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# Testing osteometric and morphological methods for turkey species determination in Maya faunal assemblages

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ABSTRACT

Identification of turkey (*Meleagris* spp.) remains in Maya archaeological deposits is problematic because the two species that co-existed during ancient Maya occupations are extremely difficult to separate osteologically. One species, *M. gallopavo*, was introduced from northern Mexico possibly multiple times. The other species, *M. ocellata*, is indigenous and was possibly husbanded though never domesticated. The two species are morphologically very similar, their size distributions overlap, and their responses to environmental conditions and human manipulation may have led to non-species delimited skeletal changes. Limited information has, so far, been available to distinguish the two species, and most analysts prefer to identify this group to the genus level only. However, the turkey is the only domesticated fowl of the New World, and is one of only two domesticated vertebrates in North/Central America. It was a source of food, medicines, feathers, and artifacts, an emblem of status and an actor in pivotal ceremonial events. Thus distinguishing among the two species, and recognizing markers of husbandry and domestication, are essential to our understanding of Maya animal use. In this study we review the key morphological and metric diagnostic features of the species and the methods that we have used to develop and test effective morphological and metric characters for distinguishing the two Maya turkeys. This study is based on our ongoing analysis of 55 modern individuals and over 2000 archaeological specimens from Preclassic through Colonial Maya assemblages.

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## 1. Introduction

The basis of all zooarchaeological analysis is the biologically-linked phenotypic variation between different animal species. But recent studies have revealed that the quality of our zooarchaeological assessments can be compromised by insufficient attention to the characters used in our comparative evaluation. Further, the quality of regional studies that draw on published datasets can suffer as a result of the use of ineffective characters or metrics in basic identification (see, especially, Atici et al., 2012; Driver, 2011; Wolverton, 2013). Archaeological remains are compared to the skeletal elements of modern exemplars of various species and are identified by similarity to these comparative specimens. Variation among individuals of a species is recognized and used in zooarchaeological research (Bochenski, 2008). However, despite our recognition of these individual variations and particularly variations between individuals from different regions or with different life-histories, our comparative collections typically include only a few individuals of most species. This is entirely reasonable given the financial and space costs of collection and curation and is balanced by our need to also include at least one example of each possible species within the geographic and temporal range of our lab's specialization. Many species can be identified by diagnostic features that are reported by taxonomist specialists in the biological literature and are known not to repeat among closely related species (either homologous or taxonomically related). Unfortunately, many other species cannot be as easily separated zooarchaeologically because osteological characters are more conservative than external features like hide or feather coloration which are often the basis for taxonomic differentiations by neontologists. Furthermore, the potential for interspecies hybridization, an occurrence observed among many extant vertebrates, is rarely recognized in the archaeological and fossil record (Bochenski and Tomek, 2000). In these cases, it is vital that analysts take particular care to compare archaeological specimens with many modern exemplars, or to diagnostic metric and morphological trait lists. These trait lists, however, are hard to come by and generally are not the subject of biological studies since neontologists have a wider range of characters to use when species are skeletally similar.

In Maya zooarchaeology, several species groups are especially problematic for identification because they are osteologically very similar and simultaneously very different in cultural or ecological terms. Thus our research is often stymied by an inability to distinguish among

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these problematic species groups. Primary among these in Maya research are the two species of turkey (*Meleagris*) found in the region, one indigenous only to the Maya area (*M. ocellata* or Ocellated Turkey) and one introduced by trade from its natural range in central/northern Mexico (*M. gallopavo gallopavo* or Southern Mexican Wild Turkey). Several ornithological studies have shown that the two birds are virtually identical osteologically, and unfortunately also very similar metrically (Bochenski and Campbell, 2005, 2006; Steadman, 1980). Bochenski and Campbell's (2006) morphological analysis finds that while 25 of the 55 traits they used are characteristic of *M. ocellata*, only five were exclusive of *M. gallopavo*. Sample size may also hinder morphological comparisons because the reference collection may not cover the entire range of intraspecific morphological variation. Steadman (1980:132) noted that his sample of 16 *M. gallopavo* and seven *M. ocellata* provided more effective characters for separation than did smaller samples analyzed by earlier researchers (for example, Brodkorb, 1964a, 1964b; Howard, 1927; Rea, 1980; Shufeldt, 1914), and Bochenski and Campbell's (2006) sample of 20 Ocellated Turkeys and 51 Wild Turkeys is by far the largest so far used.

Despite their osteological similarity, the two birds could not be more different in terms of their habits and habitats, and the cultural implications of their recovery in archaeological deposits. The Ocellated Turkey is a wild game bird native to the Maya region that is found primarily in forested and edge-zone habitats, and occasionally in agricultural fields. *M. gallopavo*, on the other hand, is a non-local domestic bird introduced to the Maya region during prehistoric times (Valadez Azúa, 2003; Thornton et al., 2012). As such it is assumed to have been a household commensal, feeding on human-provided maize and insect pests around the residential zone (Hale and Schein, 1962; Schorger, 1966; Steadman et al., 1979; Williams et al., 2010). Regardless of species, wherever the turkey is found, past or present, it is associated with ceremony, elite status-enhancing activities, and politically important settlements. It is common in both preHispanic iconography and codices, and in ethnohistoric documents from early in the contact period. Both birds were clearly valued for their meat, plumage, and symbolic meanings (Camacho-Escobar et al., 2011; Corona, 2008, 2013; Kockelman, 2011; Nimis, 1982; Pohl, 1983; Pohl and Feldman, 1982; Sharpe, 2014; Thornton et al., 2012; Tozzer, 1941; Tozzer and Allen, 1910). Their zooarchaeological separation therefore is imperative in the Maya area in order to understand the process of husbandry and domestication and whether it was a single or duplicated process, the diffusion of the bird as well as the "idea" of animal husbandry, and the stages of incorporation of wild and domesticated birds into the social system.

Many new methods have been developed for distinguishing problematic species, chief among them aDNA, protein peptides, isotopic variations based on feeding differences, and detailed three-dimensional modeling of osteometric trait complexes (for example, Morey, 2014; Owen et al., 2014). Unfortunately, most zooarchaeologists are not able to fund such methods, and in many cases where meleagrid specimens are rare, do not wish to conduct destructive analysis on these valuable specimens. Thus an important goal for our interdisciplinary study of Maya turkeys has been to create a standardized, clear, and replicable set of diagnostic and metric traits that can be used for discriminating osteological specimens of these species across the Maya area. This paper describes the methods we are using to evaluate our metric and morphological diagnostic trait list to ensure that the methods we recommend are low-cost, accurate, and effective.

## 2. Methods

To compile a dataset of known metric and morphological parameters for identification of meleagrid species and sex, we reviewed measurements and descriptors from the literature (Bochenski and Campbell, 2006; Olsen, 1968; Steadman, 1980; von den Driesch, 1976). We first tested these parameters on a small sample of modern galliform individuals from the Environmental Archaeology and Ornithology collections of the Florida Museum of Natural History (FLMNH) (Table 1). Closely related galliform birds belonging to the family Cracidae (*Crax rubra* – Great Curassow, and *Penelope purpurascens* – Crested Guan) were also included in our morphological and metric analyses due to their potential confusion with turkeys in Maya zooarchaeological assemblages. Lead authors Emery and Thornton assessed the utility of the previously reported morphological characters distinguishing Ocellated and Wild Turkeys by visual comparison and semi-blind testing of modern skeletal specimens. We rejected any morphological characters that were either not viable from the outset (unclear or indistinguishable characters) or were so variable among the specimens as to have resulted from individual variation rather than taxonomic or sex-derived traits. The final morphological trait list was then described and illustrated by drawings and photographs to ensure accurate interpretation of the written character trait descriptions. Skeletal measurements described for generalized turkeys (Olsen, 1968) and specific to Ocellated or Wild Turkeys (Bochenski and Campbell, 2006; Steadman, 1980) were combined to produce a comprehensive list of osteometrics. Illustrated guides were also produced to clarify the osteometric procedures.

All team members were instructed on recognizing the morphological characters and collecting osteometric data using standardized techniques. We defined single analysts or analyst pairs for each of the two types of studies to mitigate multiple analyst bias. Morphological analysis was done by teams of two or more researchers led by either Erin Thornton or Kitty Emery, with Thornton making all final determinations. Osteometric data was collected by Lisa Duffy and Petra Cunningham-Smith working as a team with Duffy always measuring and Cunningham-Smith always doing data entry. This work was supervised by Emery. Measurements were made using metric digital calipers equipped with an RS-232 interface to enter data directly into Microsoft Excel spreadsheet forms.

Our protocol for morphological assessment of the meleagrids included a character state scoring system wherein two character states were defined for each trait on the element, one representing *M. gallopavo*, and the other *M. ocellata*. We also applied a "confidence value" when scoring for each character. This value ranged from 1 (highest) to 4 (lowest), and is useful for understanding the effectiveness of the character list, and for weighting the results of our archaeological assessment. For example, an identification of several characters as *M. gallopavo* but with poor confidence rankings may be trumped by a single score as *M. ocellata* with a high confidence rank. After assessing each trait individually, the analyst then assigned a species identification to the element as a whole using any combination of the traits assessed, also ranking this identification by confidence. This overall assessment might or might not agree with the preponderance of the scored traits. This method allowed an assessment of the effectiveness of each trait in identifying the specimens as well as allowing a comparison between an identification based on single traits and an identification based on whole-element analysis. Traits were always accompanied by character descriptions to ensure we were describing the correct variation in that trait. All morphological assessments of modern birds were done with reference to the compiled illustrations and photographs, while archaeological specimens were identified in comparison to both the reference manual and modern specimens.

To test the extent to which our metric character set replicated known taxonomy and sex, we first applied it to the large pool of modern birds curated at FLMNH (Environmental Archaeology and Ornithology collections) and then to comparative specimens stored in the Universidad Autónoma de Yucatán (UADY) Zooarchaeology lab in Mérida, Mexico (Table 1). A few representative modern specimens were used to test the accuracy of the morphological characters, but to further test the value of these characters, we also conducted a blind test of our morphological trait list by providing 10 volunteers with trays of unlabeled modern bones representing both *M. ocellata* and *M. gallopavo*. The bones included at least three specimens per element