Introduction to the special issue - Turkey husbandry and domestication: Recent scientific advances

Erin Kennedy Thornton *
Washington State University, Department of Anthropology, College Hall 150, Pullman, WA 99164-4910, USA

ARTICLE INFO
Available online xxx

Keywords:
Animal domestication
Turkey (Meleagris gallopavo)
Mesoamerica
Southwest

ABSTRACT
The turkey (Meleagris gallopavo) is unique in being the only major vertebrate animal domesticated in ancient North/Central America. Despite its unique status, its history of use, management, and domestication has received relatively little attention in comparison to other domesticated animals. The history of turkey management and domestication is thus a large gap in our knowledge of animal husbandry, and how and why animal domestication developed in ancient North/Central America. This introductory article presents background on the history of turkey husbandry and domestication research to contextualize the collected papers presented in this special issue of the Journal of Archaeological Science: Reports. The contribution of each paper is discussed in regards to past and current research trends, and how they articulate with likely directions for future research.

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1. Introduction

Through the process of animal domestication, humans assumed increasing control over animal resources and fundamentally altered how they interacted with and impacted their environment. The topic of animal domestication is therefore of crucial importance to understanding past human societies and evolving human-animal relationships. Although animal domestication has always been a major focus of zooarchaeological research, the topic has received increasing attention in recent years due at least in part to advancements in the field of archaeogenetics (e.g., Almathen et al., 2016; Frantz et al., 2016; Kadowaki et al., 2016; Larson et al., 2012; Kimura et al., 2011; Miao et al., 2013; Xiang et al., 2014).

Animal domestication independently emerged on several continents during prehistoric times, but only a single vertebrate animal – the turkey (Meleagris gallopavo), was domesticated in ancient North America (i.e., the combined North and Central American sub-continents). We know relatively little about turkey domestication in comparison to what we know about the domestication of other animals, and still less about the unique context and process of North American animal domestication. Recent research indicates that the history of turkey husbandry (i.e., management, care or breeding) may have been highly complex including multiple locations of domestication, ongoing use of wild turkeys alongside domesticated flocks, potential breeding between wild and domestic populations, and a diversity of management or husbandry techniques (Corona-M., 2013a, 2013b; McCaffery et al., 2014; Munro, 2011; Speller et al., 2010; Thornton and Emery, 2015).

The history of turkey management and domestication in North America is thus a large gap in our knowledge of animal husbandry, a subject that relates to important aspects of subsistence systems, animal meanings, and human-environment interactions in the ancient Americas.

The collection of papers in this special issue of the Journal of Archaeological Science: Reports represents recent advances in our understanding of turkey husbandry and domestication in the archaeological record. Initial versions of many of the papers were presented in an organized session entitled “Recent Advances in Understanding Past Turkey Husbandry and Use” at the 2014 International Council for Archaeozoology (ICAZ) meeting in San Rafael, Argentina. The collected papers focus not just on turkey domestication, which by many definitions includes selective breeding (Vigne, 2011; Zeder, 2006), but also on the broader concept of turkey management, provisioning, and rearing, which we refer to as animal husbandry. Multiple papers address turkey husbandry in Mesoamerica and the American Southwest (this volume: Conrad et al.; Emery et al.; Fothergill; Götz et al.; Jones et al.; Lapham et al., Manin et al.; Martinez and Corona-M.; Speller and Yang; Thornton et al.), the two currently identified independent origin centers of turkey domestication (Speller et al., 2010). Other papers in the collection present novel data from much less well-researched areas including Southeastern and Northeastern North America (Morris et al., this volume; Peres and Ledford, this volume) and the Caribbean (Reitz et al., this volume). Methodologically, the authors employ a suite of tools including genetics, stable isotopes, osteometrics, paleoanthropology, scanning electron microscopy, and modern ethnography. The collected papers’ methodological and geographic breadth expands the

* Washington State University, Department of Anthropology, College Hall, Room 150, PO Box 644910, Pullman, WA 99164-4910, United States. E-mail address: erin.thornton@wsu.edu.

Please cite this article as: Thornton, E.K., Introduction to the special issue - Turkey husbandry and domestication: Recent scientific advances, Journal of Archaeological Science: Reports (2016), http://dx.doi.org/10.1016/j.jasrep.2016.07.016
scope of previous turkey domestication research and contributes novel perspectives on the history, process and practice of turkey husbandry.

One of the major goals of producing this special issue is to promote greater collaboration and communication between researchers studying turkey husbandry and domestication in various cultural areas. We have thus decided to organize the papers topically and methodologically rather than geographically, with the caveat that many of the papers employ multiple methodological approaches and address various aspects of turkey husbandry. This organization allows for greater comparison of approaches to unraveling the history of turkey domestication across the species’ natural and anthropogenic range. We also present a summary of the papers according to geographic area and methodological approach to illustrate additional connections among papers that may not be reflected in the articles’ running order (Table 1).

2. Turkey taxonomy and geographic distribution

Domestic and wild turkeys are both classified as Meleagris gallopavo. Ornithologists refer to the bird in its undomesticated form as the Wild Turkey. When capitalized, this common name conforms to ornithological classification and nomenclature, which uses standardized common names (indicated by capitalization) in addition to binomial nomenclature (genus and species). This common name, however, is problematic for archaeologists who often need to refer to the species in both its wild and domestic forms, and who may want to refer to the species without having to definitively classify where individuals fall on the wild-to-domesticated continuum. To avoid confusion, some contributing authors have elected to refer to this species by its scientific name, or by other widely recognized names such as “common turkey”.

The domestic turkey’s wild progenitor naturally ranges throughout much of central and northern Mexico and the southern and eastern United States (Fig. 1). There are six currently recognized subspecies of Meleagris gallopavo, including M. g. gallopavo, M. g. mexicana, M. g. intermedia, M. g. merriami, M. g. silvestris, and M. g. osceola. Genetic analysis confirms that the Southern Mexican subspecies (M. g. gallopavo) gave rise to the domestic turkeys bred and raised throughout the world today due to documented 16th Century exchanges between Europe and the Americas (Corona-, 2013b; Monteagudo et al., 2013; Schorger, 1966; Speller et al., 2010). Genetic evidence also supports independent pre-Columbian domestication of at least one other subspecies of wild turkey in the American Southwest (Speller et al., 2010). Domestic turkeys from the American Southwest, however, do not contribute to the genetic stock of modern domestic turkeys (Monteagudo et al., 2013; Speller et al., 2010). To date, potential management or rearing of wild M. gallopavo in other regions outside the recognized domestication centers of Central Mexico and the American Southwest has not been widely investigated. This topic, however, is the focus of two papers in this volume (Morris et al., this volume; Peres and Ledford, this volume).

The smaller-bodied and more brightly colored Ocellated Turkey (Meleagris ocellata) is the only other extant member of the family Meleagridae. This tropical species ranges throughout Mexico’s Yucatan Peninsula and into northern Belize and Guatemala (Fig. 1). Although the species is not thought to have been domesticated (i.e., subjected to prolonged directed selection), some researchers suggest that Ocellated Turkeys were captively-reared and managed by some ancient Maya populations (Hamblin, 1984; Masson and Peraza Lope, 2008; Pohl and Feldman, 1982; Pollock and Ray, 1957). Two articles within this special issue address the possibility of Ocellated Turkey husbandry based on new evidence (Thornton et al., this volume; Martinez and Corona, this volume). Although the natural geographic ranges of M. gallopavo and M. ocellata do not overlap, these two species were brought into coexistence through human mediated diffusion and exchange during pre-Columbian times (Martinez and Corona-M., this volume; Thornton et al., 2012). Mesoamerican zooarchaeologists therefore have the challenge of distinguishing between the two osteologically similar species of turkey, both of which may have been managed or reared by prehistoric populations.

3. Previous and recent advances towards documenting turkey husbandry and domestication

Recent reviews emphasize that animal domestication is a prolonged process of human-animal interaction that results in a continuum of states from wild to fully domestic (Zeder, 2006). Along this continuum are various levels of human control over a species’ movement, diet and reproduction ranging from taming and confinement to directed breeding. Over time, this relationship may result in morphological and genetic changes within a species, but these changes typically appear at different points throughout the domestication process (Zeder, 2006). In some cases, genetic and morphological changes do not occur at all. This is especially true in the domestication process, or when there is ongoing breeding between wild and captive populations of a species. Despite these limitations, identification of direct morphological and genetic markers of domestication is a major goal of many animal domestication studies.

Previous morphological and osteometric analyses of turkeys in the American Southwest have been unable to distinguish between wild and domestic forms of M. gallopavo in the archaeological record (Badenhorst et al., 2012; Breitburg, 1988; McKusick, 1986, 2001). Similar analyses have not yet been conducted in Mesoamerica so the potential for this line of evidence is currently unknown. Genetic markers for Mesoamerican domestic turkeys are also unknown, although some distinctions are now possible among turkeys in the American Southwest. Speller et al. (2010) identified two major mitochondrial DNA haplogroups within Southwestern archaeological turkeys. The most common haplogroup (referred to as H1) has low genetic diversity, and is genetically distinct from both wild and domestic Mesoamerican turkeys, and from wild turkeys of the Merriam’s subspecies (M. g. merriami), which are native to the region. Speller et al. (2010) thus suggest that the H1 haplogroup represents a population of managed/domesticated turkeys introduced to the Southwest from outside the region, while the other major haplogroup (H2) corresponds to local wild turkeys. A recent paper by Lipe et al. (2016), however,

Table 1

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<th>Geographic Region</th>
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<td>Mesoamerica</td>
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<td>Morphology and osteometrics: Emery et al.</td>
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<td>Paleopathology: Götz et al.</td>
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<td>American Southwest</td>
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indicates that turkeys from both haplogroups were heavily maize-fed and kept within human settlements, thus questioning the existence of distinct domestic and wild haplogroups. In the current absence of clear morphological and genetic markers for turkey domestication, it is difficult to directly identify early examples of tamed or captive-reared turkeys that appear within the natural range of the species’ wild progenitor.

The current lack of morphometric and genetic markers for domestication has required archaeologists to use more indirect evidence of turkey husbandry such as species abundance, demographic profiles, paleopathology, evidence of foddering, and the presence of pen structures. For example, overall turkey abundance at a site in comparison to wild taxa may be used to infer husbandry. Such increases, however, are potentially more indicative late in the domestication process since early domesticates may serve as occasional insurance against scarcity, or as feasting or ceremonial items to be harvested when needed long before they are managed as a staple meat resource. For example, in the American Southwest, researchers have documented a prolonged period of early, small-scale turkey husbandry dating back to at least 300–100 BCE (Badenhorst and Driver, 2009; Lipe et al., 2016; Munro, 2006). During this time, it is thought that domestic turkeys were reared primarily for their feathers, or for use in ritual offerings (Breitburg, 1988; Lipe et al., 2016; McKusick, 1986). The evidence for this comes from ethnohistoric descriptions, the recovery of feathers and feathered artifacts (e.g., blankets and feather wrapped cordage), and the absence of turkeys from general midden deposits dating to before the Pueblo II–III Periods (900–1300 CE) (Badenhorst and Driver, 2009; Muir and Driver 2002). Turkey rearing in the American Southwest later increased in intensity after 1050 CE (late Pueblo II to Pueblo III periods), possibly in response to resource depression associated with human population increases and aggregation (Kohler et al., 2012; Muir and Driver 2002).

The timing of initial and intensified turkey husbandry in Mesoamerica is much less well-documented than it is in the Southwest (Thornton and Emery, 2015), but based on taxonomic abundance, turkey husbandry was well-established in northern Mesoamerica by the Late Classic Period (600–900 CE) (Lapham et al., 2013; Valadez Azúa, 1993). Prior to this period, smaller numbers of turkeys were likely managed and reared in Preclassic central Mexico by at least 400–200 BCE (Corona, 2006; Serra Puche and Valadez Azúa, 1985; Thornton and Emery, 2015). Additional evidence for Preclassic (~1000 BCE–100 CE) origins of Mesoamerican turkey husbandry come from early appearances of M. gallopavo outside their natural geographic range. Although wild turkeys could have been transported and traded, Preclassic introductions of M. gallopavo to Oaxaca (Flannery and Marcus, 2005; Lapham et al., 2013; Martinez and Corona-M., this volume), Veracruz (VanDerwarker, 2006; Peres et al., 2013), and the Maya region (Thornton et al., 2012) imply some degree of human control over Mesoamerican turkeys at the time (Thornton and Emery, 2015).

Demographic (age and sex) profiles have also been previously used as evidence for turkey husbandry. These approaches are based on the idea that age and sex ratios of managed or domesticated populations will vary from those obtained through hunting. For example, very young individuals (e.g., poults) are not expected to appear in samples of wild hunted turkeys, and males may be culled from managed flocks at younger ages than females due to the greater utility of females in terms of egg production and flock replacement. To date, demographic approaches to studying turkey husbandry have been primarily conducted in the American Southwest (e.g., Badenhorst et al., 2012; Fothergill, 2012; McKusick, 1986; Munro, 1994), while similar studies in Mesoamerica have been lacking (although see Corona-M., 1997). Papers by Lapham et al. (this volume) and Manin et al. (this volume) address this research gap and provide new evidence on demographic turkey profiles from Mesoamerican archaeological sites. An additional paper by Peres and Ledford (this volume) also applies demographics to assess Mississippian Period turkey husbandry in the American Southeast. Methodological advances towards turkey demographics are presented in the paper by Speller and Yang (this volume), which employs innovative genetic analyses to identify the sex of archaeological turkey remains. This contribution is significant since many archaeological specimens cannot be sexed using traditional morphometric approaches due to taphonomic effects such as erosion and fragmentation.
Eggshell analysis is an additional methodological innovation related to demographic approaches to reconstructing turkey husbandry and domestication. A pioneering paper by Beacham and Durand (2007) provided a means of using a scanning electron microscope (SEM) to differentiate between eggshells that hatched versus those that broke early in development. Papers in this special issue by Conrad et al. (this volume) and Lapham et al. (this volume) build upon this previous work and present additional SEM assessments of archaeological eggshells from the American Southwest and Mesoamerica, respectively. Significantly, this line of evidence provides a means of documenting on-site rearing, as well as wild or domestic turkey egg consumption and use.

Healed fractures and other pathologies are another line of evidence that may be used to infer captive turkey rearing. Besides indicating human care or protection of injured birds, repeated pathologies on specific elements, such as the ulna, may indicate intensive feather harvesting (Fothergill, 2012). To date, paleopathologies have only been reported for turkeys from the pre-colonial American Southwest (Akins, 1985; Fothergill, 2012; McKusick, 1974) and Post-Medieval Britain (Fothergill, 2014). The paper by Fothergill (this volume) expands this important and potentially underutilized line of research, and demonstrates the utility of paleopathological analyses for documenting not only general management and care of turkeys, but also more specific information related to nutrition, penning, and use (e.g., meat versus feather harvesting).

One of the earliest changes that may have come about during the domestication process was a change in turkey diet, a point made clear in the ethnographic study by Götz et al. (this volume). Turkeys would have come into greater human contact through increasing agricultural field or midden raiding, or through intentional butchering by human hunters. All of these behaviors would potentially shift turkey diets towards greater consumption of human-provided foods. Throughout M. gallopavo's range in both North and Central America, the primary staple cultigen was maize (Zea mays). Maize utilizes a C4 photosynthetic pathway which makes it isotopically distinct from most other foods consumed by turkeys (Leopold, 1959:273; Rawlings and Driver, 2010:2435). Tame or captive reared turkeys should therefore have higher carbon isotope ratios (δ13C) than wild foraging turkeys. This method has successfully distinguished between wild and domestic turkeys in the American Southwest (Conrad et al., this volume; Jones et al., this volume; McCaffery et al., 2014; Rawlings and Driver, 2010), and the method's potential is now being tested in Mesoamerica (Thornton et al., this volume), the Caribbean (Reitz et al., this volume), and northeastern North America (Morris et al., this volume). This method has excellent potential for distinguishing between wild and captive-reared turkeys, and for identifying the earliest stages of turkey husbandry since a change from a wild to a human-provided diet high in maize likely occurred well before genetic or morphological changes appeared. As Jones et al. (this volume) further point out, the method may be also able to determine whether free range or fully-captive husbandry strategies were employed.

Distinguishing between wild, managed, or captive-reared turkeys in Mesoamerica is particularly problematic due to the presence of two osteologically similar turkey species in this region. The geographic ranges of M. gallopavo and M. ocellata do not naturally overlap, but the two species were brought into coexistence through human agency when the domestic turkey (M. gallopavo) was transported out of Central Mexico. Accurately distinguishing between the two turkey species in Mesoamerica is thus important for determining when domestic turkeys diffused throughout Mesoamerica, how wild Ocellated Turkeys and domestic turkeys may have been used differently, and whether or not pre-Hispanic populations also maintained captive, or tame populations of Ocellated Turkeys. Emery et al. (this volume) highlight the methodological difficulty of identifying Mesoamerican turkey remains to the species level, and critically evaluate what morphological and osteometric traits provide the most accurate species level designations. Along with the paper by Martinez and Corona-M. (this volume), the work by Emery et al. (this volume) progresses the study of turkey husbandry and use in southern Mesoamerica beyond identifying turkeys to the genus level alone (i.e., Meleagris sp.), which allows for more detailed reconstructions of past turkey use, husbandry and domestication in Mesoamerica.

Ancient DNA provides a complementary, but more costly approach to distinguishing between the various turkey species and sub-species. This approach is employed by Thornton et al. (this volume) in their assessment of ocellated versus domestic turkey diet. Reitz et al. (this volume) also use ancient DNA in combination with stable isotopes to determine the geographic origin, and likely wild versus domestic status of an early (16th Century) turkey bone from the Caribbean island of Hispaniola. DNA will undoubtedly continue to serve as a major methodological tool for identifying or confirming the geographic and genetic affiliations of archaeological turkey specimens.

Finally, the paper contributed by Götz et al. (this volume) emphasizes the value of historic and modern ethnographic data to the interpretation of all aspects of the archaeological record for turkey husbandry and use. As they discuss, historic and ethnographic data can inform our understanding of past animal health and disease, flock rearing and management practices, ritual use, and cultural preferences for particular types of turkey meat and dishes. Such sources may also prove useful to the interpretation of archaeological demographic profiles (Manin et al., this volume) and dietary reconstructions.

4. Directions for future research emerging from the special issue

Despite increasing archaeological research devoted to the topic of turkey husbandry and domestication, our knowledge of ancient turkey husbandry is incomplete across much of the species' geographic range. While much work has been conducted on turkey domestication in the American Southwest (McKusick, 2001; Munro, 2011), comparatively little has been done in Mesoamerica (Thornton and Emery, 2015), despite the fact that all modern domestic turkeys descend from birds originally domesticated in Central Mexico (Corona-M., 2013a, 2013b; Montaegudo et al., 2013; Speller et al., 2010). Researchers also have not yet fully explored the potential for pre-Contact turkey husbandry in Eastern North America. Taken together, this suggests the need for expanded turkey domestication research in several geographic areas. The collection of articles within this special issue contribute greatly to more comprehensive geographic coverage. Four articles build upon previous work in the American Southwest (this volume: Conrad et al., Jones et al., Fothergill, Speller and Yang), while six articles expand our knowledge of turkey husbandry in Mesoamerica (this volume: Emery et al., Götz et al., Lapham et al., Manin et al., Martinez and Corona-M., Thornton et al.), and two present novel discussions of turkey management within Eastern North America (this volume: Morris et al., Peres and Ledford). With more comprehensive geographic coverage, it will become possible to draw broader cross-cultural comparisons regarding the role captive, managed and domestic animals played in ancient North American society.

Methodologically, the collected articles demonstrate the utility of a multi-proxy approach to studying turkey husbandry and domestication. As the field of research moves forward, genetic and isotopic studies will undoubtedly figure prominently in research agendas. Several papers in this volume (Conrad et al.; Jones et al.; Morris et al.; Reitz et al., Speller and Yang, Thornton et al.) illustrate the ability of genetics and stable isotopes to reveal information that would otherwise be unattainable through more traditional morphological and osteometric approaches. In particular, expanded mitochondrial DNA analyses in addition to more complete genome sequencing of modern and archaeological turkeys will likely provide future breakthroughs related to identifying when and where the domestication process began, and what specific traits were selected for through time. Isotopic analyses will continue to provide a tool to distinguish wild/feral versus captive/domestic turkeys based on their diets, and may be able to document human feeding
and captive rearing in the absence of other lines of evidence. Genetic and isotopic analyses, however, cannot stand alone, and should instead be done in tandem with morphometrics, which provide independent measures of the poorly understood morphological changes that may have occurred in turkeys in response to captivity or human selection and management. Morphometric approaches are also critical to accurate species-level identifications (Emery et al., this volume; Martinez and Corona-M., this volume), and demographic reconstructions (Lapham et al., this volume; Manin et al., this volume; Peres and Ledford, this volume), which are essential to understanding past flock management and size as it relates to the potentially variable use of turkeys as sources of meat, eggs and feathers, and as both ritual and dietary resources.

As more details emerge regarding the history of New World turkey management, husbandry and domestication, this body of research will have broad intellectual ramifications for understanding the process and timing of animal domestication. In comparison to other regions, the North American animal domestication process is still very much unknown. This special issue will therefore contribute to comparative discussions of global animal domestication and management by documenting the unique context of this cultural phenomenon in North/Central America. Turkeys are also unique in their status as an avian domesticate. While large-bodied mammalian domesticates such as sheep, goats, cows, pigs, and horses have been extensively studied, turkeys and chickens (Gallus gallus) have only more recently garnered research attention. Differences in physiology, body size, behavior and human use could result in very different trajectories towards domestication in avian versus mammalian domesticates. Expanded turkey domestication research therefore complements recent research on chickens (e.g., Kanginakudru et al., 2008; Miao et al., 2013; Rubin et al., 2010; Storey et al., 2007; Thomson et al., 2014; Xiang et al., 2014) by documenting an additional example of avian domestication. Therefore, although the papers in this special issue focus primarily on methodological issues and elucidating some of the basic details of turkey husbandry and management in particular regions, the research forms a foundation for future synthetic and comparative discussions of animal domestication.

5. Dedication

This special issue is dedicated to Dr. Christopher Markus Götze (1975–2016), professor at the Universidade Autónoma de Yucatán. He was a dear friend and valued colleague who enriched the fields of zooarchaeology and environmental archaeology with his studies of taphonomy, past and present animal use, and ancient Maya economy and exchange.

References


