

Finding Drama in Bones: Looking Beyond Identification in Ritual Faunal

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Abstract

The Midnight Terror Cave faunal assemblage is unusual in that fish make up 21% of the vertebrate fauna, including four individual parrotfish (*Sparisoma viride*). This analysis examines why this species was selected and explores a performative interpretation that contextualizes these remains within ancient Maya ritual drama. In addition to being part of the “cult of the sea”, the parrotfish was selected because of its blue or green color which symbolizes water, rain, and abundance. The fish’s color fades quickly after death so it is clear that the fish had to be transported alive from the sea coast to the cave. The requirements for the trip are outlined. The analysis lays out the expenditures made for elite ritual and provides a glimpse into the drama of such sacrifices.¹

Key words: Maya, archaeology, fauna, caves, ritual

Between 2008 and 2010, California State University, Los Angeles conducted an intensive survey and surface collection of Midnight Terror Cave as part of the Belize Valley Archaeological Reconnaissance, directed by Jaime Awe. The cave is located some 7 km southeast of Belmopan near the village of Springfield in the Roaring Creek Valley of Belize (Figure 1). The site was reported to the Belizean Institute of Archaeology in 2006 by the residents of the Mennonite community of Springfield after they rescued a looter who had been badly injured in a fall during the middle of the night. The site was mapped by cavers Matt Oliphant and Nancy Pistole and a preliminary assessment was made by Institute personnel.

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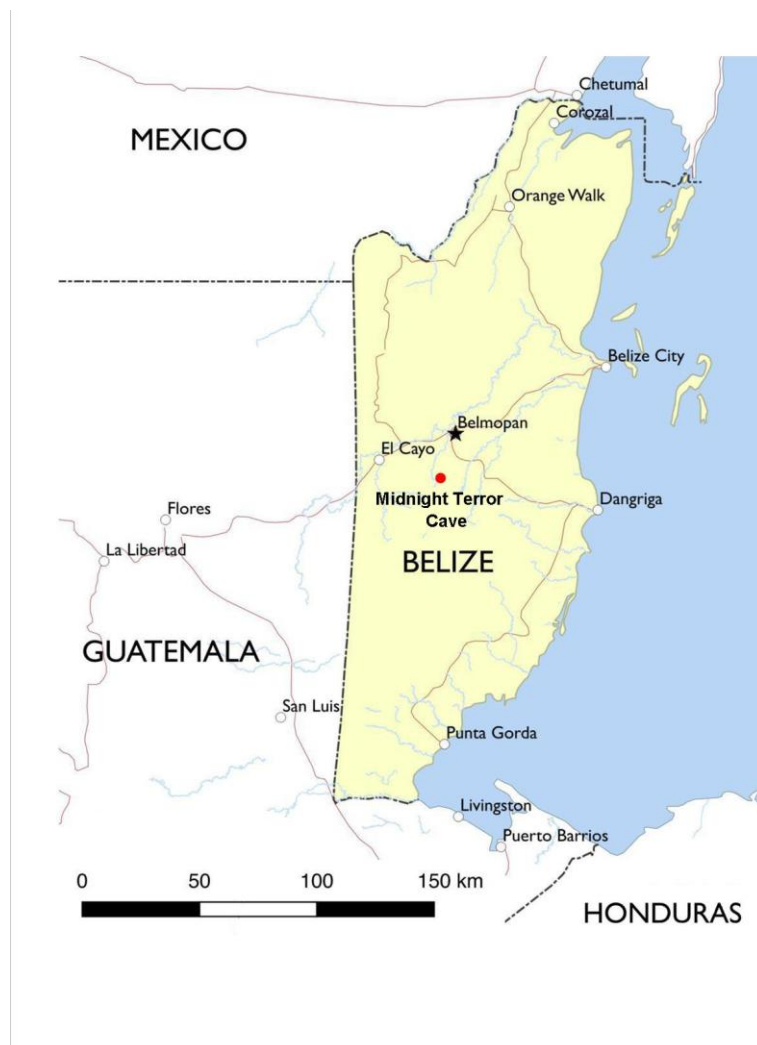


Figure 1: Map of Belize showing the location of Midnight Terror Cave

1. Cave Faunal Analyses in the Maya Area

Faunal remains from Maya caves have not been intensively studied until comparatively recently and early studies focused mainly on northern Yucatan. Henry Mercer was ahead of his time in collecting animal bone from excavations conducted in 10 caves in Yucatan in 1895. The bones were identified by E. D. Cope and the information appears in various locations in Mercer's book, *The Hill-Caves of Yucatan* (Mercer 1896). A.S. Pearse and collaborators made biological collections of vertebrate species found in 27 caves in Yucatan but made no attempt to collect archaeological specimens (Pearse et al. 1938). Biologist Robert Hatt excavated in nine caves during two visits to Yucatan in 1929 and 1947 to collect faunal remains which were then published in *Faunal and Archaeological Researches in Maya Caves* (Hatt et al. 1953). The Carnegie Institution of Washington collected faunal material during their excavations of Mayapan. In what was perhaps the first modern cave faunal analysis, Pollack and Ray (1957) presented the cenote assemblage as a context separate from surface contexts.

Cave faunal analysis begins with David Pendergast's work at Actun Balam (Pendergast 1969), Eduardo Quiroz Cave (Pendergast 1971) and Actun Polbilche (Pendergast 1974), Belize in which faunal material was collected, analyzed and presented as a separate artifact category. Mary Pohl's (1983) work marks the first synthesis of cave faunal assemblages as representing Maya ritual fauna. She devotes an entire section to cave and cenote contexts, which relies on the work of Pendergast and Pollack and Ray. Building on Pohl's synthesis, James Brady (1989) dedicates a chapter of his dissertation on Naj Tunich, Guatemala to the analysis of fauna. The chapter explores the nature of cave assemblages and tested several of Pohl's conclusions.

While cave research picks up in the new millennium, the analysis of cave fauna is somewhat uneven. Rissolo (2001:333-334) recovered fewer than a dozen bones, including human, and does not attempt an analysis of the fauna. Faunal analyses are also missing from Prufer's (2002) cave survey for the Maya Mountains Archaeological Project and Woodfill's (2007) cave survey in the Cancuen area of Alta Verapaz, Guatemala. Morton (2015:571) lists 39 faunal items recovered from the caves of the Central Belize Archaeological Survey and notes that most are riverine gastropods, *jute*. Moyes (2006:198-199) mentions an unspecified number of *jute* being found at Chechem Ha. Peterson (2006) published a short analysis of the 1,186 specimens recovered from caves in the Sibun Valley, 70% of which consists of invertebrates. Ishihara (2007) recovered 4,757 unmodified faunal elements from the *grieta* at Aguateca. She found no preference for young animals over old or left side over right side. A more detailed analysis of the assemblage was to be completed at the Florida Museum of Natural History.

During this period, the analyses of cave fauna have become more theoretical. Some of the best work has been produced by Kitty Emery (2004a, 2004b) and her students, Elyse Anderson (2009) and Erol Kavountzis (2009) using material recovered by the Petexbatun Regional Cave Survey. Halperin and colleagues (2003) surveyed faunal assemblages and note a pattern of depositing and caching of *jute* in caves. They provide ethnographic evidence that after consumption, the Maya return the shells to the earth owner in caves. Linda Brown (2005; Brown and Emery 2008) has also provided ethnoarchaeological data on small caves used as hunting shrines in the Guatemalan Highlands where bones of animals taken in the hunt are returned to the "Owner of the Animals." Brady and Coltman (2016) critique the common practice of identifying bats with the *camazotz* from the Popol Vuh and instead show that bats had a range of symbolic associations. Recently, Brady (2019) has published evidence of bat sacrifice in caves.

2. Midnight Terror Cave Faunal Assemblage

The Midnight Terror Cave faunal assemblage consists of 1,543 elements. One hundred and fourteen of these were articulated *Paca* (gibnut) bones collected from two deposits. These were considered to be intrusive and eliminated from further consideration, leaving 1,429 archaeological faunal elements. The faunal remains recovered from the surface of MTC include mammal, bird, fish, reptile, crustaceans and gastropods. About half of the collection (722 elements) consists of *Pachychilus* sp. (*jute*) shells. *Jute* is unusual in being the only class of animal found in all operations where fauna is located. The 685 vertebrate faunal elements are overwhelmingly concentrated (69%) in Operation IV at the front of the cave and no other operation contains even 10% of the assemblage (Figure 2).

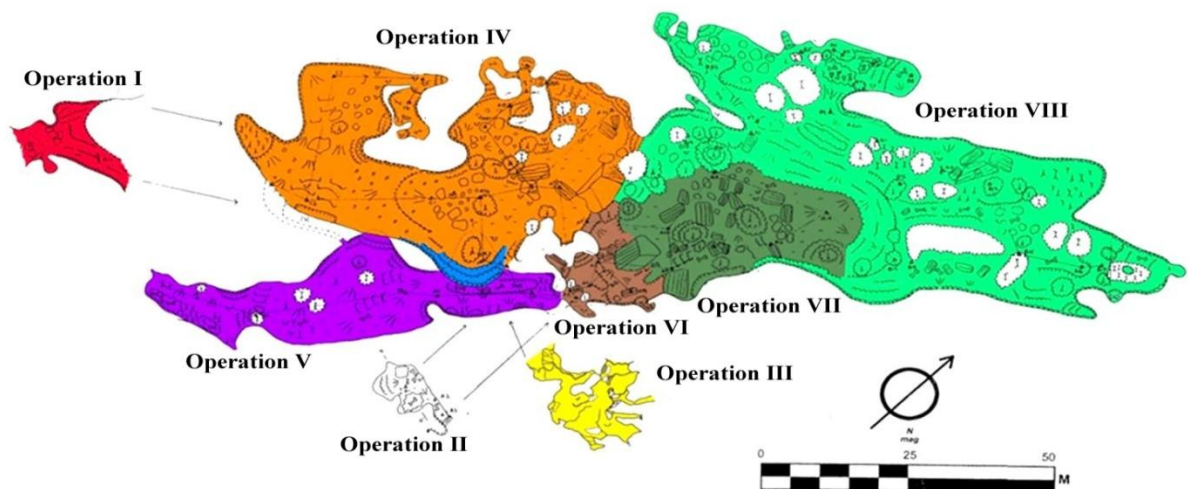


Figure 2: Plan view of Midnight Terror Cave showing the location of operations.

The most unusual aspect of the Midnight Terror Cave faunal assemblage is that 144 of the 685 recovered elements, comprising 21% of the vertebrate fauna, have been identified as fish. No other cave assemblage even comes close to this total. Furthermore, the specialization of our faunal laboratory at Cal State L.A. in marine resources has paid dividend in that a number of the bones have been identified to the species level.

Four individual parrotfish were identified by Orozco based on cranial elements including mandibles and teeth and confirmed by Thomas Wake at the University of California, Los Angeles (Figure 3).



Figure 3: Jaw and skull fragments of parrotfish from Operation IV.

The parrotfish bones at MTC were recovered in several lots in Operation IV, located in the twilight zone at the entrance chamber of the cave. The bones were recovered from the surface of a large platform constructed of a light, yellowish clay mined from another area in Operation IV. The platform is one of three in the cave and is connected to the other two via constructed pathways suggesting that they formed a circuit. They are thought to have been used for large public rituals (Brady and Kieffer 2012). While MTC is best known for its substantial number of victims of human sacrifice, that material is concentrated in two operations deeper in the cave (Prout and Brady 2018) and little human bone is associated with Operation IV. Instead, this platform contained the heaviest concentration of ceramic in the cave, suggesting that distinctive types of rituals were performed in each part of the cave. A looter's pit dug into the platform revealed that two separate floors had been laid down, and micro-excavation into the wall of the pit recovered charcoal that dated both constructions to the Early Classic. The majority of the ceramic, however, dated to the Late to Terminal Classic and the faunal remains most likely date to this later period.

3. The Stoplight Parrotfish

In addition to the individuals at MTC, parrotfish have been identified in archaeological deposits at several sites including Caracol (Teeter 2004:200) and Cozumel Island where it is one of the most commonly occurring species (Hamblin 1984:37). Given this, a closer consideration of the animal is warranted. The fact that four individuals of this species were recovered strongly suggests that this species, and not simply fish in general, was deliberately selected.

The parrotfish bones found in Midnight Terror Cave are of the coastal species *Sparisoma viride*, commonly known as the Stoplight Parrotfish. They are found in shallow waters, from 3 to 50 meters, in depth, in the tropical western Atlantic, and the Caribbean Sea south to Brazil. Stoplight Parrotfish are distinguishable from other species because of their coloration, which can vary greatly over their lifetime.

Most pass through a series of phases - juvenile phase, initial phase and terminal phase - involving significant changes in colors, patterns and body shapes (Bruggemann et al. 1994). Those that reach the terminal phase tend to be larger in size, brighter in colors and more aggressive in behavior. Since parrotfish typically live in harems in which a terminal phase male will oversee two to seven mostly initial phase females (and juveniles), terminal phase males are relatively few in number in the parrotfish population. Initial phase females range in size from 9 to 28 cm while terminal phase males measure 37 – 56 cm in length and weigh up to 1.6 kg. The species has the ability to change sex from female to male during their terminal adult phase. While the biological change in sex is not fully understood, the most dominant female in a harem transforms into a male if the male dies (Cardwell and Liley 1991). All four parrotfish recovered from Midnight Terror Cave are well within the size range of terminal phase animals, with the sizes falling toward that of terminal phase males. At least one specimen reached the large end of the species size range.

4. Discussion

According to Pohl (1983:100), a characteristic of ritual fauna is the use of species that are rare or absent in purely domestic middens. She notes that fish are particularly problematic in this regard because fish bones are rarely recovered from middens, even at sites located on rivers. This is well illustrated at Caracol where bones of marine fish have been recovered but no bones of fresh water species from the Macal River 15 km away have been found (Teeter and Chase 2004:167). Additionally, $\delta^{15}\text{N}$ values from skeletons of individuals at Lamanai on the New River indicate that fresh water fish were not eaten in quantity (White and Schwarcz 1989:467). While she acknowledges that the problem may in part be due to preservation and recovery², Pohl (1983:75) notes that fish bones appear more frequently in burials and caches which are recognized ritual contexts.

The aggregation of fish remains from multiple contexts at inland sites in the southern lowlands tends to obscure a distinction that we are interested in analyzing here. Items such as stingray spines, puffer fish spines, and sharks teeth that are frequently found in burials and caches and, although part of marine vertebrate fauna assemblage (Borhegyi 1961; Moholy-Nagy 2004), entered lowlands in most cases as objects for religious or symbolic use that had already been removed from the animal. They should be separated analytically from bones that represent the remains that had arrived as a fleshed body at the site either alive or prepared in some manner (e.g. salted, dried or cooked). At Caracol, for instance, the faunal assemblage of over 84,000 elements recovered only 197 fish bones (Teeter and Chase 2004). Even this is misleading, however, because over a quarter of that number consisted of stingray spines and sharks teeth recovered from a cache account for more of the assemblage. Thus, only a small number of bones could be attributed to actual fish brought to Caracol. This is important in that it undermines any discussion of fish as a food source (Lange 1971; Chase et al. 2004:15) and, not surprisingly, White and Schwartz (1989) found no isotopic evidence of marine resources in the diet at inland sites except for an elite male in a tomb burial at Lamanai.

Pohl (1983:74-75, 78) associates fish, along with shells, coral and other marine objects with the “cult of the sea” related to renewal, rebirth, water, and rain. As already noted, the objects recovered from burials and caches are generally seen as having a ritual function. Because of their strongly religious connection, faunal analysts should give serious consideration to the idea that all the marine remains are ritual fauna. Interestingly, ritualized behavior involving fish has been documented ethnographically in caves at the Cueva de Villa Luz, Tabasco, Mexico (Eliot 2001; Hose 1999, 2001; Hose and Pisarowicz 1999; Porter Núñez 2003) and in Nenton, Huehuetenango, Guatemala (Brady and Garza 2012). In these cases, the fish are consumed as part of communal feasting associated with the onset of the rainy season. Thus, the consumption of the fish does not negate their ritual connections.

The recognition that the parrotfish at MTC are associated with public ritual in constructed space is important because the agenda of the performance is invariably set by the elite who brought the space into existence. Midnight

Terror Cave is located within a half kilometer of the major center of Tipan Chen Uitz and no other cave in the area has received the elaboration reported from MTC (Morton 2015). Thus, the platform in Operation IV was an important ritual stage for the rulers of Tipan Chen Uitz.

While we agree with Pohl's assessment of the symbolic associations of the cult of the sea, our intention is to explore a behavioral, performative interpretation that contextualizes these remains within ancient Maya ritual drama. Evidence suggests that the Stoplight Parrotfish found in MTC were large and probably male, which strongly suggests that the parrotfish were chosen specifically for both their size and color. The brilliant blue and green parrotfish are visually spectacular with the colors symbolizing water, life and wealth (Figure 4). Our contention is supported by Götz and Stanton's (2013:220) observation that, "it appears that many of the animals used for ritual activities were characterized by visually distinctive features (e.g., bright feathers or colorful hide)." Because this was a performance, size was also important. Equally colorful but smaller species, such as the damselfish which only grow to 15 cm, were ignored for the much larger parrotfish.

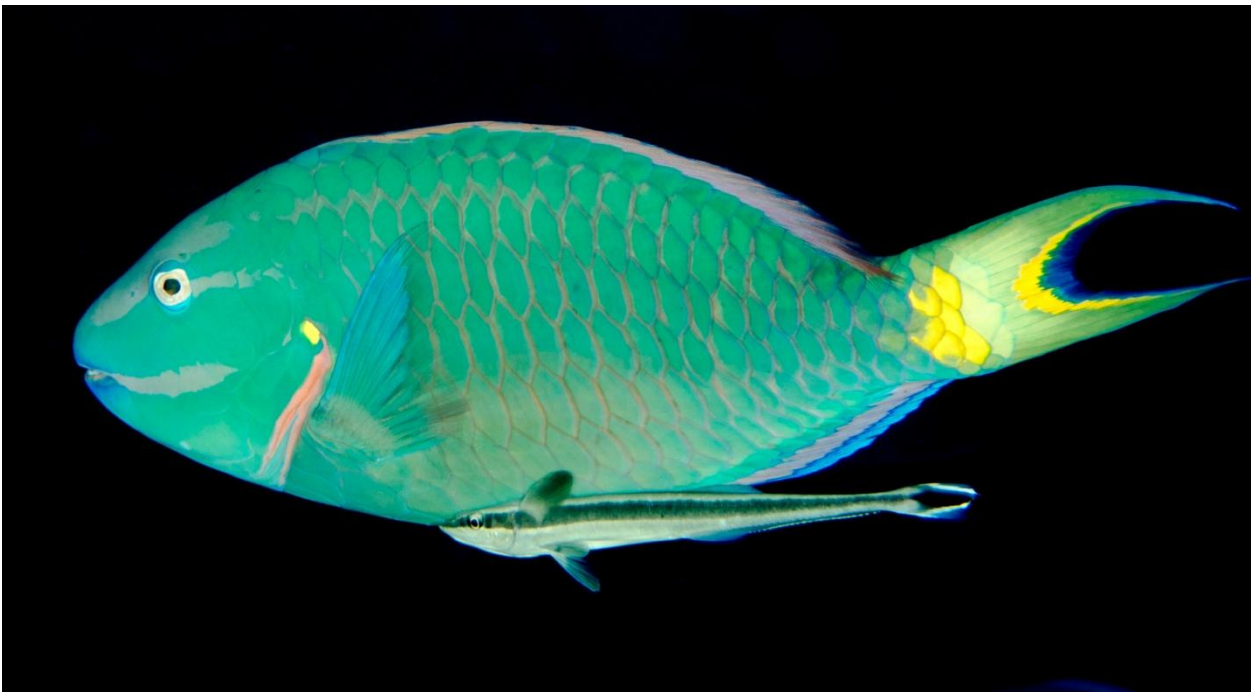


Figure 4: Photograph showing the brilliant coloration of the Stoplight Parrotfish.

If parrotfish were selected for their color, the Maya faced an immediate problem because the bright color fades rapidly when the fish dies. It seems clear, therefore, that the Stoplight Parrotfish sacrificed in MTC had to have been delivered alive. Professionals with extensive knowledge of Stoplight Parrotfish both in captivity and in the wild outlined the parameters of what would be required. In checking with fish importers for aquariums, we were told that live fish are sometimes transported in baskets by locals when other methods, such as plastic bags, are not available (Weitz, personal communication, 2019). This was most likely the method utilized by the Maya who could have fabricated a large basket made watertight using rubber. The Aztecs regularly used rubber to waterproof clothing (Torquemada 1977:430), capes, boots and hats (Clavijero 1964, Bk 1, Ch. 2:20-21). The most serious problem is providing enough room in a container for the fish, water and air to breathe. Depending on the shape of the container, a single adult Stoplight Parrotfish would require no more than 10 gallons of water to make such a journey, leaving room for a second, or possibly third, fish (Weitz, personal communication, 2019). If two or three sets of porters shifted the load, the 45 km trip from the Belizean coast to MTC could be made in two days or less. Spotlight Parrotfish are a relatively hardy species that could, according to experts, not only survive such a trip, but also be in reasonably good condition at the end of it (Weitz, personal communication, 2019).

The transport of the fish is another issue. In Central Mexico at the time of the conquest, this would have involved professional porters known as *tlameme*. The amount that a *tlameme* could carry and the distance that they could travel in a day is uncertain. After the conquest, the Spanish set limits on the size of loads to two arrobas (23 kg)

and distances to 5 leagues (21-28 km) per day but Hassig (1985: 32-33) suggests that this may have been lower than in pre-Hispanic times. If the basket was suspended from a pole and carried by two porters, the weight could be doubled. At 1.5 kg per gallon, this would allow the container to hold up to 30 gallons, far more than sufficient to transport an adult parrotfish over a one or two day period. Successful transportation of fish requires only enough water to slightly cover the fish. As important is the space at the top of the container to provide oxygen, cut down on water spillage and to keep the fish from being able to jump out.

Cunningham-Smith and colleagues provide a somewhat different model for transporting a ray found in a cache at Caracol to the site alive. They suggest riverine transport up the Belize River to the Macal River. The trip would take at least four days by canoe with the ray in a five gallon ceramic vessel with additional vessels of sea water available to replenish and oxygenate the water (Cunningham-Smith et al. 2014:47). The authors recognize that the ray's use in ritual but their interest is in a similar mechanism being used for elite food consumption. While they recognize that such a system would never have been used to feed the masses, it may have been applicable to the high elite.

In exploring a performative perspective, it is instructive to apply a *chaine opératoire* approach to the ritual. Mary Pohl (1983:100) has suggested that the procurement of fauna for ritual may have been a specialized activity. We see some evidence to support this proposition. Tozzer (1941:117; note 535) notes "There seem to have been certain persons whose office (*oficio*) was to obtain children for sacrifice by kidnapping." Such a position may have been a holdover of a more general office charged with securing offerings or perhaps organizing the entire ritual performance. Logically, the chain of activities was undoubtedly initiated from within the Tipan Chen Uitz bureaucracy with political links to a fishing community on the coast to request the fish be caught alive. This same office would then have arranged for the fabrication and waterproofing of the basket and the transport of the fish from the coast to the cave.

The high degree of modification documented in creating public space within the cave clearly indicated that MTC was appropriated by the rulers of Tipan Chen Uitz. Inomata (2006) has argued that an integral part of Maya kingship was the performance of public theatrical events. He further notes that such rituals often utilized the sacred landscape and specifically mentions their occurring in caves (Inomata 2006: 810). It is difficult to imagine a more dramatic scene than the ruler of Tipan Chen Uitz pulling a large, live blue/green fish from a bowl for sacrifice. In moving from bones to a whole fish and then incorporating that fish into a ritual, we have attempted to draw out the chain of operations required for putting on the ritual performance. Viewed in this way, the faunal remains allow us to appreciate the mounting evidence that elite ritual involved a significant expenditure of resources (Brady 2005). It emphasizes the ruler's unique position as the only one with the wherewithal and political connections to make such an elaborate offering.

4. Conclusions

This analysis of faunal material recovered from Midnight Terror Cave has attempted to highlight the unusually high number of fish bones in the assemblage and has sought, moreover, to go beyond the simple identification of bones. In doing this, the parrotfish's brilliant blue and green coloration must have had the same allure as quetzal feathers. This led to an attempt to contextualize the fauna within the drama of public ritual. While the parrotfish lends itself to that type of performance, it required getting the parrotfish to the cave alive. We proposed a chain of activities that were undoubtedly initiated within the Tipan Chen Uitz bureaucracy. The scenario outlined here provides not only a glimpse into the drama of such sacrifices but also provides a deeper appreciation of the expenditures made for elite ritual. Finally, if the ritual is further contextualized within a "drought cult" arising from the Late and Terminal Classic climatic instability, then one can readily appreciate that the legitimacy of the royal office may have been riding on the success of such petitions for rain (Moyes et al. 2009).

5. Acknowledgements

Archaeological investigation was carried out with the permission of the Belizean Institute of Archaeology and the authors would like to thank the Institute for its continued support. Field research was supported by generous grants from the Cotsen Family Foundation. The authors wish to thank Matt Oliphant and Nancy Pistole for the use of their map of MTC. Thomas Wake at UCLA provided invaluable aid in the identification of the faunal material and Kitty Emery made extensive comments on an early draft of this paper. Mark Weitz of Mark's Tropical Fish offered

expert advice on both parrotfish behavior and live fish transportation, and Jorge Yamamoto for his parrotfish photographs.

End Notes

1. An earlier version of this paper was presented at the 78th Annual Meeting of the Society for American Archaeology, Honolulu, HI, April 3-7, 2013.
2. It should be noted, however, that more recently substantial quantities of fish bone have been recovered at Trinidad de Nosotros on Lake Peten Itza using more intensive recovery techniques (Thornton 2012).

References Cited

- Anderson, E. M. (2009). Exploring Maya ritual fauna: caves and the proposed link with contemporary hunting ceremonialism. M.A. thesis, Department of Anthropology, University of Florida, Gainesville.
- Borhegi, S. F. de, (1961). Shark teeth, stingray spines, and shark fishing in ancient Mexico and Central America. *Southwestern Journal of Anthropology*, 17, 273-296.
- Brady, J. E. (1989). An investigation of Maya ritual cave use with special reference to Naj Tunich, Peten, Guatemala. Ph.D. dissertation, Archaeology Program, University of California, Los Angeles.
- Brady, J. E. (2005). The impact of ritual on ancient Maya economy. In K. M. Prufer and J. E. Brady (Eds.), *Stone houses and earth lords: Maya religion in the cave context*, (pp. 115-134). Boulder: University Press of Colorado.
- Brady, J. E. (2019). Evidence of bat sacrifice in ancient Maya cave ritual. *Archaeological Discovery*, 7, 84-91.
- Brady, J. E. & Coltman, J. D. (2016). Bats and the *camazotz*: correcting a century of mistaken identity. *Latin American Antiquity*, 27, 227-237.
- Brady, J. E. & Garza, S. (2009). Caves and fish in Mesoamerica: an initial consideration. In J. E. Brady (Ed.), *Exploring highland maya ritual cave use: archaeology & ethnography in Huehuetenango, Guatemala*, (pp. 55-59). Bulletin 20, Austin, TX: Association for Mexican Cave Studies.
- Brady, J. E. & Kieffer, C. L. (2012). Preliminary observations on the investigation of Midnight Terror Cave, Belize. *Research Reports in Belizean Archaeology*, 9, 245-253.
- Brown, L. A. (2005). Planting the bones: hunting ceremonialism at contemporary and nineteenth-century shrines in the Guatemalan highlands. *Latin American Antiquity*, 16, 131-146.
- 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, 300-337.
- Bruggemann, J. H., van Oppen, M. J. H., & Breeman, A. M. (1994). Foraging by the Stoplight Parrotfish *Sparisoma viride*. I. Food selection in different, socially determined habitats. *Marine Ecology Progress Series*, 106, 41-55.
- Cardwell, J. R. & Liley, N. R. (1991). Hormonal control of sex and color change in the stoplight parrotfish, *Sparisoma viride*. *General and Comparative Endocrinology*, 81, 7-20.
- Chase, A. F., Chase D. Z. & Teeter, W. G. (2004). Archaeology, faunal analysis and interpretation: lessons from Maya studies. *Archeofauna*, 13, 11-18.
- Clavijero, F. J. (1964). *Historia antigua de México*. Editorial Porrúa: Mexico.
- Cunningham-Smith, P., Chase, A. F. & Chase, D. Z. (2014). Fish from afar: marine resource use at Caracol, Belize. *Research Reports in Belizean Archaeology* 11, 43-53.
- Eliot, J. L. (2001). Deadly haven: Mexico's poisonous cave. *National Geographic*, 199, 5, 70-85.
- Emery, K. F. (2004a). Animales del inframundo maya: reconstruyendo los rituales de las élites a través de los restos animales de la Cueva de Los Quetzales, Guatemala. In J. P. Laporte, B. Arroyo, H. Escobedo & H. Mejía (Eds.), *XVII simposio de investigaciones arqueológicas en Guatemala, 2003*, (pp. 203-222). Guatemala: Museo Nacional de Arqueología y Etnología.
- Emery, K. F. (2004b). Animals from the Maya underworld: reconstructing elite Maya ritual at the Cueva de los Quetzales, Guatemala. In S. J. O'Day, W. Van Neer, A. Ervynck (Eds.), *Behaviour behind bones: the zooarchaeology of ritual, religion, status and identity*, (pp. 101-113). Oxford: Oxbow Books.
- Götz, C. M. & Stanton, T. W. (2013). The use of animals by the pre-hispanic Maya of the northern lowlands. In C. M. Götz & K. F. Emery (Eds.), *The archaeology of Mesoamerican animals*, (pp. 191-232). Atlanta: Lockwood Press.

- Halperin, C. T., Garza, S., Prufer, K. M. & Brady, J. E. (2003). Caves and ancient Maya ritual use of *jute*. *Latin American Antiquity*, 14, 207-219.
- Hamblin, N. L. (1984). *Animal use by the Cozumel Maya*. Tucson: University of Arizona Press.
- Hassig, R. (1985). *Trade, tribute, and transportation: the sixteenth-century political economy of the valley of Mexico*. Norman: University of Oklahoma Press.
- Hatt, R. T., Fisher, H. I., Langebartel, D. A. & Brainerd, G. W. (1953). *Faunal and archaeological researches in Yucatan caves*. Bulletin No. 33. Bloomfield Hills, MI: Cranbrook Institute of Science.
- Hose, L. D. (1999). Cave of the sulfur eaters. *Natural History*, 108, 3, 54-61.
- Hose, L. D. (2001). La pesca de la sardina - 2001. *National Speleological Society News*, 59, 221-246.
- Hose, L. D. & Pizarowicz, J. A. (1999). Cueva de Villa Luz, Tabasco, Mexico: reconnaissance study of an active sulfur spring cave and ecosystem. *Journal of Cave and Karst Studies*, 61, 13-21.
- Inomata, T. (2006). Plazas, performers, and spectators political theaters of the classic Maya. *Current Anthropology*, 47, 805-842.
- Ishihara, R. (2007). *Bridging the chasm between religion and politics: archaeological investigations of the grietas at the late classic Maya site of Aguateca, Peten, Guatemala*. Ph.D. dissertation, Department of Anthropology, University of California, Riverside.
- Kavountzis, E. G. (2009). *Evaluating cave use through spatial analysis of animal remains from Maya caves in Guatemala and Belize*. M.A. Thesis, Department of Anthropology, University of Florida, Gainesville.
- Lange, F. W. (1971). Marine resources: a viable subsistence alternative for the prehistoric lowland Maya. *American Anthropologist*, 73, 619-639.
- Mercer, H. C. (1896). *The hill-caves of Yucatan: a search for evidence of man's antiquity in the caverns of Central America*. Philadelphia: J. B. Lippincott.
- Moholy-Nagy, H. (2004). Vertebrates in Tikal burials and caches. In K. F. Emery (Ed.), *Maya zooarchaeology: new directions in methods and theory*, (pp. 193-205). Cotsen Institute of Archaeology, Monograph 51. Los Angeles: University of California.
- Morton, S. G. (2015). *Pahn-Ti-Pan: the rise and fall of complex socio-political and economic systems as attested in subterranean site contexts of Central Belize, C.A.* Ph.D. dissertation, Department of Anthropology and Archaeology, University of Calgary.
- Moyes, H. (2006). *The sacred landscape as a political resource: a case study of ancient Maya cave use at Chechem Ha Cave, Belize, Central America*. Ph.D. dissertation, Department of Anthropology, State University of New York at Buffalo.
- Moyes, H., Awe, J. J., Brook, G. A. & Webster, J. W. (2009). The ancient Maya drought cult: late classic cave use in Belize. *Latin American Antiquity*, 20, 175-206.
- Pearse, A. S. and Collaborators. (1938). *Fauna of the caves of Yucatan*. Publication 491. Washington, D.C.: Carnegie Institution of Washington.
- Pendergast, D. M. (1969). *The prehistory of Actun Balam, British Honduras*. Art and Archaeology Occasional Paper No. 16. Toronto: Royal Ontario Museum.
- Pendergast, D. M. (1971). *Excavations at Eduardo Quiroz Cave, British Honduras (Belize)*. Art and Archaeology Occasional Paper No. 21. Toronto: Royal Ontario Museum.
- Pendergast, D. M. (1974). *Excavations at Actun Polbilche, Belize*. Monograph 1. Toronto: Royal Ontario Museum.
- Peterson, P. A. (2006). *Ancient Maya ritual cave use in the Sibun Valley, Belize*. AMCS Bulletin 16. Austin: Association for Mexican Cave Studies.
- Pohl, M. (1983). *Maya ritual faunas: vertebrate remains from burials, caches, caves, and cenotes in the Maya lowlands*. In R. M. Leventhal & A. L. Kolata (Eds.), *Civilization in the ancient Americas: essays in honor of Gordon R. Willey*, (pp. 55-103). Albuquerque: University of New Mexico Press.
- Pollock, H. E. D. & Ray, C. E. (1957). *Notes on vertebrate animal remains from Mayapan*. Current Reports No. 41. Washington, D.C.: Carnegie Institution of Washington.
- Porter Núñez, R. (2003). *La pesca de la sardina: milenaria ceremonia en Tobasco*. México Desconocido, 314, 18-24.
- Prufer, K. M. (2002). *Communities, caves and ritual specialists: a study of sacred space in the Maya Mountains of southern Belize*. Ph.D. dissertation, Department of Anthropology, Southern Illinois University, Carbondale.

- Rissolo, D. A. (2001). Ancient Maya cave use in the Yalahau region, northern Quintana Roo, Mexico. Ph.D. dissertation, Department of Anthropology, University of California, Riverside.
- Teeter, W. G. (2004). Animal utilization in a growing city: vertebrate exploitation at Caracol, Belize. In K. F. Emery (Ed.), *Maya zooarchaeology: new directions in methods and theory*, (pp. 177-191). Cotsen Institute of Archaeology, Monograph 51. Los Angeles: University of California.
- Teeter, W. G. & Chase, A. F. (2004). Adding flesh to bone: using zooarchaeology research to answer big picture questions. *Archaeofauna*, 13, 155-172.
- Thornton, E. K. (2012). Animal resource use and exchange at an inland Maya port: zooarchaeological investigations at Trinidad de Nosotros. In A. Foias & K. Emery (Eds.), *Motul de San Jose: politics, history and economy in a classic Maya polity*, (pp. 326-356). Gainesville: University of Florida Press.
- Torquemada, J. de. (1977). *Monarquía indiana: de los veinte y un libros rituales y occidentales, de sus poblaciones, descubrimiento, conquista, conversión y otras cosas maravillosas de la misma tierra*, vol. 4. Mexico: Universidad Nacional Autónoma de México.
- Tozzer, A. M. (1941). *Landa's relación de las cosas de Yucatan: a translation*. Papers of the Peabody Museum of American Archaeology and Ethnology, Vol. 18. Cambridge: Harvard University.
- White, C. D. & Schwarcz, H. P. (1989). Ancient Maya diet: as inferred from isotopic and elemental analysis of human bone. *Journal of Archaeological Science*, 16, 451-474.
- Woodfill, B. K. S. (2007). *Shrines of the Pasion-Verapaz Region, Guatemala: ritual and exchange along an ancient trade route*. Ph.D. dissertation, Department of Anthropology, Vanderbilt University.