CULTURAL AND GENETIC CONTEXTS FOR EARLY TURKEY DOMESTICATION IN THE NORTHERN SOUTHWEST

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The turkey (Meleagris gallopavo) was independently domesticated in Mesoamerica and the Southwest, the latter as the only case of Native American animal domestication north of Mexico. In the upland (non-desert) portion of the American Southwest, distinctive closely related mtDNA lineages belonging to haplogroup H1 (thought to indicate domestication) occur from ca. 1 A.D. (Basketmaker II period) through early historic times. At many sites, low frequencies of lineages belonging to haplogroup H2 also occur, apparently derived from the local Merriam’s subspecies. We report genetic, stable isotope, and coprolite data from turkey remains recovered at three early sites in SE Utah and SW Colorado dating to the Basketmaker II, III, and early Pueblo II periods. Evidence from these and other early sites indicates that both the H1 and H2 turkeys had a predominantly maize-based diet similar to that of humans; prior to late Pueblo II times, the birds were kept primarily to provide feathers for blankets and ritual uses; and ritualized burials indicate turkeys’ symbolic value. We argue that viewing individuals from the H1 and H2 haplogroups as “domestic” versus “wild” is an oversimplification.

El pavo (Meleagris gallopavo) fue domesticado independientemente en Mesoamérica y el Sureste Americano, siendo este último el único caso de domesticación al norte de México. En las tierras altas (no desérticas) del Sureste Americano se encuentran linajes de ADN mitocondriales distintivos y estrechamente relacionados pertenecientes al haplogrupo H1 (considerado indicador de domesticación) desde ca. 1 d.C. (Período Basketmaker II) hasta comienzos de los tiempos históricos. En muchos sitios también existe la presencia de bajas frecuencias de linajes pertenecientes al haplogrupo H2, aparentemente derivados de las subespecies Merriam locales. Presentamos información genética, de isótopos estables, y coprolitos de restos de pavos recuperados en tres sitios tempranos en el suroeste de Utah y suroeste de Colorado datados para los periodos Basketmaker II, III, y Pueblo Temprano II. La evidencia de estos y otros sitios tempranos indica que tanto los pavos H1 como los H2 tuvieron una dieta predominantemente basada en maíz, similar a la de los humanos; antes de los tiempos Pueblo Tardío II, las aves fueron criadas principalmente para proveer plumas para cobijas y usos rituales; entierros ritualizados indican el valor simbólico de los pavos. Argumentamos que catalogar a los individuos de los haplogrupos H1 y H2 como “domésticos” versus “salvajes” es una simplificación excesiva.

Recent genetic research in the American Southwest indicates that Pueblo communities regularly kept and independently domesticated turkeys (Meleagris gallopavo spp.) prior to the Spanish occupation. Speller et al. (2010) assessed mitochondrial DNA (mtDNA) from archaeologically recovered turkey bones and coprolites from 38 archaeological sites located across the upland portions of the Southwest and spanning late Basketmaker II (ca. 1 A.D.) to early...
historic times. Approximately 85 percent of the 143 successfully sequenced archaeological samples belong to one major mitochondrial haplogroup (matrilines that descend from a common ancestor, in this case labeled haplogroup H1). This haplogroup differs genetically both from the wild and domestic turkeys (*M. g. gallopavo*) found in central Mexico and from the lineages commonly exhibited by Merriam’s subspecies (*M. g. merriami*), found in the upland Southwest.

Ninety-five percent of the H1 haplogroup members display a single haplotype (i.e., a single maternal lineage) labeled aHap1; the others differ from aHap1 by single base-pair mutations (Speller et al. 2010:2808 and Figure 3). Speller et al. (2010:2809) attribute H1’s low genetic diversity to “a severe genetic bottleneck and breeding isolation almost certainly associated with the domestication process.” Breeding control is indicated by the fact that the H1 haplogroup remained distinct over an area of several thousand square miles and for over 1600 years. The H1 lineages’ closest relationships are to mitochondrial lines observed in modern populations of the Rio Grande (*M. g. intermedia*) and Eastern (*M. g. silvestris*) subspecies (Speller et al. 2010), suggesting that the founding population was introduced from the east or southeast.

The other approximately 15 percent of the turkey samples analyzed by Speller et al. were assigned to haplogroup H2, examples of which occurred at 15 of the 38 archaeological sites. It includes haplotypes that regularly appear in the modern Merriam’s and in one case the Gould’s (*M. g. mexicana*) subspecies. Most of the H2 archaeological samples belong to the lineage called aHap2, also the most common haplotype (43 out of 73 birds) in the modern Merriam’s populations sampled by Mock et al. (2002). Speller et al. (2010:2811) concluded that the H2 archaeological samples probably consist of wild-captured birds.

However, we question whether each case represents a bird born wild and brought into a flock, or whether once introduced, some H2 lines might not have persisted through multiple generations. If the offspring of a captured H2 hen did not have undesirable phenotypic characteristics, the human keepers may not have culled them.

Archaeological faunal remains from the northern Southwest show a decline in large game and a corresponding increase in small mammals and domestic turkeys in the late Pueblo II and Pueblo III periods (P II and P III, ca. 1050 to 1280) (Badenhorst and Driver 2009; Driver 2002; Muir and Driver 2002a; Windes 1987), evidently in response to population growth and consequent game depletion. Most authors see little evidence that turkeys were consistently used as food in the earlier Basketmaker (BM) II and III, and P I periods. Rawlings and Driver (2010:2434) note that during these periods “turkeys were kept primarily for ritual use; they were probably raised for their feathers, and their bones are typically recovered from deliberate interments.” Other authors (Hill 2000; McKusick 2001; Munro 2006) express similar inferences.

Here, we review genetic, isotopic, pollen, and contextual data from three early sites that are relevant to the questions of maize dependence by turkeys, ritual uses, the importance of feathers, whether turkeys were confined by their keepers, and whether members of the two genetically different haplogroups were treated differently. These questions bear on how the domestication process (Zeder et al. 2006; Zeder 2012) unfolded in the northern Southwest. The sites we discuss are the BM II Turkey Pen and the BM III Croom sites, both in the Cedar Mesa area of southeastern Utah, and Champagne Spring, an early P II site in southwestern Colorado (Figure 1). We review genetic and carbon isotope data from turkey bones at the latter two sites, and genetic and pollen data from turkey coprolites at Turkey Pen.

**The Turkey Pen Site (42SA3714)**

This is a large natural shelter on public land managed by the Bureau of Land Management (BLM) in Grand Gulch, southeast Utah. It was among the sites dug by Richard Wetherill in the 1890s (Blackburn and Williamson 1997; Webster 2014). Turkey Pen also has structures dating to a P II–P III occupation between about A.D. 1060 and 1270 (Bedell 2000; Matson et al. 1988). These include the partially standing remains of a brush and mud (jacal) enclosure that has never been excavated, but which visitors have informally labeled a turkey pen—hence the site’s name.

In 1972, as part of the Cedar Mesa Project, Matson (1991:90–96, 2014, 2015) dug a single test pit in an extensive deep dry midden deposit...
in the central part of the shelter’s floor. Over the years, 32 samples from this test pit’s profile have been radiocarbon dated, 26 of them by AMS (Matson 2014, 2015). A single date from Layer A-1 at the very top of the midden falls in the PI period. The other dates indicate that the main deposit accumulated between about A.D. 1 and 200.

The 1972 test pit yielded large quantities of dry organic material, including abundant turkey and human coprolites, corn cobs, parts of corn plants, squash rind fragments, feathers, loose strands of human hair, and cordage made of human hair or plant fiber. Pottery was absent, and stone flakes and scraps of bone were rare. Richard Wetherill characterized the midden thusly: “The debris seemed too much for us to work in the limited time we had. Also too filthy as it was composed almost entirely of desiccated [sic] turkey droppings” (Wetherill, 1896–1897). Pollen and macrobotanical analysis of human coprolites from the test pit (Aasen 1984; Matson 1991), as well as midden constituent analysis (Matson 1991, 2015), showed that maize was by far the most common food item. Isotopic analyses of BM II human remains from other Cedar Mesa sites (Chisholm and Matson 1994; Matson and Chisholm 1991) indicate that maize provided around 80 percent of their caloric needs. Decker and Tieszen (1989) obtained similar results for BM III through PIII individuals from Mesa Verde National Park. Carbon isotopes of a small sample of human hair from the Turkey Pen midden (Cooper 2013) indicate high levels of maize consumption, as do more extensive isotopic analyses of BM II remains in Utah and Arizona (Coltrain and Janetski 2013; Coltrain et al. 2007; Matson and Chisholm 2007). DeBoer (2007; reported in McCaffery et al. 2014) obtained similar results for a sample of 50 individuals from P II and P III sites in northwestern New Mexico.

Dried turkey droppings from the Turkey Pen midden test pit were analyzed by Speller et al. (2010), and represent the only BM II samples in that study. Of these, 14 could be definitely and five probably assigned to aHap1 (based on whether the sequences were complete—spanning nucleotide positions [nps] 15554–16013—or partial). Seven were assigned to aHap2 (three definitely and four probably; Speller et al. 2010, Table S2). Nott (2010:Table 5) genetically analyzed ad-
ditional coprolites from the site and assigned six to aHap1 and one to aHap2. Counting both definite and probable assignments, the combined BM II coprolite sample from Turkey Pen is 75.8 percent haplogroup H1 and 24.2 percent H2. Speller et al. (2010:Table S3) list 136 post-BM II archaeological bones that could be definitely or probably assigned to the H1 or H2 haplogroups; the 27 samples listed in our Table 2 bring the post-BM II number to 163, with 81.6 percent in the H1 and 18.4 percent in the H2 group.

Maize pollen and fragments of maize kernel pericarp were present in the two turkey coprolites that were analyzed by Aasen (1984:44 and Figure 7). Arakawa et al. (2001) identified maize pollen in six of eight other specimens from the test pit. Nott (2010) found maize pollen in 22 of 27 turkey coprolites. She compared pollen frequencies from the coprolites and the midden layers in which they were found and concluded that contamination from adjacent deposits was minimal. Her comparison of the pollen profiles from coprolites of the H1 and H2 haplogroups indicated no significant differences in frequencies, indicating that the birds of both mtDNA lineages had similar diets. The turkey coprolite pollen types and frequencies were similar to those Aasen (1984) reports for human coprolites from the test pit.

Looters heavily disturbed the site’s extensive dry midden in 1979 (Green and Herrick 1985). In 1980, the BLM contracted with the Division of Conservation Archaeology at the San Juan County Museum in Farmington, New Mexico, to recover data from the looters’ pits by screening backdirt, profiling deposits, and collecting surface artifacts, after which the pits were filled in. Margaret Powers (1984) directed and reported the work. The collections are curated at the Edge of the Cedars Museum in Blanding, Utah.

Powers’ assessment was that the looters’ pits had encountered intact archaeological contexts from both the BM II and P II/III occupations of the site, in addition to disturbed and mixed deposits resulting primarily from digging in the 1890s. She inferred from the distribution of cultural material that the BM II deposits were the most extensive. Two very large looters’ pits (Nos. 18 and 26) appeared to have intruded primarily into BM II deposits (Powers 1984:66–68). Analysis of faunal material from backdirt and profile clearing of these two pits showed that turkey bones were rare (Powers 1984:Appendix L). Of 460 vertebrate faunal items, three were identified as “Aves”; three as “large bird”; two as M. gallopavo; and two as probable turkey eggshell. A recent survey of faunal remains from BM II sites in the northern Southwest indicates that when turkey bones are present, they occur in similarly low frequencies (Reynolds 2012).

Turkey coprolites and feathers occur in all levels of the 1972 midden sample from the Turkey Pen site, showing that the birds were present throughout accumulation of the excavated portion of the midden. Powers (1984:99) notes the wide distribution of turkey coprolites in the looted deposits and infers that the birds were probably not confined. Caked turkey droppings might be expected if turkeys had been kept in pens, but neither the 1972 excavation nor the 1980 data recovery project encountered this type of deposit. A reliable water source is available close to the site, and crops were probably planted on the adjacent floodplain. These may have kept turkeys “close to home” even if they were not consistently confined.

The BM II period appears to be when blankets made of feather-wrapped cordage began to replace those made of cords wrapped with furry strips of rabbit hide. The abundance of coprolites at Turkey Pen does not necessarily imply the presence of large numbers of turkeys, if they were being kept primarily to provide feathers for ritual purposes and feather-cord blankets. In the 1980 Turkey Pen “clean-up,” fragments of feather-wrapped cordage outnumbered fur-wrapped examples 191 to 97 (Powers 1984:102). Undoubtedly, items from both BM II and P II/III contexts are included, but if Powers is correct that the looted midden deposits are predominantly BM II, this would be consistent with production of both types of fabric at that time.

In sum, the Turkey Pen evidence indicates (1) turkey husbandry was well established by A.D. 1 to 200; (2) and their keepers were heavily dependent on maize-farming; (3) the birds were in regular close contact with humans; (4) they were probably not confined in pens or enclosures; (5) birds of the two different mtDNA haplogroups had similar diets, with maize by far the largest component; and (6) turkeys were not a regular food source. We propose that turkeys were kept
at Turkey Pen primarily to provide feathers for blankets and ritual uses.

The Croom Site\(^1\) (42SA3701)

This is a late BM III Mossbacks phase (Matson et al. 1988, 1990) open site located on Cedar Mesa approximately 8 km SSW of the Turkey Pen site. Limited excavations were carried out in 1970 by SUNY-Binghamton field school students directed by William Lipe (Barrentine 2009). Residential pit structures were not found, but surface evidence of such features is minimal, and remote sensing or auger surveys were not carried out. The presence of several large storage cists, plus abundant ceramics, lithics, ground stone, and fragments of burned adobe, indicate that Croom was a habitation site with multiple activity loci. The excavations yielded nearly 5,000 potsherds, none of types dating later than BM III. The absence of San Juan Red Ware sherds indicates that occupation ended before A.D. 700. We estimate that the Croom site was occupied sometime between A.D. 620 and 700; this is consistent with its pottery assemblage and with tree-ring dates from other Mossbacks phase sites on Cedar Mesa.\(^2\)

There are three widely separated occupation loci: Areas A, B, and C–D. The concentration of turkey remains reported here is from Area A (Barrentine 2009). The only cultural feature in Area A is a midden, approximately 17 x 11 m in extent, with a central 8 x 9 m area of very dark ashy soil. The midden is 30 to 45 cm deep in its central part. A shallow 6-x-1-m looter’s trench was present in the central dark area; it had exposed and undoubtedly displaced some of the turkey bones reported here. The excavations consisted of fifteen 5-x-5-ft (approximately 1.5 x 1.5 m) test pits; nine were joined to comprise a SW-NE trench across the center of the midden. All excavated deposits were passed through 1/4-in screens. Approximately 80 percent of the pottery collected at the site is from Area A.

The Area A excavations yielded 146 bones. Because large birds were heavily represented, in 1971 the assemblage was sent (via Lyn Hargrave) to Charmion McKusick for analysis. She identified 115 of the bones as turkey (\(M.\ gallopavo\)). (Some bones not identifiable to species might also have been from turkeys). The turkey bones were concentrated in the center of the dark “core” of the midden, the majority from a single grid unit. The site catalog notes 73 gizzard stones from this unit (presumably collected while troweling, as most would likely have passed through the screen). A piece of eggshell is also cataloged from this unit, and another piece was collected from the midden surface elsewhere in Area A. No turkey bones were found elsewhere at the site, although several eggshell fragments occurred in Area C.\(^3\)

McKusick’s analysis notes record bone element, side, and indicators of age and sex, as well as bone condition and which specimens likely belonged to the same individual. She reported numerous old breaks, but did not find evidence of butchering or burning. Most of the Area A bones were encountered only 0–30 cm below modern ground surface, so bioturbation likely accounts for the observed disarticulation and breakage. Based on bone elements alone, we established an MNI of three. If McKusick’s age estimates and the locations where bones were found are taken into account, this can be increased to five: three adults in the primary concentration (two males and a female based on the tarsometatarsi), plus an adult female located 7.5 m and a juvenile 4.6 m from the concentration.

The three adults in the central concentration appear to represent a single burial event; it is not clear whether the other individuals were part of the same event. Bones other than turkey are rare in Area A. Rapid burial likely accounts for the survival of the Area A turkey bones. Had they been discarded with other refuse on the midden surface, they would have been immediately vulnerable to scavenging.

The Champagne Spring Site (5DL2333)

This is a large privately owned early- to mid-P II period site located approximately 11.3 km south of Dove Creek, Colorado (Dove 2012, 2014; Four Corners Research 2015). Remote sensing was done in 2003 and 2004 (Dove 2006), with several sessions of excavation between 2008 and 2013 by members of the Verde Valley Archaeology Center and the Colorado Archaeological Society under the direction of David Dove.

Surface survey and remote sensing indicate the presence of at least 50 kivas/pit structures, 250
surface rooms, a 6-m-diameter “oversized pit structure,” a great kiva, and extensive middens. Pottery styles indicate occupation over an approximately 200-year period, from A.D. 900–1100, though with shorter histories for individual structures and areas within the site (Dove 2012). Dove interprets the North Hill section, where the great kiva is located, as the ceremonial center of a community living at and near the site. Six kivas or pit structures located close to the great kiva were the focus of excavation.

Structure 34, a small kiva with a floor area of 18 m², was partially excavated in 2008 and 2011. Styles of pottery and architecture date it to the A.D. 900s, with an ending date between A.D. 950 and 1000 (Dove 2012:7–8). The structure had been re-roofed several times, indicating a long history of use, and differed from ordinary Mesa Verde area small “household” kivas in having an elaborated sipapu in the form of a large floor vault (cf. Wilshusen 1989), and little evidence of domestic activities. It was not burned at abandonment, a type of “closing down” ritual (Wilshusen 1986) common for pit structures and kivas in the Central Mesa Verde area (and for the other kivas excavated at the site).

Structure 34 was the locus for another type of closing ritual. The floor vault and ash pit were filled with clean sand and capped by sandy red adobe, and complete animals were placed on the floor south of the floor vault and in the southwest quadrant of the structure (Dove 2012). These consisted of the complete articulated remains of six adult and one sub-adult turkeys, 14 recently hatched juvenile turkeys, four canids (probably dogs), a cottontail rabbit, and a headless rat-tlesnake. The animal remains showed no carnivore damage or weathering, indicating that they were covered very soon after being emplaced. The structure was eventually filled with what appears to be household midden.

Other excavations at the North Hill complex at Champagne Spring have revealed additional animal burials, including at Structure 37, another small kiva that was partially excavated in 2012. It is approximately contemporaneous with Structure 34. The Structure 37 excavations revealed an elaborate complex of animal interments (Figure 2). Robin Lyle has identified turkey remains consisting of ten adult females; three adult males; one young adult male; and two of unknown age and sex, as well as 37 newly hatched or young turkey poults (Supplemental Tables 1 and 4). Excavation also recovered two young canids (probably dogs), as well as one adult American Crow (Corvus brachyrhynchos).

Most of the animal interments were within a circular mound of stone slabs and earth fill approximately 150 cm in diameter and 80 cm in maximum height from the floor. It was located over the hearth, the nearby ash pit, and a subfloor ventilator opening. Dove infers that the mound was built up rapidly. Lyle observed that the bones showed no signs of perimortem trauma, burning, or carnivore damage, and inferred that the animals were intact and fully fleshed when emplaced. At some point after fill had accumulated over the burial mound, the remains of the roof were burned.

Only a small amount of excavation has been done in the extensive middens at Champagne Spring, but the kiva/pit structure fills include what appears to be household trash. Dove (personal communication, March 2015) reports that turkey bones not related to the purposeful interments are rare relative to the bones of lagomorphs and artiodactyls. From the faunal remains recovered so far, he concludes that turkey was not a favored food source at Champagne Spring before the eleventh century.

Analysis of Croom and Champagne Spring Turkeys and Comparison with Modern Wild Specimens

We obtained genetic and isotopic data from the BM III turkey interments in Area A at the Croom site (n = 5) and from the early Pueblo II Structure 34 at Champagne Spring (n = 6) (Table 1; Supplemental Tables 1 and 2). We also obtained isotopic data from modern wild turkeys collected by hunters (n = 13; Table 2, Supplemental Table 3) so that evidence of their diets could be compared with that from the archaeological remains. The modern data establish a baseline isotopic dietary signature for wild turkeys. Eight of these are Merriam’s turkeys collected in southwestern Colorado and northwestern New Mexico. In addition, three birds collected in Texas and Washington State are from the Rio Grande subspecies; one from Kansas is either Rio Grande or Eastern; and one from
Sonora, Mexico, is from the Gould’s subspecies. The Washington State specimens are from a recently introduced population. Technical details of sample processing and analysis for the DNA and isotopic determinations are described in the Supplemental Materials.

Mitochondrial DNA sequences were recovered from all 11 archaeological samples (Table 1 and Supplemental Table 2); none differed from haplotypes reported by Speller et al. (2010:Table S1). Each of the five Croom site turkeys and one from Champagne Spring belong to the H2 haplogroup, and the remaining five Champagne Spring birds are H1. Four of the Croom turkeys are assigned to aHap2 and the fifth to aHap2c. The five H1 birds from Champagne Spring are assigned to aHap1, and the single H2 turkey to aHap2. Thus, birds from both the H1 and H2 haplogroups were treated similarly in the sense of being purposefully interred at these sites.

All archaeological and modern samples yielded sufficient collagen for isotopic analysis (Tables 1 and 2). Yields of bone collagen in the ancient samples were not high (around 1 percent), but the C:N ratios are acceptable and the collagen appeared in good condition. The modern samples were in excellent condition. The Croom site samples showed high $\delta^{13}C$ and moderately high $\delta^{15}N$ values (Table 1) that contrasted strongly with measurements of 11 lagomorphs from archaeological contexts at Shield’s Pueblo in southwestern Colorado (Rawlings and Driver 2010; a reanalysis of one lagomorph bone is reported in the Supplemental Materials) and with the modern wild turkeys reported here (Table 2; Figure 3).

The $\delta^{13}C$ and $\delta^{15}N$ values from the Croom and Champagne Spring turkeys (Table 1; Figure 3) are within the range of those measured in humans from BM II sites in southeastern Utah (Coltrain and Janetski 2013). The enriched $\delta^{13}C$ values indicate turkeys at both sites consumed much C$_4$ plant matter—presumably maize. The higher mean $\delta^{13}C$ value from Champagne Spring ($\mu = -8.6‰$, $\sigma = .2$) than Croom ($\mu = -10.0‰$, $\sigma = 1.15$) suggests these turkeys were fed a slightly more maize-rich diet than those at Croom; a Welch’s $t$-test indicates this difference is statistically significant ($t[4.21] = -2.72$, $p = .05$). Overall, these results indicate high consumption of maize by the Croom and Champagne Spring turkeys, and are consistent with similar results from later P II and P III turkey remains from southwestern Colorado.

Figure 2. Detail of turkey burial in Structure 37, Champagne Spring site (photo by David Dove).
Table 1. Genetic and Isotopic Results from this Study, Rawlings and Driver (2010), and Speller et al. (2010).

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<td>H1</td>
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<td>8.2</td>
<td>3.3</td>
<td>aHap1</td>
<td>H1</td>
</tr>
<tr>
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<td>McPhee Village (5MT4475)</td>
<td>820–980</td>
<td>-8.4</td>
<td>7.1</td>
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<tr>
<td>TU-47</td>
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<tr>
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<td>7.7 (1.11)</td>
<td></td>
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<td></td>
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</tr>
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</table>

All archaeological turkey samples analyzed in this study (Table 1) showed enriched $\delta^{15}N$ values ($n = 11, \mu = 7.6‰, \sigma = .79$), indicating a higher trophic level diet—usually assumed to be the result of consuming more animal matter—than for the modern wild turkeys (Table 2; $n = 13, \mu = 5.3‰, \sigma = 1.02; t[21.868] = 6.38, p < .01$) or humans from BM II sites in southeastern Utah (Coltrain and Janetski 2013) ($n = 149, \mu = 7.0‰, \sigma = 1.28; t[14.155] = 2.46, p = .0276$). These observations contradict inferences (Rawlings and Driver 2010:2439) that prehistoric turkeys were probably not permitted to forage. Rawlings and Driver (2010:2440) suggest that enriched readings for archaeological turkeys might result from their having regularly eaten human fecal waste. However, analysis by McCaffery et al. (2014:344, 348) indicates that the turkeys they tested were not eating a measurable amount of human feces.

While the present study represents the first joint genetic and isotopic analysis of turkey remains, Rawlings and Driver (2010) separately analyzed the isotope values for some of the specimens for which Speller et al. (2010) had obtained genetic data. The combined results ($n = 16$) are presented in Table 1 alongside those from the present study ($n = 11$). When all the samples are considered, there is no statistically significant difference between the $\delta^{13}C$ or $\delta^{15}N$ values of turkeys...
were consuming large amounts of maize and that were being treated similarly in this respect. turkey domestication in the Southwest, the birds logically recovered birds (wild counterparts significantly different from those of their modern 2.16; 1.5, mal protein (s

<table>
<thead>
<tr>
<th>Sample ID</th>
<th>Provenience</th>
<th>δ¹³C</th>
<th>δ¹⁵N</th>
<th>C:N</th>
</tr>
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<td>3.41</td>
</tr>
<tr>
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<td></td>
<td>-19.0 (2.16)</td>
<td>5.3 (1.02)</td>
<td>3.5 (1.02)</td>
</tr>
</tbody>
</table>

Note: Isotopic ratios are per-mil (%e). See Supplemental Table 3 for additional information.

Isotope values for the total sample of archaeologically recovered birds (n = 27; δ¹³C: µ = -9.0‰, σ = 1.15; δ¹⁵N: µ = 7.7‰, σ = 1.11) were significantly different from those of their modern wild counterparts (n = 13; δ¹³C: µ = -9.0‰, σ = 1.15; δ¹⁵N: µ = 7.7‰, σ = 1.11) were

<table>
<thead>
<tr>
<th>Sample ID</th>
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<th>δ¹⁵N</th>
<th>C:N</th>
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<td>-19.7</td>
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<td>-19.0 (2.16)</td>
<td>5.3 (1.02)</td>
<td>3.5 (1.02)</td>
</tr>
</tbody>
</table>

Table 2. Modern Turkey Isotopic Results.

Discussion

Turkeys as Food

The evidence from the three early sites reviewed here supports the inferences of Badenhorst and Driver (2009), Muir and Driver (2002a), and Windes (1987) that in the northern Southwest, turkeys did not often serve as food until after about A.D. 1050. This is based on the relative paucity of turkey bones in household refuse at earlier sites and their high frequency at the later ones. Dietary use is thought to have intensified in late P II and P III in response to wild game depletion as Pueblo populations increased and village-sized aggregates formed (Badenhorst and Driver 2009; Bocinsky 2011; Driver 2002).

Maize Provisioning

Pollon and macrobotanical analysis of the BM II period turkey coprolites and isotope data from 11 bones from BM III Croom and early P II Champlagne Spring contexts show a consistent pattern of heavy maize dependence. The δ¹³C values from the latter two sites indicate that C₄ plants contributed an estimated 70 to 75 percent of the turkeys’ protein intake—most likely from maize—for many months prior to their deaths. Isotopic data for 30 samples from P I through P III contexts (Rawlings and Driver 2010:Tables 5 and 6) and 48 samples from P II and P III Middle San Juan River sites for which comparable collagen isotope values are reported (McCaffery et al. 2014:Table 2) show the same range of high C₄ values, with one possible exception. Hobson and Clark (1992) measured the turnover half-life of carbon isotopes in quail as 173 days; the half-life is perhaps longer in the much larger turkey, but to our knowledge has not been measured experimentally. The bone isotopes noted above thus reflect foods eaten by the birds over a period of at least a year and cannot represent just maize encountered by wild or semi-wild birds while foraging in farm fields (a food source available only a few months a year). The
possible exception from the Middle San Juan sites yielded a δ¹³C value of -18.1, perhaps representing a wild bird that had some access to maize. (See further discussion in McCaffery et al. [2012:346]).

Thus 88 of the 89 δ¹³C isotope values noted above do not overlap with those of our sample of wild birds (Figure 3). Rawlings and Driver (2010) also report isotope values for likely “garden pests” from P II–III contexts at the large Shields Site in southwestern Colorado. These animals (six cottontails and five jackrabbits) would certainly have had access to cornfields. However, these laggomorphs’ average δ¹³C values match the average values for the free-ranging wild birds reported in our Table 2 and Figure 3. Schollmeyer and Coltrain (2010) found that archaeologically recovered bones of deer and pronghorn from Mimbres area sites showed modest evidence of increased consumption of C₄ plants (presumably maize) relative to modeled values for natural forage, but the δ¹³C values of these specimens also fall within the range for wild turkeys (Figure 3). It therefore is highly unlikely that seasonal foraging in cornfields could account for the δ¹³C values displayed by the 11 early turkeys reported here (which are part of the sample of 88 archaeological turkeys noted above).

The evidence from the Turkey Pen site is based on pollen (and maize pericarp in two coprolites analyzed by Aasen [1984]), rather than isotopic data, but indicates the importance of maize in BM II turkey diets. One bit of supporting evidence from farther south are the maize kernels that filled the crop of a turkey carcass from Tularosa Cave, New Mexico, that is thought to date to BM II equivalent times (Schorger 1961; Hough 1914). The abundance of both turkey and human coprolites in the Turkey Pen midden, along with other material common in household refuse, indicates that the birds spent much time in close association with the human occupants of the site. However, the absence of caked deposits of turkey droppings indicates that they were probably not confined to one part of this large shelter.

A BM II turkey carcass from Canyon de Chelly (Nabhan 1989; Schorger 1970) has a cord around its neck, which might indicate control by tethering. Desiccated carcasses of two probable BM II period turkeys from southeastern Utah with attached cordage also are present in the collections of the Museum of Peoples and Cultures at Brigham Young University and the Field Museum in Chicago (personal communication, Laurie Webster 2015). Tethering may have been a suitable method for controlling small numbers of turkeys prior to the increase in flock size that must have accompanied their increased dietary use in late P II and P III.

Overall, the consistent record of very heavy maize dependence starting in the BM II period is the strongest evidence for substantial restrictions on free foraging by turkeys. If there was a nearby source of water, and the turkeys had become habituated to being fed regularly, they might have ranged short distances from their “home” habitation sites, perhaps seasonally. As noted previously, however, the persistence of the aHap1 haplotype for at least 1,500 years and over a huge area indicates, at least, control of hens during breeding season.

Ritual/Symbolic Uses

Ritual/symbolic uses are likely to have accompanied turkey keeping from earliest times. Muir and Driver (2002b) discuss the ritualized disposal of animal remains, and indicate that best evidence for such treatment of turkey remains prior to late P II is the strong contrast between the relative frequency of intentional burials of complete animals and the scarcity of bones in household refuse. Badenhorst and Driver (2009) refer to examples of burials from the earlier periods, and the Croom Site interments add one more BM III example. The possibly tethered BM II turkey carcass from Canyon de Chelly had been decapitated.
and a corncob shoved into its gullet (McKusick 1986; Nabhan 1989; Schorger 1970), surely a symbolic act. Anecdotal reports of large numbers of BM II and III desiccated turkey carcasses from Tularosa Cave and Tseahatso (Breitburg 1993:156; Hough 1914; McKusick 2001; Morris 1933; Schorger 1961) are difficult to evaluate as possible ritualized burials because the carcasses were not saved, and there are no published details of the archaeological contexts or analyses of faunal assemblages at these sites.

The elaborate Champagne Spring turkey interments (this article and Dove 2012, 2014) may provide evidence for seasonality of ritual turkey sacrifice. Associated with the 23 adult turkeys from two different structures were the remains of 51 turkey poults ranging in age from a few days to over a month (Supplemental Table 4). In Colorado, annual wild turkey incubation occurs in April through May (Healy 1992). Assuming that domesticated and wild turkeys had similar breeding schedules, the age range of turkey poults at Champagne Spring indicates that they were sacrificed (along with some adults) in late spring, around the time that corn would have been planted.
The timing of the Champagne Spring turkey interments suggests they might have been part of spring rituals designed to ensure a bountiful crop. A Mimbres Classic period depiction of a turkey with a corn ear as its neck (McKusick 2001:49) and the corncob inserted in the craw of the BM II turkey from Canyon de Chelly (Nabhan 1989) indicate an association between turkeys and corn.

Ritualized turkey interments continued after the birds became an important food source in late P II (Hill 2000: Muir and Driver 2002b). McKusick (2001:43) suggests that Southwestern turkey sacrifice may be a distant echo of Mesoamerican rituals devoted to Tlaloc, who represents the spirit of rain falling on fields. Di Peso (1974:565–569) reviews both archaeological and ethnographic evidence for symbolic connections between turkey feathers and turkey sacrifice, on the one hand, and corn planting and prayers for rain, on the other. Tyler (1979) notes that in historic and present-day Pueblo societies, turkeys are associated with the earth and also with the dead, who can become cloud spirits and bring rain.

Importance of Feathers

It seems likely that ensuring an abundant and steady supply of feathers was an important factor in turkey-keeping from the beginning. Blankets made of feather-wrapped cordage start to appear in the northern Southwest in BM II times. In subsequent periods, these largely replaced blankets made of cords wrapped with furry strips of rabbit hide. Blinman (2001) indicates that turkey feather blankets are both warmer and much more durable than those made of rabbit fur. Adult turkeys molt twice a year with the most complete one being in the late summer or fall (Leopold 1943). This ensures a regular supply of feathers.

Morris (1939:18–19) reports observing evidence of both fur-cord and feather-cord blankets in the same BM II interments in Canyon de Chelly, and notes that John Wetherill told him that he had seen both types in BM II interments in Grand Gulch. Textile expert Laurie Webster (personal communication, September/October 2015) has observed both types in museum collections from BM II contexts in the Cedar Mesa area, but notes that fur cord blankets with minor elements of feather cord are more common. Kidder and Guernsey (1919:174–175) and Morris and Burgh (1954) report “feather string” as an ornamental embellishment for fabrics made of “fur string” in BM II contexts. Feather-cord blankets were customarily used as shrouds for the dead, which would have established or reinforced symbolic associations between turkeys and the dead.

In archaeological contexts, feathers are seldom preserved, even in dry sites. However, we get a glimpse of the richness of ancient feather use in the rare cases where feathers and feather artifacts have been preserved. Kidder and Guernsey (1919) and Guernsey and Kidder (1921) illustrate BM II feather bundles and artifacts employing feathers that would have had ritual or personal adornment uses, or both. These included feathers from a number of different species of birds (as do prayer sticks and other ritual items in the Pueblo world today).

Tyler (1979:93–94) notes that the sixteenth-century Coronado party reported that the Pueblos kept turkeys primarily for their feathers “because they make cloaks of them.” In contemporary Pueblos, cloaks/blankets are no longer regularly made. However, prayer-sticks often incorporate turkey feathers, which are referred to as the “clothes” of the offering, harking back to the use of feather cloaks (Tyler 1979:93). Such ritual uses require a constant supply of feathers. For example, the numerous prayer-sticks made each year by a Zuni family are deposited in the cornfields as gifts to the ancestors, the masked gods, and the sun and moon, and are allowed to disintegrate into the earth (Ladd 1998). A Zuni family of five is expected to provide 17 prayer sticks for both the summer and winter solstice, requiring between 250 and 350 feathers annually, not counting offerings that might be made at various ceremonies (Ladd 1998:126). In an ethnographic survey of Pueblo uses of fauna, Gnabasik (1981) describes the ritual/symbolic uses of birds; turkeys are listed more frequently than parrots and macaws, and are second only to eagles.

“Domestic” vs. “Wild” Turkeys

The evidence reviewed here indicates that at sites where both genetic and isotopic evidence is available, birds from both the H1 “domestic” and the H2 “wild” haplogroups (Speller et al. 2010) were treated similarly, with regard to being closely associated with humans at habitation sites; having a
diet similar to humans, including very heavy dependence on maize; and ritual interment. In other words, individuals from the two groups were all treated as domestic animals. The H1 haplogroup’s low genetic diversity, its probable introduction from outside the upland Southwest in late B.C. times, and the fact that it was not swamped by H2 haplotypes from the surrounding Merriam’s populations indicate that humans exercised regular control over the breeding of the H1 hens—an indicator of domestication. On the other hand, the occurrence of the aHap1 haplotype in low frequencies in present-day Merriam’s wild populations indicates that H1 birds occasionally went feral. The regular presence of Merriam’s-derived H2 haplotypes in archaeological turkeys also indicates an open relationship of some type between the H1 birds and wild populations of Merriam’s turkeys.

As discussed above, once an H2 haplotype was introduced into a domestic flock, that line could have been maintained for multiple generations unless it was associated with undesirable physical or behavioral phenotypes that were culled. The possibilities are that (1) each archaeological case of an H2 haplotype represents a bird captured in the wild and then kept by humans; (2) H2 hens were occasionally brought into flocks kept by humans and then gave rise to some number of generations of H2 birds; or (3) H2 haplotypes were included in the original source population for the turkeys that were kept by humans for at least 1,500 years over the upland Southwest.

As noted under Provisioning, virtually all the archaeological turkeys for which we have isotopic data had been subsisting primarily on maize for at least a year prior to their deaths. This is consistent with their having been born in captivity or having been captured in the wild at an early age. One possible candidate for the latter instance is the juvenile specimen from the Croom site, which has a δ13C reading of -12 (Table 1), though this is still within the range of BM II human values (Figure 3). However, if the “capture” scenario was common, we should expect more δ13C values intermediate between those of present-day wild turkeys and the archaeological examples.

Regular capture of young birds to be raised in captivity implies regular access to wild Merriam’s populations and would presumably be accompanied by hunting full-grown wild turkeys, whose bones should then show up in archaeological deposits. However, the typical habitat for the Merriam’s subspecies is Ponderosa pine forest, rather than the pinyon-juniper and scrubland environments that BM II through P III farmers generally used. Cedar Mesa, where the earliest evidence of BM II turkey-keeping has been found, is outside the historically documented range of the Merriam’s subspecies (Schorger 1966:Figure 6). Furthermore, there is essentially no evidence that wild turkeys were hunted in the northern Southwest in the Archaic or Early Agricultural periods (Parmalee 1980; Rea 1980; Shaw 2002). The evidence to date regarding the recurrent presence of H2 birds in archaeological contexts favors an inference of occasional rather than regular capture of young wild birds for incorporation into domestic flocks.

We do not think that the H1–H2 genetic distinction should be equated with McKusick’s (1974, 1986, 2001) proposal that a large and a small Indian domesticate (LID and SID) both appear in the Southwestern archaeological record. Her work is based primarily on morphological analysis of bones, and secondarily on visual assessment of the Tularosa turkey carcass (Schorger 1961) as well as on depictions of prehistoric turkeys in rock art and on pottery. The genetic and cultural data presented here do not have a direct bearing on evaluating McKusick’s model, or on Breitburg’s critique (1988) and her response (McKusick 2001).

Future Research

Further genetic work with both archaeological and current wild populations, ideally including additional genetic markers located across the genome, should help to reconstruct the history of turkeys in the Southwest and to identify traits important in domestication. Additional isotope analyses that allow assessment of the diet of birds of varying ages and from the two haplogroups should aid in assessing the frequency with which wild birds were brought into captivity.

Overall, the mutualistic cultural and biological relationships expected under domestication do not seem well developed, at least initially (Zeder 2012:Figure 9.1). This likely changed when turkeys became an important food source in late
Domestication is typically a complex and historically contingent process (Larson et al. 2014; Zeder et al. 2006; Zeder 2012), often involving long-term gene flow between wild and semi-domestic populations (Marshall et al. 2014), so there is much more to be learned about how the process played out with turkeys in the Southwest. This region offers exceptional preservation of faunal remains and contexts, exceptional chronological control, and an abundance of relevant museum collections. Pueblo traditional knowledge and current cultural practices can provide insights into what turkeys and their feathers symbolize. Further studies of Southwestern turkeys thus have much to contribute to both regional and general understandings of the domestication process.

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Data Availability Statement. All data are included in the Supplemental Materials that accompany the online version of this paper. Additionally, genetic sequences for the eleven samples reported here (Table 1 and Supplemental Table 2) have been submitted to Genbank: http://www.ncbi.nlm.nih.gov/genbank/. The collections and records from the 1972 excavation at the Turkey Pen site are curated at the Washington State University Museum of Anthropology, as are the collections and records of the 1970 excavation at the Croom Site. The collections and records from the 1980 post-looting “clean-up” project at Turkey Pen (Powers 1984) are curated at the Edge of the Cedars State Park Museum in Blanding, Utah. The collections and records of excavations at the Champagne Spring site are curated by David Dove, on behalf of Four Corners Research, Cortez, Colorado.

Supplemental Materials. Supplemental materials are linked to the online version of this paper, which is accessible via the SAA member login at www.saa.org/member-login:
Supplemental Table 1. Samples Analyzed in this Study.
Supplemental Table 2. Genetic Sequence Results.
Supplemental Table 3. Modern Turkeys Results.
Supplemental Table 4. Turkey Poults Recovered from the Champagne Spring Site.

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Notes

1. The site is named for Karen Croom, one of the field school students.

2. Two radiocarbon analyses in 1970 produced dates of 1610 ± 95 and 1510 ± 100 radiocarbon years, from charcoal found in Areas A and C, respectively. The samples were not from structural members, and probably represent “old wood” firewood dates.

3. Kyle Bocinsky examined these eggshell fragments under an electron microscope, following the approach of Beacham and Durand (2007) and concluded that they did not represent full-term eggs that had hatched.

4. Several *M. gallopavo* bones are reported from Paleoarchaic deposits at North Creek Shelter in southern Utah (Newbold et al. 2012).