



Reconstructing animal husbandry: Trauma in *Meleagris gallopavo* (domestic turkey) ulnae from the American Southwest (c. 900–1678 CE)



B. Tyr Fothergill

School of Archaeology and Ancient History, University of Leicester, University Road, Leicester LE1 7RH, United Kingdom

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ABSTRACT

Palaeopathological and metrical analyses of faunal remains have the potential to illuminate features of past husbandry practices including demography, stocking, injury and care, housing, transport and movement, diet, and breeding. This paper presents the results of metrical and palaeopathological analyses of turkey (*Meleagris gallopavo*) remains from nine assemblages excavated from sites across the American Southwest.

Metrical data demonstrate variation in the size and overall morphology of turkeys across these sites and support the idea that meat production was not the sole purpose for turkey husbandry. The most frequently-occurring type of lesion in any skeletal element was trauma (physical injury), and 36% of these pathologies were present in ulnae. Lesions in ulnae at five sites provide evidence for the possibility that feathers were harvested from live turkeys at some sites.

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1. Introduction

Whilst there is now a broad acceptance of turkey domestication in some form, there is little understanding of quotidian husbandry practices, and interpretations are often based upon wild turkey behaviour or modern breeds and methods. Particularly lacking are studies of turkey keeping, or turkey-specific animal husbandry, a focus of this volume (Thornton, 2016—in this issue). Palaeopathology is one potentially powerful, if underdeveloped, area which can shed light on this subject. It provides a means of accessing a portion of the life histories of individual animals, vividly illustrates the impact of human behaviour, and reveals aspects of human attitudes to animals (Davies et al., 2005; Thomas and Miklíková, 2008; Bartosiewicz and Gál, 2013). Disease and injury in past animal populations were influenced by a range of human and environmental effects, as is the case today. Lesions present in faunal remains can inform upon the environment in which animals were kept (indoors or outdoors, damp conditions, stocking density), their feeding regime (nutritional deficiencies and excesses), handling methods (trauma), patterns in breeding (inherited conditions), as well as the care they may have received (Udrescu and Van Neer, 2005).

Assemblages from nine archaeological sites in the American Southwest (Table 1) were analysed using standardised metrical and palaeopathological methods as part of a larger project examining the translocation of the turkey to Europe. Results from the modern era investigations are detailed elsewhere (Fothergill, 2014). For the American Southwest, the expectation was that the turkey had always been a valuable flesh resource, and that examining past turkey husbandry would reveal a focus upon (and increasingly intensive production for) meat from the 10th to the 17th century CE. Evidence that humans in the

American Southwest consumed turkeys in the Pueblo II and Pueblo III periods (1050–1300 CE) (McCaffery et al., 2014) supports this idea, but does not exclude additional turkey husbandry purposes from consideration. The results of the palaeopathological and metrical analyses detailed here indicate that other motives for turkey-keeping, namely feather production, were also present at some of the investigated sites. Traumatic injury to ulnae point to the skeletal impact of feather harvesting, and metrical analyses show the presence of non-natural sex ratios and trends in limb length which do not conform to models of skeletal change due to breeding for meat production alone.

2. Materials and methods

Faunal material from nine sites in New Mexico and Utah which ranged in date from 900 to 1678 CE was examined for this research. These assemblages were from the Bluff Great House, Salmon Ruin, the Eleventh Hour site, Eleanor Ruin, Arroyo Hondo, Ojo Bonito (Hinkson), Heshotauthla, Quarai, and Gran Quivira (Fig. 1, Table 1).

Certain sites were targeted because pathologies in turkey elements had been mentioned in previous publications, e.g., Salmon Ruin (Durand and Durand, 2006) and the Eleventh Hour (Gillespie, 1991). Other sites were investigated because they were accessible for research. Due to the need to record every pathology consistently and establish a population profile in which to contextualise the identified pathologies, each assemblage was systematically analysed by the author. This process also helped to avoid artificially inflating or deflating pathological percentages for partially-unavailable assemblages. Site dates, turkey NISP (number of identified specimens) and relevant publications are listed in Table 1.

Table 1
Assemblages and associated dates, NISP and references.

Site	Date (CE)	Period	Region	Turkey NISP (analysed)	Published source
Arroyo Hondo	1300–1420	Late	Rio Grande	129	Lang and Harris (1984)
Bluff Great House	1075–1250	Early	Northern San Juan	629	Driver et al. (2008); Fothergill (2008)
Eleanor Ruin	950–1350	Early	N/A	150	Roler (1999)
Eleventh Hour (29SJ633)	900–1200	Early	San Juan Basin	121	Gillespie (1991)
Heshotauthla	1200–1350	Late	Zuñi	72	N/A (but see Fothergill, 2012)
Gran Quivira	1300–1672	Late	Salinas	88	Clark (2003)
Ojo Bonito (Hinkson)	1175–1225	Early	Zuñi	63	Clark (1998)
Quarai	1200–1300s to 1678	Late	Salinas	186	Moore (1994)
Salmon	1088–1270	Early	San Juan Basin	157	Durand and Durand (2006)
Total				1595	

Recording included data on age and sex, butchery type and location, rodent and carnivore gnawing, burning, and root etching. An element was identified as juvenile if it had a porous appearance and was in a developing state. Males and females were distinguished using a combination of metrical clustering analysis (for complete, adult elements only) and by the presence of medullary bone. The presence of spurs was not used as a sole identifying characteristic for males since female turkeys occasionally develop them. No attempt was made to sex juvenile bones. All available and identifiable turkey element fragments were recorded and, where possible, measured and sided, regardless of pathology, using Cohen and Serjeantson's zoning method (1996). Using zones ensured that calculations of the frequency of pathology types could be precise not only to the level of skeletal element, but the location of lesions on the element. Measurements were taken to a tenth of a millimetre.

Vann and Thomas's (2006) standardised methodological protocols were used to record pathology. These were developed to overcome the lack of a recording system applicable to all animal palaeopathology.

This system was explicitly designed with lesion description at the forefront, so that structured differential diagnosis could be built upon detailed observations.

3. Assemblage classifications

Sites did not have compatible phasing systems and some did not link phasing to the animal bones, leading to difficulty with regard to temporal organisation of the data. In order to facilitate comparisons across time, the assemblages have been divided into two groups: the prosaically-entitled "Early" and "Late" (Table 1). An "Early" assemblage is one which primarily dates to before 1300 CE; a "Late" assemblage mainly dates to after 1300. This division does not tidily coincide with the Pecos Classification, and whether an assemblage was "Early" or "Late" was based upon the date range from which a majority of the bones in that assemblage originated. In the case of Heshotauthla for example, the excavator advised that most of the material was likely to be later in date (Keith Kintigh, pers. comm.).

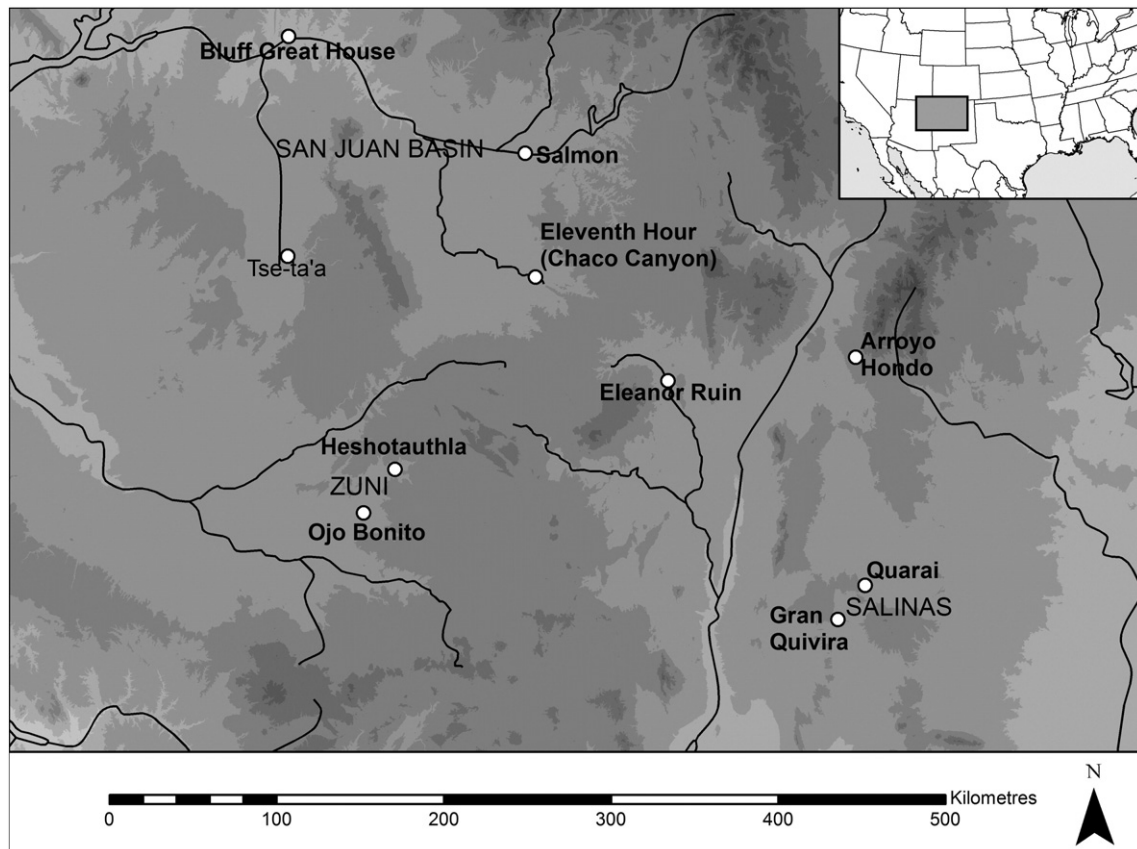


Fig. 1. Map of sites with analysed assemblages or featured in the text.

Regional grouping of sites was based on their specific area (e.g., near Zuñi). Sites that were historically and geographically linked (e.g., the Salinas pueblos) were grouped together. Since Bluff, Eleanor Ruin, and Arroyo Hondo were the sole representatives of their regions, they were included in regional comparisons as individual sites. Skeletal data from all sites was included in metrical analysis, assessment of population factors, taphonomy, and palaeopathology.

4. Results

4.1. Demography and taphonomy

Details of turkey population structure and taphonomic effects are key components of faunal analysis and are vital in palaeopathological interpretation. Both factors can impact the quantity of (and accuracy with which) pathologies are detected. Population structures can help to contextualise pathologies; older animals are more likely than younger animals to have pathologies present, and younger elements do not preserve as well. Most taphonomic traces can obscure pathologies and make them more difficult to describe and, ultimately, diagnose. Furthermore, depending upon the type of pathology present in any given skeletal element, a bone might be more or less vulnerable to taphonomic processes (Bartosiewicz, 2008a). Overall, levels of preservation were very high across the examined assemblages. Although burning, butchery, gnawing, and rootlet etching were present to varying degrees, when these effects were combined, they had no statistical relationship (with a Spearman's ρ result of 0.25) to the percentage of juveniles present and it is therefore unlikely that these factors substantially affected the presence of juveniles (Fothergill, 2012:98–99). It is also improbable that they impacted the preservation of pathologies.

As in other aspects, the assemblages vary with regard to the presence of juveniles and the proportions of males and females (Table 2). Most of the assemblages included here have low percentages of juveniles as a proportion of the turkey assemblage, but these values range widely from the mean average of all sites.

Female elements generally outnumber those from males at a ratio of approximately 2:1. Only at the Eleventh Hour site do male elements outnumber those from females by a small margin. A Spearman's ρ of -0.48 indicates a slight inverse relationship between the percentage of males and the percentage of juveniles at the sites, a finding which would have interpretive potential if a larger sample size were considered.

Although the ratio of male to female turkeys at each site does not vary significantly from the mean average of all sites (assemblages with very high or very low percentages are the sites with the smallest NISP), these ratios differ significantly from a natural 1:1 ratio in newly-hatched turkey clutches; at the 0.05 level of significance with eight degrees of freedom, $\chi^2 = 29.64$. Whilst the sample sizes are small and the sites do not vary significantly in their composition by sex, the number of males is non-random. Although male turkeys have aggressive behavioural tendencies, assemblages with a higher proportion of males did not have increased proportions of traumatic pathology (trauma).

Table 2
Proportions of males and juveniles across assemblages.

Site	Male %	Juvenile NISP	Juvenile %
Arroyo Hondo	38.7	22	17.1
Bluff Great House	34.1	5	0.8
Eleanor Ruin	31.9	0	0
Eleventh Hour	53.9	1	0.8
Heshotauthla	35.7	2	2.8
Gran Quivira	8.3	28	31.8
Ojo Bonito	5.6	3	4.8
Quarai	36.9	22	11.8
Salmon Ruin	30.2	32	20.4

4.2. Visualising turkey size and shape

Despite the interpretive utility of metrical data and the long-standing availability of methodological protocols (e.g., von den Driesch, 1976; Cohen and Serjeantson, 1996), standardised measurements are not routinely gathered from turkey elements excavated in the American Southwest. Badenhorst et al. (2012) have called attention to the value of these data with respect to turkey husbandry, and encourage zooarchaeologists to begin collecting them as a matter of course.

The adult elements for which length and breadth measurements were available have been log-scaled against those from a male Rio Grande wild turkey skeleton (*Meleagris gallopavo intermedia*) held at the Natural History Museum, Tring (UK). This technique allows multiple elements to be plotted and compared together for anterior and posterior limbs (Figs. 2–5). Wing element plots include metrical values for coracoids, humeri, radii, ulnae and carpometacarpus; leg elements include femora, tibiotarsi and tarsometatarsi. The distribution of the metrical data shows some differences between “Early” and “Late” sites as well as patterns across the regional study areas. Since only length measurements were obtained from the Bluff material, those data points are shown along the x-axis below the other data.

In these scatter graphs, clusters of overlapping male and female turkeys are visible; both the wing and leg elements plot broadly in the same regions with similar ranges regardless of whether they are from “Early” or “Late” assemblages. In terms of where the modal peaks occur, there is a very slight increase in the length of wing and leg elements in females and smaller individuals over time (Figs. 2 and 3). This trend is linked to larger measurements from Arroyo Hondo and the Salinas pueblos of Gran Quivira and Quarai, which were occupied later than Arroyo Hondo, well after the Spanish arrived in the American Southwest. Notably, the Zuñi elements are consistently shorter than their counterparts from other assemblages.

Diversity in element length initially appears to be more spatially than temporally linked, which could underline the importance of regional husbandry practices. This might result from the predominance of early sites in northern areas and later sites in the south and may be clarified by incorporation of more data. However, patterns of regional occupation make such potential comparisons unlikely; the San Juan drainage was abandoned during the late 13th century AD (Duff and Wilshusen, 2000). Previous osteometrical work on the species, mainly focussed on distinguishing domestic skeletal morphology, has established that turkey populations were not homogeneous (Breitburg, 1988; Munro, 1994). This, combined with small sample sizes, prevents in-depth interpretation of turkey size and shape. Trends in human population movement throughout the greater study area further complicate matters. Assemblage-level patterns cannot be drawn out because the number of measurable bones is not sufficient to draw meaningful conclusions.

Some patterns emerge from the metrical data despite these issues. If the turkey was husbanded only for meat across all sites, one would expect to find an overall decrease in upper limb element size and a proportional increase in lower limb element size as a result of increased reliance upon the lower limbs for locomotion and a greater need for weight-bearing support. This trend was described in other avian species by Bramwell (1977) in the assemblage from King's Lynn, by Reichstein and Pieper (1986) with regard to Haithabu, and Kevin MacDonald et al. (1993) for an assemblage from Dublin. Even considering the sample size, the metrics do not support such a conclusion (apart from perhaps at the later Salinas Pueblos). Ancient DNA research suggests that a genetic “bottleneck” may have occurred in some turkey populations (Speller et al., 2010); this may be linked to breeding-related selection. The non-natural sex ratios in most assemblages could indicate the use of practices which may be linked with attempts to increase turkey flock sizes (Phillips, 2008) or selection of specific males for breeding. Additionally, since turkeys reach maximum weight prior to skeletal maturity (Schorger, 1966: 295–296), the high proportion of adult males in

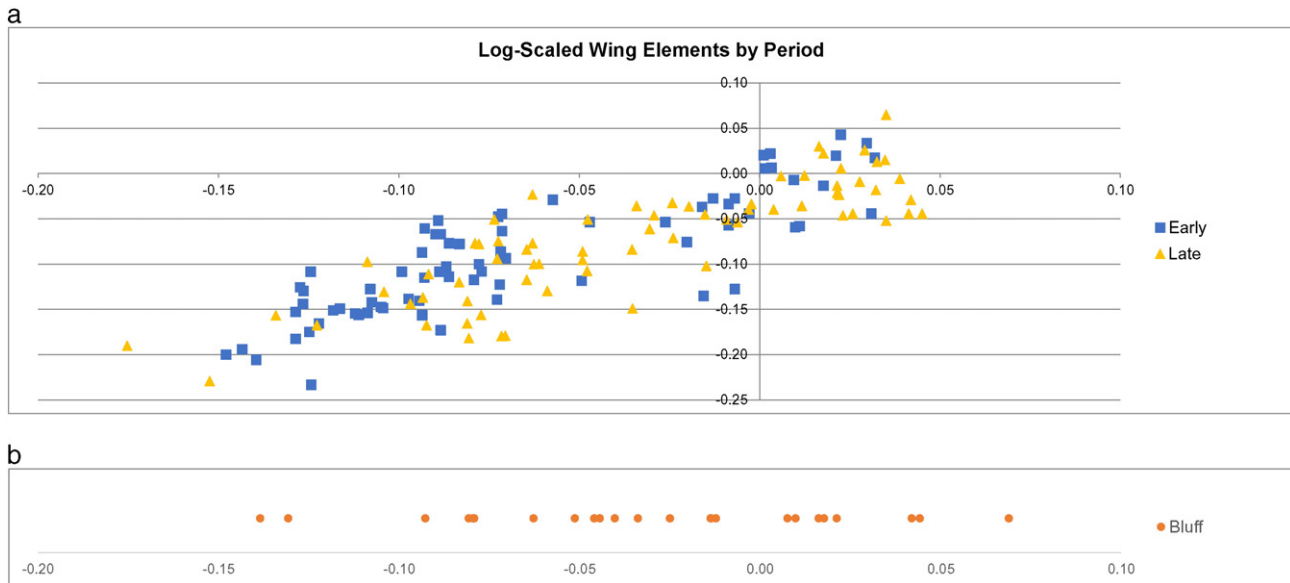


Fig. 2. Log-scaled wing elements by period.

the Eleventh Hour assemblage suggests that meat production was not the sole purpose of turkey husbandry at that site (Table 2), though unusual use of birds is not unexpected for a site within Chaco Canyon.

4.3. Pathologies

4.3.1. Percentages and types

In total, fifty-five lesions were identified and described across all of the assemblages. Although the proportion of pathologies varied by site, pathologies were present in every assemblage and the majority were not previously described. The Bluff material was more fragmented than other assemblages here (fewer length measurements were obtainable in proportion to other sites), which probably decreased the number of identifiable pathologies. The Arroyo Hondo assemblage has two sets of values in Table 3: one which includes pathologies from contexts which had been fully re-analysed, and another (in parentheses) which has been inflated by the addition of pathological elements from contexts which could not be re-analysed.

In terms of general pathology types (following Vann and Thomas, 2006; see Table 4.15 in Fothergill, 2012:157), the turkey assemblages contained: bone formation lesions such as enthesophytes (ossified tendons, 4 instances) and osteophytes (5 instances), some of which could be linked to arthropathies (joint disease, 8 instances); bone destruction in the form of pitting at joint surfaces (4 instances), eburnation (polishing from bone-on-bone contact, 1 instance), necrosis secondary to trauma (bone death following an injury, 2 instances) and hypervascularity (evidence of increased blood flow, 5 instances); shape change in the form of bowing was also present in tibiotarsi (3 instances), one of which was juvenile. The most frequently encountered pathology was trauma: 25 traumatic lesions were identified, 45.45% of all recorded pathologies.

Other multi-site analyses of palaeopathological data help to contextualise these findings on a broader scale. The overall percentage of pathological specimens is high in comparison to Bartosiewicz's large-scale study of archaeological assemblages. In his examination of 128 European and American sites, Bartosiewicz (2008b) recorded an

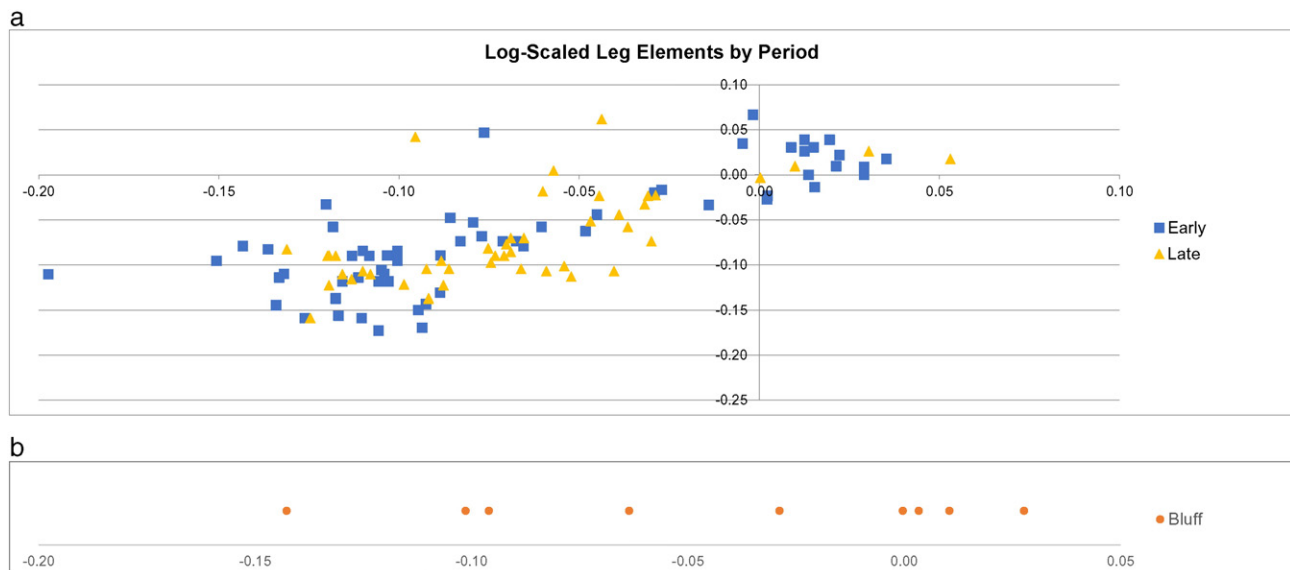


Fig. 3. Log-scaled leg elements by period.

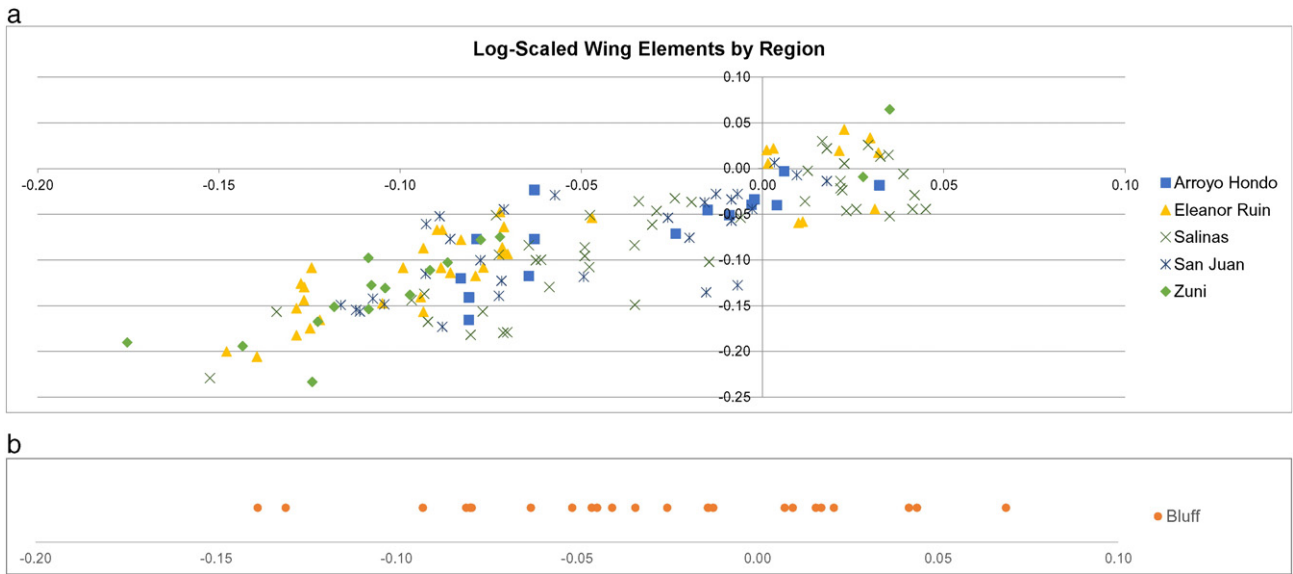


Fig. 4. Log-scaled wing elements by region.

average of just 0.41% of all specimens as pathological. However, a study of medieval Estonian assemblages conducted by Maldre (2008) reports a higher occurrence of pathologies (266 lesions in 21,302 elements), which is comparable to the turkey assemblages from the American Southwest. Maldre (2008:51) does caution that the distribution was 'far from normal', however. Notably, trauma was relatively rare in Maldre's (2008:52) study and only 8 examples were reported, whereas dental lesions accounted for 56% of the reported pathologies.

Assemblages of avian remains may provide more appropriate anatomical correlates, but pathological frequencies are highly variable for a number of reasons and husbandry strategies would have been temporally and regionally diverse. In another multi-site analysis, Gál (2013:217) found that (of 1241 pathologies reported across 37 assemblages) chickens and geese possessed only 3.2% of all pathologies and that, like the turkey assemblages presented here, trauma was the most frequently occurring pathology type in avians (Gál, 2013:219). However, these assemblages were unsieved, which can lead to underrepresentation of avian elements (O'Connor, 2008:34; Serjeantson,

2009). In my ongoing study of chicken elements from the recently-excavated Anglo-Saxon site of Lyminge, traumatic injuries account for 10.39% of recorded pathologies. These examples contrast with the overall proportion of trauma present in this study, despite not being perfect parallels.

4.3.2. Trauma

Trauma to ulnae was present at Arroyo Hondo, the Bluff Great House, Eleanor Ruin, the Eleventh Hour, and Salmon; these constituted 36% of all traumatic pathologies. There were more occurrences of trauma to ulnae alone than in all leg elements combined. However, ulnar trauma was not detected in the analysed portions of assemblages from the Salinas or Zuni regions. Studies unconnected to my research describe signs of traumatic injury in domestic turkey ulnae from other sites of similar time periods in the American Southwest and northern México: Tse Ta'a (Steen, 1966), Pueblo Bonito (Judd, 1954, Akins, 1985), and Paquimé (McKusick in Di Peso, 1974). A healed ulnar fracture from Tse-Ta'a in north-eastern Arizona may be one of the first

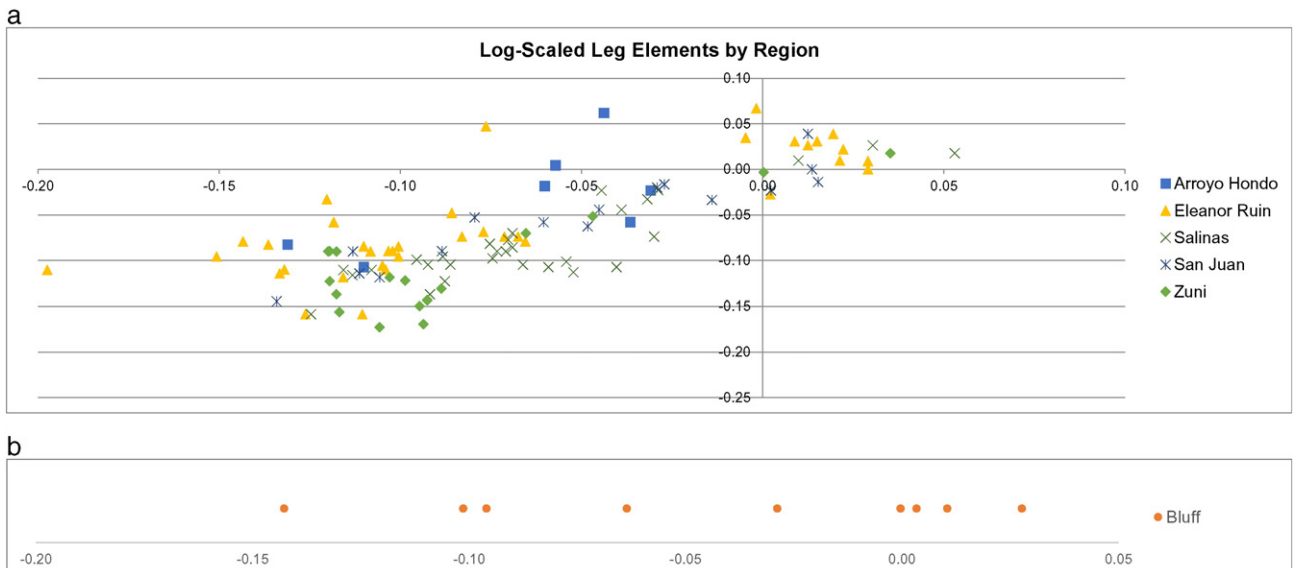


Fig. 5. Log-scaled leg elements by region.

Table 3
Overall pathological frequency and rates of trauma.

Site	Lesion count	Pathological %	Trauma (all)	Trauma (ulnae)
Arroyo Hondo	8 (11)	6.20% (8.53%)	6	4
Bluff Great House	6	0.95%	5	2
Eleanor Ruin	9	6.00%	4	1
Eleventh Hour	5	4.13%	3	1
Heshotauthla	2	2.78%	0	0
Gran Quivira	4	4.55%	2	0
Ojo Bonito	1	1.59%	0	0
Quarai	10	5.38%	2	0
Salmon Ruin	7	4.45%	3	1

published images of archaeological turkey pathology (Plate 1 in Steen 1966). Fig. 6 shows an ulna with extensive periosteal new bone formation, likely in response to traumatic injury, which was excavated from Pueblo Bonito, one of the largest and most impressive Great Houses in Chaco Canyon.

The bony changes evident in this ulna are consistent with those present in an ulna from Arroyo Hondo (Fig. 10).

4.3.3. Traumatized ulnae

These lesions present in different ways, but are consistent as a group with regard to the presence of trauma in the same element. This set of lesions included obvious fractures, some of which are well-healed and some which are necrotic in nature or show signs of secondary infection, as well as more subtle forms of trauma which initially impacted the periosteum or surrounding soft tissue. Figs. 7–14 show the affected elements.

In considering the viable reasons for the proportionately high occurrence of these pathologies, I reviewed the possibilities. A taphonomic bias was unlikely due to the fact that ulnae do not necessarily survive better than other avian elements, particularly considering the preferred locomotion strategy of the turkey (Livingston, 1989). Another option was injury by other turkeys, perhaps the result of wing-buffeting in the manner of geese (Lamprecht, 1986). Although male turkeys do chase and engage each other in combat, their preferred anatomical targets are the heads and necks of their opponents; wing-buffeting is not routinely employed (Dickson, 1992; Schorger, 1966). It is possible that dogs injured these turkeys; however, dogs target the hindquarters and viscera of turkeys (Beranger et al., 2007) rather than their wings. Dog remains were not present in the assemblage from Eleanor Ruin (Roler, 1999:144) and no gnawing was observed during this study. Furthermore, the housing strategies used by turkey-keepers and the propensity of turkeys to defensive territorial behaviour may have mediated potential dog attacks. Behavioural resistance to tethering has been suggested as another cause of fractures in turkey appendicular elements (Grimstead et al., 2014), and although this could be linked to trauma in leg elements (see Figs. 4.24, 4.37, 4.39, 4.67, and 4.74 in Fothergill, 2012), there is no evidence to suggest that turkeys were tethered by their wings. Wing-breaking may have been undesirable as a control



Fig. 6. Pathological ulna excavated from Pueblo Bonito with normal comparative (original image by Jon Driver).



Fig. 7. Healed fracture in diaphysis of an ulna from Arroyo Hondo.

method due to the locomotory adaptations of turkeys and the detrimental effects of trauma on feather growth.

The ulna includes attachment sites for the ligaments of the follicles (“quill knobs” or *papillae remigiales* following Baumel and Witmer, 1993:101, 127) for the secondary feathers of the wing. These sites are fundamental to avian locomotion, and reduction in the anatomical prominence of these features has been linked to underdeveloped flight morphology in Late Preclassic turkeys from El Mirador (Thornton et al., 2012). At least one instance of ulnar trauma in this study specifically affected the *papillae remigiales* (Fig. 10) and other lesions impacted a substantial portion of the diaphysis, including these features.

5. Discussion

5.1. Archaeological evidence

The importance of turkey feathers to the peoples of the American Southwest cannot be overstated. Munro (2011:548) declares: “Feathers used for both ritual and utilitarian purposes are thus generally maintained to have been the primary motivation for turkey domestication.”. Turkey feathers were used to create various objects including robes, blankets, cordage, and footwear (Webster, 2008:174) as well as regalia and sacred items (Eckert and Clark, 2009), including prayer sticks (Ladd, 1998). According to Tyler (1979:6, 85–106), turkey feathers serve as “clothes” for most prayer sticks and could be attached by anyone. Furthermore, the concept of the venerable male turkey was of critical importance to some ceremonies of leadership, and strands of a gobbler’s “beard” played specific sacred roles (Tyler, 1979:103–106).

A number of studies mention turkey feathers, their continued importance (Reyman, 2007, 2008), and their past utility and symbolic significance (Breitburg, 1988; Clark, 2003; Clark, 1998; McKusick, 1986; Moore, 1994; Munro, 2011). This topic has not been fully developed within zooarchaeology because the physical evidence of feather-related practices is scant. Further research will help to clarify the extent of this activity, but traumatic lesions present in the ulnae discussed here may be evidence of turkeys being plucked for their feathers whilst still alive, and kept for when feathers were required, like macaws in the historic Pueblos (Judd, 1954:263; Plate 75 shows a well-plucked macaw living at Zuñi in 1939). It is feasible for a bird the size of a turkey (and with equally aggressive tendencies) to be plucked whilst alive. Live



Fig. 8. Healed fracture with displacement in a right ulna from Arroyo Hondo.



Fig. 9. Traumatic injury to distal portion of papillae remigiales in a right ulna from Arroyo Hondo.

geese were plucked twice a year from Roman times (Albarella, 2005) and records of goose-plucking demonstrate that the practice continued in some European locales until late in the Post-Medieval period (though it persists in others (Serjeantson, 2002)). It seems probable that some expertise and caution would have been necessary to avoid injury to both the avian and human involved. Any difficulty in handling an unwilling turkey during the plucking process could have resulted in traumatised wing elements.

There are good reasons to pluck feathers directly from a turkey rather than collecting them after a moult. Turkey feathers which are shed during the normal course of activity will have outlived their usefulness and have a dull and battered appearance. When a feather is shed (ecdysis) or is plucked from a turkey, a new one will regrow immediately (endysis), whereas cutting a feather will prevent growth until the next moult. A study of ethno-ornithology by a Zuñi scholar suggests that feathers from specific parts of the turkey body were needed for certain purposes (Ladd, 1998); if this was true of nearby regions in the past, plucking rather than gathering the feathers would ensure that the appropriate part of the turkey was obtained. Secondary wing feathers are attractively symmetrical, and removing the feathers necessary for lift during flight would also temporarily limit the aerial movement of a turkey.

Considering the trends in metrical data and potential DNA evidence for directed breeding (Speller et al., 2010), it seems possible that feather colour and quality were amongst the attributes that people may have selected for with regard to turkey breeding (see also McKusick, 1986). A preponderance of males at the Eleventh Hour site could indicate that the feathers (or beard strands, etc.) of male turkeys were required for some reason.

5.2. Historical evidence and ethnography

There is ample documentary evidence regarding the use and harvesting of turkey feathers. Albert Hazen Wright (1914:347, 1915:66–68), writing in 1914–1916, thought that the turkey was probably used primarily for feathers prior to European contact and his works include



Fig. 10. Unhealed fracture with secondary necrosis in a right ulna from Arroyo Hondo.



Fig. 11. Two healed compound fractures to the diaphyses of a left and a right ulna from the Bluff Great House.

statements from Spanish sources from 1520 to 1540 CE which record that turkeys were used for feathers and food by native peoples in the American Southwest (Wright, 1914). Elsie Clews Parsons, Hamilton Tyler, and Edmund Ladd also wrote extensively on the roles of birds and feathers in a Pueblo context (Parsons, 1933, 1939; Tyler, 1979; Ladd, 1998). A.W. Schorger, a lifelong scholar of the turkey, wrote a book dedicated to the species and translated a number of Spanish records in the process (Schorger, 1966).

The Spanish found it baffling that turkey meat was considered a less important product than feathers or was avoided altogether by some Pueblo peoples. The Pueblo people of Zuñi reportedly told Coronado that they kept turkeys solely for feathers:

“We found fowls, but only a few, and yet there are some. The Indians tell me that they do not eat these in any of the seven villages, but keep them merely for the sake of procuring feathers. I do not believe this, because they are very good and better than those of Mexico” [Ramusio (1606:302) translated by Schorger (1966:34)]

In 1598, Juan de Oñate recorded that the inhabitants of Hawikuh offered turkey feathers to their “idols”, as well as using them to create blankets, clothing, objects of adornment, and pouches (Bolton, 1916:235; Schorger, 1966:360).

Historical scholarship and Spanish colonial sources offer some context for later period sites such as Quarai and Gran Quivira. Ethnographic work from the 19th century is also informative on aspects of turkey



Fig. 12. Trauma to diaphysis of a left ulna from Eleanor Ruin.



Fig. 13. Healed fracture to diaphysis of a right ulna from the Eleventh Hour site.

husbandry and the importance of feathers. Frank Hamilton Cushing (in the 1880s) and Alexander M. Stephen (1890s) wrote about their observations and experiences at the Pueblos of Zuñi and Hopi respectively.

Cushing describes tools and the process of plucking feathers from turkeys at Zuñi, as well as the transfer of feather plucking terminology and technological approaches to the harvesting of sheep's wool:

“When I first went to live with the Zuñis, their sheep were plucked, not sheared, with flat strips of band iron in place of the bone spatulae originally used in plucking the turkeys; and the herders always scrupulously picked up stray flecks of wool-calling it “down,” not hair, not fur-and spinning it, knitting, too, at their long woolen leggings as they followed their sheep, all as their forefathers used ever to pick up and twirl the stray feathers and knit at their down kilts and tunics as they followed and herded their turkeys.”

[Cushing (1979:183)]

At Hopi, Stephen noted a paucity of turkey feathers for prayer-sticks, the presence of turkeys which had been plucked into a status of perceived non-existence, and his own role in obtaining suitable feathers:

“Ka'kapti took the northwest prayer-sticks, that is all the prayer-sticks made by those in kiva today, to be deposited for them, but not at a spring. (I must see as to this again.) If there had been more turkey feathers there would have been more prayer-sticks made. I gave them a note yesterday to get some turkey feathers from T.V.K. Is it possible they depend on this supply? This can not [sic] be, for they have turkeys here on the mesa, but this is what they say, they have no turkey. Further talk elicits the fact that the turkeys have already been plucked here, plucked bare of all the kinds of feathers appropriate for prayer-stick trimming.”

[Stephen (1936:605)]

Apart from matters of observation and biases which can affect these historical and ethnographic records, animal husbandry, like other practices, has not remained static over time. Although these sources help to contextualise the roles of the turkey at the later-period sites and lend a form of support to the feather-harvesting hypothesis, the archaeologically-derived palaeopathological and metrical data form the foundations of such interpretations.



Fig. 14. Healed fracture with slight angular deviation in an ulna from Salmon Ruin.

6. Conclusions: feathers and further

Standardised palaeopathological and metrical analyses of nine assemblages excavated in the American Southwest produced evidence that meat production was not the sole purpose for turkey-keeping. In particular, traumatic injuries to turkey ulnae at five sites support the hypothesis that feathers were harvested from live individuals. The nature and frequency of these injuries, in combination with metrical data gathered from the turkey assemblages, suggest that feather harvesting practices were part of turkey husbandry regimes at some sites in the American Southwest. This is not to suggest that turkeys were not kept as a source of protein, but rather (as described at Pottery Mound, Clark, 2007:216) that feather production was a husbandry focus. Feather harvesting is a single facet of human-turkey relationships in the American Southwest, which would have been nested, if one pardons the pun, within other turkey-keeping strategies.

This research presents a starting point for future investigations of palaeopathological data with respect to past turkey-human relationships. Standardised, routine examination of archaeological turkey pathology could lead to more detailed interpretations of husbandry. Some lesions encountered in turkey elements could potentially be linked to husbandry practices with further differential diagnosis (using radiography or other imaging techniques). For example, if a turkey had osteomalacia (known as rickets in juveniles), it might have suffered from a dietary deficiency or received insufficient sunlight as a result of being kept indoors, a possibility noted with regard to turkeys at Paquimé (McKusick in Di Peso, 1974:280). Age-related joint disease may hint at the reasons for which turkeys were being kept; turkeys can live for up to 14 years, and become skeletally mature only after they are adult-sized (Dickson, 1992; Schorger, 1966: 295–296). Metrical data also have excellent potential to inform upon past relationships between humans and turkeys (Badenhorst et al., 2012) and new sexing techniques can provide a clearer picture of turkey population structures in the future (Speller and Yang, 2016–in this issue).

In addition to examining the idea of feather harvesting with more data and new techniques in the future and applying metrical and palaeopathological analyses consistently, turkey husbandry research will achieve deeper and more meaningful results if approached from several angles at once. Past turkey husbandry warrants a comprehensive and nuanced understanding, and much has been achieved in this regard: scholars have used everything from eggshell analyses (Beacham and Durand, 2007) to stable isotopes (Grimstead et al., 2014; McCaffery et al., 2014) to illuminate facets of past turkey-human relationships. The articles in this issue provide a host of exciting perspectives on these relationships, and if we interpret the results from each method in an integrated and balanced manner, we could then begin to reconstruct turkey husbandry as an activity and series of relationships rather than focussing solely on single attributes such as movement restriction, diet, or size.

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