1
maxillary PM3	—	—	—	—	1	1	—	—	—	2
maxillary PM4	—	—	2	—	2	1	—	—	—	5
mandible	—	—	—	—	—	2	—	—	—	2
mandibular canine	—	—	—	—	7	2	—	—	—	9
mandibular I3	—	—	—	—	1	—	—	—	—	1
mandibular M1	—	—	8	—	8	4	—	—	—	20
mandibular M2	—	—	—	—	—	1	—	—	—	1
mandibular M3	—	—	1	—	1	—	—	—	—	2
mandibular PM2	—	—	—	—	—	1	—	—	—	1
mandibular PM3	—	—	—	—	4	1	—	—	—	5
mandibular PM4	—	—	—	—	—	1	—	—	—	1
canine tooth	—	—	—	—	1	—	—	—	—	1
vertebra-atlas	—	—	4	—	—	1	—	—	—	5
vertebra-cervical	—	—	1	—	—	1	—	—	—	2
vertebra-lumbar	—	—	—	—	—	1	—	—	—	1
vertebra-thoracic	—	—	1	—	—	—	—	—	—	1
vertebra-thoracic (T15)	—	—	—	—	—	—	—	—	1	1
rib	—	—	11	—	—	1	—	—	10	22
rib-1st	—	—	1	—	—	—	—	—	1	2
humerus	3	—	8	—	—	1	—	—	—	12
radius	—	—	1	—	3	—	—	—	1	5
ulna	—	—	—	—	—	—	—	—	1	1
ox coxae	—	—	1	—	—	—	—	—	—	1
femur	1	—	1	—	1	—	—	—	—	3
tibia	—	1	1	—	2	—	—	—	1	5
long bone fragment	—	—	—	—	—	—	—	—	2	2
metapodial	—	—	—	—	2	1	—	—	—	3
phalanx-1st	—	—	2	1	1	4	—	—	—	8
phalanx-2nd	—	—	1	—	1	—	—	1	—	3
phalanx-3rd	—	—	—	—	1	—	—	—	—	1
<b>Grand Total</b>	<b>4</b>	<b>1</b>	<b>52</b>	<b>1</b>	<b>52</b>	<b>40</b>	<b>2</b>	<b>1</b>	<b>20</b>	<b>173</b>

estimated using a combination of element size and epiphyseal fusion, including adult individuals (inferred from fully-fused elements), sub-adults (fusion line visible), and juveniles (unfused elements). Epiphyseal fusion tables by Summer-Smith (1966: table 2) indicate that domestic dog long bone epiphyses fuse between five and 11 months, and most fuse earlier than nine months, suggesting that the individuals in this assemblage with unfused long bone elements were less than nine months old. A single sub-adult was represented by a recently-fused medial

(2nd) phalanx, which fuses anywhere from 16 weeks to five months in age. For cranial specimens, adult and juvenile specimens were identified based on whether teeth were deciduous or permanent, as well as their size, morphology, and degree of crown and root development. Many of the juvenile dogs were identified through the presence of isolated, unerupted mandibular M1 and maxillary M1 crowns, identified by their lack of roots and their papery texture (Fig. 4E-G). One element was a mandible fragment with an erupted deciduous

PM2, with the crown of the adult tooth visible and intact below it (Fig. 4B). In modern dogs, permanent mandibular PM2 teeth erupt at four to six months old, while mandibular M1 crowns erupt at five to seven months old, suggesting that these juvenile dogs were younger than seven months old, and probably younger than five months (Wiggs & Lobprise 1997). Two specimens had significant wear on the occlusional surfaces of their dental cusps, and were classified as “old adults” while other specimens included very small (likely juvenile) ribs, two of which had healed breaks (Fig. 4X). Eight elements were burned; of these, two cranium fragments were burned black; a radius was burned black and brown, and five teeth were burned at a range of temperatures from light brown (N=1) to dark brown and black (N=4) to dark gray (N=1). Black, brown, and dark gray colors are suggestive of low temperatures up to 400°C (Garcia-Lorenzo 2014: table 1) associated with hearth fires. Crania are not typically targeted as food, suggesting that burning on cranial elements may indicate the remains of deceased household dogs that were buried in middens that were subsequently burned, or derive from waste elements that were discarded and burned on a hearth. Most burned canine elements were recovered near the surface or in the fill of terraces surrounding Structure 9 (a large house); thus, we consider the former interpretation more likely.

The assemblage from the outlying residential hilltop and funerary cave included dogs with a variety of dental morphologies, including a number of unusual morphologies that have been documented in the hairless xoloizcuintle. Modern xoloizcuintle dogs have a large variety of dental anomalies (Kupczik *et al.* 2017), a trait shared with other hairless dogs such as the Peruvian hairless dog (Urbano Torricco 2007). The FOXI3 mutation can lead to a variety of traits in the hair and skin, such as canine ectodermal dysplasia (CED; Parker *et al.* 2017), and dental anomalies, such as a loss of the permanent canines and premolars in the mandibular and maxillary dentition, and the absence of distal and lingual cusps in the deciduous fourth premolar and permanent first and second molars (Kupczik *et al.* 2017). Raúl Valadez, Christopher Götz and colleagues have identified cranium and mandible fragments with dentary mutations at sites in West Mexico, Central Mexico, Campeche, and Quintana Roo (Valadez Azúa *et al.* 1999; Rodríguez Galicia *et al.* 2001; Blanco *et al.* 2006, 2008; Valadez *et al.* 2009), while others have been identified from Tizayuca, Central Mexico (Manin *et al.* 2018b). Researchers identified a variety of haplotypes in the aDNA analysis of eight domestic dog mandibles from Central Mexican sites presenting dental anomalies, suggesting the possibility that dental anomalies are associated with developmental anomalies, but these are not limited to CED (Manin *et al.* 2018b: 128-136).

The Moxviquil sample includes eight maxillary M1 teeth with visible cusp mutations, and a ninth broken cusp fragment which also appears to have had a cusp mutation (Fig. 4H, N-U). It also includes a maxilla fragment with a heavily worn PM2 with a lack of adjacent premolars or alveoli, or substantial bone remodeling suggesting antemortem loss. One tooth with the cusp mutation is from the residential hilltop, while the other eight are

TABLE 4. — Minimum number of individuals (MNI) estimates of *Canis lupus familiaris* Linnaeus, 1758 from the Proyecto Económico de los Altos de Chiapas (2009, 2015-2016).\*, none of the mandibular M1 adults from the hilltop were found in the same units as the maxillary M1 adults from the hilltop; \*\*, two of the mandibular M1 juvenile individuals may correspond to two maxillary M1 juvenile individuals, as the elements were from the same contexts, so the MNI is counted as 6; \*\*\*, none of the mandibular M1 adults from the cave were found in the same contexts as the maxillary M1 adults from the cave.

	Residential hilltop	Funerary cave
mandibular M1	9* adults (2 from 2009, 7 from 2015, no mutation)	8** juveniles, 4*** adults (no mutation)
maxillary M1	1 adult (large-sized with mutation, 2009), 1 adult (no mutation, 2015)	5 juveniles (large-sized with mutation), 3 adults with mutation (including 1 large-sized with mutation, 2 small-sized with mutation)

from the cave; all except two are from different 1 × 1 m units, and include five left and three right elements, all with different morphologies in their cusp mutations. They range significantly in size, including adults with small tooth dimensions and juveniles of large tooth dimensions, suggesting that there may have been large-sized (MNI=7) and small-sized (MNI=2) individuals presenting these mutations (Fig. 4N-V). However, the range of canines, premolars, and molars lacking the cusp mutation that were present in the sample, suggests that many dogs did not have dental anomalies in which these teeth were absent.

If used as meat, dogs would have provided a substantial amount of protein, although it would have been relatively small when compared to the biomass provided by white-tailed deer. The sample includes an MNI of 29 dogs, including 18 adult dogs and 12 juveniles, including at least seven large-sized individuals with cusp mutations and three small-sized individuals with cusp mutations. While tooth size and morphology in domestic dogs is not perfectly correlated with body size in modern domestic dogs, and is also influenced by development and ancestry (Morey 1992: 199), we base our size criteria on the significant discrepancy between the anterior-posterior length of small-sized crowns (length: 7.4-8.2 mm) and large-sized crowns (length: 10.6-12.2 mm) for the maxillary M1, noting that juvenile dogs do not have deciduous maxillary M1 teeth. These calculations were made with the following assumptions: dog elements from a single individual were not found in both the hilltop and cave, or distributed across the multiple contexts; and that cusp mutations and tooth sizes were roughly symmetrical when considering potential paired left and right elements (Table 4). Hamblin (1984: table 7.2) reports an average weight of 19.39 lbs for archaeological dogs on Cozumel Island; we assume a similar average weight for adult dogs at Moxviquil. As large mammal bone weight is approximately 8.74 percent of live weight, and 10.77 percent of fat-free weight, and assuming the juveniles are, on average, five months old and approximately half the weight of an adult, we can assume 188.34 kg of muscle protein or 192.62 kg of protein and fat, represented by the dogs

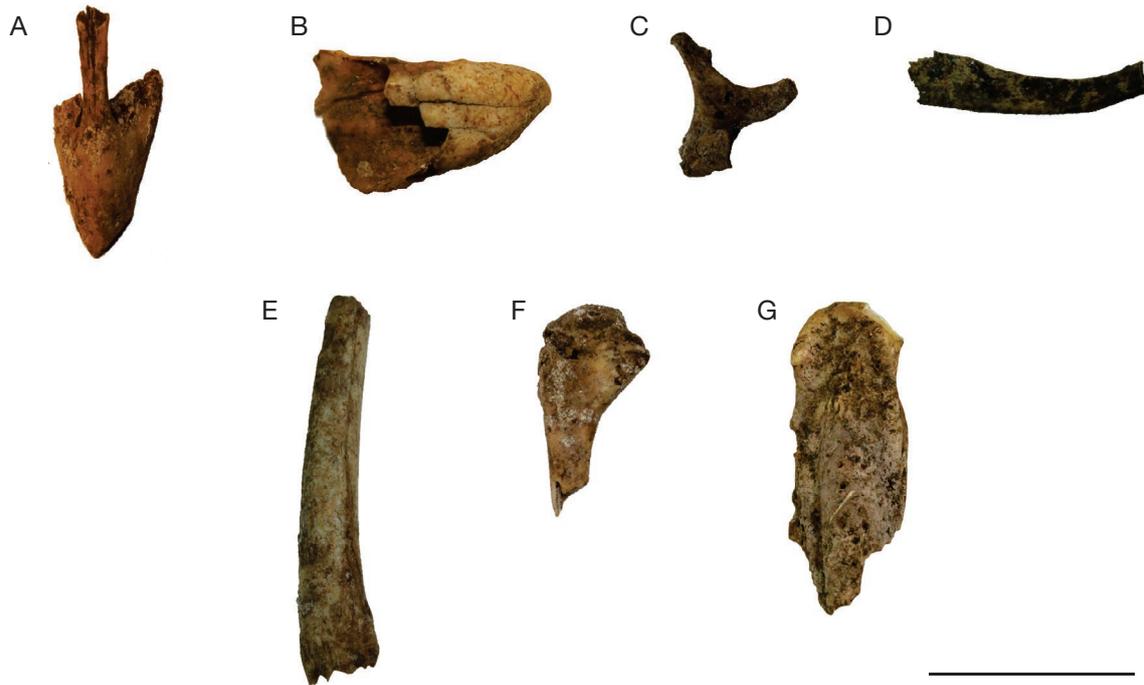


FIG. 5. — Birds: **A**, *Gallus gallus* Linnaeus, 1758 premaxilla; **B**, *Melagris* sp. premaxilla; **C**, medium bird (*Fulica americana* Gmelin, 1789 or similar) right quadrate; **D**, medium bird distal shaft of last rib; **E**, medium bird distal femur shaft; **F**, medium bird left proximal humerus; **G**, unidentified element. Photographs: Elizabeth Paris. Scale bar: 4 cm.

at the outlying hilltop and funerary cave combined. At least one additional domestic dog was represented by the specimens in the monumental zone, but it was not included in the biomass estimates, because the canid elements from the monumental zone consisted entirely of ornaments that were modified through perforation or incised design, and could potentially have been imported to the monumental zone from other residences or sites.

Turkeys were also domesticated in pre-Columbian times (Masson & Peraza Lope 2008). Two species of wild turkey existed in ancient Mesoamerica, including the ocellated turkey (*Meleagris ocellata* Cuvier, 1820) native to the tropical lowlands. The wild turkey (*Meleagris gallopavo* Linnaeus, 1758) is native to central and northern Mexico, and the continental United States, but evidence from the site of El Mirador suggests that it was introduced to the Peten region of the Maya Lowlands by the Late Preclassic period (250 BC-AD 250; Thornton *et al.* 2012; Thornton & Emery 2017). Seven turkey elements were identified in the funerary cave (e.g. Fig. 5B). However, since no turkey elements were recovered at the residential hilltop or the monumental zone, we cannot be confident that they were raised at the site, and it remains a possibility that they were hunted wild turkeys used in funerary offerings. None of the turkey elements were diagnostic to species (Emery *et al.* 2016).

### Hunting

In ancient highland Chiapas, atlatls and darts were used to hunt larger game (Clark 1988); numerous chert projectile points and chert debitage recovered from the residential

middens at Operation 4 suggest that these residences may also have been a site of weapons production, in addition to Terrace 3 of the monumental zone (Weiant 1954). Two carved bone atlatl fingerloops were found in the Moxviquil's monumental zone in Cache 1; they were carved from a large, thick piece of spongy bone, possibly a manatee rib (Fig. 6C, D; see Blom & Weiant 1954; Paris *et al.* 2015: fig. 10). They were likely originally attached to the atlatl with thin leather or maguey fiber cords, and given the location of the cache just below the Upper Plaza, may represent a weapon belonging to a member of the ruling family or other high-ranking person. Fray Diego de Landa reports that deer hunting in northern Yucatan were collective endeavors by hunting parties of men, and that portions of the meat were given to local rulers, with the remainder distributed among the rest “as among friends” (Tozzer 1941: 97), and similar hunting practices may have taken place in highland Chiapas.

Hunters at Moxviquil may also have used blowguns to hunt birds and small animals; these weapons are still used today by Jakaltek Maya communities in western Guatemala and Lacandon Maya communities in east Chiapas (Nations & Clark 1983; Ventura 2003). Copper chisels have been identified at the Late Postclassic period sites of Canajaste (Blake 1985) and Guajilar (Gabriel Lalo Jacinto pers. comm. 2019) in the Upper Grijalva River Valley of eastern Chiapas, and in the Late Postclassic period component of Chiapa de Corzo (Lee 1969: 185), all made from copper alloy. A hammered iron chisel was identified in a Late Postclassic/Colonial period context at Moxviquil Operation 2, similar in form and pro-



FIG. 6. — Bone artifacts from the tombs and caches of the Moxviquil monumental zone: **A**, Olivinae tinklers (currency), Tomb 3; **B**, *Puma concolor* Linnaeus, 1771 inferior canine, Cache 1; **C**, **D**, large mammal bone atlatl fingerloops, Cache 1. Photographs: Elizabeth Paris. Scale bar: 4 cm.

portion to the Chiapa de Corzo and Guajilar examples, with one pointed end and one spatulate end. These may be the implements described by Fray Diego de Landa for northern Yucatan: “a certain soft brass which, when founded with a light mixture of gold from which they made their hatchets, and some little bells with which they danced, and a certain kind of small chisels with which they made their idols and bored their blowguns” (Tozzer 1941: 186); in northern Yucatan, blowguns were particularly used in hunting wild turkeys (Tozzer 1941: note 972). The archaeological examples of chisels are also similar to ethnohistorical examples of chisels used to hollow out Jakalteek blowguns. The presence of both copper and iron chisels in the region suggests that the use of blowguns in hunting continued in Central Chiapas through the Late Postclassic and Colonial periods. Modern hunters in highland Chiapas also use slingshots and snare traps (Hunn 1977: 13), which are made with sticks and baited tension lines made from string, unfortunately leaving few archaeological traces.

White-tailed deer and non-diagnostic large mammal elements (almost certainly white-tailed deer as well) represent a very high proportion of the elements and inferred caloric contribution at Moxviquil (Fig. 7). We calculate at least three adult individual white-tailed deer from the cave, and eight individuals from the hilltop (one juvenile, one full-sized sub-adults and six adults). There were also a number

of non-diagnostic large mammal elements, mostly long bone shaft fragments with a thickness of 2-3 mm. These are most likely to be either white-tailed deer or peccary. Diagnostic peccary elements are rare at Moxviquil; on the tentative assumption that the large mammals also represent white-tailed deer, we get an additional 19 individuals (18 adults and one juvenile) from the hilltop, and an additional two adults and two juveniles from the cave; a total of 34 individuals for the whole site. Deer would have provided a substantial amount of protein and calories for Moxviquil’s population; according to biomass calculations by Madrigal & Holt (2002), a full-sized male provides approximately 20 kg of meat (102 178.1 Kcal), while a six to eight month female fawn provides just under 5 kg (15 450.4 Kcal). If we assume that the large mammals are all deer, we can estimate a total of 620 kg of meat provided by white-tailed deer for the outlying hilltop settlement and funerary cave combined, roughly four times the amount of meat hypothetically provided by the domestic dogs in the sample. Thirty-four deer is still a fairly small amount when considering that the hilltop supported at least four residences across multiple generations; however, it is possible that some midden refuse from the residences was periodically dumped elsewhere so as not to crowd living space. The residents of the hilltop settlement likely supplemented calories from deer with domesticated dogs and a variety of hunted small mammals.



FIG. 7. — Deer and large mammals: **A**, *Odocoileus virginianus* Zimmermann, 1780 long bone shaft fragments; **B**, *Mazama temama* Kerr, 1792 long bone shaft fragments; **C**, large mammal long bone shaft fragment used as awl; **D**, *M. temama* juvenile distal metapodial shaft; **E**, *O. virginianus* maxillary M2 anterior portion; **F**, *O. virginianus* lumbar vertebra; **G**, **H**, large mammal long bone fragment awls (burned). Photographs: Elizabeth Paris. Scale bar: 4 cm.

The prevalence of adult specimens in the Moxviquil assemblage suggests that deer were hunted, not managed as at northern Yucatan cities like Mayapan (Masson & Peraza Lope 2008). Most of the white-tailed deer elements at Moxviquil were associated with the outlying hilltop residences, suggesting that they were less important as food or symbolic offerings in the cave. Many of the elements were burned; three fragments of white-tailed deer and eleven large mammal bone fragments were burned at a range of temperatures (brown, black and white-gray); the color is suggestive of very high temperatures between 400 and 600 °C (García-Lorenzo 2014: table 1), rather than lower temperatures associated with roasting meat, and some bone tools also exhibit burning (Fig. 7G, H), suggesting that they may have been burned in middens or hearths. Very few white-tailed deer elements were found in the cave, suggesting that deer were not common funerary offerings. Two brocket deer specimens were also identified, both metapodial fragments: an adult specimen from the hilltop residences and a juvenile specimen from the cave (Fig. 7B, D).

White-tail deer long-bone fragments were used in a variety of ways, and were particularly important as tools used in cloth production activities. Many sewing and weaving tools were crafted from white-tailed deer bone, including four long, thin implements made from large mammal long bone shafts which were likely weaving battens (Fig. 8A), and three long bone fragments (including a distal metapodial) carved into awls. These implements suggest that deer bone tools were frequently used in cloth production by monumental zone residents. White-tailed deer long bone shaft fragments were also modified into perforators (Fig. 7C, D) and awls (Fig. 7G, H) in the outlying residential zone. At the monumental zone, white-tailed deer and non-diagnostic large mammal bones were also carved into ornaments, including maize deity effigies, perforated pendants, and elements with cross-hatched designs (Fig. 8D, E, H-L). White-tailed deer antler tines recovered on Terrace 3 of the Moxviquil monumental zone were likely used in flintknapping (Fig. 3A-C; see also Blom



FIG. 8. — Bone artifacts from the Moxviquil monumental zone: **A**, large mammal long bone fragment weaving implements; **B**, Pelecaniformes (likely *Ardea herodias* Linnaeus, 1758) humerus, modified with perforations, possibly a fan handle; **C**, Pelecaniformes (likely *Ardea alba* Linnaeus, 1758) proximal tarsometatarsus awl; **D**, large mammal long bone fragment carved as a deity head; **E**, large mammal bone fragment incised with cross-hatched design; **F**, *Canis lupus familiaris* Linnaeus, 1758 maxillary canine with perforation; **G**, *Canis lupus familiaris* mandibular canine with perforation; **H**, *Odocoileus virginianus* Zimmermann, 1780 right 1st phalanx with perforation; **I**, *O. virginianus* metapodial fragment awl; **J**, large mammal long bone fragment carved awl; **K**, large mammal long bone fragment carved and perforated awl; **L**, large mammal long bone fragment carved and incised as a maize deity head. Photographs: Elizabeth Paris, courtesy of the Museo Na Bolom. Scale bar: 4 cm.

1954; Weiant 1954). In 1970's Zinacantan, farmers used a deer bone husker (*hatobal*) to harvest corn, which has a pointed distal end and a perforated proximal end, used to tie it to their belt (Vogt 1969); however, this type of tool has not yet been identified at Moxviquil.

In present-day highland Chiapas, small mammals are an important component of subsistence hunting (Hunn 1977: 13). Commonly-hunted species include cottontail rabbit, raccoon (*Procyon lotor* Linnaeus, 1758), opossum, and paca; less common species include long-tailed weasels, pocket go-

phers (*Orthogeomys hispidus* Le Conte, 1852), gray foxes, and large ground-dwelling birds (Hunn 1977: 13). Numerous scattered elements from the funerary cave included small carnivores and omnivores (Fig. 9) such as Virginia opossum (*tlacuache*; *Didelphis virginiana* Kerr, 1792), and tayra (*viejo de monte*; *Eira barbara* Linnaeus, 1758); as well as lagomorphs and rodents (Fig. 10) such as cottontail rabbit, agouti, paca, Hispid's cotton rat, Mexican woodrat, Guatemalan vole (*Microtus guatemalensis* Merriam, 1898), and Gray squirrel (*Sciurus aureogaster* F. Cuvier, 1829). Ethnobiological studies

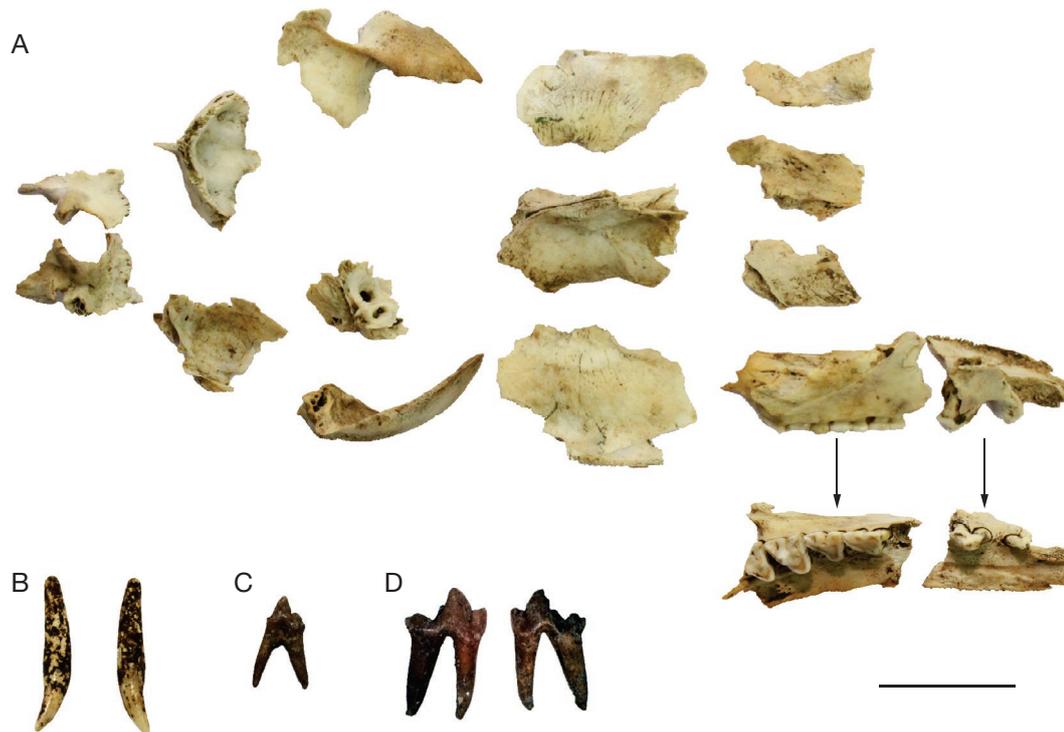


FIG. 9. — Small marsupials and carnivores: **A**, *Didelphis virginiana* Kerr, 1792 cranial fragments, with ventral view of right dentary fragments; **B-D**, *Eira barbara* Linnaeus, 1758: **B**, adult right and left maxillary canines; **C**, adult right mandibular PM2; **D**, adult right and left mandibular M1. Photographs: Elizabeth Paris. Scale bar: 4 cm.

have documented the importance of rodents in market trade and diet in modern highland Chiapas; a study by Barragán *et al.* (2007: table 1) on the rodent trade in Oxchuc identified most of the species that were present in the Moxviquil sample, with Mexican woodrat being the most important species in both present-day trade and the Moxviquil funerary cave assemblage. The relative scarcity of rodent elements in the residential areas of Moxviquil may be at least partially due to superior preservation in the funerary cave; nevertheless, the discrepancy is notable. It is also uncertain whether or not the rodent elements in the cave represent food offerings, ritual offerings, native species, or some mixture of the above (see below). Hispid's cotton rats do not favor cave environments as habitat, so it is likely that this species was deposited in the cave. It is possible that some rodents were deposited by small carnivores such as *E. barbara* or *U. cinereoargenteus*; taphonomic studies of breakage patterns of micromammal osteological remains by both small carnivores and humans suggest similar breakage patterns, with decapitation preceding ingestion, a low survivorship of postcranial elements, and a high rate of dislocation of teeth from mandibles (Matthews 2002: 366; Dewar & Jerardino 2007: 10). However, because the most dominant rodent species are also those most important in the modern highland Chiapas rodent trade (Barragán *et al.* 2007: table 1), we consider human deposition of the rodent remains to be a more likely explanation for the majority of specimens, as we would expect small carnivore predation to be more randomly distributed across available rodent species. None of the elements were recovered as complete or semi-

complete individuals in primary context, which is consistent with the postdepositional disturbance observed in the cave, and a range of elements were represented, particularly cranial fragments, ox coxae, sacrum fragments, and hindlimb elements. Cottontail rabbits and rodents such as pocket gophers, rats, and agoutis are also commonly recovered at other sites in Chiapas, including Paso de la Amada (Wake 2004), Chiapa de Corzo (Flannery 1969), Palenque and Tenam Puente (Zúñiga-Arellano 2008), suggesting that rodents and lagomorphs were an important dietary component over several millennia and a broad geographic area.

As part of our study, we used morphological measurements from Holbrook (1970: 90-95) to quantify the range in sizes and species of rodents and lagomorphs in the Moxviquil cave using mandibles. A calibrated Dino-lite microscope was used to take measurements to 0.001 mm accuracy (Table 5). Species measured in the study include Mexican woodrat (*N. mexicana* Baird, 1855), Hispid's cotton rat (*S. hispidus* Say & Ord, 1825), and cottontail rabbit (*Sylvilagus* sp.). Species were distinguished through diagnostic dental cusp morphologies. The results suggest significant variation in size among individuals of the same species (Fig. 11), suggesting that a wide range of individuals from a robust wild population were being trapped and eaten. The identification of unfused elements from all three species suggests that both adults and juveniles were utilized.

Several birds were identified in the sample, including small quail (Odontophoridae Family) and a number of waterbird species (Fig. 5). A proximal humerus fragment was identified as a wood duck (Anatidae; Fig. 5F); species of Anatidae



FIG. 10. — Rodents and lagomorphs: **A**, *Neotoma mexicana* Baird, 1855, left mandible; **B**, *Sigmodon hispidus* Say & Ord, 1825 right mandible; **C**, *Microtus guatemalensis* Merriam, 1898 left and right maxillae; **D**, *N. mexicana*, right and left os coxae; **E**, *S. hispidus* left and right os coxae; **F**, *S. hispidus* right and left proximal femurs; **G**, *S. hispidus* juvenile right and left tibia fragments; **H**, *Sylvilagus* sp. left and right maxillae; **I**, *Sylvilagus* sp. juvenile right mandible; **J**, *Sciurus aureogaster* F. Cuvier, 1829 atlas; **K**, **L**, *Dasyprocta* sp. mandibular I1; **M**, *Sylvilagus* sp. juvenile right proximal humerus; **N**, *Sylvilagus* sp. left distal radius; **O**, *Cuniculus paca* Linnaeus, 1766 right 4th metacarpal; **P**, *C. paca* right 4th metatarsal; **Q**, *M. guatemalensis* juvenile left femur shaft. Photographs: Elizabeth Paris. Scale bar: 4 cm.

that are found in Central Chiapas include the Black-bellied Whistling-Duck (*Dendrocygna autumnalis* Linnaeus, 1758), which breeds in lowland Chiapas; the Blue-winged teal (*Spatula discors* Linnaeus, 1766), which is a winter visitor to highland Chiapas; and the Ruddy Duck (*Oxyura jamaicensis* Gmelin, 1789) which breeds in Chiapas (Hunn 1977: 138). The collection also includes a number of medium-sized bird elements, which include a femur, a humerus, a quadrate, and two ribs (Fig. 5C-E). The femur contained a small amount of medullary bone, suggesting a female that died either at the beginning or the end of the breeding season, and the curvature is suggestive of a waterbird species such as a wood duck, goose or coot; however, since only the shaft is present, it could not be identified. The humerus had no visible medullary bone. The quadrate could not be identified to species, but came from a bird with a long and slender beak, similar to the American coot (*Fulica americana* Gmelin, 1789; see Elzanoski *et al.* 2001), which lives in wetlands and open water bodies, and is local to Chiapas year-round. Two additional heron/egret specimens were also recovered in the monumental zone (see below). The quail elements could not be identified to species, but could be Common Bobwhite (*Colinus virginianus*

Linnaeus, 1758) which is common in the Central Plateau, Singing Quail (*Odontophorus guttatus* Gould, 1838), found in virgin rainforest across a range of altitudes, or Ocellated Quail (*Cyrtonyx ocellatus* Gould, 1837), which today is found in Western Chiapas (Hunn 1977: 153). Some of the waterfowl specimens may have been transported or traded from the Central Depression, while others may have inhabited or visited the smaller streams of the Central Highlands. Freshwater turtle species belonging to the Emydidae Family (pond turtles) may also have been eaten; however, they also had important ritual uses, and are therefore discussed below.

A wide variety of insects and snails are incorporated into modern highland diets, for which archaeological evidence is currently lacking, but may one day be identified. The most archaeologically visible are edible Jute snails (*py*; *Pachychilus* sp.), which we recovered at the hilltop residences and also in the funerary cave (Fig. 12C-D); these snails are still eaten in Tenejapa (Hunn 1977: 13) and Zinacantan (Vogt 1969: 67). Other types of large terrestrial landsnails (e.g. *Lysinoe ghiesbreghtii* (Nyst, 1841); Fig. 12A, B) could also be food, but may also be natural; they are not considered edible in modern Tenejapa, although they were eaten by

TABLE 5. — Measurements of rat and cottontail rabbit species from Moxviquil Op. 7, following Holbrook (1970: figs. 12, 14).

Species	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16	H17
<i>Sigmodon hispidus</i> Say & Ord, 1825	5.39	1.49	1.85	2.05	—	—	—	4.1	2.57	—	—	4.59	4.5	2.94	0.49	—	—
	4.93	1.666	1.512	1.81	—	—	—	3.89	2.065	—	—	4.486	4.009	3.493	—	—	—
	4.195	1.877	1.156	1.205	—	—	—	3.296	1.866	—	—	4.525	3.851	3.296	1.358	—	—
	5.181	2.108	1.676	1.581	14.62	8.56	2.957	3.14	1.601	8.127	6.998	4.187	3.817	2.401	0.661	3.567	7.195
	6.56	2.2	2.92	1.43	18.03	10.69	7.34	3.6	2.31	9.72	7.938	5.547	5.258	3.91	0.873	5.066	10.29
	6.114	2.382	2.527	1.588	—	12.44	—	4.23	2.38	—	—	5.89	5.36	3.7	—	—	—
<i>Neotoma mexicana</i> Baird, 1855	—	2.657	—	—	—	—	—	4.962	2.144	—	—	5.121	—	4.128	—	—	—
	7.017	2.727	2.403	1.835	—	—	—	4.922	2.779	—	—	5.875	5.518	4.882	—	—	—
	—	2.792	—	—	—	—	—	—	2.898	—	—	—	—	—	—	—	—
	—	2.951	2.789	—	—	—	—	5.559	2.461	—	—	5.24	5.121	5.121	—	—	—
	—	3.11	2.831	—	—	—	—	3.017	2.501	—	—	6.312	5.915	3.653	—	—	—
	8.12	3.12	2.821	2.153	—	13.11	—	7.792	2.117	—	—	6.441	5.585	7.522	—	—	—
	—	3.127	2.852	—	—	—	—	—	2.739	—	—	—	—	—	—	—	—
	—	3.158	—	—	—	—	—	5.694	2.5	—	—	6.944	6.157	5.046	—	—	—
	—	3.159	—	—	—	—	—	4.63	2.22	—	—	5.69	—	3.87	—	—	—
	8.115	3.201	2.839	1.984	—	—	—	—	—	—	—	—	—	—	—	—	—
	—	3.308	3.139	—	—	—	—	5.86	2.47	—	—	7.36	6.97	5.2	—	—	—
	8.761	3.349	2.917	—	25.66	14.75	3.84	6.88	3.57	13.3	11.06	6.88	7.04	5.42	0.79	7.64	13.27
	—	3.572	3.175	—	—	—	—	6.83	1.68	—	—	6.92	5.82	4.98	—	—	—
	—	4.323	2.757	—	—	—	—	5.897	3.414	—	—	—	—	5.2	—	—	—
<i>Sylvilagus</i> sp.	9.17	8.853	1.35	1.588	1.63	1.828	1.154	3.909	7.027	8.022	—	3.374	—	—	—	—	—
	9.3	10.5	1.9	0.9	1.5	1.9	1.4	3.0	9.1	9.4	—	5.4	—	—	—	—	—
	—	17.17	4.218	3.188	3.18	2.866	2.191	6.415	—	—	—	—	—	—	—	—	—
	9.447	—	1.985	1.906	—	—	—	3.643	7.86	8.415	—	3.85	—	—	—	—	—

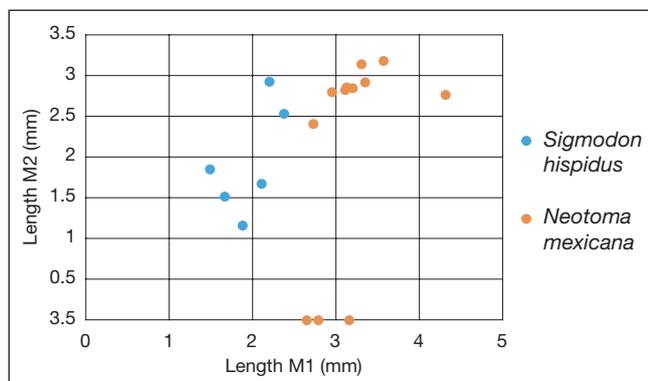


FIG. 11. — Differences in dental dimensions for *Sigmodon hispidus* Say & Ord, 1825 and *Neotoma mexicana* Baird, 1855. M2 data is unavailable for three fragmentary specimens in which only M1 was preserved.

some indigenous communities in Guatemala (Hunn 1977: 257). A single example of African terrestrial gastropod, *Leptinaria lamellata lamellata* Potiez & Michaud, 1838, is likely Colonial or Modern, and was found just below ground surface. In modern communities, wild hives of small stingless bees (*Trigona* sp.) are harvested, and the logs suspended from the eaves of houses; the nests of ground-dwelling *Trigona* species may be excavated and placed in pottery sherds; and wild nests may be raided for honey (Vogt 1969: 67; Hunn 1977: 12). Other insects, such as flying ants, caterpillar larvae, bee larvae, and waterbugs are also eaten, usually roasted (Hunn 1977: 12).

MID-LEVEL MEANINGS: STATUS AND LONG-DISTANCE TRADE  
 Among ancient Mesoamerican elites, important animal species were traded, kept in captivity, and often sacrificed. At Teotihuacan in Central Mexico, dog-wolf hybrids were bred, kept and sacrificed in important ritual deposits in caves under the important temples of the city (Valadez et al. 2002). Ritual deposits also included other carnivorous species such as golden eagles (*Aquila chrysaetos* Linnaeus, 1758), pumas, jaguars, wolves (*Canis lupus* Linnaeus, 1758) and rattlesnakes (*Crotalinae*) (Sugiyama et al. 2013, 2015). At Copan, isotope values suggest that felids were kept in captivity and sacrificed for inclusion in royal tombs; jaguar pelts from hunted wild individuals were also included in the tombs (Sugiyama et al. 2018). Animal products were often used in headdresses and masks; felid elements were imported from the lowlands and used in funerary masks at Kaminaljuyu (Emery et al. 2013), while deer antlers and mandibles were used at Mayapan (Masson & Peraza Lope 2008). Marine products such as sting-ray spines, shark teeth, *Strombus* sp. (conch) shell trumpets, and *Spondylus* sp. (spiny oysters) were traded throughout the Maya area as important ritual implements, funerary offerings, cache materials (Newman 2016), and olive shells (*Olivinae*) were used as currency (Masson & Freidel 2012). During the Late Postclassic period, high-value animal products such as jaguar skins, tropical bird feathers, and rabbit fur moved through Zinacantan, located in the valley just to the west of the Jovel Valley (Sahagún 1959: book 9), which was famous as an important market center and a “town of merchants” (Díaz del Castillo 1960).

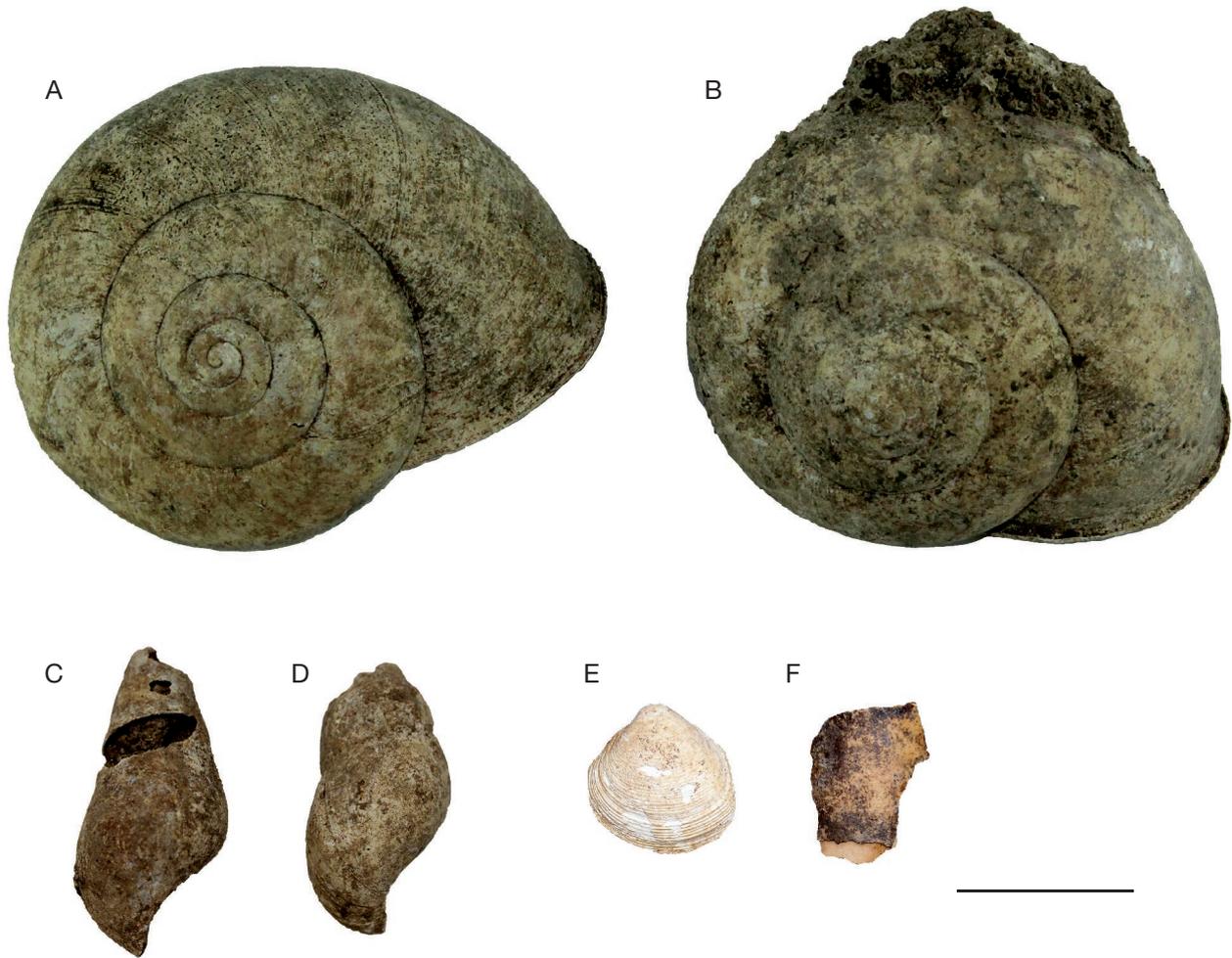


FIG. 12. — Mollusca: **A, B**, *Lysinoe ghiesbreghtii* Nyst, 1841; **C, D**, *Pachychilus* sp.; **E**, *Dosinia* sp. or *Mercenaria mercenaria* Linnaeus, 1758; **F**, Ostreidae shell fragment. Photographs: Elizabeth Paris. Scale bar: 4 cm.

As mentioned previously, several faunal elements were crafted into bone tools and ornaments; while some represent utilitarian implements, others likely reflect intra-site status differences. Many of the elements were ornaments, some carved with geometric or iconographic designs, which may have been status objects used by the site's ruling family. The large mammal long bones that were modified into weaving battens represent the only examples found in any context at the site, and were found at the monumental zone (Fig. 8A); lower-status individuals from outlying residential areas may have used wood battens. Perforated and modified dog teeth used as ornaments were recovered in the funerary cave (N=2) as well as the monumental zone (N=2), but were absent from outlying residential areas (Figs 4M; 8F, G). Although the sample is small, this raises the possibility that perforated dog tooth ornaments were worn mostly by high-status individuals.

The jaguar is a tropical lowland forest species that is not local to highland Chiapas, and all jaguar elements present in the Moxviquil fauna sample were thus imported across political borders and ecological zones. Jaguars were incred-

ibly important animals that were (and are, in many modern Tzotzil communities) considered to be the spirit companions of royal/wealthy individuals (Sugiyama *et al.* 2018; see also Gossen 1999). Jaguar skins were frequently used in royal regalia and paraphernalia by Maya rulers, and the crania were used in headdresses (Saunders 1989; Ballinger & Stomper 2000). A single jaguar tooth (maxillary PM4) was identified in the funerary cave (Fig. 13E), with a highly unusual and extensive wear pattern on the occlusional surface, such that the paraconid and metaconid were worn down past the dentine layer to impact the root itself; the wear appears to be from abrasion and does not appear to be due to dental caries. Dental abrasion caused by grinding against the bars or walls of an enclosure is a common issue in captive Felidae under circumstances of psychological stress from the captive environment (Bollez 2018). This may indicate that the tooth from the Moxviquil cave derived from an animal held in captivity for a significant duration of time, as Sugiyama *et al.* (2018) have proposed; the captive environment was not necessarily at Moxviquil itself, but likely a lowland political center. The distal portion of a third phalanx from a large carnivore was

also found in the funerary cave (Fig. 13F); its morphology is strongly similar to those of large felids (either *Panthera onca* or *Puma concolor*), but species could not be determined as only the distal portion of the phalanx was preserved, and the proximal portion is more highly diagnostic to species.

The presence of jaguar elements in both the monumental zone and the cave suggests two possible interpretations: first, the trade and possession of jaguar elements was not exclusive to the royal family; or second, royal individuals may have been interred in the funerary cave as well as the monumental zone. The presence of a tooth suggests the possibility that isolated teeth or skull fragments may have been exchanged, while the third phalanx may be from a pelt, as pelts often included 2nd and 3rd phalanges (Sugiyama *et al.* 2018); however, only one such element was identified.

Blom and Weiant also documented two felid canines in Cache 1, a dedicatory deposit in the monumental zone that was found on a residential terrace immediately adjacent to the Upper Plaza; it was likely occupied by members of the extended royal family or other high-ranking individuals (Paris *et al.* 2015). Brady *et al.* identify a puma inferior canine in their sample (Table 2; Fig. 6C), which appears correct based on its relative size. It is unclear why only one of the two specimens was included in their study, as Blom's photos of the Cache 1 contents clearly show two different elements (Paris *et al.* 2015); however, only one of the canines is currently on display at the Museo Na Bolom. While jaguar and puma have similar crania, the jaguar is typically larger, and the canine on display is of a size more typical for pumas. Pumas are adapted to mountain habitats, and were historically present in highland Chiapas (Hunn 1977). The presence of large felid elements suggests that high-status individuals at Moxviquil participated in the inter-polity exchange of valuable and symbolic animal products, which were frequently associated with power and royalty across ancient Mesoamerica.

Two surprising inclusions in the funerary cave were two catfish vertebrae (Fig. 13G, H). The vertebrae were both from the thoracic region; one was roughly circular in plan (12.2 cm diameter), while the other was lenticular (16.0 × 13.3 cm); the differences in their size and shape suggest two different individuals). Catfish are not local to the streams and rivers of highland Chiapas; the closest catfish habitats are the Grijalva River in the Central Depression, or the lowland rivers of eastern Chiapas/Guatemala. Salted fish were an important trade item in northern Yucatan, as evidenced by the overrepresentation of cranial portions at coastal sites, and the overrepresentation of vertebrae at inland sites (Masson & Peraza Lope 2008); salted catfish may also have traded to highland Chiapas as well. The fact that only two vertebrae were found suggests that the fish may have been traded in midsection slices, a method still used to in Chiapas today prepare and serve catfish and other large fish. The technique is called *cortado en rodajas*, and the midsection slices, which contain vertebrae, are called *postas*. However, the fact that the catfish vertebrae were deposited in the funerary cave may also have a symbolic element as well (see below).

A small ray-finned fish rib (Class Actinopterygii) has not been identified to species; it may have been from a specimen obtained by fishing from a local stream, or imported from elsewhere (Fig. 13I). It was recovered in the funerary cave, suggesting that like the catfish, its consumption may be more closely related to status or ritual activity, as fish remains were not recovered in residential spaces at the site.

Peccary elements were also present, although uncommon, in the Moxviquil assemblage (Fig. 13). The white-lipped peccary (*Tayassu pecari* Link, 1795) is mainly found in lowland environments, while the collared peccary (*Pecari tajacu* Linnaeus, 1758) is common across a wide range of ecological zones, including at altitudes up to 3000 masl in the Sierra Madre of Chiapas; collared peccary were alleged to exist near Tenejapa in the mid 20th century (Hunn 1977). A vertebra and three teeth, including a relatively complete mandibular canine (tusk), were recovered from the Moxviquil funerary cave (Fig. 13A, B, D). It is often difficult to distinguish non-diagnostic fragments of peccary species from deer species, so any non-diagnostic peccary element fragments would be classified as "large mammal" elements. Two peccary canines (tusks) were also recovered along with the jaguar canines in Cache 1 by Blom & Weiant (see Paris *et al.* 2015: fig. 10); however, peccary elements were entirely absent from domestic middens in the outlying residential zone. This suggests that at Moxviquil, peccary were more closely associated with wealth and status than with regular food consumption; however, the presence of a vertebra suggests that they may have been hunted locally, rather than represented through the exchange of isolated products such as tusks. The presence of an unfused crown of a mandibular 1st molar from the funerary cave is from a domestic pig (*Sus scrofa* Linnaeus, 1758), suggesting that domestic pigs may have served a similar role to peccaries in offerings made during the Colonial period as wild peccary populations decreased (Fig. 13C).

Two elements from the monumental zone were large heron or egret (Pelecaniformes) elements modified into high-status implements. One was a humerus shaft with both the proximal and distal ends removed, probably by sawing with a lithic flake, and with three perforations, two at one end and one in the center. Based on the size, shape, and the location of the perforations, we hypothesize that the implement was a bone handle for a feather fan, often considered to be a symbol of royal power and authority among the ancient Maya (Prüfer *et al.* 2003). Additionally, the humerus is the right size and morphology to belong to a large heron or egret, most likely a Great blue heron (*Ardea herodias* Linnaeus, 1758; Fig. 8B). The second implement is the proximal end and shaft fragment of a large heron or egret modified into an awl, most likely a Great egret (*Ardea alba* Linnaeus, 1758; Fig. 8C), and together with the bone weaving implements and deer bone awls, was part of cloth production by elite women in the monumental zone. Both of these species winter in Mesoamerica, and generally inhabit open water and wetlands, and are observed in the Central Plateau including at Tenejapa (Hunn 1977: 140); however, they are more common at lower elevations and along larger rivers such as the Grijalva. Although it is



FIG. 13. — Rare or exotic species in the Moxviquil assemblage: **A**, Tayassuidae sp. right mandibular canine (tusk); **B**, Tayassuidae sp. left maxillary I1; **C**, *Sus scrofa* Linnaeus, 1758 right mandibular PM2; **D**, large mammal tooth root; **E**, *Panthera onca* Linnaeus, 1758 left mandibular PM4; **F**, *Puma concolor* Linnaeus, 1771 or *Panthera onca* 3rd phalanx; **G**, **H**, Siluriformes vertebrae; **I**, Sub-class Actinopterygii rib; **J**, Emydidae plastron fragments. Photographs: Elizabeth Paris. Scale bar: 4 cm.

possible that the occasional heron or egret was hunted locally in the small rivers and wetlands of the Jovel Valley by the residents of Moxviquil, these species are more common in the Central Depression, and may have been hunted and traded from that area.

Marine shell was also associated with wealth and status at Moxviquil, as it also was throughout the Maya area (Freidel *et al.* 2002; Masson & Freidel 2012); given the geographic distance of Moxviquil from coastal areas, all marine shell is the product of low-volume long-distance exchange. Shell beads include one *Strombus* sp. discoidal bead from the funerary cave, and five olive (Olivinae) shell tinklers recovered by Blom & Weiant from Tomb 3 in the monumental zone

(Paris *et al.* 2015). The five tinklers were perforated at one end of the shell body and their apices sawn off, probably with a lithic tool (Fig. 6A). Olive shells are marine gastropods found throughout the Gulf Coast and Caribbean; they were commonly modified, traded, and used as currency throughout the Maya region (Masson & Freidel 2012; see also Paris & López Bravo 2012). They were most likely obtained by the rulers of Moxviquil as a currency exchange for local products, where they were curated by the royal family and included in the tomb as a funerary offering. Two small, unmodified pieces of shell were also found at the hilltop residences in association with a residence on one of the lower terraces (Structure 8): half of a Venus clam shell (*Dosinia* sp. or *Mercenaria merce-*

*naria* Linnaeus, 1758), and a small fragment of an oyster shell (Ostreidae Family); both were likely traded to the highlands from the Gulf Coast (Fig. 12E, F).

Current evidence suggests that if animal products were subject to sumptuary laws or hunting restrictions, individuals with access to these products were engaging in ritual behavior at both the monumental zone and funerary cave. It is notable that both jaguar and peccary are found at both the monumental zone and the funerary cave. White-tailed deer and dog are found in both contexts as well, where their elements were used as both utilitarian tools and ornaments. Unfortunately, the non-quantitative nature of the monumental zone sample does not permit a more detailed consideration of differences between status ranks.

#### HIGH-LEVEL MEANINGS: RELIGIOUS BELIEFS AND PRACTICES *Caves and ritual behavior*

In highland Chiapas, caves are also considered to be a link between the visible world, *Balamil*, and *'Olon Balamil*, the Underworld; they are the homes of the ancestral gods, the *Totil-me'iletik* (Father-Mothers). Caves may also be home to *Yahval Balamil* (the Earth Owner), a deity who lives inside the earth, and often described as a large, fat, Ladino (non-local rich person, who generally identifies as non-indigenous) who owns all natural resources that people use, including domestic animals, as well as the lightning, clouds, rain, and natural springs (Vogt 1969; Laughlin 1996; Vogt & Stuart 2005: 164). Similarly, in the pre-Columbian past, caves may have been the focus of rituals aimed at maintaining fertility and managing rainfall. Modern Tzotzil communities often share names with particular nearby caves (Brady 2001) and waterholes (Vogt 1969) around which particular ritual activities are organized.

For ancient Maya polities, and Mesoamerican polities more broadly, built landscapes were crafted specifically with reference to caves. An extensive corpus of sites have been documented in which the principal temple(s) and/or the site Acropolis sits over a cave (Brady 2001). These were zoomorphic caves; in Classic period Maya iconography from lowland political centers, temples doorways representing caves were often sculpted such that the doorway is depicted as the maw of a zoomorphic "Earth Monster", variously considered to be a crocodile, centipede, or other animal with underworld connotations (Brady 2001). The positioning of a principal residential settlement zone at Moxviquil over a natural cave was likely quite intentional, as was the deposition of a diverse range of faunal remains into the cave together with human remains.

Animals form an important component of traditional Maya religious beliefs and rituals in highland Chiapas, conceptually and physically. Every person is considered to have an animal "soul companion" (*ch'anul*) who is associated with their health and destiny (Gossen 1999). Many communities believe that the soul companions roam the landscape by day, and are kept in a sacred corral within a particular nearby mountain (Tzontewitz, in the case of Chamula) to protect them from attacks by witches; soul loss, illness and death can result from these attacks, or from a person unknowingly the

soul companion (sometimes their own, by accident; Gossen 1975). The type of animal soul companion is considered to be correlated with the person's wealth and importance: larger animals such as jaguars are considered to correlate with rich individuals; coyotes, foxes, ocelots and weasels are of intermediate status; and smaller animals such as rabbits, opossums, skunks and squirrels are correlated with poverty (Gossen 1975: 448; 1999: 74). Notably, jaguars are considered important soul companions despite not being native to highland habitats (Gossen 1975). The importance of jaguars as animal soul companions may have motivated highland elites to import jaguar teeth from lowland areas, and include them in important ritual contexts.

The identification of two catfish vertebrae may have ritual overtones, in addition to being an indication of long-distance exchange. In the Popol Vuh, the Maya creation story as told by the *K'iche'* Maya of highland Guatemala, the Hero Twins allow themselves to be killed by the Lords of the Underworld, and are reborn as a pair of catfish (Tedlock 1996). However, as noted above, only two vertebrae were found in the cave, each from a different individual; this suggests that the salted sections were traded as midsections (*postas*). The *postas* themselves may have been used as food offerings in the cave, or the *postas* and/or just the vertebrae may have included in the cave for symbolic purposes. Catfish vertebrae have not been recovered elsewhere at the site.

While Moxviquil lacked ritual marine fauna such as shark's teeth or stingray spines (e.g. Hamblin 1984), the latter appear in obsidian effigy. An obsidian eccentric was identified at the hilltop residence, made from a prismatic third-series blade, pressure-flaked along both lateral edges with a series of small notches (Paris 2012). We argue that it is a stylized representation of a stingray spine. The small notches are quite delicate, and would not have survived actual use as a perforator. Notably, the eccentric was not recovered from a ritual context; it is a medial segment that was broken across the mid-section on both the proximal and distal edges, and discarded on a lower residential terrace just to the south of Structure 9.

In highland Guatemala, hunters construct hunting shrines at sacred mountain landscape features, usually caves or rock-shelters, where they believe the Animal Guardian resides (Brown & Emery 2008: 315; Emery & Brown 2012: 85). Hunters make offerings of corn or copal to petition for a successful hunt; after an animal is hunted and butchered, the hunter collects its bones and takes them as an offering to the Animal Guardian, to give thanks to the Animal Guardian and prove that they have not hunted too many animals. They also believe that this process returns the deceased animal's life force to the Animal Guardian, who will use the bones to repopulate the forests and replenish the supply of available forest game. The elements represented in Moxviquil funerary cave include scattered small mammal remains from many body portions, including cranial fragments, teeth, os coxae, vertebrae and long bones. These elements do not constitute complete individuals but may be consistent with highly intermingled and dispersed animal offerings made over several generations. The intermingled nature of the elements is also consistent with Brown &

Emery's (2008) description of regular sweeping in hunting shrines to maintain cleared areas for ceremonies, and would also have resulted from interment of successive primary burials that we have hypothesized for the human remains (Paris *et al.* 2019). However, this raises important questions about whether the entrance would have been sealed between funerary interments and/or hunting shrine activities. Due to the collapse of the ancient cave entrance from a past earthquake (Paris *et al.* 2019), archaeological evidence on this point is lacking. Sealing the cave between uses would have made its use as a hunting shrine potentially more difficult, or at least more labor-intensive to use.

### *Medicinal use of animals*

Modern Tzotzil communities still use specific animal products that are associated with medicinal uses; Hunn (1977) and Enríquez Vázquez *et al.* (2006) have both compiled detailed databases on this topic. Among the most widely used include the opossum, Hispid's pocket gopher, white-tailed deer, poisonous snakes, and skunks (Mephitidae Family), which are used to treat a wide variety of ailments including fever, stomach pain, cancer, arthritis, mental illness, infertility, and to accelerate childbirth. Stingless bee (Meliponidae Family) honey is also particularly important, used to treat cough and stomach pain. More broadly, animal products, particularly meats and broths, are considered to be "hot" or "cold" in traditional medicine, which dictates the ways they can be consumed, and by whom, under particular conditions (Hunn 1977).

Several specimens from the residential hilltop may be present due to medicinal use. One specimen is the opossum, of which 15 cranial fragments from a single individual were recovered in a single 2 × 2 m unit (Fig. 9A). The specimen was recovered between the exterior of the north wall of Structure 9 (a large house) and the south wall of Structure 7 (a small outbuilding). Opossum have numerous uses in traditional medicine; the tail is used to accelerate childbirth; it is also used as a cure for swelling, as sick people are bathed in boiled broth from the animal (Enríquez Vázquez *et al.* 2006). The fact that the opossum was recovered from a hilltop residence, rather than the cave, raises the possibility that it was left over from a curing ceremony or childbirth event taking place at the house. Opossum are also trapped and eaten in highland Chiapas (Hunn 1977). In either case, the lack of post-cranial remains is unusual.

Twelve plastron fragments are diagnostic to Emydidae (pond turtles; Fig. 13J). Two species of mud turtle, *Kinosternon scorpioides cruentatum* (Duméril & Bibron, 1851) and *Kinosternon leucostomum* (Duméril & Bibron, 1851) are known from Tenejapa, while larger species such as the Central American river turtle (*Dermatemys mawii* Gray, 1847), pond slider (*Trachemys scripta* Thunberg ex Schoepff, 1792) and Mexican musk turtle (*Staurotypus triporcatus* Wiegmann, 1828) occur in northern Chiapas; the former is common in Palenque assemblages (Zúñiga-Arellano 2008). Mud turtle flesh and eggs from *Kinosternon* sp. are eaten in highland Chiapas (Hunn 1977: 232); however, they are also used in traditional

medicine (see below). In highland Chiapas, the carapaces of *Kinosternon* sp. is used to treat malaria and tuberculosis, while the meat is eaten by women who only have children of one sex, who hope to give birth to a child of the other sex (Enríquez Vázquez *et al.* 2006). In northern Belize, the carapaces of mud turtles (*Kinosternon* sp.) are used as a treatment for respiratory ailments such as asthma; the chest area of the plastron is scraped to form a powder, which is mixed with water and given to babies to drink (Carr 1991). The meat is eaten by elderly people as a tonic to improve health (Carr 1991). The plastron fragments were recovered at Operation 4, the outlying residential hilltop, just two meters to the east of the opossum cranial fragments, also between the exterior walls of Structures 7 and 9. Faunal elements are not numerous in this location (15 other specimens were recovered, consisting of white-tailed deer, large mammal, and dog elements); conversely, opossum and turtle elements were only recovered in this location at the site, raising the possibility that the turtle and opossum elements both resulted from curing ceremonies.

Chickens and chicken eggs are also important components of traditional medicine in highland Chiapas (Hunn 1977), and it is likely that turkeys and their eggs would have been used similarly in the pre-Columbian period (Vogt 1969: 67). Chickens are commonly sacrificed as an offering and/or eaten (often as broth) as part of curing ceremonies; eggs are commonly used in divination and curing ceremonies (Vogt 1969; Gossen 1975; Page Pliego 2005: 312). Chicken are prepared in a ritual meal offered to the Earth Lord at the beginning of the growing season, and their feet are dipped in the bags of seed corn in order to make the crop grow well (Vogt 1969: 45). The turkey elements in the funerary cave may represent part of a pre-Columbian ritual meal or offering, while the chicken beak may represent the remains of a similar, post-Colonial period event (Fig. 5A), as other areas of Moxviquil remained occupied during the Colonial period (Paris 2012).

## DISCUSSION

The species represented in the different assemblages at Moxviquil attests to the complexities in the construction of domestic and ritual space in Early Postclassic period highland Maya polities. Rather than a hard boundary between house and wilderness, sacred and profane, many animals and animal products were part of cultural practices in both spaces. Domestic spaces reflect the selective husbandry and hunting of animals for everyday living, compared to the carefully constructed microcosm of ritual activities represented in the funerary cave. Outlying hilltop residences were spaces where white-tailed deer and small mammals such as agouti and possibly domestic dogs were processed for dietary purposes, while Virginia opossum and turtle could have served either dietary or medicinal purposes. The high-status residences of the monumental zone contain a large number of elements that were transformed into ornaments, as well as tools to facilitate economically important crafts such as flintknapping implements, awls, and weaving battens. In contrast, the tombs and caches of the

monumental zone were sites where wealth, political power and ritual behavior were expressed through the caching of elements from lowland species, including elements that had been transformed into currency or elements of high-status weaponry. The taxa represented in the funerary cave represent a broad array of hunted animals that are mostly local to highland Chiapas, combined with a small number of highly symbolic, selected elements from lowland species such as catfish and jaguar. As Brown & Emery (2008: 328) suggest, such spaces facilitate crucial negotiations between the human community and the animated forest. Notably, the funerary cave has low quantities of white-tailed deer, the most common hunted species represented in the hilltop residential contexts; rather, the range of taxa represented in the cave is more similar to the descriptions of hunted small animal elements deposited in hunting shrines in highland Guatemala (Emery & Brown 2012).

Due to its ecological context and cultural frontier location, Moxviquil contrasts significantly with many of the other sites where faunal assemblages have been intensively studied. Its higher altitude, relatively cold climate, and combination of Evergreen Cloud Forest and Pine-Oak-Liquidambar Forest habitats result in an assemblage where many of the tropical forest species that characterize most Maya Lowland sites are absent, as are most marine and riverine species. Comparisons with Tenam Puente, a comparatively larger pre-Columbian city on the southeast edge of the Comitán Plateau (*c.* 1500 masl; Zúñiga-Arellano 2008), and Hunchavin, a small center on the northwest edge of the Comitán Plateau (Kaneko 2010), suggest broad similarities, in which the common taxa, such as deer and dog, were supplemented by lagomorphs such as cottontail rabbits, and rodents such as rats, agouti, and paca. The Moxviquil faunal assemblage contrasts sharply with Toniná, a large city in the transitional zone on the northeast edge of the Central Highlands (Becquelin & Baudez 1982), with Palenque, the largest city in the lowlands of northeast Chiapas (*c.* 80 masl; Zúñiga-Arellano 2008), and with other urban centers along the Usumacinta, Yaxchilan and Piedras Negras (Sharpe & Emery 2015). Moxviquil has a much larger representation of edible rodents, lagomorphs and small carnivores, but lacks significant representation from lowland tropical forest species such as tapir and jaguar, as well as larger river species such as fish, turtles and freshwater snails; reptiles such as iguanas, other lizards and vipers; tropical birds such as parrots; large and small felids; manatee from the Gulf of Mexico; and small tropical forest mammals such as coatimundi. Large lowland taxa such as jaguars would have been acquired at Moxviquil exclusively through long-distance exchange, transforming them into rare and highly symbolic commodities. It is possible that the rulers of Moxviquil were considered to have jaguar spirit companions, and also possible that they and the majority of their subjects may never have seen a live jaguar. Similarly, a tapir maxilla is depicted on one of the effigy incense burner lids from Moxviquil Tomb 3 in the monumental zone (see Paris & López Bravo 2019: figs 4, 5), despite the fact that its occupant may never have seen a live tapir.

With regard to the assemblages themselves, some notable similarities are observed between Moxviquil and Tenam Puente. Both kingdoms were continuously occupied through the Late Classic to Early Postclassic period transition, and are strategically located in Central Highland areas that had trade route access to neighboring lowlands. Additionally, both sites principally utilized terrestrial mammalian species, as they are both located at a significant distance from large rivers, lakes and coastlines. Cottontail rabbits, various rat species (particularly *N. mexicana*), peccary, turkey, and white-tailed deer are all observed in significant quantities at both Tenam Puente and Moxviquil (Zúñiga-Arellano 2008: table 1); these likely reflect broad similarities in diet at both sites. A major difference is the significant number of armadillo (*Dasyus novemcinctus* Linnaeus, 1758) specimens found at Tenam Puente, but absent at Moxviquil; armadillo prefer warmer habitats and are not common in the Jovel Valley. Tenam Puente also has puma elements, but not jaguar; jaguar elements are more common at Palenque and Usumacinta River sites (Zúñiga-Arellano 2008). This may suggest that Moxviquil obtained jaguar elements from lowland trade partners, rather than Tenam Puente. Agouti, paca, tayra, long-tailed weasel, and gray fox are present at Moxviquil, but absent at Tenam Puente; these differences may speak to minor differences in ritual behavior as reflected in the diverse range of species present in Moxviquil funerary cave. The presence of gray foxes in the Moxviquil assemblage is also distinctive, although there are only three diagnostic elements at Moxviquil (MNI=2), all from the funerary cave; relatively high proportions of gray foxes have been observed in Postclassic period contexts on Cozumel Island (Hamblin 1984: 153). The Moxviquil assemblage also appears to have a higher proportion of bone tools and ornaments than Tenam Puente, with the exception of shell beads and tinklers. While perforated bone ornaments at Tenam Puente are limited to three specimens (dog molar, peccary canine, and rabbit calcaneus; Zúñiga-Arellano 2008), modified bone was common at Moxviquil, in both domestic and ritual contexts.

At Hunchavin, on the opposite end of the Comitán Plateau, identified species include domestic dog, deer, rabbit, peccary, opossum and turkey (Kaneko 2010); with the exception of peccary at Moxviquil, these suggest that the principal mammalian species of importance were broadly shared across the eastern and western highlands. Notably, Hunchavin also has a small “short-faced” dog with an unusual cranial morphology, but with a lack of the dental anomalies and cusp mutations that are often associated with the xoloitzcuintle (Valadez Azúa 2014). Since complete domestic dog crania are not present at Moxviquil, it is not possible to evaluate whether this type of dog was present, but it provides additional support for the diversity of dog breeds kept in the region during the Classic and Postclassic periods.

Comparisons between Moxviquil and Chiapa de Corzo (Flannery 1969) also suggest some broad regional similarities in diet between the highlands and the Central Depression. It is worth observing that the site of Chiapa de Corzo sits at an altitude of 430 masl, with a tropical lowland forest and freshwater riverine ecology, due to its location on the Middle

Grijalva River; additionally, most of the analyzed sample derives from Preclassic period contexts. As such, the sample contains a number of lowland species not present in the Jovel Valley, including tapir (*Tapirella bairdii* Gill, 1865), numerous turtle and fish species, black iguana (*Ctenosaura acanthura* Shaw, 1802), and numerous large wading bird species. Other dominant species include white-tailed deer, collared peccary, domestic dog, and two species of cottontail rabbit, all of which are present at Moxviquil. As at Moxviquil, domestic dogs dominate the assemblage; Flannery argues that they were an important component of the Preclassic period diet at Chiapa de Corzo, and were eaten more regularly than deer (Flannery 1969: 211). A polished stingray spine (Flannery 1969: 212) further indicates that the residents of Chiapa de Corzo obtained marine fauna with important symbolic connotations and ritual use through long-distance exchange networks.

## CONCLUSION

The range of hunted and domestic fauna utilized at small highland centers such as Moxviquil is relevant to debates over Maya cities and towns as ‘agro-urban landscapes’ (Isendahl 2012) characterized by land-use strategies which interspersed specific types of agronomic production within ancient cities. This perspective is part of a growing consideration of ‘green cities’ (Graham 1999), ‘garden cities’ (Chase & Chase 1998; Dunning *et al.* 1998; Dahlin *et al.* 2005), ‘forest gardens’ (Ford & Nigh 2009), and low-density cities (Fletcher 2012) as characteristic of many ancient agrarian-based states. Moxviquil and other highland cities in southeast Mesoamerica were deliberately constructed on high hilltops and ridges surrounding large valleys; the upper portions of the hilltops reflect extensive artificial terracing to maximize and fortify horizontal living spaces, while the use of maguey-reinforced terraces provided both resources and a first line of defense in times of insecurity. Residential clusters on the hilltops would have housed domestic dogs and possibly turkeys. Adjacent semi-terraces would have provided residents with food security in times of conflict, and created planted gardens and milpas that attracted deer, peccary and rodents such as *S. hispidus* that thrive in secondary forests and opportunistically forage on milpa crops. Nearby evergreen cloud forest and pine-oak forest areas would have supported species such as tayra, long-tailed weasels, gray foxes, and Mexican woodrats. Small, low-density highland cities such as Moxviquil were also influenced by the cultural beliefs and practices of their lowland neighbors with regard to the significance of different animal species. High-ranking families at Moxviquil imported exotic animal products over long distances, may have raised specialized and high-maintenance breeds of dogs such as the xoloitzcuintle, and participated in broader networks of symbolic thought that linked large felids, peccary, tapir and catfish with status and sacredness.

The diverse range of fauna that constituted dietary subsistence, medicinal practice, and symbolic behavior at Moxviquil also speak to the resiliency of highland environments during

a period of political and climatological stress for Maya lowland kingdoms. At highland sites such as Moxviquil, Tenam Puente and Hunchavin, a wide range of small mammals, birds, and turtles supplemented dietary consumption of deer, dog, and turkey, which constituted the foundational meat sources at many tropical forest sites (Sharpe & Emery 2015). Climatological factors limiting the diversity of highland taxa may have encouraged highland residents to seek out alternate meat sources as a foundational practice of diversified hunting strategy. These diversified hunting practices may have provided a buffer against environmental stress and dietary hardship during the Late Classic to Early Postclassic period transition.

## Acknowledgements

The Proyecto Económico de los Altos de Chiapas was carried out under the permission of the Consejo de Arqueología of the Instituto Nacional de Antropología e Historia (INAH) in 2009 and 2015-2016. Funding for field research and laboratory analysis was provided by a National Science Foundation Doctoral Dissertation Improvement Grant (Award ID 0836590) to Paris in 2009, and a Wenner-Gren Foundation International Collaborative Research Grant to Paris & López Bravo in 2015, with additional funds provided by the Christopher DeCormier Memorial Scholarship, the University of Albany, SUNY, and the Universidad de Ciencias y Artes de Chiapas. We thank the University of Calgary, ProNatura Chiapas, Museo Na Bolom, the New World Archaeological Foundation, our project staff and students. Stephanie Reyes Ibelles and Nicholas Pagnucco contributed to illustrations and photographs that appear in this article. We are grateful to Aurélie Manin and an anonymous reviewer for their excellent advice and suggestions for improvement.

## REFERENCES

- ACHESON N. 1966. — Etnozoología Zinacanteca, in VOGT E. Z. (ed.), *Los Zinacantecos. Un pueblo tzotzil de los altos de Chiapas, México*. Mexico, Instituto Nacional Indigenista: 433-454. (Colección de Antropología Social).
- ADAMS R. M. 1961. — Changing patterns of territorial organization in the Central Highlands of Chiapas, Mexico. *American Antiquity* 26 (3): 341-360. <https://doi.org/10.2307/277401>
- AUBRY A. 2008. — *San Cristóbal de Las Casas: Su Historia Urbana, Demografía y Monumental 1528-1990*. Apoyo al Desarrollo de Archivos y Bibliotecas de México, México; San Cristóbal de Las Casas, 264 p. (Coll. Apuntes de Lectura; 16-20).
- BALLINGER D. A. & STOMPER J. 2000. — The jaguars of Altar Q, Copán, Honduras: faunal analysis, archaeology and ecology. *Journal of Ethnobiology* 20 (2): 223-236.
- BARRAGÁN F., RETANA O. G. & NARANJO E. J. 2007. — The rodent trade of tzeltal indians of Oxchuc, Chiapas, Mexico. *Human Ecology* 35 (6): 769-773. <https://doi.org/10.1007/s10745-007-9116-7>
- BARTHES R. 1979. — *The Eiffel Tower and Other Mythologies*. The Noonday Press, New York, 152 p.
- BARTHES R. 2012. — Toward a psychosociology of contemporary food consumption, in COUNIHAN C. & VAN ESTERIK P. (eds), *Food and Culture. A Reader*. Routledge, New York: 37-44.
- BECQUELIN P. & BAUDEZ C.-F. 1982. — *Tonina, une cité Maya du Chiapas (Mexique)*. Mission archéologique et ethnologique fran-

- caise au Mexique, Mexico; Éditions recherche sur les civilisations, Paris, 3 vol. [1456] p. (Coll. Études mésoaméricaines; 6/1-3).
- BERLIN B., BREEDLOVE D. E. & RAVEN P. H. 1974. — *Principles of Tzeltal Plant Classification: an Introduction to the Botanical Ethnography of a Mayan Speaking People of Highland Chiapas*. New York, Academic Press, 660 p.
- BLAKE T. M. 1985. — *Canajaste: an Evolving Postclassic Maya State*. Unpublished Ph.D. dissertation, University of Michigan. UMI Microfilms, Ann Arbor.
- BLANCO A., RODRÍGUEZ B., VINIEGRA F., OLMOS K., MORA C. & VALADEZ R. 2006. — Cánidos del templo Mayor de Tenochtitlan. *AMMVEPE* 17 (5): 217-226.
- BLANCO A., GÖTZ C. M., MESTRE G., RODRÍGUEZ B. & VALADEZ R. 2008. — El xoloitzcuintle prehispánico y el estándar actual de la raza. *AMMVEPE* 19 (5): 131-138.
- BLOM F. 1954. — Informe de los trabajos llevados a cabo en Moxviquil. *Archivo INAH VIII* (165-8) [Estado de Chiapas 1952-1956].
- BLOM F. & WEIANT C. W. 1954. — Informe de los trabajos llevados a cabo en Moxviquil. *Archivo INAH VIII* (166-9) [Estado de Chiapas 1952-1956].
- BOLLEZ A. 2018. — *Oral Pathological Conditions of Felidae in Captivity*. Master of Veterinary Medicine Dissertation, Ghent University, Ghent, 43 p.
- BOURDIEU P. 1984. — *Distinction: a Social Critique of the Judgement of Taste*. Harvard University Press, Cambridge MA, 640 p.
- BRADY J. E. 2001. — Uncovering the dark secrets of the Maya: the archaeology of Maya caves, in GRUBE N. (ed.), *Maya: Divine Kings of the Rainforest*: 296-307.
- BROWN L. A. & EMERY K. F. 2008. — Negotiations with the animate forest: hunting shrines in the Guatemalan Highlands. *Journal of Archaeological Method and Theory* 15 (4): 300-337.
- BRYANT D. D. 1988. — Excavations at House 1, Yerba Buena, Chiapas Central Highlands, Mexico, in BRYANT D. D., CALNEK E. E., LEE T. A. JR. & HAYDEN B. (eds), *Archaeology, Ethnohistory, and Ethnoarchaeology in the Maya Highlands of Chiapas, Mexico*. Brigham Young University, Provo UT, 113 p. (Coll. Papers of the New World Archaeological Foundation; 54).
- CALNEK E. E. 1988. — Highland Chiapas before the Spanish conquest, in BRYANT D. D., CALNEK E. E., LEE T. A. JR. & HAYDEN B. (eds), *Archaeology, Ethnohistory, and Ethnoarchaeology in the Maya Highlands of Chiapas, Mexico*. Brigham Young University, Provo UT, 84 p. (Coll. Papers of the New World Archaeological Foundation; 55).
- CARR H. S. 1991. — The Maya medicinal turtle, Xkokak, and a suggested alternate reading of two Yucatec ethnomedical texts. *Journal of Ethnobiology* 11 (2): 187-192.
- CHASE A. F. & CHASE D. Z. 1998. — Scale and intensity in Classic period Maya agriculture: terracing and settlement at the “garden city” of Caracol, Belize. *Culture, Agriculture, Food and Environment* 20 (2-3): 60-77. <https://doi.org/10.1525/cag.1998.20.2-3.60>
- CLARK J. E. 1988. — Appendix 1: The chipped stone artifacts, in BRYANT D. D., CALNEK E. E., LEE T. A. JR. & HAYDEN B. (eds), *Archaeology, Ethnohistory, and Ethnoarchaeology in the Maya Highlands of Chiapas, Mexico*. Brigham Young University, Provo UT: 85-108. (Coll. Papers of the New World Archaeological Foundation; 54-56).
- CLUTTON-BROCK J. & HAMMOND N. 1994. — Hot dogs: comestible canids in Preclassic Maya culture at Cuello, Belize. *Journal of Archaeological Science* 21 (6): 819-826. <https://doi.org/10.1006/jasc.1994.1079>
- CULBERT T. P. 1965. — *The Ceramic History of the Central Highlands of Chiapas, Mexico*. Brigham Young University, Provo UT, viii + 91 p. (Coll. Papers of the New World Archaeological Foundation; 19).
- DAHLIN B. H., BEACH T., LUZZADDER-BEACH S., HIXSON D., HUTSON S., MAGNONI A., MANSSELL E. & MAZEAU D. E. 2005. — Reconstructing agricultural self-sufficiency at Chunchucmil, Yucatan, Mexico. *Ancient Mesoamerica* 16 (2): 229-247. <https://doi.org/10.1017/S0956536105050212>
- DE FRECE A. & POOLE N. 2008. — Constructing livelihoods in rural Mexico: milpa in Mayan culture. *The Journal of Peasant Studies* 35 (2): 335-352. <https://doi.org/10.1080/03066150802151090>
- DEWAR G. & JERARDINO A. 2007. — Micromammals: when humans are the hunters. *Journal of Taphonomy* 5 (1): 1-14.
- DÍAZ DEL CASTILLO B. 1960. — *Historia verdadera de la conquista de la Nueva España*. Porrúa, México, 2 vol. (513 + 517 p.).
- DIETLER M. & HAYDEN B. (eds) 2001. — *Feasts: Archaeological and Ethnographic Perspectives on Food, Politics, and Power*. Smithsonian Institution Press, Washington D.C., 440 p.
- DIETLER M. & HERBICH I. 1998. — Habitus, techniques, style: an integrated approach to the social understanding of material culture and boundaries, in STARK M. T. (ed.), *The Archaeology of Social Boundaries*. Smithsonian Institution, Washington, London: 232-263.
- DUNNING N., BEACH T., FARRELL P. & LUZZADDER-BEACH S. 1998. — Prehispanic agrosystems and adaptive regions in the Maya lowlands. *Culture, Agriculture, Food and Environment* 20 (2-3): 87-101. <https://doi.org/10.1525/cag.1998.20.2-3.87>
- ELZANOWSKI A., PAUL G. S. & STIDHAM T. A. 2001. — An avian quadruped from the Late Cretaceous Lance Formation of Wyoming. *Journal of Vertebrate Paleontology* 20 (4): 712-719. [https://doi.org/10.1671/0272-4634\(2000\)020\[0712:AAQFTL\]2.0.CO;2](https://doi.org/10.1671/0272-4634(2000)020[0712:AAQFTL]2.0.CO;2)
- EMERY K. F. & BROWN L. A. 2012. — Maya hunting sustainability: perspectives from past and present, in CHACON R. & MENDOZA R. (eds), *The Ethics of Anthropology and Amerindian Research*. New York, Springer: 79-116.
- EMERY K. F., THORNTON E. K., CANNAROZZI N. R., HOUSTON S. & ESCOBEDO H. 2013. — Archaeological animals of the southern Maya highlands: zooarchaeology of Kaminaljuyu, in GÖTZ C. M. & EMERY K. F. (eds), *The Archaeology of Mesoamerican Animals*. Lockwood Press, Atlanta: 381-416.
- EMERY K., THORNTON E., SHARPE A., CUNNINGHAM-SMITH P., DUFFY L. & MCINTOSH B. 2016. — Testing osteometric and morphological methods for turkey species determination in Maya faunal assemblages. *Journal of Archaeological Science: Reports* 10: 607-631. <https://doi.org/10.1016/j.jasrep.2016.08.018>
- ENRÍQUEZ VÁZQUEZ P., MARIACA MÉNDEZ R., RETANA GUIASCÓN Ó. G. & NARANJO PIÑERA E. J. 2006. — Uso medicinal de la fauna silvestre en los altos de Chiapas. *Interciencia* 31 (7): 491-499.
- FLANNERY K. V. 1969. — Appendix II: an analysis of animal bones from Chiapa de Corzo, Chiapas, in LEE T. A. JR. (ed.), *The Artifacts of Chiapa de Corzo, Chiapas, Mexico*. Brigham Young University, Provo UT: 209-218. (Coll. Papers of the New World Archaeological Foundation; 26).
- FLETCHER R. 2012. — Low-density, agrarian-based urbanism: scale, power and ecology, in SMITH M. E. (ed.), *The Comparative Archaeology of Complex Societies*. Cambridge University Press, New York: 285-320.
- FORD A. & NIGH R. 2009. — Origins of the Maya forest garden: Maya resource management. *Journal of Ethnobiology* 29 (2): 213-236. <https://doi.org/10.2993/0278-0771-29.2.213>
- FREIDEL D. A., REESE-TAYLOR K. & MORA-MARÍN D. 2002. — The origins of Maya civilization: the old shell game, commodity, treasure and kingship, in MASSON M. A. & FREIDEL D. A. (eds), *Ancient Maya Political Economies*. Altamira Press, Walnut Creek: 41-86.
- GARCIA-LORENZO M. L. 2014. — Bone mineral change during experimental calcination: an X-ray diffraction study. *Journal of Forensic Sciences* 59 (6): 1602-1606. <https://doi.org/10.1111/1556-4029.12525>
- GOSSEN G. H. 1975. — Animal souls and human destiny in Chamula. *Man* 10 (3): 448-461. <https://doi.org/10.2307/2799813>
- GOSSEN G. H. 1999. — *Telling Maya Tales: Tzotzil Identities in Modern Mexico*. Routledge, New York, 256 p.
- GÖTZ C. M. 2014. — La alimentación de los mayas prehispánicos vista desde la Zooarqueología. *Anales de Antropología* 48 (1): 167-199. [https://doi.org/10.1016/S0185-1225\(14\)70494-1](https://doi.org/10.1016/S0185-1225(14)70494-1)

- GRAHAM E. 1999. — Stone cities, green cities. *Archeological Papers of the American Anthropological Association* 9 (1): 185-194. <https://doi.org/10.1525/ap3a.1999.9.1.185>
- GUERRERO MARTÍNEZ F. 2015. — Concepciones sobre los animales en grupos mayas contemporáneos. *Revista pueblos y fronteras digital* 10 (20): 6-43. <https://doi.org/10.22201/cimsur.18704115e.2015.20.31>
- HAMBLIN N. L. 1984. — *Animal Use by the Cozumel Maya*. University of Arizona Press, Tucson AZ, 206 p.
- HASTORF C. A. 2017. — *The Social Archaeology of Food: Thinking about Eating from Prehistory to the Present*. Cambridge University Press, New York NY, 414 p.
- HERRERA-FLORES B. G., SANTOS-FITA D., NARANJO E. J. & HERNÁNDEZ-BETANCOURT S. 2019. — Importancia cultural de la fauna silvestre en comunidades rurales del Norte de Yucatán, México. *Península* 14 (2): 27-55.
- HOLBROOK S. J. 1970. — *Prehistoric Paleocology of Northwestern New Mexico*. Berkely, Ph.D Dissertation in Zoology, University of California, Berkeley.
- HUNN E. S. 1977. — *Tzeltal Folk Zoology: the Classification of Discontinuities in Nature*. Academic Press, New York, 412 p.
- ISENDAHL C. 2012. — Agro-urban landscapes: the example of Maya lowland cities. *Antiquity* 86 (334): 1112-1125. <https://doi.org/10.1017/S0003598X00048286>
- KANEKO A. 2010. — Hunchavín, in VALVERDE VALDÉS M. DEL C., LIENDO STUARDO R. & GUTIÉRREZ LEÓN G. J. (eds), *Mayas: Guía de Arquitectura y Paisaje = The Maya: an Architectural and Landscape Guide*. Centro de Estudios Mayas de la Universidad Nacional Autónoma de México, México ; Consejería de Obras Públicas y Vivienda, Sevilla: 460-461.
- KENT S. 1990. — Activity areas and architecture: an interdisciplinary view of the relationship between use of space and domestic built environments, in KENT S. (ed.), *Domestic Architecture and the Use of Space*. Cambridge University Press, New York: 1-8. (Coll. New Directions in Archaeology).
- KUPCZIK K., CAGAN A., BRAUER S. & FISCHER M. S. 2017. — The dental phenotype of hairless dogs with FOXI3 haploinsufficiency. *Scientific Reports* 7 (5459). <https://doi.org/10.1038/s41598-017-05764-5>
- LAMPMAN A. M. 2007. — General principles of ethnomycological classification among the Tzeltal Maya of Chiapas, Mexico. *Journal of Ethnobiology* 27 (1): 11-27. [https://doi.org/10.2993/0278-0771\(2007\)27\[11:GPOECA\]2.0.CO;2](https://doi.org/10.2993/0278-0771(2007)27[11:GPOECA]2.0.CO;2)
- LAUGHLIN R. M. 1996. — Zinacantán dreams. *Grand Street* (56): 90-107. <https://doi.org/10.2307/25008006>
- LEE T. A. JR 1969. — *The Artifacts of Chiapa de Corzo, Chiapas, Mexico*. Brigham Young University, Provo UT, 231 p. (Coll. Papers of the New World Archaeological Foundation; 26).
- LÉVI-STRAUSS C. 1969. — *The Raw and the Cooked*. Harper & Row, New York, 387 p. (Mythologies; 1).
- MADRIGAL T. C. & HOLT J. Z. 2002. — White-tailed deer meat and marrow return rates and their application to eastern woodlands archaeology. *American Antiquity* 67 (4): 745-759. <https://www.jstor.org/stable/1593802>
- MANIN A., CORONA-M. E., ALEXANDER M., CRAIG A., THORNTON E. K., YANG D. Y., RICHARDS M. & SPELLER C. F. 2018a. — Diversity of management strategies in Mesoamerican turkeys: archaeological, isotopic and genetic evidence. *Royal Society Open Science* 5 (1): 171613. <https://doi.org/10.1098/rsos.171613>
- MANIN A., OLLIVIER M., BASTIAN F., ZAZZO A., TOMBRET O., EQUIHUA MANRIQUE J. C. & LEFÈVRE C. 2018b. — Can we identify the Mexican hairless dog in the archaeological record? Morphological and genetic insights from Tizayuca, Basin of Mexico. *Journal of Archaeological Science* 98: 128-136. <https://doi.org/10.1016/j.jas.2018.08.008>
- MASSON M. A. & FREIDEL D. A. 2012. — An argument for Classic era Maya market exchange. *Journal of Anthropological Archaeology* 31: 455-484. <https://doi.org/10.1016/j.jaa.2012.03.007>
- MASSON M. A. & PERAZA LOPE C. 2008. — Animal use at the Postclassic Maya center of Mayapán. *Quaternary International* 191 (1): 170-183. <https://doi.org/10.1016/j.quaint.2008.02.002>
- MATTHEWS T. 2002. — South African micromammals and predators: some comparative results. *Archaeometry* 44 (3): 363-370. <https://doi.org/10.1111/1475-4754.00069>
- MOREY D. F. 1992. — Size, shape and development in the evolution of the domestic dog. *Journal of Archaeological Science* 19 (2): 181-204. [https://doi.org/10.1016/0305-4403\(92\)90049-9](https://doi.org/10.1016/0305-4403(92)90049-9)
- NATIONS J. D. & CLARK J. E. 1983. — The bows and arrows of the Lacandon Maya. *Archaeology* 36 (1): 36-43.
- NEWMAN S. E. 2016. — Sharks in the jungle: real and imagined sea monsters of the Maya. *Antiquity* 90 (354): 1522-1536. <https://doi.org/10.15184/aqy.2016.218>
- OLSEN S. J. 1973. — *Mammal Remains from Archaeological Sites. Part 1, Southeastern and Southwestern United States*. Harvard University, Cambridge MA, 174 p. (Coll. Papers of the Peabody Museum of Archaeology and Ethnology; 56).
- OLSEN S. J. 1982. — *An Osteology of some Maya Mammals*. Harvard University, Cambridge MA, 104 p. (Coll. Papers of the Peabody Museum of Archaeology and Ethnology; 73).
- PAGE PLIEGO J. T. 2005. — *El Mandato de los Dioses: Etnomedicina entre los Tzotziles de Chamula y Chenaló*. Universidad Nacional Autónoma de México, Mexico D.F., 404 p.
- PARIS E. H. 2012. — *Political Economy on the Postclassic Western Maya Frontier*. Ph.D. dissertation, Department of Anthropology, University at Albany, State University of New York, Albany NY.
- PARIS E. H. & LÓPEZ BRAVO R. 2012. — Mercancías, riqueza y redes de intercambio en el Valle de Jovel, Altos de Chiapas, in LOWE L. S. & PYE M. E. (eds), *La Arqueología Reciente de Chiapas: Contribuciones de la conferencia en honor del 60o Aniversario de la Fundación Arqueológica del Nuevo Mundo*. Brigham Young University, Provo UT: 145-160. (Coll. Papers of the New World Archaeological Foundation; 72).
- PARIS E. H. & LÓPEZ BRAVO R. 2018. — *Informe del Proyecto 'Interacción Entre Reinos en los Altos de Chiapas'*. Informe temporal para el Consejo Nacional de Arqueología de México, Mexico D. F., 544 p.
- PARIS E. H. & LÓPEZ BRAVO R. 2019. — Gulf Coast influence at Moxviquil, Chiapas, Mexico. *Cambridge Archaeological Journal* 30 (2): 1-17. <https://doi.org/10.1017/S0959774319000465>
- PARIS E. H., TALADOIRE E. & LEE T. A. JR 2015. — Return to Moxviquil: form and function in a small Maya city. *Ancient Mesoamerica* 26 (1): 81-112. <https://doi.org/10.1017/S095956536115000048>
- PARIS E. H., LÓPEZ BRAVO R. & SERAFIN S. 2019. — A funerary cave at Moxviquil, Chiapas, Mexico. *Journal of Field Archaeology* 45 (2): 86-105. <https://doi.org/10.1080/00934690.2019.1693091>
- PARKER H. G., HARRIS A., DREGER D. L., DAVIS B. W. & OSTRANDER E. A. 2017. — The bald and the beautiful: hairlessness in domestic dog breeds. *Philosophical Transactions of the Royal Society B: Biological Sciences* 372 (1713). <https://doi.org/10.1098/rstb.2015.0488>
- PENDERGAST D. M. 1969. — *The Prehistory of Actun Balam, British Honduras*. Royal Ontario Museum, Toronto, 68 p. (Coll. Occasional Paper; 16).
- PENDERGAST D. M. & LUTHER E. 1974. — *Excavations at Actun Polbiche, Belize*. Royal Ontario Museum, Toronto, 103 p. (Coll. Archaeology monograph; 1).
- POHL M. D. 1990. — The ethnozoology of the Maya: faunal remains from five sites in the Petén, Guatemala, in SABLOFF J. A. (ed.), *Excavations at Seibal, Guatemala*. Harvard University Press, Cambridge MA: 142-174.
- POHL M. & FELDMAN L. H. 1982. — The traditional role of women and animals in lowland Maya economy, in FLANNERY K. V. (ed.), *Maya Subsistence*. Academic Press, New York: 295-311.
- POLLOCK H. E. D. & RAY C. E. 1957. — *Notes on Vertebrate Remains from Mayapan*. Carnegie Institution of Washington, Washington D.C.: 633-684. (Coll. Current Reports; 41).

- PRUFER K. M., WANYERKA P. & SHAH M. 2003. — Wooden figurines, scepters, and religious specialists in Pre-Columbian Maya Society. *Ancient Mesoamerica* 14 (2): 219-236. <https://doi.org/10.1017/S0956536103142022>
- RAPOPORT A. 1982. — *The Meaning of the Built Environment: a Nonverbal Communication Approach*. London, Sage, 224 p.
- REITZ E. J. & WING E. S. 1999. — *Zooarchaeology*. Cambridge University Press, Cambridge, 475 p.
- RETANA O. G. & LORENZO C. 2002. — Lista de los mamíferos terrestres de Chiapas: endemismo y estado de conservación. *Acta zoológica mexicana* (85): 25-49.
- RODRÍGUEZ GALICIA B., VALADEZ AZÚA R., PEREIRA G., VINIEGRA RODRÍGUEZ F., OLMOS RODRÍGUEZ K. & BLANCO PADILLA A. 2001. — Restos arqueozoológicos de perros (*Canis familiaris*) encontrados en el sitio de Guadalupe, Estado de Michoacán. *AMMVEPE* 12: 199-209.
- RODILES-HERNÁNDEZ R., GONZÁLEZ-DÍAZ A. A. & CHAN-SALA C. 2005. — Lista de peces continentales de Chiapas, México. *Hidrobiológica* 15 (2): 245-253.
- RODILES-HERNÁNDEZ R., LUNDBERG J. G. & SULLIVAN J. P. 2010. — Taxonomic discrimination and identification of extant blue catfishes (Siluriformes: Ictaluridae: *Ictalurus furcatus* Group). *Proceedings of the Academy of Natural Sciences of Philadelphia* 159 (1): 67-83. <https://doi.org/10.1635/053.159.0105>
- SAHAGÚN B. DE 1959. — *Florentine Codex: General History of the Things of New Spain. Book 9, The Merchants*. ANDERSON A. J. O. & DIBBLE C. E. (trans.). School of American Research, Santa Fe N.M., 97 p.
- SAUNDERS N. J. 1989. — *People of the Jaguar: the Living Spirit of Ancient America*. Souvenir Press, London, 176 p.
- SHARPE A. E. & EMERY K. F. 2015. — Differential animal use within three Late Classic Maya states: implications for politics and trade. *Journal of Anthropological Archaeology* 40: 280-301. <https://doi.org/10.1016/j.jaa.2015.09.003>
- SHAW L. C. 1991. — *The Articulation of Social Inequality and Faunal Resource Use in the Preclassic Community of Colha, Northern Belize*. Ph.D. dissertation, Department of Anthropology, University of Massachusetts, Amherst MA.
- SUGIYAMA N., VALADEZ R., PÉREZ G., RODRÍGUEZ B. & TORRES F. 2013. — Animal Management, preparation and sacrifice: reconstructing burial 6 at the Moon Pyramid, Teotihuacan, México. *Anthropozoologica* 48 (2): 467-485. <https://doi.org/10.5252/az2013n2a18>
- SUGIYAMA N., SOMERVILLE A. D. & SCHOENINGER M. J. 2015. — Stable isotopes and zooarchaeology at Teotihuacan, Mexico reveal earliest evidence of wild carnivore management in Mesoamerica. *PLOS ONE* 10 (9): e0135635. <https://doi.org/10.1371/journal.pone.0135635>
- SUGIYAMA N., FASH W. L. & FRANCE C. A. M. 2018. — Jaguar and puma captivity and trade among the Maya: stable isotope data from Copan, Honduras. *PLOS ONE* 13 (9): e0202958. <https://doi.org/10.1371/journal.pone.0202958>
- SUMMER-SMITH G. 1966. — Observations on epiphyseal fusion of the canine appendicular skeleton. *Journal of Small Animal Practice* (7): 303-311.
- TEDLOCK D. 1996. — *Popol Vuh*. Simon and Schuster, New York, 384 p.
- THORNTON E. K. & EMERY K. F. 2017. — The uncertain origins of Mesoamerican turkey domestication. *Journal of Archaeological Method and Theory* 24 (2): 328-351. <https://doi.org/10.1007/s10816-015-9269-4>
- THORNTON E. K., EMERY K. F., STEADMAN D. W., SPELLER C., MATHENY R. & YANG D. 2012. — Earliest Mexican turkeys (*Meleagris gallopavo*) in the Maya region: implications for Pre-Hispanic animal trade and the timing of turkey domestication. *PLOS ONE* 7 (8): e42630. <https://doi.org/10.1371/journal.pone.0042630>
- THORNTON E., EMERY K. F. & SPELLER C. 2016. — Ancient Maya turkey husbandry: testing theories through stable isotope analysis. *Journal of Archaeological Science: Reports* 10: 584-595.
- TOZZER A. M. 1941. — *Landa's Relacion De Las Cosas De Yucatan: a translation*. Harvard University, Cambridge MA, xviii + 394 p. (Coll. Papers of the Peabody Museum of Archaeology and Ethnology; 18).
- URBANO TORRICO L. A. 2007. — Contribución al estudio de la dentición del perro sin pelo del Perú. *Ciencia y Desarrollo* 8: 19-33.
- VALADEZ R., RODRÍGUEZ B., MANZANILLA L. & TEJEDA S. 2002. — Dog-wolf hybrid biotype reconstruction from the archaeological city of Teotihuacan in Prehispanic Central Mexico, in SNYDER L. M. & MOORE E. A. (eds), *Dogs and People in Social, Working, Economic or Symbolic Interaction. 9th ICAZ Conference, Durham 2002*. Oxbow Books, Oxford: 120-130.
- VALADEZ R., BLANCO A., RODRÍGUEZ B. & GÖTZ C. 2009. — Perros pelones del México prehispánico. *Archaeobios* 3 (1): 5-19.
- VALADEZ AZÚA R. 2014. — Un perro de raza desconocida de Hunchavín, Chiapas, México. *Antropoógicas Boletín, Instituto de Investigaciones Antropoógicas – UNAM* 3 (52): 1-11.
- VALADEZ AZÚA R., PAREDES GUDIÑO B. & RODRÍGUEZ GALICIA B. 1999. — Entierros de perros descubiertos en la antigua ciudad de Tula. *Latin American Antiquity* 10 (2): 180-200. <https://doi.org/10.2307/972202>
- VARELA SCHERRER C. M. & TRABANINO F. 2017. — La cacería tradicional chol y tseltal en los acahuales de Palenque: implicaciones para la zooarqueología maya. *Pueblos y Fronteras* 11 (22): 165-191. <https://doi.org/10.22201/cimsur.18704115e.2016.22.274>
- VENTURA C. 2003. — The Jakalteek Maya blowgun in mythological and historical context. *Ancient Mesoamerica* 14 (2): 257-268. <https://doi.org/10.1017/S0956536103132154>
- VOGT E. Z. 1969. — *Zinacantan: a Maya Community in the Highlands of Chiapas*. Harvard University Press, Cambridge, xxxii + 736 p.
- VOGT E. Z. & STUART D. 2005. — Some notes on ritual caves among the Ancient and Modern Maya, in BRADY J. E. & PRUFER K. M. (eds), *In the Maw of the Earth Monster: Mesoamerican Ritual Cave Use*. University of Texas Press, Austin: 155-185.
- WAKE T. A. 2004. — A vertebrate archaeofauna from the early formative period site of Paso de la Amada, Chiapas, Mexico: preliminary results, in EMERY K. F. (ed.), *Maya Zooarchaeology: New Directions in Method and Theory*. Cotsen Institute of Archaeology, UCLA, Los Angeles: 209-222. (Coll. Monograph; 51).
- WEILANT C. W. 1954. — Digging in Chiapas. *The Explorers Journal* 32 (4): 30-36.
- WHITE C. D., POHL M. E., SCHWARCZ H. P. & LONGSTAFFE F. J. 2001. — Isotopic evidence for Maya patterns of deer and dog use at Preclassic Colha. *Journal of Archaeological Science* 28 (1): 89-107. <https://doi.org/10.1006/jasc.1999.0560>
- WIGGS R. & LOBPRISE H. 1997. — Oral Anatomy and physiology, in WIGGS R. & LOBPRISE H. (eds), *Veterinary Dentistry: Principles and Practice*. Lippincott-Raven, Philadelphia, 55-86.
- WING E. S. 1978. — Use of dogs for food: an adaptation to the coastal environment, in STARK B. L. & VOORHIES B. (eds), *Prehistoric Coastal Adaptations: the Economy and Ecology of Maritime Middle America*. Elsevier, Amsterdam: 29-41.
- ZÚÑIGA-ARELLANO B. 2008. — Evidencias arqueológicas del uso de la fauna en Palenque y Tenam Puento, Chiapas, in LIENDO STUARDO R. (ed.), *El territorio maya: memoria de la Quinta Mesa Redonda de Palenque*. Instituto Nacional de Antropología e Historia, Mexico D. F.: 41-67. (Coll. Cuadernos CICOSUL, Serie Mesas redondas).

Submitted on 23 October 2019;  
accepted on 21 January 2020;  
published on 13 March 2020.