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Artículo

The walled city and the dogs: the ritual and domestic role of *canis lupus familiaris* in Mayapán, Yucatán

La ciudad amurallada y los perros: el papel ritual y doméstico del *canis lupus familiaris* en Mayapán, Yucatán

Yajaira Núñez Cortés*
University at Albany, State University of New York. 1400 Washington Ave., Albany, NY 12222, USA.

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Abstract

This paper documents the role of domestic dogs (Canis lupus familiaris) in the domestic and ritual contexts of Mayapán. Mayapán was the last capital of the Postclassic Maya to be located on the Yucatán Peninsula. Dog remains have been recovered from ceremonial, elite, and lower-class contexts in the city. I analyze the distribution of skeletal elements and contexts of deposition in temples, halls, and houses, both in Iztmal Ch'en's monumental center and outlying ceremonial center.

This paper presents the results of the identification of dog remains per structure, osteometric analysis, and estimations of weight and age. Counts of the number of identified specimens and the minimum number of individuals are performed, along with Chi-square, Fisher's exact test and principal coordinate analysis, to compare the presence of skeletal elements and the abundance of dog remains in each of the structures. Osteometric data from documented dog breeds, including the Mesoamerican common dog, the hairless dog, the Mayan short-faced dog, the tlalchichi, and the dog-wolf hybrid, are compared with measurements of maximum long bone length and the length and breadth of upper and lower first molars. An allometric formula used mandible height measurements at the middle of the first lower molar to predict body weight in grams. Observations of ossification in each skeletal element and dental eruption were compared to age charts to identify the ages of dogs recovered in Mayapán. This study shows that dogs were an important component of ritual life in Mayapán and

Resumen

Este artículo documenta el papel del perro doméstico (*Canis lupus familiaris*) en contextos domésticos y rituales de Mayapán. Mayapán fue la última capital del Posclásico Maya localizada en la península de Yucatán. Se han recuperado restos de perros en contextos ceremoniales, de élite y de personas de bajo estatus social. En esta investigación se analiza la distribución de los elementos del esqueleto y los contextos de deposición en templos, salas hipóstilas, y casas, tanto del centro monumental como del centro periférico Iztmal Ch'en.

Este artículo presenta los resultados de la identificación de restos de perro doméstico por estructura, análisis osteométricos y estimaciones de peso y edad. Se presenta el número de especímenes identificados y el número mínimo de individuos, junto con los análisis estadísticos Chi cuadrado, prueba exacta de Fisher y análisis de coordenadas principales para comparar la representación de elementos del esqueleto y la abundancia de restos de perro doméstico en cada una de las estructuras analizadas. Se utilizan datos osteométricos de razas de perro documentadas, incluyendo el perro común mesoamericano, el perro pelón, el perro maya de rostro corto, el Tlalchichi y el híbrido entre perro y lobo, para cotejarlas con las mediciones de longitud máxima en huesos largos y de longitud anteroposterior y ancho en el primeros molares superiores e inferiores. Se utilizó una fórmula alométrica para predecir el peso corporal (g) a partir de la medición de la altura de la mandíbula en la mitad del primer molar inferior. Observaciones de osificación por cada elemento del esqueleto y de

* Correo electrónico: yahanc@gmail.com

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were offered at ceremonies or feasts in the Templo Redondo group. It also demonstrates that the use of dogs in burial rituals and their consumption in domestic contexts was not restricted to elites.

erupción dental fueron comparadas con tablas de edad para estimar las edades de los perros encontrados en Mayapán. Este estudio demuestra que los perros fueron un componente importante en la vida ritual de Mayapán y que posiblemente fueron ofrecidos en ceremonias y festines en el grupo del Templo Redondo. Además, se demuestra que el uso de perros en entierros y en el ámbito doméstico no estuvo restringido a los personajes de élite.

Keywords: perro doméstico; área maya; uso ritual y doméstico; osteometría; zooarqueología.

Palabras clave: domestic dog; Maya area; ritual and domestic use; osteometry; zooarchaeology.

Archaeological and ethnohistorical evidence reveals the importance of domesticated dogs in Mesoamerica as early as the Late Archaic period and all the way through the Contact era (Valadez Azúa *et al*. 2003; White *et al.* 2001, Valadez Azúa *et al.* 2013). Dog remains have been recovered at ceremonial and elite centers (Pendergast 1974; Masson and Peraza Lope 2013; Rosenswig 2007; Valadez Azúa 2003) and human burial sites throughout Mesoamerica (Hamblin 1984; Wing 2013). They were used as a steady source of meat, as tribute payments, for medicinal purposes, in rituals, in hunting, and for companionship (Emery *et al.* 2013: 412). Iconographic and ethnohistoric evidence indicates that dogs were symbolically important in Mesoamerican religion and were linked to death, destruction, earth, and fire. They were seen as messengers who prepared the way to the other world and as companions when crossing "the nine rivers to the land of the dead" (Sahagun 1974; Tozzer and Allen 1910:360-362; Wing 2013:44).

The prevalence of dogs in zooarchaeological assemblages is evident in investigations across the Maya world, especially considering that dogs were the only true domesticated animal before the introduction of the domestic turkey during the Late Postclassic (Emery 2004:45; 2013:411). Dog remains were most prominent during the Preclassic period (Emery 2004:45; Cunningham-Smith *et al.* 2020:167). They were an important source of food in Cuello (Clutton-Brock and Hammond 1994), as well as Colha and Cerros, where they were recovered from ceremonial and elite contexts (Carr 1985, 1986; Shaw 1991). Dog bones were also used in jewelry, as evidenced by the 299 molars and 79 long bones that were drilled to form beads and separators for anklets interred with a woman in a Late Preclassic burial site in Caracol (Teeter 2004:188-189). Emery (2004:48; Emery *et al*. 2013:413) suggests that the abundance of dog remains during the Preclassic may be linked to political development, which also explains their association with administrative and ceremonial structures. Ritual feasting to solidify power during the Preclassic may be responsible for the prevalence of dog remains in such contexts (Shaw 1999:94-95). The Classic period is defined by a decrease in the quantity of dog remains recovered, followed by a resurgence during the Postclassic period (Emery 2004:47). As examples, the presence of dog remains alongside human bones in caches declined during the Early Classic at Tikal (Moholy-Nagy 2004:198); and small quantities of dog remains have been recovered from the epicenter of Caracol in structures dating from the Late/Terminal Classic (Teeter 2001:211-213, 2004:185). A general trend in Petén sites indicates that dogs tend to prevail in Preclassic and Postclassic contexts with a significant decrease during the Late Classic (Pohl 1976). Similarly, dogs dominate Preclassic assemblages at Kamilajuyu and are reported in Early Classic tombs but not in Late Classic deposits (Emery *et al.* 2013:411-412). Increasing frequencies of dog remains at Postclassic sites, such as Lamanai, support the idea that the demand for specific animals as tributes or sacrifices was of great importance to commercial relations during the Postclassic period (Emery 1999:75). Emery (2004:49) raises the possibility that an increase in the quantity of dog remains recovered during the Postclassic may be related to a proliferation of ritual and social feasting activities.

Their significance in ritual practices was portrayed in Postclassic Maya codices, which depict dogs being used as sacrificial offerings for yearly renewal ceremonies (Pohl 1983; Pohl and Feldman 1982). Fray Diego de Landa reports cases of dog sacrifices during the contact period. According to Landa (1941:164), dogs stained with cacao spots were sacrificed in cacao rituals. Landa and others note that animals were fattened in anticipation of these events and their meat was usually consumed at feasts (Pohl and Feldman 1982:302; Shaw 1991:259). Isotopic signatures of dog remains recovered in feasting contexts at the Classic Maya site of Lagartero indicate that dogs preferentially ate maize (White *et al.* 2004:156) but it is uncertain whether they got it from garbage and food scraps or were intentionally fed with it.

Moreover, investigations have shown that dogs were used in ceremonial and domestic structures in Mayapan, the last regional political capital of the Maya region. As one of the most prominent Late Postclassic sites, Mayapan offers the opportunity to study the importance and function of dogs during this period. In the following pages, I analyze dog samples recovered from architectural structures in different sectors of the city in terms of their frequency, skeletal distribution, osteometry, weight, and age. This study also explores the variability of skeletal representation and the possibility that different breeds of dogs were used in domestic and ceremonial structures in the monumental center and outlying ceremonial centers of Itzmal Ch'en.

Dog remains in the city of Mayapan

Mayapan is located on the Yucatán Peninsula in Mexico and was the political capital and largest urban center of the Postclassic Maya world from 1200-1450 AD. The nucleated urban zone is circumscribed by a wall with a circumference of 9.1 km and 12 formal gates (Masson and Peraza Lope 2014; Masson *et al.* 2016:241). Dispersed houselots are located beyond the city wall to a distance of 500 m (Russell 2008). The monumental center of Mayapan features mostly religious architecture, civic and administrative buildings, and elite residences (Chase 1992: Fig.8.4; Delgado Kú 2004: 11-13; Smith 1962:265-266). Outlying ceremonial sites probably used for local celebrations in the style of those held in the monumental center (Peraza Lope and Masson 2014a) were erected within the city limits. Elaborate elite residences in Mayapan are located around the eastern and western margins of the site center while lower-class neighborhoods throughout the city were mostly occupied by commoners (Hare *et al.* 2014:170, 190).

Dog remains have been found in Mayapan in a variety of architectural structures including shrines, elite residences, and dwellings occupied by artisans and commoners, and are especially prominent in temples, colonnaded halls, and cenotes. They are unusually concentrated in the Templo Redondo group, which includes Templo Redondo (Q-152), the Hall (Q-151), and associated Structures (Q-152a, Q-152b and Q-152d) (see Masson and Peraza Lope 2013:Table 7). The public and ceremonial character of these structures confirms the role of dogs as an important component in Postclassic Mayapan rituals. House structures from all strata account for just a small percentage of the dog remains found in the city (see Pollock and Ray 1957; Masson and Peraza Lope 2008, 2013).

Pollock and Ray (1957:543) report an abundance of dog remains at Mayapan, second only to deer as the most common mammals recovered by the Carnegie Project. The Carnegie sample included single dog bones, teeth, and jaws from simple houses, elite dwellings, colonnaded halls, temples, and cenotes. The highest frequencies were recovered from cenote deposits and midden materials adjacent to a colonnaded hall and a temple (Pollock and Ray 1957:543). Masson and Peraza Lope (2008, 2013, 2014) faunal studies include remains recovered by the INAH (Instituto Nacional de Antropología e Historia) and PEMY (Economic Foundations of Mayapan) projects in the monumental center and the outlying settlement zone. Dog remains in the INAH and PEMY faunal assemblages are substantial, following white-tailed deer, turkey, and iguana as the most common taxa in the monumental center. In the residential zone, dog remains were the fourth most abundant taxa, followed by white-tail deer, iguana, and turkey (Masson and Peraza Lope 2014: 401).

Sample contexts

In this paper, I analyze dog remains recovered during the 1997 and 1998 INAH Templo Redondo group (Q-152) excavations and restorations, and six structures (Q-39, Q-40a, Q-176a, H-15, H-17, I-55) excavated and restored during 2008 and 2009 by the PEMY archeological project (Figure 1). The Templo Redondo group was excavated with test pits and larger units of variable dimensions (see Peraza Lope *et al.* 1999; Delgado Kú 2004). All the structures excavated by PEMY were horizontally exposed with grids of 2x2 m and test pits in specific sectors of the architectural layout (Masson *et al.* 2012). The faunal assemblages from structure Q-152 have been analyzed and published by Masson and Peraza Lope (2008, 2013).

Structure Q-152, or Templo Redondo, is located in main plaza of the city's monumental center. It consists of a rounded structure with four doors spaced evenly around the central core, vaulted interiors, and a reverse-batter cornice. Mural fragments in two niches have designs outlined in black paint with step frets, feathers, and rosettes (Delgado Kú 2004:70; Milbrath and Peraza Lope 2003:11-12).

Three of the houses studied here are in the vicinity of the monumental center: Houses Q-39, Q-40a and Q-176a, which were part of an artisanal neighborhood where surplus production was concentrated. House Q-40a is located inside the outer property walls of an elite house (the elaborate Q-41 residence), which suggests that elites supervised the pottery, effigy censer, copper, and figurine production at this dwelling (Masson *et al.* 2012, 2016). House Q-39 is adjacent to the elite residential Q-41 group but is contained by its own outer walls. An elaborate family tomb in House Q-39 suggests a family relationship with the residents of Q-41; the residents of Q-39 also made handicrafts such as clay figurines, shell ornaments, copper objects, obsidian, and high-quality chalcedony. House Q-176a, in contrast, was more independent insofar as it was not directly next to or inside an elite compound. The residents of this house produced pottery, obsidian blades, shell ornaments, and figurines (Masson and Peraza Lope 2014; Masson *et al.* 2012, 2016).

The outlying ceremonial center of Itzmal Ch'en is on the eastern side of the city. Three structures in this area have been included in this analysis: a temple, a colonnaded hall, and an affluent commoner's house. Structure H-17, located almost 2 km from the site's monumental center, is the second largest temple in Mayapan. It was decorated with sculptures depicting humans and other animals, mainly serpents. H-15 is one of the halls in the group. It was decorated with cut geometric stones in addition to animal and human sculptures including a dog effigy tenoned sculpture. A mass grave was identified in a platform next to H-15. The structure I-55a corresponds to a wealthy commoner's house where obsidian and shell

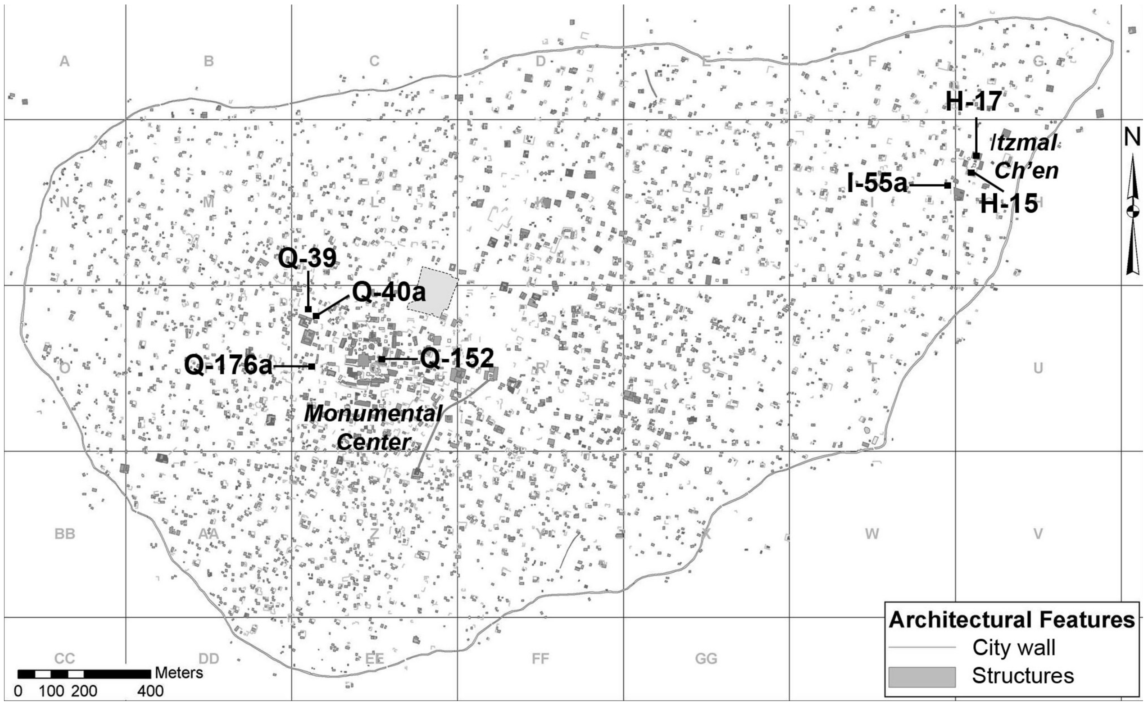


Figure 1. *Location of structures analyzed in this study: Crafting houses Q-39, Q-40a, and Q-176, Templo Redondo Q-152, Wealthy commoner house I-55a, Hall H-15, and Temple H-17. Map of structures and defensive wall courtesy of Timothy Hare.*

objects were manufactured (Hutchinson and Delgado Kú 2012; Peraza Lope and Masson 2014b:119; Masson *et al.* 2016).

Methods

I assess the representation, age, and frequency of the skeletal remains of dogs found in the aforementioned seven architectural contexts. Skeletal identifications are based on comparisons with reference collections from the Maya zooarchaeological laboratory at the University at Albany-SUNY. Dog bones were classified according to element, portion, side, and other attributes such as cultural modification (for example, burning). All samples were quantified by bone count (NISP), minimum number of individuals (MNI) based on sided or unique elements of the body, and density (NISP per cubic meter). Structural comparisons are based on these frequencies.

R Software (R Core Team 2019) was used to perform Chi Square and Fisher exact tests on pairs of structures to compare the frequency of skeletal elements. The Fisher exact test was used in cases where the sample size was too small to implement Chi square. Furthermore, a correspondence analysis was employed as an ordination method to measure the abundance of skeletal remains in different structures, the precise location of which provides contextual data to interpret the roles of dogs in ritual and domestic activities in the houses, halls, and temples of Mayapan.

Osteometric analyses were conducted on the most complete elements or on those with observable attributes. Measurements were taken based on criteria established by Von Den Driesch (1976), including the maximum length and breadth of the proximal and distal ends of long bones and the length and breadth of first molars. Given the fragmentation of the sample, some measurements were impossible to document. Osteometric analyses of long bones and teeth were used for the comparison of Mayapan dogs to the documented metrics of dog breeds in Mesoamerica (Table 1), including the Mesoamerican common dog (Valadez 2000, 2003, Valadez *et al.* 2009), the hairless or *xoloitzcuintli* dog (Valadez 2009; Valadez *et al.* 2010), the short-nosed or Mayan dog (Valadez 2000), the tlalchichi (Valadez 2009; Valadez *et al.* 2011), and the wolf-dog hybrid (Valadez *et al.* 2001; Valadez *et al.* 2006).

Following Wing (1978: Table 2.1) and Hamblin (1984: 100), an allometric formula was utilized to predict body weight in grams (g) from the measurement of mandible height (mm) at the middle of the first lower molar (carnassial). The following regression formula was used for that purpose: $Log\ y = 2.2574(Log\ x) + 1.164$. According to Wing (1978: 31), this formula is more accurate than those based on the length of the premolar or molar tooth row since the crowding of the teeth could produce a misleading estimate. Differences in body weight could indicate differences in breeds as well as age (Hamblin 1984: 100). Determination of age categories is based on the observation of fused and non-fused epiphysis and dental eruption. Age was determined by consulting the age charts created by Sutton *et al.* (2018:Table 11.3, Table 11.7). It was not possible to determine the age of all elements because of the high fragmentation of the sample analyzed.

Table 1. Metrics of long bones per breed in archeological and modern specimens from Mesoamerica.

Breed	Long bones (mm)				Archaeological site	Reference
	Humerus lenght	Radius lenght	Femur lenght	Tibia lenght		
Mesoamerican Commong Dog	130	115	136	136	Reference collection	Valadez *et al.* 2011
	122	120		133	Modern specimen	Rodríguez *et al.* 2001
	128		139	138	Teotihuacan, state of Mexico	Valadez 2000
	136	120	147	152	Huixtoco, state of Mexico	Valadez *et al.* 2004
		130	148			
	129	123	136	139	Punta Pájaros, Quintana Roo	Blanco *et al.* 1999
		121	136	138		
				130	Tula, Hidalgo	
	135.5		144	149	Tula, Hidalgo	Blanco *et al.* 2009
	144.2		160	161	Teopancazco, Teotihuacan	
Hairless Dog	138	132	140	151	Tula, Hidalgo	Valadez 2000
	133	124		140	Punta Pájaros, Quintana Roo	Blanco *et al.* 1999
				140		
				134	Teotihuacan, state of Mexico	Blanco *et al.* 2009
	134.81		149	136.35	Guadalupe, Michoacán	Rodríguez *et al.* 2001
	127.8	129.91		145.86	Modern specimen	
Short-nosed Mayan dog				121	Punta Pájaros, Quintana Roo	Valadez 2000
	105.5			109	Cozumel, Quintana Roo	Hamblin 1984
	109			135		
			126	140	Punta Pájaros, Quintana Roo	Blanco *et al.* 1999
Tlachichi dog	97	86	114	114	Tula, Hidalgo	Valadez *et al.* 2011
	79	70	91	78	San Blas, Mazatlan, Sinaloa	
	88.6					
				81.3	Teopancazco, Teotihuacan	
				78.5		
		83.7		90.6	Santa Cruz Atizapan, state of Mexico	
Wolf-Dog Hybrid	189	192	200	210	Tenochtitlán, Mexico City	Valadez et al. 2001
	190	197.5	202.5	208		
		151.2			Teotihuacan, state of Mexico	Valadez *et al.* 2006

Results

The sample analyzed here includes the variety of structure types reported in previous studies (Masson and Peraza Lope 2008, 2013) and is consistent with their findings. The structures located in or in the vicinity of the monumental center of Mayapan (Q-152, Q-39, Q-40a, Q-176a) present higher total percentages and densities of dog remains than those located in the outlying ceremonial center of Itzmal Ch'en (I-55a, H-15, and H-17). The sample consists of 619 bones including head elements (skull, mandibles, teeth), axial elements (vertebrae), limbs (scapulae, humeri, radii, ulnae, femora, tibiae, fibulae), and feet (carpals, tarsals, metatarsals, metacarpals, phalanges). A total of 33 MNI were identified in the sample, of which 22 were found in Templo Redondo. These 22 individuals were identified by the presence of 22 right dentaries. The density values of the sample indicate that Templo Redondo (Q-152) and two houses in the monumental center (Q-40a, Q-176a) are the structures with the highest relative abundance of dog remains (Table 2).

Skeletal Elements Found

The distribution of skeletal elements per structure indicates that the sample is mainly front limb bones (18.6%) consisting of humeri, radii, and ulnae. Front limbs are followed by detached teeth (13.1%), vertebrae (12.9%) and crania bones (12%). Other elements account for less than 10% of the total sample (rear limb 9.9%, dentary 9.5%, metapodial/phalanges 9.4%, pelvis 5.3%, ribs 4.7%, scapulae 3.1%, calcaneous 1.0%, and astragalus 0.5%) (Table 3).

Templo Redondo (Q-152) is the structure where the most complete array of skeletal elements were found. This temple is also the structure with the highest NISP (n=511) and relative density of dog remains. Artisans' houses in the vicinity of the monumental center –Q-176a (n=34) and Q-40a (n=25)– were next in terms of NISP and the density of skeletal remains, including cranial and postcranial bones. In contrast, Q-39 has a smaller NISP (n=12) and rear limb bones predominate in its assemblage. Given that it is one of the smallest structures in this study, a relatively large number of dog bones was recovered from Q-40a (Table 2, Figure 3). Structures H-15 (n=20), H-17 (n=9), and I-55a (n=8) in the Itzmal Ch'en outlying ceremonial center have consistently smaller NISP, quantities, and densities of skeletal remains. H-15 (the Hall) has the highest numbers in this sector, which is coherent with previous observations indicating the high number of dog remains in halls (Pollock and Ray 1957; Masson and Peraza 2008, 2013).

Hall H-15 in the Itzmal Ch'en outlying ceremonial center is differentiated by higher concentrations of foot and toe bones. Crania elements are absent in both the Hall (H-15) and Temple (H-17). Most of the elements found at H-17 are limb bones, especially femurs. The wealthy commoner's house (I-55a), also in the Itzmal Ch'en center, has a small number of elements but it is mostly characterized by the presence of detached teeth (Figure 2).

A series of Chi squares and Fisher exact tests were done to compare the pairs of structures analyzed (Table 4). The results indicate a significantly different distribution of skeletal elements in Templo Redondo (Q-152), an artisan's house (Q-39), the Hall (H-15), and the Temple (H-17).

A correspondence analysis for the distribution of skeletal elements in each structure indicates the relationship between structures and the number of skeletal elements recovered from them (Graph 1). The structures with similar distributions are represented by their proximity in the graph. The proximity of the structures to specific elements illustrates the relative frequency of said element in the structure. Two artisans' houses (Q-40a and Q-176a) have similar compositions to I-55a and are close to Q-152. As mentioned above, Templo Redondo (Q-152) is the structure with the highest number of elements. The Hall (H-15) shows a particularly different composition with a larger number of metapodials and phalanges. The Temple (H-17) is the only structure apart from Templo Redondo where astragali were recovered. Similarly, the artisan's house Q-39 is the only structure apart from Templo Redondo where calcanei were found.

Distribution of Dog Remains per Structure

The spatial distribution of skeletal elements in and outside the structures was analyzed for residential houses (Figure 3) and temples and halls (Figure 4). House I-55a corresponds to a wealthy artisan's house located in the vicinity of the Itzmal Ch'en group (Masson *et al.* 2016). The majority of the dog remains found in this house were recovered from a midden outside the northeastern corner of the structure. A radius shaft, phalanges, metapodials, skull fragments, and detached teeth were deposited in

Table 2. Summary of sample details

Structure	Structure Type	Area excavated (m3)	NISP	%	MNI	Density (NISP/ m^3)
H-15	Hall	126.4	20	3.2%	2	0.16
H-17	Temple	328.2	9	1.5%	1	0.03
I-55a	House	47.3	8	1.3%	1	0.17
Q-176a	House	33.1	34	5.5%	3	1.03
Q-39	House	34.2	12	1.9%	2	0.35
Q-40a	House	21.7	25	4.0%	2	1.15
Q-152	Templo Redondo	282.0	511	82.6%	22	1.81
Total		872.9	619	100%	33	4.70

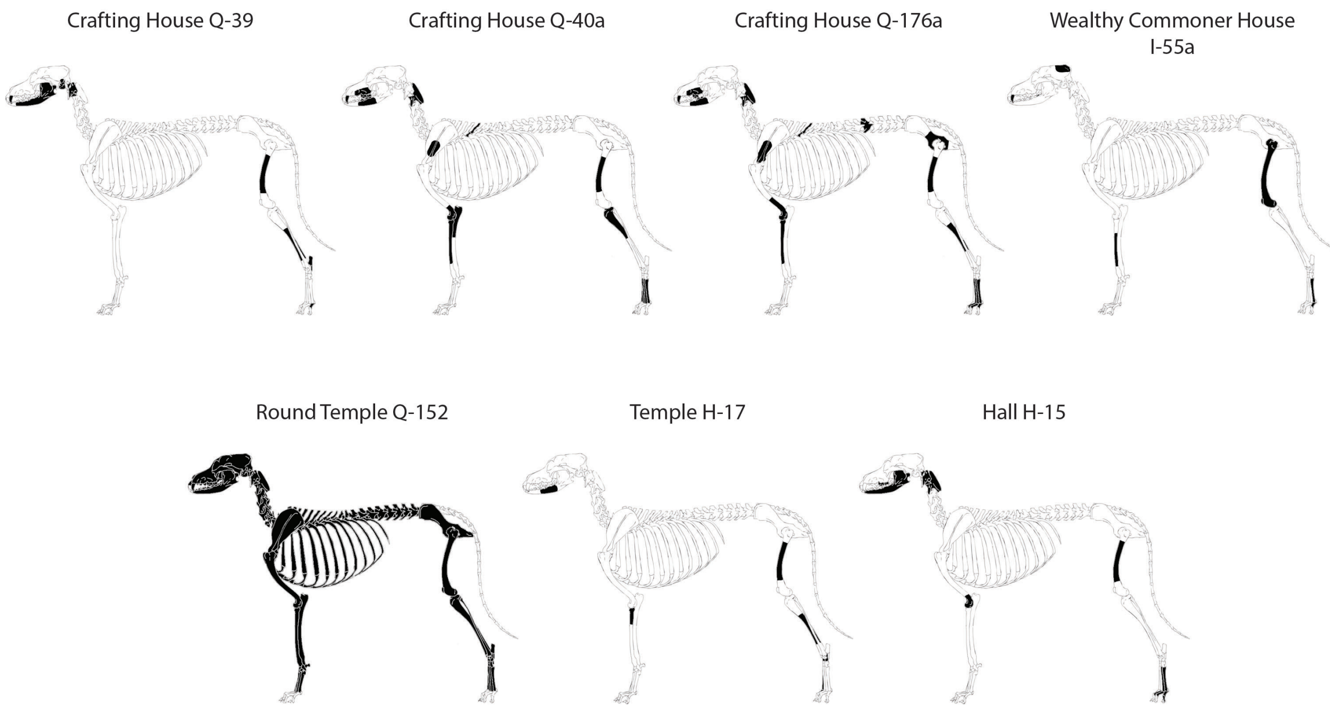
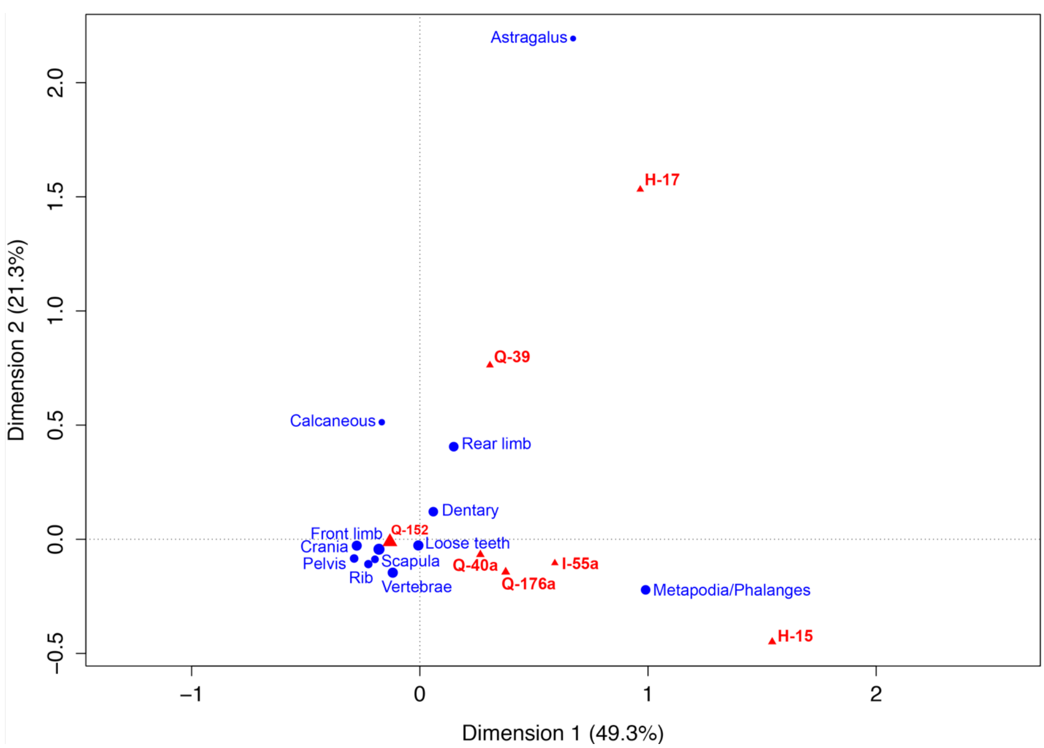


Figure 2. Skeletal element representation by structure.



Graph 1. *Correspondence analysis map of the distribution of skeletal elements by structure.*

this midden. The femur located at the southwestern corner of I-55a was in the structure's construction fill.

Most of the dog bones found at artisan's house Q-39 were found just outside the western side of the structure and possibly belong to domestic refuse. One of the femur shafts was found in the fill below the burial cist. Only two femur shafts were found inside the structure. At artisan's house Q-40a, the majority of dog remains were found just outside the southwestern structure boundary. Based on the discovery of two left ulnae, it may be assumed that at least two individuals were left there. Dog remains at artisan's house Q-176a were recovered from middens

Table 3. Skeletal representation per structure

	Q-152	H-15	H-17	I-55a	Q-176a	Q-39	Q-40a
Crania	13.5%	-	-	12.5%	5.9%	8.3%	4.0%
Dentary	9.8%	15.0%	22.2%	-	2.9%	8.3%	8.0%
Loose teeth	12.7%	10.0%	-	37.5%	11.8%	25.0%	16.0%
Vertebrae	13.7%	10.0%	-	-	17.6%	-	8.0%
Scapula	3.1%	-	-	-	-	-	12.0%
Rib	5.1%	-	-	-	8.8%	-	-
Pelvis	6.1%	-	-	-	5.9%	-	-
Rear limb	8.6%	5.0%	33.3%	12.5%	14.7%	33.3%	12.0%
Front limb	20.0%	5.0%	11.1%	12.5%	11.8%	-	24.0%
Metapodial/Phalanges	6.1%	55.0%	22.2%	25.0%	20.6%	8.3%	16.0%
Calcaneous	1.0%	-	-	-	-	8.3%	-
Astragalus	0.4%	-	11.1%	-	-	-	-
Limb	-	-	-	-	-	8.3%	-

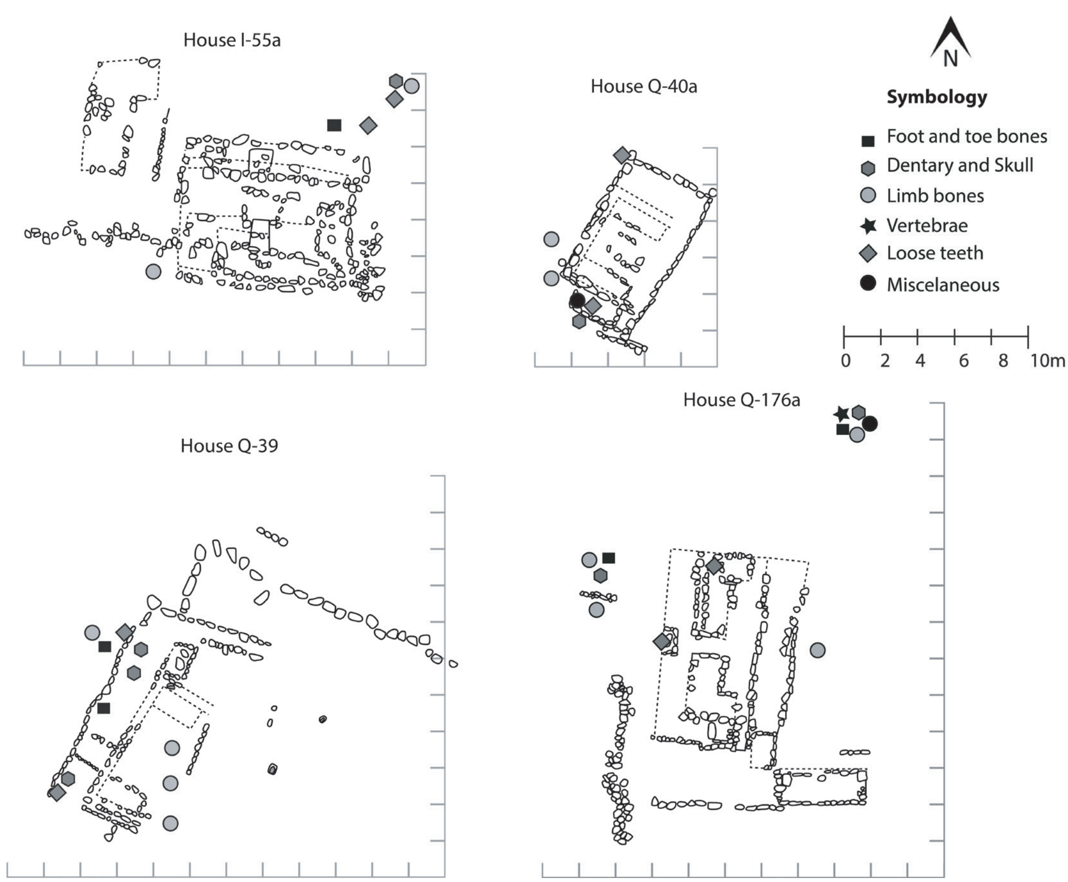


Figure 3. *Distribution of skeletal elements in the structures I-55a, Q-40a, Q-39, and Q-176a (modified from Masson et al. 2012: Figures 9.3., 11.2, 12.1. and 13.5.)*

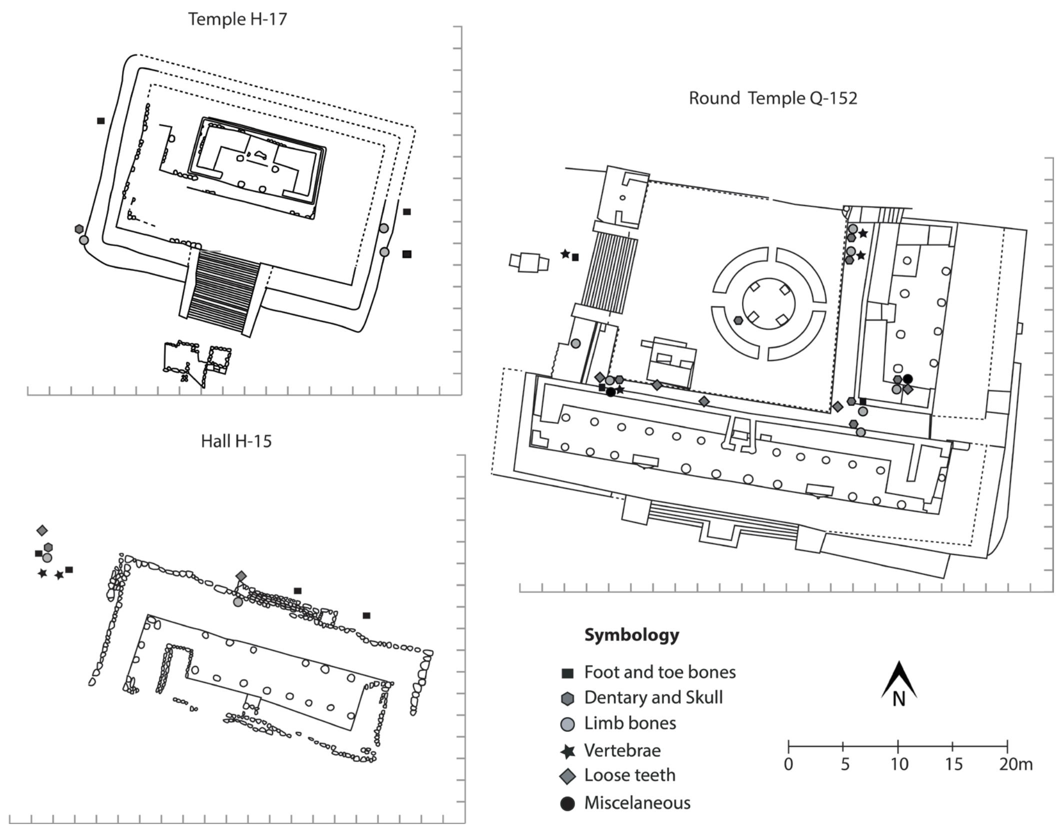


Figure 4. *Distribution of skeletal elements in structures H-17, H-15, and Q-152 (modified from Masson et al. 2012: Figures 6.260. and 7.194., and from Delgado Kú 2004: Figura 22).*

located at the western and southern outside edges of the structure. Most of the dog remains from this structure were found during the excavation of an infant burial site six meters north of the house structure. At least two dog specimens were recovered from the same level as the burial. The MNI is calculated by the presence of two left humeri and two right femur shafts. The size of slipped serving vessels found at these three houses suggest that festive meals could have been served there (Peraza Lope and Masson 2014b:122). Dog remains were also used for ornamental purposes since two of the canine teeth from artisans' houses Q-39 and Q-176a show holes drilled through the roots, suggesting their modification for use as personal ornaments that could have been used as status or lineage paraphernalia (Shaw 1991:263). The use of dog teeth as jewelry has been widely documented throughout the Maya area (Clutton-Brock and Hammond 1994:825; Hamblin 1984:114; Teeter 2004:188).

Most of the dog bones recovered from the colonnaded Hall H-15 were found at the west side of the structure. A staircase leading to the Itzmal Ch'en group platform was built at the northeast corner of H-15. Evidence of a mass human burial and a burning event were discovered at this locality. The human bones recovered from this area are disarticulated, highly fragmented, and present evidence of postmortem modifications such as direct exposure to fire, blows, and cut marks (Serafin *et al.* 2012:242; Paris *et al.* 2017).

The presence of ritual ceramics such as effigy censers along with these human remains suggests that the local elites of Itzmal Ch'en were the victims of this mass killing (Masson *et al.* 2012:18-19). Ritual pottery appeared in great quantities in the mass grave while very little was recovered from the hall, suggesting the removal of ritual pottery from the hall, and possibly other ceremonial buildings of Itzmal Ch'en, to be placed in the grave (Peraza Lope and Masson 2014b:117). Most disarticulated dog remains were recovered at the mass burial site together with other common species in Mayapan such as iguana, white-tail deer, brocket deer, peccary, turkeys, rabbits, turtles, and various marine fish species. Animal bones found in the mass grave suggest a mixture of midden debris with human remains (Paris *et al.* 2017:80). Metapodials and phalanges predominate in this sample, followed by dentary fragments, vertebrae and detached teeth. In addition to the two burned dog phalanges found in this sector, several human remains from the mass grave evidence burning (Paris *et al.* 2017:73-74), suggesting that burning events at the mass grave site may also have altered the faunal remains deposited nearby. The rest of the dog bones reported from H-15 were recovered from the front steps of the colonnaded hall (phalanges, a molar tooth, and a femur shaft), which means that they too were disarticulated.

Dog remains were recovered from the upper levels of the western and eastern sides of Temple H-17. On the eastern side, the skeletal elements were a femur shaft, a tibia shaft, and radius as well as metapodials and astragalus. On the western side, two dentaries were found along with another femur shaft and phalanges. Itzmal Ch'en temple H-17 was an important place for rituals and administrative activities as evidenced by the great abundance of ritual pottery recovered there (Peraza Lope and Masson 2014b:118). Along with Temple Q-58 in the center of the city, H-17 is the second tallest temple in Mayapan (Masson *et al.* 2012:10). The presence of serpent imagery in Itzmal Ch'en temple H-17 suggests that ceremonies dedicated to Kukulcan were important in this group (Chowning 1956; Masson *et al.* 2012:10). Dog bones were found in association with other faunal remains and artifacts, including Ch'en Mul effigy censers (Cruz and Flores 2012).

Templo Redondo (Q-152) is where the majority of dog remains has been found and it presents the largest number of skeletal elements identified in this study. The remains are concentrated in specific areas of the Templo Redondo platform (Figure 4). Most of the dog remains in this group were found at the edges of the Templo Redondo platform and behind the colonnaded halls (Q-151) or the Hall of Chaac Masks and Q-152c or Huhí Nah. The materials recovered by the Carnegie Project at the Hall of Chaac Masks suggests ritual activities that included vessels associated with copal burning (Shook and Irving 1955:148; Milbrath and Peraza Lope 2003:11). Some ceramic drums were recovered from Hall Q-152c but overall there are very few materials there (Peraza Lope and Masson 2014b:113). Human skulls and disarticulated bones between Q-152 and Q-151, and between Q-152 and Q-152c, were reported by previous excavations (Milbrath and Peraza Lope 2003:11, 15). Masson and Peraza Lope (2013:271) also report large quantities of dog remains at Halls Q-87a and Q-87a/Q-88a, which are part of the Templo Redondo group. The concentration of dogs in this group, along with elite serving vessels, suggests that dogs were preferred and possibly included in activities such as sacrifices, feasts, and ceremonies held at Templo Redondo and its surrounding buildings (Masson and Peraza Lope 2013:271; Peraza Lope and Masson 2014b:111).

The concentration located at the western side of the platform between Hall Q-151 and Sanctuary Q-152a represents 89.2% of the dog bones recovered from the Templo Redondo group. A total of 20 right dentaries were recovered from this same location. The dog remains from Hall Q-152c were found in much smaller quantities (7.8%), and the other two right dentaries came from this hall. Other elements dispersed in Templo Redondo, its platform, and at the base of Altar Q-152d make up the remaining 3% of the total bones. It is important to mention that dog phalanges are absent in this sample and foot bones make up a small percentage of the skeletal elements reported (Table 3).

Osteometric Analysis

Osteometric analysis included measurements of maximum length and breadth of the dogs' proximal and distal long bone ends. Given the fragmentation of the sample and the large number of unfused bones, measurements were only recorded for a sample of six complete limb bones (see Table 5) recovered at Templo Redondo, which were fused at both proximal and distal ends.

Metric data can be compared to information reported for the five breeds identified in Mesoamerica: the Mesoamerican common dog, the Mexican hairless dog or *xoloitzcuintle*, the short-nosed or Mayan dog, the tlalchichi dog, and a wolf-dog hybrid. The Mesoamerican common dog is the most widely identified dog breed in Mexico. It is characterized by a medium-sized body and dolichocephalic skull (Valadez Azúa 2000:195; Valadez Azúa *et al.* 2013:572). The Mexican hairless dog can be found in Central Mexican and Mayan settlements. Its most outstanding osteological characteristics are the absence of premolars, small teeth, and poorly formed incisors and molars (Valadez Azúa 2000: 197, Valadez Azúa *et al.* 2009, 2010). The short-nosed dog is limited to the Maya area. Its morphological characteristics are its complete dentition, comparatively short height, short nose, and brachycephalic skull (Valadez Azúa 2000:200). Valadez Azúa (2000) and Valadez Azúa *et al.* (1999) argue that this type of dog corresponds to Allen's (1920) short-nosed dog as well as to the specimens recovered by Hamblin (1984) on Cozumel Island.[1] The tlalchichi, or short-legged dog, tends to be scarce in archaeological contexts but has been found in Central Mexico sites and at Chichén Itzá. It has full dentition and a dolichocephalic skull, but short limbs are this breed's main characteristic (Valadez Azúa 2000:198, Valadez Azúa *et al.* 2011). The wolf-dog hybrid presents a large robust head, thin face, permanent deciduous incisors and canines together, and larger dentition. Specimens of this hybrid breed have been identified in Teotihuacan and Tenochtitlan in Central Mexico, Cerro de las Minas in Oaxaca, and Xcambó in Yucatán (Valadez Azúa *et al.* 2006; Valadez *et al.* 2014).

Humerus, femur, radius and tibia length from the Mayapan specimens were compared to the measure-

[1] Early identifications of dog breeds in the Maya area (Carr 1986: Hamblin 1984) followed Allen's (1920) classification of dogs and found strong similarities with small Indian dogs or Techichi. Recent research conducted by Valadez Azúa (2000:202) argues that the term Techichi as reported in the etnohistorical record and later interpreted by Allen corresponds to the Mesoamerican common dog. The examples reported in Cozumel can be more closely related to the Mayan dog, which is characterized by its short nose (Valadez Azúa et al. 1999). Both the small Indian dog and the short-nosed Indian dog of Allen (1920) are characterized by short nasal cavities with some variation in the length of limb bones. Due to the studies of Valadez Azúa and the overlap in long bone metrics and teeth metrics, I integrated Hamblin (1984) identifications with the short-nosed or Mayan dog as reported by Blanco Padilla et al. (1999) and Valadez Azúa et al. (1999).

Table 4. Results of Chi square and Fisher exact test.

Structures	Hall H-15	Temple H-17	Temple Q-152	House I-55	House Q-176a	House Q-39	House Q-40a
Hall H-15	/						
Temple H-17	No difference (p: .1137)	/					
Temple Q-152	Different (χ2 : 67.45 p: 3.7216e-10)	Different (χ2: 33.92 p: .0003)	/				
House I-55	No difference (p: .133)	No difference (p: .2963)	No difference (χ2:11.63 p: .3923)	/			
House Q-176a	No difference (p: .1323)	No difference (p: .2092)	No difference (χ2:17.82 p: .08575)	No difference (p: .7545)	/		
House Q-39	Different (p: .0093)	No difference (p: .5431)	Different (χ2:22.56 p: .0202)	No difference (p: .7896)	No difference (p: .1794)	/	
House Q-40a	No difference (p: .0744)	No difference (p: .35)	No difference (χ2:15.02 p: .1812)	No difference (p: .7824)	No difference (p: .3136)	No difference (p: .2016)	/

Note: tests based on comparisons of frequencies of crania bones, dentaries, all loose teeth, rear limbs, front limbs, metapodial/phalanges, vertebrae, astragalus, calcaneous, pelvis, ribs, and scapulae between fully-excavated structures, p = .05, df = 11, p-values >/= .05 reject the null of no difference. Chi square values were calculated for comparisons only with Q-152. Chi square values are only approximate because assumptions are violated.

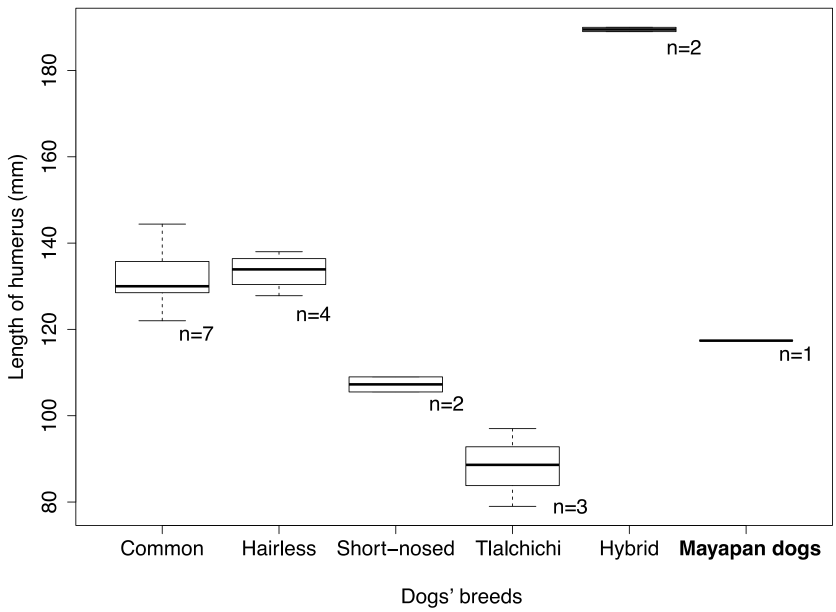
ments described in the literature as these are the most consistently reported measurements (Table 1). Graph 2 shows the comparison of humerus lengths with the only complete fused humerus from Mayapan. The Mayapan example falls below measurements reported for the Mesoamerican common dog, hairless dog, and wolf-dog hybrid and above those reported for the short-nosed and the tlalchichi dogs. Graph 3 indicates a similar comparison, as Mayapan radii measurements fall below those of the Mesoamerican common dog, hairless dog, and wolf-dog hybrid and above those of the tlalchichi dog. No measurements were available for the short-nosed or Mayan dog.

Graph 4 shows the comparison of Mayapan femurs with the aforementioned breeds. Although only one specimen of Mayapan dog is reported in this graph, this measurement is clearly below that of the Mesoamerican common dog, hairless dog, and wolf-dog hybrid and above that of the tlalchichi dog. Femur lengths from Mayapan are the same as those reported for the short-nosed dog femur. Tibia lengths are also very similar (Graph 5). The Mayapan dog's tibia length falls below that of the Mesoamerican common dog, hairless dog, and wolf-dog hybrid and above that of the tlalchichi dog. This profile is a closer match to the short-nosed dog. It is important to mention that although the sample size is small, the comparison of different skeletal elements can still provide clues about the breeds of dogs from Mayapan. The sizes of the Mayapan's dog limbs are uniformly smaller than those reported for the Mesoamerican common dog

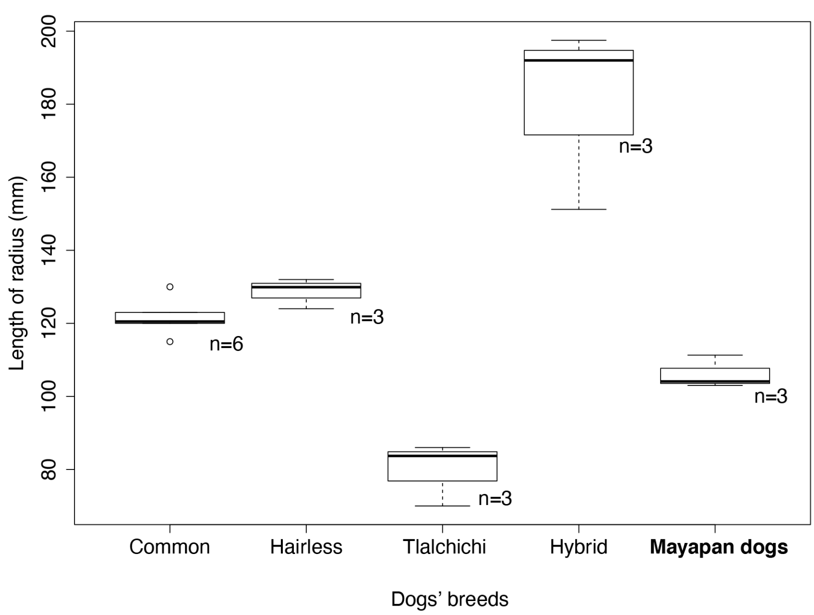
Table 5. Postcranial (limb) measurements of Mayapán dogs.

Humerus Meassurements (mm)		
GL	Bd	Bp
117.4	25.4	28.5
Radius Meassurements (mm)		
GL	Bd	Bp
104.1	19	14
103	16	13.5
111.3	19.2	14
Femur Meassurements (mm)		
GL	Bd	Bp
124.5	29	25
Tibia Meassurements (mm)		
GL	Bd	Bp
124	19.4	27.6

Note: GL= Greatest length, Bd= Breath of the distal end, Bp= Breath of the proximal end (based on Von den Driesch 1976).



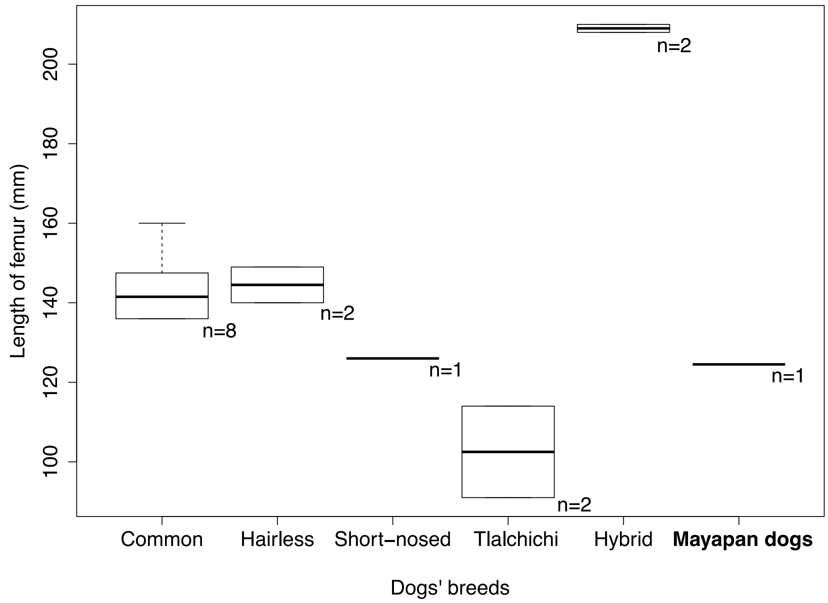
Graph 2. *Comparison of humerus length between Mayapán dogs and Mesoamerican Common Dog (Blanco Padilla et al. 1999; Valadez Azúa 2000; Rodríguez Galicia et al. 2001; Valadez Azúa et al. 2004; Valadez Azúa et al. 2011), Hairless Dog (Blanco Padilla et al. 1999; Valadez Azúa 2000; Rodríguez Galicia et al. 2001; Blanco Padilla et al. 2009), Short-nosed or Mayan dog (Blanco Padilla et al. 1999; Hamblin 1984; Valadez Azúa 2000), Tlachichi (Valadez Azúa 2000; Valadez Azúa et al. 2011), and wolf-dog hybrid (Valadez Azúa et al. 2001).*



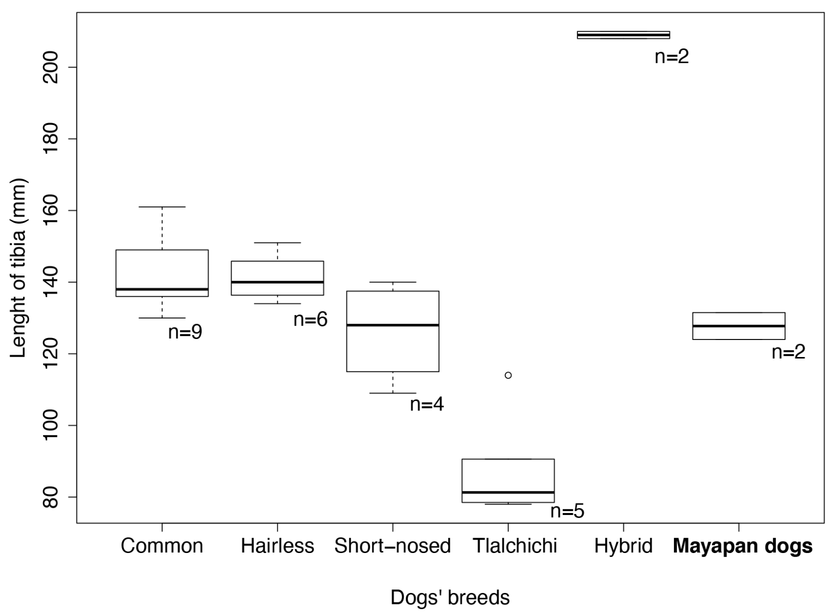
Graph 3. *Comparison of radius length between Mayapán dogs and Mesoamerican Common Dog (Blanco Padilla et al. 1999; Rodríguez Galicia et al. 2001; Valadez Azúa et al. 2004; Valadez Azúa et al. 2011), Hairless Dog (Blanco Padilla et al. 1999; Valadez Azúa 2000; Rodríguez Galicia et al. 2001; Blanco Padilla et al. 2009), Tlachichi (Valadez Azúa 2000; Valadez Azúa et al. 2011), and wolf-dog hybrid (Valadez Azúa et al. 2001; Valadez Azúa et al. 2006).*

and Mexican hairless dog and seem to make a better match with the smaller breeds reported for Mesoamerica. A larger sample and skull measurements are needed for more conclusive data and to account for variations among Mayapan dogs.

Measurements of first molar tooth length and breadth were taken for 27 teeth, including detached teeth and teeth attached to maxillae and dentaries (Table 6). The measurements of the first lower and upper molar were compared to those given by Rodríguez Galicia *et al.* (2001), Valadez Azúa (2000), Valadez Azúa *et al.* (2004, 2009) and Blanco Padilla *et al.* (2009) for the same teeth in the Mesoamerican common dog, hairless dog, short-nosed dog, and wolf-dog hybrid (Graph 6). Measurements of both breath and length are not provided in the literature for tlalchichi breeds. Ranges of length for lower first mo-



Graph 4. Comparison of femur length between Mayapán dogs and Mesoamerican Common Dog (Blanco Padilla *et al.* 1999; Valadez Azúa 2000; Valadez Azúa *et al.* 2004; Blanco Padilla *et al.* 2009; Valadez Azúa *et al.* 2011), Hairless Dog (Valadez Azúa 2000; Rodríguez Galicia *et al.* 2001), Short-nosed or Mayan dog (Blanco Padilla *et al.* 1999), Tlachichi (Valadez Azúa 2000; Valadez Azúa *et al.* 2011), and wolf-dog hybrid (Valadez Azúa *et al.* 2001; Valadez Azúa *et al.* 2006).



Graph 5. Comparison of tibia length between Mayapán dogs and Mesoamerican Common Dog (Blanco Padilla *et al.* 1999; Valadez Azúa 2000; Rodríguez Galicia *et al.* 2001; Valadez Azúa *et al.* 2004; Blanco Padilla *et al.* 2009; Valadez Azúa *et al.* 2011), Hairless Dog (Blanco Padilla *et al.* 1999; Valadez Azúa 2000; Rodríguez Galicia *et al.* 2001; Blanco Padilla *et al.* 2009), Short-nosed or Mayan dog (Blanco Padilla *et al.* 1999; Hamblin 1984; Valadez Azúa 2000), Tlachichi (Valadez Azúa 2000; Valadez Azúa *et al.* 2011; Valadez Azúa and Rodríguez Galicia 2012), and wolf-dog hybrid (Valadez Azúa *et al.* 2001; Valadez Azúa *et al.* 2006).

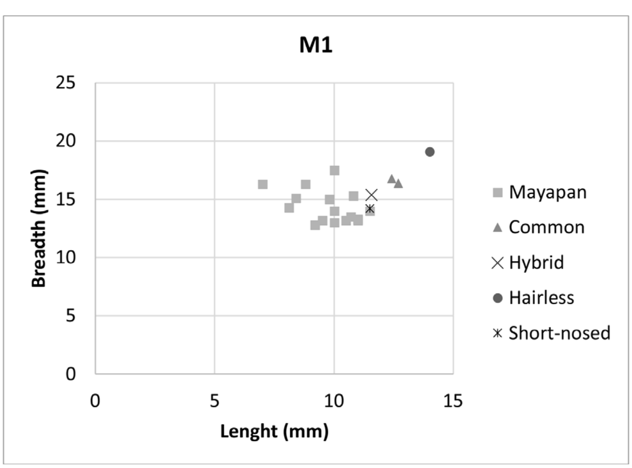
lar were obtained from Allen (1920), Rodríguez Galicia *et al.* (2001), Valadez Azúa (2000), Valadez Azúa *et al.* (2004, 2009) in examples of the Mesoamerican common dog, Mexican hairless dog, short-nosed dog, tlalchichi dog, and wolf-dog hybrid. The lower first molar teeth from Mayapan have lengths of 17-18 mm. These lengths clearly fall within the range of the short-nosed dog (17.5-18.7 mm) and the Mexican hairless dog (17.1-19.9 mm).[2] They are below the ranges reported for the Mesoamerican common dog (18.7-21.2 mm), tlalchichi

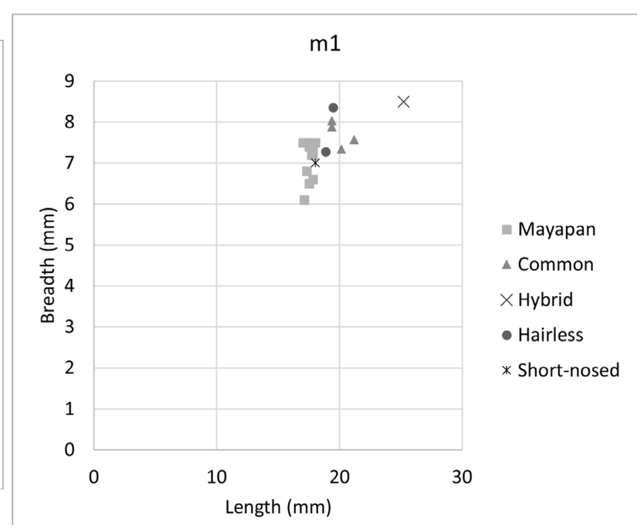
[2] Valadez Azúa et al. (2009: Table 2) only report one specimen with lower first molar length below 19 mm. This dog was found in the caves in tunnels from Teotihuacan.

Table 6. First molar measurements of Mayapán dogs.

Structure	Structure type	Tooth	Side	Measurements (mm)	
				L	B
Q-152	Templo Redondo	m1	L	18.00	7.5
Q-152	Templo Redondo	m1	L	17.5	7.4
Q-152	Templo Redondo	m1	L	17.5	6.5
Q-152	Templo Redondo	m1	R	17.0	7.5
Q-152	Templo Redondo	m1	R	17.7	7.2
Q-152	Templo Redondo	m1	R	17.8	7.4
Q-152	Templo Redondo	m1	L	17.3	6.8
Q-152c	Hall	m1	R	17.5	7.5
Q-176a	Crafting house	m1	R	17.8	6.6
Q-39	Crafting house	m1	R	17.8	7.2
Q-40a	Crafting house	m1	L	17.1	6.1
Q-152	Templo Redondo	M1	L	11.5	14
Q-152	Templo Redondo	M1	R	10.8	15.3
Q-152	Templo Redondo	M1	R	10.7	13.5
Q-152	Templo Redondo	M1	R	11	13.3
Q-152	Templo Redondo	M1	R	10.5	13.2
Q-152	Templo Redondo	M1	R	9.8	15
Q-151	Templo Redondo	M1	R	9.5	13.2
Q-152	Templo Redondo	M1	L	9.2	12.8
Q-152	Templo Redondo	M1	R	10	14
Q-152c	Hall	M1	R	10	13
Q-152c	Hall	M1	L	11	13.2
Q-40a	Crafting house	M1	L	8.1	14.3
Q-40a	Crafting house	M1	L	10	17.5
Q-176a	Crafting house	M1	L	7	16.3
Q-176a	Crafting house	M1	L	8.4	15.1
Q-176a	Crafting house	M1	L	8.8	16.3

Note: m1= lower first molar, M1= upper first molar, L= Length, B= Breadth. Ranges for lower first molar length by breed: Mesoamerican Common dog= 18.7-21.2 mm (Rodríguez Galicia et al. 2001; Valadez Azúa et al. 2004); Mexican Hairless Dog=17.1-19.9 mm (Rodríguez Galicia et al. 2001; Valadez Azúa et al. 2009); Short-nosed Indian dog=17.5-18.7 (Allen 1920; Hamblin 1984; Valadez Azúa 2000); Tlachichi=18.5 mm (Valadez Azúa 2000); dog-wolf hybrid= 25 mm (Valadez Azúa et al. 2001).





Graph 6. Comparison of upper and lower first molars between Mayapán dogs and Mesoamerican Common Dog (Rodríguez Galicia *et al.* 2001; Valadez Azúa *et al.* 2004), Hairless Dog (Rodríguez Galicia *et al.* 2001), the dog-wolf hybrid (Valadez Azúa *et al.* 2001), and the Short-nosed or Mayan dog (Blanco Padilla *et al.* 2009).

(18.5 mm), and wolf-dog hybrid (25 mm). When measurements of both breath and length were given in the literature and compared to the Mayapan examples, it is clear that both lower and upper first molar dimensions fall below those given for the Mesoamerican common dog, hairless dog and wolf-dog hybrids. The reported measurement for the short-nosed or Mayan dog[3] (Blanco Padilla *et al.* 2009: Table 12-14) falls within the range of measurements for upper and lower molars of Mayapan. Further analysis of dentition and additional cranial and tooth measurements are needed to make better comparisons. For the moment, the dental information suggests two possibilities: (1) that there are strong similarities with smaller breeds of dogs, or (2) that there are hairless dogs within the sample which usually have atypical teeth.

Measurements of mandibular height at the lower first molar were used to calculate the body weight of specimens.[4] Mayapan body weights range from 3,408 g to 10,841 g. Blanco Padilla *et al.* (1999: Figure 7 and Figure 9) report body weight calculations for different breeds, including examples of two common Mesoamerican dogs found at Chac-Mool with weights of 9,480 g and 9,420 g and a short-nosed or Mayan dog weighing 8,610 g; a common Mesoamerican dog from Teotihuacan with a weight of 9,420 g; examples from Tula include two common Mesoamerican dogs with weights of 11,265 g and 9,885 g, a hairless dog weighing 11,475 g and a tlalchichi with a weight of 10,485 g. Moreover, Valadez Azúa *et al.* (2001) report the following range of weights: common Mesoamerican and hairless dogs from 9,000 to 10,000 g, the short-nosed or Mayan dog 5,500 to 8,700 g, and the tlalchichi 9,500 g.

Body weight estimates indicate that the smallest specimen is found in artisan's house Q-40a, weighing an estimated 3,408 g, while the largest is at Templo Redondo, with an estimated weight of 10,841 g (Table 7). Weights below 9,000 g are more common in the Mayapan sample (n=14, 70%), suggesting the presence of smaller breeds such as the short-nosed dog. These were found in all the structures analyzed. On the other hand, the few examples (n=6, 30%) with weights above 9,000 g were recovered from Templo Redondo, which suggests the presence of larger breeds in this context.

Hamblin (1984:100) cautions that body weight variation could be related to breeds or age. In the Mayapan sample, almost all (n=18, 90%) of the mandibles measured exhibited erupted teeth, which occurs when the animal is about seven months old (Sutton *et al.* 2018: Appendix). Two examples (10%) with unerupted third molars (with weights of 8,742 g and 9,333 g) in mandibles were recovered from Templo Redondo.

[3] Measurements correspond to a young adult specimen, reported as PP8 from Chac-Mool, Punta Pájaros

[4] Blanco Padilla *et al.* (1999) present calculations of body weight for different breeds based on head-body length, which require measurements for cranium and spine lengths.

Age Distribution

Dog ages were calculated according to published epiphyseal fusion schedules (Sutton *et al.* 2018: Table 11.3, Table 11.7). The fragmentation of the sample made it impossible to determine ages for all specimens. A total of 51.9% (n=125) of the sample of limb bones and foot bones were sufficiently preserved to document epiphyseal fusion stages. Limb bones with fused proximal and distal ends (or both) comprise 68% of the sample, while 32% present unfused epiphyses.

Table 8 presents late-fusing long bones along with metapodials and calcanea, which fuse early. The majority of elements from Mayapan are fused, indicating that the growth and ossification stage had been completed. Unfused elements were not recovered in all of the structures investigated. The majority of unfused bones were found in the Templo Redondo group, followed by House Q-40a and Hall H-15. The remaining structures present only fully fused bones (Table 9), suggesting the presence of adult dogs.

It is important to note that the sample from domestic contexts included in this analysis is very small and the majority of bones reported correspond to metapodials and calcanea, which are early-fusing elements.

Summary

This study provides further evidence of the utilization of dogs in different structures of the Postclassic city of Mayapan. It seeks to broaden our understanding of their use in domestic and ceremonial contexts, the spatial distribution of skeletal remains, their ages, estimated weights, and possible breeds of dogs raised in Mayapan.

Dogs were regarded as an important symbolic component of rituals, feasts, and ceremonies as indicated by their presence in temples and halls both at the site center and the Itzmal Ch'en ceremonial center. Templo Redondo (Q-152) presents the highest frequency and skeletal representation of dog remains, including an important number of unfused elements indicating the presence of juvenile dogs in the deposits. Diego de Landa (Tozzer 1941) reports the use of puppies in Maya ceremonies, which suggest a preference for juveniles in ritual contexts such as the case of Templo Redondo (Q-152), which also features the largest specimens in the sample based on body weight, which suggest the presence of larger and probably different breeds of dogs. Most remains are concentrated between Templo Redondo platform and the back of Chaak Masks Hall.

This study indicates that dogs were also integrated in the domestic and everyday economy of Mayapan. They were recovered from middens of both commoner's and affluent houses. The important quantities of major limb bones in all artisans' houses could indicate their preference for or access to certain portions of the skeleton.

Table 7. Estimation of body weight.

Structure	Structure type	Height Mandible (mm)	Body Weight (g)
Q-40a	Crafting house	15.5	7,096.7
Q-40a	Crafting house	11.2	3,408.0
Q-39	Crafting house	17.1	8,858.6
Q-176a	Crafting house	15.3	6,891.6
Q-152c	Hall	18.0	9,946.1
Q-152	Templo Redondo	17.5	9,333.3
Q-152	Templo Redondo	17.0	8,742.1
Q-152	Templo Redondo	17.2	8,976.0
Q-152	Templo Redondo	16.5	8,172.4
Q-152	Templo Redondo	14.8	6,393.7
Q-152	Templo Redondo	15.5	7,096.7
Q-152	Templo Redondo	17.3	9,094.2
Q-152	Templo Redondo	18.7	10,840.7
Q-152	Templo Redondo	17.8	9,698.4
Q-152	Templo Redondo	16.1	7,731.9
Q-152	Templo Redondo	16.8	8,511.6
Q-152	Templo Redondo	17.5	9,333.3
Q-152	Templo Redondo	15.0	6,590.4
Q-152	Templo Redondo	16.0	7,624.0
Q-152	Templo Redondo	17.0	8,742.1

Note: Estimation of weight according to mandibular height at m1 (Log y= 2.2574(Log x)+ 1.164) x= mandibular height in m1 (Wing 1978:Table 2.1).

Table 8. Number and percentage of fused and unfused dog limb bones in all analyzed structures.

Element	Fused		Unfused	
Humerus (whole)	1	50.0%	1	50.0%
Distal humerus	15	88.2%	2	11.8%
Proximal humerus	7	63.6%	4	36.4%
Radius (whole)	3	42.9%	4	57.1%
Distal radius	2	33.3%	4	66.7%
Proximal radius	2	25.0%	6	75.0%
Proximal ulna	5	71.4%	2	28.6%
Femur (whole)	1	33.3%	2	66.7%
Distal femur	2	33.3%	4	66.7%
Proximal femur	3	42.9%	4	57.1%
Tibia (whole)	1	33.3%	2	66.7%
Distal tibia	5	100.0%	-	-
Proximal tibia	3	50.0%	3	50.0%
Distal calcaneus	-	-	1	100.0%
Calcanea (whole)	2	100.0%	-	-
Metapodials (whole)	20	100.0%	-	-
Proximal metapodial	8	100.0%	-	-
Distal metapodials	5	83.3%	1	16.7%
Total	35	68.0%	40	32.0%

Note: Distal humerus fuses at 6-10 mo., proximal humerus fuses at 10-15 mo., distal radius fuses at 10-12 mo., proximal radius at 7-10 mo., proximal ulna fuses at 7-10 mo., proximal and distal femur 9-12 mo., proximal tibia fuses at 10-12 mo., distal tibia fuses at 12-15 mo., in metapodials proximal MC1 fuses at 6-7 mo. and distal MC2-5 fuses at 6-7 mo. (Sutton et al. 2018: Table 11.3, Table 11.7).

Table 9. Number and percentage of fused and unfused elements by structure.

Element	Templo Redondo Q-152 & Q-152c		Crafting House Q-39		Crafting House Q-40a		Crafting House Q-176a		House I-55a		Hall H-15		Temple H-17	
	Fused	Unfused	Fused	Unfused	Fused	Unfused	Fused	Unfused	Fused	Unfused	Fused	Unfused	Fused	Unfused
Humerus (whole)	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Distal humerus	14	-	-	-	-	1	1	-	-	-	-	1	-	-
Proximal humerus	7	4	-	-	-	-	-	-	-	-	-	-	-	-
Radius (whole)	3	4	-	-	-	-	-	-	-	-	-	-	-	-
Distal radius	2	4	-	-	-	-	-	-	-	-	-	-	-	-
Proximal radius		6	-	-	-	-	-	-	-	-	1	-	1	-
Proximal ulna	5	1	-	-	-	1	-	-	-	-	-	-	-	-
Femur (whole)	1	2	-	-	-	-	-	-	-	-	-	-	-	-
Distal femur	2	4	-	-	-	-	-	-	-	-	-	-	-	-
Proximal femur	3	4	-	-	-	-	-	-	-	-	-	-	-	-
Tibia (whole)	1	1	-	-	-	1	-	-	-	-	-	-	-	-
Distal tibia	5		-	-	-	-	-	-	-	-	-	-	-	-
Proximal tibia	2	3	-	-	1	-	-	-	-	-	-	-	-	-
Distal calcaneus	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Calcaneus (whole)	1	-	1	-	-	-	-	-	-	-	-	-	-	-
Metapodials (whole)	15	-	-	-	2	-	2	-	-	-	1	-	-	-
Proximal metapodial	4	-	-	-	1	-	-	-	2	-	1	-	-	-
Distal metapodials	-	1	-	-	-	-	2	-	-	-	3	-	-	-
Total	66	36	1	0	4	3	5	0	2	0	6	1	1	0
%	52.8%	28.8%	0.8%	0.0%	3.2%	2.4%	4.0%	0.0%	1.6%	0.0%	4.8%	0.8%	0.8%	0.0%

Note: Distal humerus fuses at 6-10 mo., proximal humerus fuses at 10-15 mo., distal radius fuses at 10-12 mo., proximal radius at 7-10 mo., proximal ulna fuses at 7-10 mo., proximal and distal femur 9-12 mo., proximal tibia fuses at 10-12 mo., distal tibia fuses at 12-15 mo., in metapodials proximal MC1 fuses at 6-7 mo. and distal MC2-5 fuses at 6-7 mo. (Sutton et al. 2018: Table 11.3, Table 11.7).

However, it is important to note that artisanal or differential discard may have affected the representation of skeletal elements. Mandibles recovered in artisans' houses Q-40a, Q-39, and Q-176a indicate the presence of mostly smaller dogs based on estimated body weight.

House Q-176a presents a special context in which dog remains were concentrated and the skeleton was more complete than in other areas. This context is associated with the child burial at the north of the house structure. It is possible that dogs were buried to accompany the child. This is a significant burial practice that has been documented at sites such as Yaxuná (Götz and Stanton 2013) and Chac Mool (Blanco Padilla *et al.* 1999).

Dogs' symbolic importance is reaffirmed by their interment with humans and in ritual contexts. They were also utilized as personal paraphernalia as evidenced by the presence of drilled dog canines. No other modification marks (cutting) were observed in the assemblage that could indicate defleshing, dismembering, or butchering. Two burned phalanges from H-15 may have been the result of burning events at the mass grave that also affected nearby deposits.

The osteometric data is preliminary and require verification using a larger sample, additional measurements of cranial elements, and analysis of dentition. The data examined here suggest the presence of smaller breeds of dogs, probably the short-nosed or Mayan dog, which has been already identified at other sites in the Maya region (Blanco Padilla *et al.* 1999; Hamblin 1984). Other larger breeds are suggested by body-weight estimates and are concentrated in the Templo Redondo group.

Age estimation based on epiphyseal fusion stages suggests the importance of adult specimens and indicates that, in most cases, dogs were allowed to grow to their full size, which is expected in domestication practices. Younger specimens based on fusion rates were found at Templo Redondo, Hall H-15 and artisan's house Q-40a.

Conclusion

Previous studies have provided evidence of the predominance of dog remains at the monumental center of Mayapan and of their identification as a sacrificial animal (Masson and Peraza Lope 2008, 2013). At the regional level, the high frequency of dog remains during the Postclassic may be related to the increase in ritual and feasting activities (Emery 2004:49). The fact that dogs can be raised and controlled but are still not found in high frequencies in domestic contexts may speak to the symbolic importance of this animal for Mayan societies. Fewer dog remains in domestic contexts in Mayapan follows the tendency documented at other inland sites such as Chichén Itzá, Dzibilchaltún, and Siho (Götz 2008) in what seems to be a trend in the Maya region during all periods (Cunningham-Smith *et al.* 2020:172).

The mention of dogs in Postclassic codices and ethnohistorical accounts provide further evidence of their role in Maya communities. Diego de Landa wrote that dogs were viable substitutes for human sacrifice and they were commonly chosen for that purpose (Tozzer notes on Landa 1941:114, Masson and Peraza Lope 2013:272). His account of the Yax Cocah Mut sacrifice mentions an offering of virgin dogs, which suggests the selection of juveniles for this purpose, a case that could be related to the importance of subadults in rituals at Templo Redondo.

This study indicates that dogs were not solely used in elite and ceremonial contexts. The presence of dog remains in commoner's houses in Mayapan suggests that their breeding and utilization was part of the everyday lives of the Postclassic Maya. Records from the sixteenth century indicate that dogs were raised and fattened for feasting events (Pohl and Feldman 1982:302). They were used as gifts to reaffirm kin ties, to barter in the marketplace (Masson and Peraza Lope 2008:181), and may have been offered to elites as a tribute (Shaw 1991:261).

During a time of political integration and restructuration in Postclassic Mayapan, the manipulation of faunal resources in community and regional rituals may have helped to integrate and stabilize social relations (Masson 1999). Dogs formed part of rituals and economic activities that linked residents and governing officials as well as the broad economic network of the city.

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