As one of the few New World animal domesticates, the turkey represented an important resource for the pre-contact peoples of Mesoamerica and the Southwest United States. Within the American Southwest, the Ancestral Puebloans were the predominant exploiters of turkeys, and the turkeys served as both a spiritual and secular resource. Turkey bones and feathers have been recovered from a variety of archaeological contexts, indicating that they were used not only for food, textile and tool sources, but for ritual purposes as well. Despite the fact that turkey bones and feathers are often well preserved in archaeological sites, a number of questions surrounding the origin and use of domestic turkeys remained unanswered. This project applied ancient DNA techniques to archaeological turkey bones and coprolites to shed light on the origin of domestic turkey stocks in the Southwest.
In the Southwest, the first evidence of turkey use appears around 100BC in the Basketmaker II phase, and there are two major hypotheses for the origin of these domestic turkeys. The first hypothesis is the independent domestication of local wild turkeys. One problem with this hypothesis, however, is that there is little evidence for the long term exploitation of wild turkeys prior to first evidence for domestic turkeys, leading some researchers to questions if wild stocks were even present in the Southwest during this time.

The second hypothesis suggests that following a pattern similar to domestic cultigens, previously domesticated turkeys would have been introduced into the Southwest. According to this hypothesis, the first domestic turkey to have been introduced was the Small Indian Domesticate (or SID) which was thought to have originated around Eastern Coastal Mexico (here is a photo of a desiccated Small Indian Domesticated bird recovered from a Basketmaker II archaeological site). Around 500 years later, a second introduction of a larger domestic breed has also been hypothesized, with these Large Indian Domesticates (or LID), potentially originating somewhere to the East of the four-corners region.
The first evidence for turkey use begins in the Basketmaker II Phase, a period when the Ancestral Pueblo were practicing maize and squash horticulture, with some limited hunting and gathering. Some of the earliest evidence of turkeys includes a few turkey bones, loose feathers, feather blankets and some turkey coprolites. By the Basketmaker III phase (dating to 500-750AD), there is more reliable evidence of on-site turkey husbandry, with more archaeological evidence for turkey coprolites, eggshells, turkey pens and loose feathers within the sites – as well as some turkey bone tools. The lack of turkey remains in refuse areas suggests that turkeys may not have been eaten, but rather may have been raised primarily for their feathers.

Turkey husbandry increases throughout the four-corners during the Pueblo periods. Ritual use of turkeys may also been seen in the interment of complete turkey carcasses in kivas or occasionally associated with human burials. After 900AD, in the San Juan area, turkey bones some with cut marks as seen here) are found more routinely in domestic middens, suggesting they were butchered and consumed, and turkeys become an important food source in the later Pueblo periods. This trend for larger turkey stocks, and turkey consumption in the Pueblo II and III periods also corresponds with a shift away from large wild game, such as deer, towards smaller wild game like rabbits.

Turkeys continue to play an important role in Ancestral Puebloan culture until the 18th and 19th century. The lifestyle changes associated with Spanish Colonialism after 1539, and the introduction of European domesticates such as sheep and chicken, contributed to dramatic declines in local turkey husbandry, possibly even resulting the disappearance of the Southwest domestic breed. With no currently known populations of this indigenous domestic breed surviving into the present, this project turned to ancient DNA analysis to help us understand the origins of this domestic bird.
Our project applied DNA analysis to 200 archaeological and modern turkey samples. The archaeological turkey samples included 29 turkey coprolites from the site of Turkey Pen Ruin, located in Grand Gulch, southwestern Utah. The majority of the tested coprolites were recovered from Basketmaker II midden deposits dating to between 250BC-400AD.

DNA analysis was also applied to 149 turkey bones from an additional 37 archaeological sites distribute throughout the Southwest. Most of the sites focused on the northern portion of four-corners region, within the Northern San Juan and Dolores areas of southwest Colorado. These archaeological sites ranged in time from the late 700s to 1600AD, but concentrated on the Pueblo III period. Most sites were represented by around five turkey bones, usually turkey humeri.

We also applied DNA analysis to 12 modern commercially-raised turkeys obtained from grocery store meat, so we could compare the relationship of the Southwest turkeys to modern commercial breeds.
This project was a collaboration between Washington State University and Simon Fraser University, and so the samples were processed in two different ancient DNA laboratories. The turkey coprolites were processed at the ancient DNA lab at WSU, while the bones were processed in the lab at SFU. Both labs have very stringent controls to prevent contaminating the samples with modern DNA – including the use of protective clothing, as you can see here. The DNA data were carefully scrutinized according to published criteria to ensure that the ancient DNA was authentic.
This project used overlapping primers to target 438bp of the turkey mitochondrial d-loop. This region was selected since mitochondrial is easier to recover from degraded remains than nuclear DNA, and also because this same mitochondrial locus was used in a recent genetic survey of modern wild turkeys, so the results from this study would be comparable to a larger data set. The DNA sequences recovered in this study were phylogenetically compared to each other and to North American wild turkey populations in order to assess their genetic relationships.
There are five sub-species of wild turkey currently living in North America, and this is a map showing their distribution as of 2002. The colours representing the subspecies will remain constant throughout the presentation.

We can see the study area here, and Merriam’s wild turkey, shown in red, is the local wild turkey of the region, and it populates the mountain region of the south-western US. The green area is the habitat of the Rio Grande wild turkey, which ranges over the south central plains and north-eastern Mexico. The large blue section is the range of the Eastern wild turkey, which inhabits roughly the eastern half of the US. The Florida subspecies is restricted to the yellow region in Florida, while the Gould’s wild turkey (in orange) occupies north-western Mexico and parts of southern Arizona and New Mexico. There is also a sixth subspecies, the South Mexican wild turkey, whose historic range lies within south-central Mexico, but which is now thought to be extinct. The South Mexican turkey is the ancestor to the domestic turkey used by the Aztecs and other Mesoamerican groups – eventually becoming the forerunner to our modern commercial breeds. Since no genetic analyses had been conducted on the South Mexican Wild turkey, this study extracted DNA from 10 historic South Mexican wild turkey samples from the Smithsonian. There is mitochondrial genetic data for the other North American wild turkey populations based on a genetic diversity study conducted in 2002.
Ancient DNA Results

- Complete DNA sequence from 143 of 178 archaeological samples
- 80% success rate for DNA extraction from archaeological remains
- 12 different mitochondrial haplotypes identified

Overall, our study had a high success rate for ancient DNA amplification, and complete DNA sequences were obtained for 143 of the 178 archaeological bone and coprolite samples – an 80% success rate.
This is a network diagram showing the relationship of the 12 types. Each circle represents a different haplotype and the size of the circles is proportional to the number of individuals that carry that haplotype (so the larger the circles, the more common the haplotype). The lines that connect the circles represent one base pair change, unless there is hatching, which denotes multiple changes. In this diagram, the grey areas represent the Southwest archaeological bones and coprolites, the white areas represent the modern commercially raised turkeys, and the pink areas represent the historic South Mexican wild turkey samples. The turkeys in this study fell roughly into three groups. The majority of the SW archaeological samples (85%) fell into a single group, H1. The remaining samples fell into two other haplogroups – H2 containing approximately 15% of the ancient samples, and H3 – which included all of the modern commercially-raised turkey samples and South Mexican wild turkey samples. Interestingly, both groups of Southwest turkeys were distinct from the South Mexican wild turkeys, and modern day domestic turkeys (which are ultimately descended from the turkeys raised by the Aztecs of Mesoamerica). There were no common haplotypes found between the ancient Southwest turkeys and the turkeys of Mesoamerica. In the Southwest samples, you can see that one haplotype – aHap1 contains the vast majority of the archaeological turkey samples – with 116 samples sharing an identical haplotype (81%). Considering the relatively high mitochondrial diversity of modern wild turkey populations, the uniformity of the aHap1 group points to a genetic bottleneck. Since the domestication process usually involved the isolation of a small founding breeding population, this type genetic bottleneck is often associated with domesticated animals. Archaeologically, these aHap1 turkeys were recovered from sites with evidence for turkey husbandry, such as turkey pens and eggshells. So, the evidence for a severe genetic bottleneck, in combination with archaeological evidence for turkey domestication, suggests that H1 group represents the signature of the Southwestern domestic turkey. In order to find the geographic origin of the H1 domestic lineage, we compared the ancient haplotypes to modern North American wild turkey populations.
This is a combined network showing the haplotypes from this study (in grey) and the North American wild turkeys. The coloured circles represent haplotypes found in the different wild turkey subspecies.

The haplotypes found in this study tend to maintain their distinction in three groups. We can see here that the H1 group forms a distinct clade, but is most closely with the Eastern wild turkeys (shown in blue) and Rio Grande haplotypes (shown in green), as well as some Florida haplotypes (in yellow).

The H2 turkeys group with the Merriam’s wild turkey (the local subspecies in the study area) with one haplotype grouping with the Gould’s wild turkey of S. Arizona and New Mexico. The H3 clade (made up primarily of the modern commercial turkeys, and South Mexican wild turkeys) groups other modern domestic turkeys as well as some Rio Grande wild turkeys.

We can see from the network that there is a still a clear distinction between the H3 ‘Mesoamerican turkeys’ and the ancient Southwest turkeys, suggesting there were two distinct origins for the domestic birds of both regions. This genetic data seems to rule out the Mesoamerican domestic turkey as the progenitor to the Southwest domestic breeds. If we return to the distribution map of wild turkey subspecies, we can begin to pinpoint the origins of both H1 and H2 turkeys in the Southwest.
If we zoom into the study area, we can examine the geographic origins Southwest turkeys. Turkey bones showing the H2 types were recovered from sites within the modern range of Merriam’s wild turkey, and the one haplotype closely related to Gould’s wild turkey was also found within is natural range. The presence of these local turkey types in the archaeological record indicates that the Ancestral Puebloans were indeed exploiting some local turkeys –Almost all the H2 turkey samples were recovered from archaeological sites within the natural range of the wild turkey, near ponderosa pine forest, suggesting that they represent the remains of hunted or captured local birds. However, these H2 types only made up 15% of the overall archaeological samples, indicating that local wild turkeys did not play a significant role in the domestication process.

The most predominant types, the H1 domestic turkeys, were turkey recovered from sites throughout the Southwest, and this haplotype is not common within the local wild turkey populations. Instead it is more closely related to Eastern and Rio Grande wild turkey populations. This genetic data suggests that the H1 turkeys were imported into the Southwest through human-mediated exchange of domestic (or at least captive) birds. Pinpointing the precise origin of these domestic birds is challenging, since they appear to be related to both the Eastern and Rio Grande wild turkeys. It is likely that the H1 turkeys originated from an area east/southeast of the Southwest United States (within the historic range of the Eastern and Rio Grande wild turkey), however, two subspecies occupy an enormous geographic range encompassing much of the Eastern United states and Northwestern Mexico. If the ranges of Eastern or Rio Grande turkeys extended farther west in the past, populations with relatively high frequencies of H1 haplotypes may even have been available for domestication somewhere within the Southwest, or at least on the peripheries of the Southwest. While this study may not be able to pinpoint the origin of the Southwest domestic bird, it does point to the possibility a new animal domestication centre in North America. Further archaeological and genetic work will hopefully allow us to pinpoint this turkey domestication center in the future.
Conclusions

- DNA supports the introduction of domestic turkey into SW
- Two independent domestication centres in N. America
- Single lineage of turkey distribution throughout Southwest


Rather than validating the domestication of local wild turkeys, ancient DNA analysis of archaeological turkey remains suggests that previously domesticated turkeys were imported into the Southwest. The presence of local turkey types in the archaeological remains confirms that local wild turkeys were indeed exploited, but their low frequency suggests that they didn’t play a significant role in the domestication process. The genetic differences between the Southwest domestic turkeys, and modern domestic turkeys points to separate domestication histories for the Mesoamerica and Southwest turkey breeds and raise the possibility of two turkey domestication events in North America.

The same domestic lineage seems to be present for over 1000 years. This domestic lineage appears in the Basketmaker II coprolites at Turkey pen, during the earliest periods of domestication and persists until the arrival of the Spanish. The same lineage is distributed over several hundred square kilometres suggesting that domestic turkeys were traded between sites, not only between Ancestral Puebloan groups, but between cultural traditions.
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