Excavation and Additional Studies at the Haynie Site (5MT1905) by the Crow Canyon Archaeological Center Annual Report 2022

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Introduction

In the summer of 2016, the Crow Canyon Archaeological Center (Crow Canyon) initiated the Northern Chaco Outliers Project (NCOP), a multi-year excavation and laboratory analysis project focused on the Haynie site (5MT1905) in southwestern Colorado (Ryan 2016). This report describes the project background and research objectives and summarizes archaeological work conducted under State of Colorado permit #81256 at the Haynie site in 2022 as well as preliminary results of laboratory analyses.

The Northern Chaco Outliers Project

Chacoan society flourished between A.D. 840 and 1140 and was centered in Chaco Canyon, New Mexico (Judge 1979; Judge and Cordell 2006; Lekson, ed 2006, 2015; Plog and Heitman 2010; Reed 2004; Saitta 1997; Sebastian 1992; Van Dyke 2007; Vivian 1990; Ware 2014). Chacoan culture was characterized by the construction of monumental masonry great houses, great kivas, earthworks, road segments, nonlocal exchange networks, significant social inequality, a suite of ritual practices, and a recognizable stylistic cannon. Between A.D. 1050 and 1140 Chaco-style architecture, landscapes, and settlement patterns expanded across the northern Southwest, appearing in what is now northeastern Arizona, southeastern Utah, and southwestern Colorado (Brown et al. 2013; Cameron 2008; Kantner and Mahoney, eds 2000; Lipe 2006; Ryan 2008; Reed, ed. 2008; Van Dyke 1999). Scholars debate precisely what kind of social, cultural, or political phenomenon this expansion represents. The NCOP seeks to understand the impact of Chacoan influence in the northern San Juan region of southwestern Colorado during the Chaco and post-Chaco periods by addressing four interrelated research domains: the role of community centers with public architecture, social stratification, identity formation, and human-environment interaction (Ryan 2016).

The NCOP uses data from a multi-great house community known as the Lakeview Group. The Lakeview Group includes four great houses and a great kiva within a 1-km radius of each other. Multi-great house communities are an important but poorly understood facet of the Chacoan and post-Chacoan periods in the northern San Juan region; archaeologists identify multi-great house communities at Aztec Ruins (Brown and Paddock 2011; Lekson 2015; Turner 2015, 2019; Van Dyke 2007), Mitchell Springs (Dove 2014; Smith 2009), Lowry Pueblo (Kendrick and Judge 2000), and at the Lakeview Group. The Haynie site contains two great house structures within a 5-acre area. Wallace Ruin, or Site 5MT6970 (Bradley 1988, 1992, 1993; Bradley and Bradley 2019, 2020) is located 335 m south of Haynie. An additional great house and an associated great kiva are found at the Ida Jean site (5MT4126) (Brisbin and Brisbin 1973), located 859 m west of the Haynie site.

Archaeologists have little explored the relationships between monumental structures within multi-great house communities, and it is not clear how these clusters functioned within the adjacent domestic community. Furthermore, the role of the northern multi-great house communities within the Chacoan regional system is uncertain. To address these issues, Crow Canyon archaeologists have developed a series of guiding research questions, situated within the four research domains described above (and summarized from Ryan 2016):

- How did the Lakeview Group first arise, and how did it develop over time? How did each great house function and what kinds of relationships existed between great houses?

- How was inequality expressed within the Lakeview community?

- Drawing on the communities of practice concept (Lave and Wenger 1991), how did identities unfold within the Lakeview Group during the Chacoan period (ca. A.D. 1080-1140) and did they change during the post-Chacoan period (ca. A.D. 1140-1225)?

- What conditions of possibility (or impossibility) arose during periods of significant environmental change, for example the great drought of A.D. 1130-1180? How was environmental change intertwined with community formation, inequality, and identity?

Crow Canyon researchers designed the NCOP fieldwork and laboratory analyses to produce environmental and material culture data that can address these questions. This research will contribute to regional archaeological issues—such as the degree of political centralization present within Chacoan society—and anthropological questions concerning culture and environment more broadly.

The NCOP has fieldwork and laboratory components. Crow Canyon's archaeological fieldwork in the Lakeview Group focuses on the Haynie site (5MT1905), a 5-acre preserve owned by The Archaeological Conservancy. Staff and participants have conducted excavation, remote sensing, architectural documentation, and artifact analysis at the site since 2016. Laboratory analyses of material excavated from the Haynie site is underway. In addition, laboratory staff, volunteers, and participants are processing and analyzing ceramic artifacts from the Wallace Ruin (including Greenstone Pueblo) and Ida Jean site. Bruce Bradley has conducted excavation at Wallace Ruin for over 50 years (Bradley 1988, 1992, 1993, Bradley and Bradley 2019, 2020). Although much of the Ida Jean site has been disturbed, the great kiva is partially intact and some information on the site is available from work conducted in the 1970s (Brisbin and Brisbin 1973). Finally, notes, maps, and artifact data exist from previous, nonprofessional excavation at the Haynie site. Crow Canyon is integrating these data into a research database to augment the data newly collected through excavation at Haynie.

Project Area Location and Ownership

The Lakeview Group is located in Montezuma County, Colorado, east-northeast of the modern-day town of Cortez (Figure 1). The sites in this group are in the heart of the Mesa Verde archaeological region, north of the Mesa Verde escarpment and near the confluence of Simon Draw and McElmo Creek; Stinking Springs is located southeast of the Lakeview Group. The majority of the Haynie site is located on a 5-acre property recently acquired by The Archaeological Conservancy from the Haynie Ranch, LLC. The easternmost portion of the Haynie site is on private land not accessible to Crow Canyon. Bruce Bradly owns Wallace Ruin and Greenstone Pueblo, a small domestic habitation adjacent to Wallace. The Ida Jean site, including the great kiva, is on private land not accessible to Crow Canyon.

Environmental Setting

The NCOP study area includes an environment defined by the surrounding drainages and by current agricultural use of the land. Figure 2 shows the locations of sites in the Lakeview Group. The Haynie site is located at 1,911 m (6,270 ft) and sits at the toe of a ridge to the north of, and just above, a shallow, broad valley within Simon Draw. The head of Simon Draw is located about 6 km north of the Haynie site. Simon Draw empties into McElmo Creek 4 km southwest of the Haynie site.

The soils of the valley bottom south of the Haynie and Ida Jean sites, and upon which Wallace Ruin sits, are predominantly Gladel-Pulpit complex (an eolian loess), and Ramper clay loam (a well-drained eolian loess). These soils are among those with the greatest agricultural potential in the entire region (Van West 1994:162–167). Today the valley bottom is plowed and irrigated and produces primarily alfalfa/grass hay. Small, undisturbed areas are present in the valley, and these are covered in sagebrush, lesser amounts of greasewood and saltbush, and some riparian vegetation that includes cottonwood, willow, cattails, and sedges. The Chaco-style great houses and the midden deposits at the Haynie site are covered mostly with greasewood, sagebrush, saltbush, and grasses. Sandstone ridges flank and rise above the valley floor, and these ridges support pinyon-juniper woodland.

Crow Canyon Excavation and Documentation System

In 2009, Dr. Susan Ryan and other Crow Canyon archaeologists established a permanent, primary site datum. Based on this datum, they used a total station to lay out a grid across the entire Haynie site. The “0,0” origin point is located southwest of the property’s southwest corner, thus all grid coordinates have a “northing” and “easting” number (e.g. 400N 300E). In 2016, we used a high-resolution TopCon Hifer II High Resolution GPS Geodetic Receiver to obtain more precise coordinates for the primary datum and backsite. The Haynie site is divided into Architectural Blocks—the West great house and surrounding remains are referred to as “Architectural Block 100.”

Most of Crow Canyon’s excavations at the Haynie site occur within excavation units (EU) of defined size (e.g. 2-x-4-m, 1-x-1-m) oriented to cardinal directions. We refer to Excavation Units by the size of the unit and the coordinate of the southwest corner (e.g. “3-x-2-m unit, 459N 376E”). Field archaeologists choose unit size and orientation based on the archaeological remains under investigation. Occasionally, the field crew conducted excavations that were less concretely defined than grid units—these are referred to as “Segments” and assigned a number (e.g. Segment 5). We typically use segments to expose partially buried walls or to extend a grid unit to capture the corner of a room or structure. Table 1 provides a list of all prior and in progress excavation units at the Haynie site and Figure 3 shows their locations in Block 100.

During Haynie site excavations, we often place several grid units and/or segments adjacent to one another. Contiguous grid units and segments are generally used for exploring structural remains. Crow Canyon also excavates random 1-x-1-m sample units in suspected midden deposits. Finally, we often use smaller 1-x-2-m or 2-x-2-m test units to target specific archaeological features identified through remote sensing, pedestrian survey, or archival work (for example, units of this size were used to seek remains of mechanically-disturbed areas). We refer to clusters of excavation units as “excavation areas” and we assign each excavation area a letter (e.g. Area A, Area B) (Figure 4).

Within excavation units, we excavate strata by natural layers, subdividing strata into 10-cm levels. Archaeological contexts that represent distinct natural and cultural deposits or construction events are designated a “study unit” or “SU.” The study unit is the key unit of analysis within the Crow Canyon documentation and recording system. There are three kinds of study units: Arbitrary (ARB), Structure (STR), and Nonstructure (NST). Arbitrary units tend to be deposits with edges that are either difficult to define or are a result of natural processes, e.g. fallen wall debris, or wind and water-laid post-occupational sediments. Structures include both surface structures and subterranean pit structures and kivas. We give each room within a multi-room surface habitation an individual structure number. Nonstructures typically include “constructed” deposits that are not structures, such as middens and use surfaces. We give each newly defined study unit one of these three designations depending on its origin and assign it a number.

Excavations at the Haynie Site in 2022

This section describes major study units investigated by Crow Canyon during 2022. For the location of structures in Architectural Block 100, please see Figure 5.

Excavation in Area C: A Pueblo I-Pueblo II Roomblock and Midden

Structure 1003

Structure 1003 is a masonry-lined Pueblo II period kiva tested with a 1-m-wide excavation trench (4-x-1-m unit 457N 370E and 3-x-1-m unit 454N 370E) that passed through the center of the structure from north to south. Excavation was completed during 2022, which clarified the construction and use history of the kiva. There were three floor surfaces in Structure 1003, a series of superimposed hearths (Features 2, 5, 7, and 8), a deflector (Feature 3), a slab-lined pit (Feature 6), and a ventilator tunnel and shaft (Features 4 and 1, respectively). Each floor surface was associated with the same ventilator tunnel which was slightly remodeled with each subsequent floor.

The earliest version of the kiva, associated with Surface 3, had a hearth that was remodeled once (Feature 7 and 8) and a large slab-lined pit (Feature 6) between the hearth and the ventilator tunnel (Feature 4) (Figure 6). Between Surface 3 and Surface 2 was a stratum of roof fall that suggests the kiva was dismantled or collapsed. The stratum was relatively thin and had been truncated by the constructed of Surfaces 1 and 2. Surface 2 was poorly preserved and associated with a hearth (Feature 5) that was remodeled (Feature 2) when Surface 1 was laid atop Surface 2.

The kiva may have originally had a masonry bench and upper lining wall. At some point in its history, possibly between Surface 3 and Surfaces 1 and 2, masonry was used to fill in the area above the bench. This architectural sequence was most obvious in the north wall of Structure 1003. Following the use of Surface 1 the structure collapsed leaving a thick stratum of roof fall. Midden debris was deposited in the depression left by the collapsed pitstructure.

None of the floors had significant artifact assemblages, indicating that the structure was cleaned out in each instance. Several of the superimposed hearths were well oxidized and archaeomagnetic samples were retrieved from three of them. The sample from Feature 2, the hearth associated with Surface 1, was analyzed in 2021 and returned dates of A.D. 935-1150, A.D. 1100-1265, and A.D. 1435-1690 (Table 3). The first two date ranges best fit the known period of occupation at the Haynie site (ca. A.D. 750-1250) and suggest the structure fell out of use around A.D. 1100-1150. A radiocarbon date of 1028-1172 cal AD (95.4%) was obtained from charcoal within this hearth and reinforces a terminal date ca. A.D. 1150. Three additional radiocarbon dates have been obtained for the roof fall and midden deposits above Surface 1 (Throgmorton et al. 2019:Table 3), suggesting these deposits date between 1033-1190 cal AD (94% confidence) or 1070-1154 cal AD (~50% confidence).

Structure 1002 and Structure 1036

Work recommenced in Structure 1002 and Structure 1036 during 2022 (they had been covered since 2019). Structure 1036 is an earthen-walled pitstructure nested within a larger earthen-walled pitstructure, Structure 1002. Based on sherds observed during excavation, both pitstructures are thought to date to the Pueblo I period. The exact relationship of Structure 1036 to 1002 has been difficult to discern, but a thin lens of ash/charcoal and artifacts observed in the southern half of the test trench (3-x-1-m 451N 374E) may be the floor surface of Structure 1036. A cluster of burned roof beams was encountered at both the south and the north end of the test trench (3-x-1-m unit 451N 374E and 3-x-1-m unit 454N 374E). The beams retained the orientation that they had while within the roof (Figure 7) and were mapped (Figure 9) and collected for dendrochronological analysis. The beam cluster was abruptly truncated. Strata within the west profile face of the test trench were also truncated at the same spot. This may indicate where Structure 1036 has cut into burned roof fall from Structure 1002 (Figure 10). Work in these two structures is ongoing and further clarification of the relationship of these structures may change interpretations given here.

Structure 1124/Nonstructure 1094

A use surface with a partially reconstructable pottery vessel was identified in 2021 on the northern slope of Area C. The surface appeared to be associated with a wall segment in the south profile face of 2-x-1-m unit 464N 364E and was therefore designated Surface 1 within Structure 1094. Further work in 2022 revealed that this area is more complicated than previously thought. A pit feature was found in association with the reconstructable vessel. However, it was determined that the wall segment was probably not associated with the surface, pit feature, and vessel because the footer trench for the wall cut through the surface and possibly even removed the upper portion of the pottery vessel. Both the wall segment (NST 1121, Feature 2) and footer trench (NST 1121, Feature 1) originated on an upper, ephemeral—and presumably extramural—surface that was designated Nonstructure 1121.

Therefore, Structure 1094 was redesignated Nonstructure 1094 and considered an extramural surface. It may be within a room, but no walls were found that are unequivocally associated with Nonstructure 1094. The pit feature became Feature 1 of Nonstructure 1094. Nonstructure 1094 was built atop naturally deposited silts (Arbitrary 1122) that in turn were resting on a collapsed adobe and clay wall (Arbitrary 1123). After clearing away the wall rubble, a well-preserved clay and cobble wall foundation was found (Figure 10) that formed the south wall of Structure 1124. There are at least two floor surfaces associated with Structure 1124. An upper ephemeral floor is associated with a remodel of Structure 1124 that involved adding a partition wall perpendicular to the cobble and clay foundation. The partition wall rested on a thin layer of sediments that had accumulated in Structure 1124 and effectively created two rooms, each with its own floor surface on fill. The lower floor was a prepared surface that articulated with the clay and cobble foundation. Additional cultural deposits continue beneath this floor surface. Work in Structure 1124 is ongoing.

Structure 1100

An east-to-west test trench initiated in 2021 (1-x-3-m unit 457N 358E and 1-x-3-m unit 457N 361E) identified a poorly preserved surface room designated Structure 1100. An additional unit (1-x-1.5-m 458N 359.50E) was added to sample the preserved portion of room (Structure 1100). This room is located at the southwest end of an architectural area that includes Structures 1010, 1124, 1026/1042, 1052, and 197. Much of Structure 1100 had been damaged by a looter pit. A poorly preserved ephemeral surface with an equivocal thermal feature (Feature 1) was designated Surface 1. Excavation continued within Structure 1100 during 2022, identifying a prepared floor surface (Surface 2) that contained a slab-lined post hole (Feature 3) (Figure 11). Work in this area is ongoing.

Nonstructure 1082

Nonstructure 1082 is a midden deposit at the west end of Area C. Aerial photos suggest that the midden was badly looted prior to the 1960s and it was mechanically excavated sometime between the late 1980s and the 2000s. The western edge, however, appears to be largely intact and in 2021 several 1-x-1-m test units were placed to sample the remaining midden deposits. Work on these 1-x-1-m units continued in 2022. In places, Nonstructure 1082 is much deeper than would be expected given the surrounding topography. There may be a natural topographic anomaly here, possibly a small drainage channel, although it is possible the midden fills a large subterranean feature. The midden deposits continue downward to a depth that appears to place them below the current elevation of the floodplain, suggesting that the floodplain has accumulated against cultural deposits at the west end of the Haynie site.

Nonstructure 1104

Nonstructure 1104 is a midden deposit at the southeast end of Area C. It may be the east side of the badly looted midden designated Nonstructure 1082 some 20 m to the west. Two new units were laid out in 2022 to further sample Nonstructure 1104 (1-x-1-m unit 440N 374E and 1-x-1-m unit 442N 374E). In the northern of these two units, a prepared extramural surface (Nonstructure 1117) was encountered within NST 1104. The surface may be associated with a structure located somewhere to the north.

Excavation in Area D: West great house

Structure 1115

In the late 2000s, Joel Brisbin tested a pitstructure that was located beneath the northeast corner of the west great house. Ralph Haynie placed a backhoe trench diagonally across the structure and Brisbin documented the floor of the structure and the stratigraphy of the fill. His notes indicate there were burned roof beams laying on the floor of the pitstructure. Sherds collected during excavation suggest the pitstructure dates to the Pueblo I period. In 2022, Crow Canyon re-excavated the trench to obtain dendrochronological samples.

Three 2-x-4-m test units were laid out over the presumed location of the pitstructure with the intention of excavating in plan view until the outline of the trench and pitstructure appeared. A thick layer or redeposited silty sediment was encountered. Based on the presence of several circular pits filled with potting soil and a number of fragments of plastic vegetable tags, this area was determined to have been Ralph Haynie’s vegetable garden. The backhoe trench was located by excavating a small east-to-west hand trench in the northernmost unit (2-x-4-m unit 448N 423E). Once the backhoe trench was located an additional hand trench was excavated along the north profile face until the wall of the pitstructure was located in the northeastern corner of the unit. Excavation then focused on following the edges of the backhoe trench to the southwest. Work in this area is ongoing.

Structure 1125

Hand-drawn maps from the mid-1980s depict a large, masonry lined subterranean structure northwest of the “paint shop.” In 2019, a geophysical survey project tested this area. Data sheets from this work depicted a large circular anomaly. In 2021, a backhoe trench (Segment 33) was placed east-to-west to locate this structure and a series of adobe rooms also indicated on the maps. Segment 33 identified a masonry wall corresponding to the east edge of this subterranean structure. In 2022, a hand trench (Segment 34) followed the wall segment to the north and south, confirming that it was a curved, double-wythe wall. The subterranean structure—probably a large, masonry-lined kiva—was designated Structure 1125.

In November of 2022 a small, mechanical excavator was used to continue tracing the extent of the masonry wall around its northern circumference. The west side of the kiva is poorly preserved, damaged by the installation of a septic system, but the estimated diameter of Structure 1125 is 9 to 10 m. Excavation of Segment 33 continued downward into the fill of Structure 1125 to determine whether there were intact deposits. A previous backhoe trench appears to have bisected Structure 1125 and removed some of the fill, but excavation of Segment 33 identified intact fill against its east wall and suggests that mechanical excavation may not have reached the floor of the structure. It also indicates that deposits with the kiva extend at least 1.5 m below the modern ground surface. Work in this area is ongoing.

Stabilization

In 2018 Crow Canyon conducted stabilization on the east great house (Diederichs 2018). The treatment primarily involved recapping walls and repointing the upper three to five courses of masonry. In addition, a trail was established so that visitors to the site could safely reach the top of the East great house with minimal impact to the structural integrity of the building.

Four years of exposure to the elements and frequent visitor foot traffic had begun to erode wall caps stabilized in 2018 and stones had been knocked loose from a previously stabilized wall crossed by the visitor foot trail. Following the methods established in 2018, Crow Canyon interns (Connor Ball, Liv Winnicki, Richie Sahneyah, Janelle Scarritt, and Katie Kemp) repointed and capped walls in Structures 200 and 201 (both kivas) and recapped the west wall of Structure 241 (Figure 12). A mortar mixture of 10 parts local sediment to one part Portland cement was used. Stabilization work occurred from July 18th to July 21st and August 30th to September 1st, 2022. Shanna Diederichs provided an overview of the methods and rationale for archaeological stabilization and Steve Copeland supervised the work.

Structure 200

Work on Structure 200 occurred from July 18th to July 21st, 2022. The upper lining wall and pilasters of the kiva were inspected for loose stones and the entire exposed circumference was repointed approximately two stones deep. No new stones were added. Approximately 60 buckets of mortar and 40 +/- gallons of water were used. Pre-and post-work photos were taken.

Structure 201

Work on Structure 201 occurred from August 30th to September 1st, 2022. The upper lining wall and pilasters of the kiva were inspected for loose stones. Loose stones were mortared into place and the upper two to five stones of the wall were repointed. Approximately 25 buckets of mortar and 20 +/- gallons of water were used, and pre- and post-work photos were taken. The entire exposed circumference, with the exception of the southern recess and southeast pilaster, were repaired. Pre-and post-work photos were taken.

Structure 241 West Wall

Due to visitation, several stones had been dislodged from the top cap. The upper courses of stone were repointed and the top cap repaired and remortared. Because of the significant amount of wear experienced by this wall segment, the mortar mixture contained more that 10% Portland cement. Pre-and post-work photos were taken.

Artifacts and Sample Analyses

Lab Analysis

Crow Canyon staff, participants, and volunteers cataloged and analyzed the flaked stone, ground stone, ceramic, and dendrochronological artifacts recovered during excavation. This year, participants in the National Science Foundation Research Experiences for Undergraduates Sites College Field School, the Archaeology Research Program, the National Endowment for the Humanities K-12 Institute participants, and the laboratory and dendrochronology interns assisted in laboratory analyses. Through Crow Canyon's volunteer program, 10 volunteers assisted with a pottery rehousing project, as well as chipped stone analyses, artifact cataloging, pottery temper analysis, and renovating the research library. Chronometric samples for radiocarbon or dendrochronological dating were analyzed. In-house cataloging and analyses of artifacts for the Haynie site is in progress. To date, staff, participants, and volunteers have catalogued more than 52,294 bags of artifacts and samples. Analyses have included 20,450 flaked stone artifacts, 70,003 sherds, 122 pieces of ground stone, 38 dendrochronological samples, and other types of samples and artifacts from the Haynie site. The pottery types identified at the Haynie site and tree-ring dates indicate a primary occupation during the early Pueblo I through Pueblo II periods (A.D. 750–1150). A substantial Pueblo III period (A.D. 1150-1300) occupation at the site is also evident, though modern disturbances have impacted these deposits significantly.

Special analyses were conducted on a variety of artifact types. For example, we continued to develop our Pueblo II design analysis protocols and dataset. At this point, 334 Cortez Black-on-white and Mancos Black-on-white bowl rim sherds have been analyzed. A total of 678 bowl rim sherds from the Lakeview community have been analyzed, including 67 sherds from Greenstone Pueblo (5MT6970), 172 sherds from Wallace great house (also 5MT6970), and 105 bowl rim sherds from the Ida Jean great house (5MT4126). The preliminary results of these analyses show that the potters in the Lakeview community decorated their white ware bowls with similar design styles as seen in the larger region, but the timing and use of distinct designs styles within a common repertoire of design grammars differed from those reported in other areas of the region. A similar analysis has been applied to the 32 Pueblo III white ware bowls in our ongoing analyses of white wares at the site. Additional special analyses include the temper of 934 rim sherds and analyzed attributes of 1004 projectile points and 21 beads.

Archaeofaunal Analyses

Crow Canyon post-doctoral researcher, Dr. Jonathan Dombrosky completed analyses of faunal specimens that have been catalogued as of October, 2022. He was assisted by zooarchaeology intern Eric Gilmore. See Appendix D for the archaeofaunal report. Dombrosky and Gilmore examined a total of 5,882 specimens. Of these, 1,601 (27.22%) were identifiable and 4,281 (72.58%) were not. Mammals, birds, and fishes were present. Of the 1,601 identifiable specimens, *Lagomorpha* was the most abundant order (31.67%), followed by *Artiodactyla* (16.68%), small mammals (16.11%), medium mammals (9.68%), *Rodentia* (8.31%), *Carnivora* (6.5%), large birds, most likely dominated by turkeys (5.87%), *Galliformes* or turkey (2.62%), with the remaining percentage composed of members of the classes *Aves* (birds) and *Actinopterygii* (fishes).

AMS Dating

In April of 2022 we received results from Beta Analytic for samples taken for AMS dating. These results are presented in Table 2. Dates range about A.D. 770 to A.D. 1170 and will help us refine the chronology of structures within Architectural Block 100. The dates provide Pueblo I and early Pueblo II dates for several contexts and solidify interpretations that Structure 1003 dates to the late A.D. 1000s and early 1100s.

Archaeomagnetic Sampling

In January of 2022 we received results from East Tennessee State University for archaeomagnetic samples taken from a hearth (Feature 2) associated with the uppermost floor (Surface 1) in Structure 1003, a kiva. The hearth was a remodel of an earlier hearth (Feature 5) also associated with Surface 1. After excavation of the feature, Kay Barnett removed the sample cubes that were used for dating. Results are presented in Table 3. We believe that the most likely date ranges are A.D. 935-1150 and A.D. 1100-1265, as A.D. 1435-1690 is well after the main occupation of the Haynie site (ca. A.D. 750-1250).

Two additional archaeomagnetic samples were taken from hearths within Structure 1003. A sample was taken from Feature 5, a hearth associated with Surface 2. This was the hearth that was remodeled to created Feature 2 of Surface 1. A sample was also taken from Feature 7, a hearth associated with Surface 3 and located beneath Features 2 and 5. We are awaiting results from these samples.

Supplemental Studies

College Field School Auger Testing Project

Crow Canyon's College Field School was sponsored by the National Science Foundation Research Experiences for Undergraduates Sites program. Three students from the field school—Brooke Prevedel, Ashley Bravo, and Lauren Bowlin—conducted auger testing south of the west great house at the Haynie site. The goal of the project was to determine whether intact subsurface deposits were present in the backyard of the modern house and to attempt to define the edges of a large, masonry-lined pitstructure encountered by a backhoe in 2021.

The students created a poster (Appendix B) describing the project and its results and they presented the poster at the 2022 Pecos Conference at Rowe Mesa, New Mexico. There are intact subsurface deposits in the backyard of the house extending up to 140 cm below the modern ground surface. Deposits in several auger holes resemble midden and pitstructure roof fall. The occurrence of these strata strongly suggests there are buried pitstructures in the backyard. No boundaries could be discerned between pitstructures, perhaps because later structures cut through earlier ones, creating a "zone" of pitstructure deposits rather than deposits associated with individual structures. At least one pitstructure was located south of Structure 1024, a Pueblo I pitstructure documented in 2019. One interpretation of the location and extent of pitstructure fill is that the pitstructures are in a plaza-like space associated with a Pueblo I roomblock that underlay the west great house. Evidence of this roomblock has been found to the west (Structures 186, 193, 1049, 1063, 1073, 1093) and to the east (unnumbered structures north of the "paint shop").

College Field School Pottery Design Analysis Project

Four students from the College Field School completed a project that compared pottery designs in the Lakeview Community (including the Haynie site) to contemporaneous sites in the northern Southwest (Appendix C). The study found that the focused design styles developed for Mancos and Cortez Black-on-white pottery were broadly comparable to the pottery typologies used at sites in New Mexico, such as Pueblo Alto, Salmon Pueblo, and Bis Sa'Ani. The Sosi design style is common within the Lakeview Community as well as at other Chaco-style sites in the San Juan Basin of New Mexico, but it is uncommon at Pueblo Alto within Chaco Canyon. This suggests there was an interaction sphere amongst outlying communities that did not entirely overlap with great houses within the canyon. While the Dogoszhi design style is more common by far within Chaco Canyon, it is present in the Lakeview Community indicating that Lakeview residents participated in a broader social sphere related to that style. The Black Mesa and Sosi/Black Mesa styles were especially common at the Haynie site, but uncommon in many other communities.

Curation Agreement

Crow Canyon entered into an agreement with the Canyons of the Ancients Visitors Center and Museum (formerly the Anasazi Heritage Center), located in Dolores, Colorado, for the curation of collected materials from the Haynie site. The Canyons of the Ancients Visitors Center and Museum will take possession of these materials after the completion of fieldwork and analyses as stipulated in the research design (Ryan 2016).

Participant Archaeology and Education

Four educational programs took place at the Haynie site in 2022 (Table 4). There were two sessions of the Field Internship Program, each with two interns (Connor Ball, Liv Winnicki, Janelle Scarritt, and Katie Kemp). Ten students participated in the College Field School. Twenty-eight K-12 teachers participated in a day-long excavation program at the Haynie site as part of the National Endowment for the Humanities Institute. Twenty-two students from Old Orchard High School participated in a two-day excavation program at the Haynie site. Numerous high school and college students toured the Haynie site during non-excavation programs (Table 7).

Research Presentations, Social Media, and Public Outreach.
Several presentations given at professional conferences focused on research at the Haynie site. These presentations are listed in Table 5. Dr. Jonathan Dombrosky presented a poster at the Society for American Archaeology meeting in Chicago showing preliminary results of faunal analyses. Dr. Kellam Throgmorton discussed decisions surrounding the treatment of the artifact assemblage in Structure 1047 at the 2022 Pecos Conference at Rowe Mesa, New Mexico. That presentation drew extensively on the Annual Report from 2021 (Throgmorton et al. 2022). Dr. Benjamin Bellorado presented on efforts to refine the chronologies of Cortez and Mancos Black-on-white pottery by defining distinct design styles within each type. Two posters were presented by College Field School students at the 2022 Pecos Conference.

A total of 54 social media posts referenced the Haynie site or the NCOP (Table 6). These posts appeared on Facebook, Twitter, Instagram, YouTube, and as blog posts and interviews.

Over 200 people visited the Haynie site during open houses, Cultural Explorations trips, educational tours, or private tours (Table 7). A major event during 2022 was the Hart Award ceremony which was conducted at the Haynie site on July 14th, 2022 when over two dozen community members and representatives from the History Colorado visited. On May 7th, a benefit for the La Plata Open Space Conservancy, who manages the conservation easement at the Haynie site, occurred at the Haynie site.

References Cited

Bradley, Bruce A.

1988 Wallace Ruin Interim Report. *Southwestern Lore* 54(2):8–33.

1992 *Wallace Ruin: Implications for Outlier Studies.* Manuscript on file, Crow Canyon Archaeological Center, Cortez.

1993 Annual/Preliminary Report of Excavations: Wallace Ruin (5MT6970), 1993 Field Season. Report submitted to the Office of the State Archaeologist, Colorado Historical Society, Denver. Manuscript on file, Crow Canyon Archaeological Center, Cortez.

Bradley, Bruce A. and Cynthia S. Bradley

2019 Annual Report on Excavations at the Wallace Great House (5MT6970) 2019. Report Submitted to the Office of the State Archaeologist, Colorado Historical Society, Denver. Electronic Document, https://www.researchgate.net/publication/337948742_Annual_Report_on_Excavations_at_the_Wallace_Great_House_5MT6970_2019/link/5df795854585159aa480bf5f/download, accessed December 19, 2019.

2020 Annual Report on Excavations at the Wallace Great House (5MT6970) 2020. Report Submitted to the Office of the State Archaeologist, Colorado Historical Society, Denver.

Brisbin, Joel M., and Charlotte Brisbin

1973 North McElmo #8, Work Areas (A) through (D), Rooms #11 though #13, Montezuma County Colorado. Manuscript on file, Anasazi Heritage Center, Dolores, Colorado.

Brown, Gary M., Paul F. Reed, and Donna M. Glowacki

2013 Chacoan and Post-Chaco Occupations in the Middle San Juan Region: Changes in Settlment and Population. *Kiva* 78 (4): 417–48.

Brown, Gary M., and Cheryl I. Paddock

2011 Chacoan and Vernacular Architecture at Aztec Ruins: Putting Chaco in its Place. *Kiva* 77(2):203-224.

Cameron, Catherine M.

2008 Chaco and Post-Chaco in the Northern San Juan Region. In *Chaco and After in the Northern San Juan: Excavation at the Bluff Great House,* by Catherine M. Cameron, pp. 18-43. Tucson: University of Arizona Press.

Diederichs, Shanna

2018 Condition Assessment and Stabilization of Standing Architecture in the East and West Great Houses of the Haynie Site in Southwest Colorado. Manuscript on file, Crow Canyon Archaeological Center, Cortez, Colorado.

Dove, David

2014 Mitchell Springs Community Project Update. Four Corners Research, Cortez. Electronic document, http://www.fourcornersresearch.com/Mitchell_Springs_Community_Project_Update_2014.pdf. Accessed December 19, 2019.

Judge, W. James
1979 The Development of a Complex Cultural Ecosystem in the Chaco Basin, New Mexico. In *Proceedings of the First Conference on Scientific Research in the National Parks, Vol. II*, edited by R. M. Linn, 901–6. Transactions and Proceedings, Series 5. Washington DC: National Park Service US Department of the Interior.

Judge, W. James, and Linda S. Cordell
2006 Society and Polity. In *The Archaeology of Chaco Canyon: An Eleventh-Century Pueblo Regional Center*, edited by Stephen H. Lekson, 189–210. School of American Research Advanced Seminar Series. Santa Fe: School for American Research Press.

Kantner, John, and Nancy M. Mahoney (editors)
2000 *Great House Communities Across the Chacoan Landscape*. Vol. Vol. 64. Anthropological Papers of the University of Arizona. Tucson, AZ: University of Arizona Press.

Kendrick, James and James Judge
2000 Household Economic Autonomy and Great House Development in the Lowry Area. In *Great House Communities Across the Chacoan Landscape*, edited by John Kantner and Nancy Mahoney, pp. 111-129. Anthropological Papers of the University of Arizona, Vol. 64. Tucson: University of Arizona Press.

Lave, Jean and Etienne Wenger
1991 Situated Learning: Legitimate Peripheral Participation. New York: Cambridge University Press

Lekson, Stephen H.
2015 *The Chaco Meridian: Centers of Political Power in the Ancient Southwest*. Second Edition. Walnut Creek, CA: AltaMira Press.

Lekson, Stephen H., ed. 2006. *The Archaeology of Chaco Canyon: An Eleventh Century Pueblo Regional Center*. School of American Research Advanced Seminar Series. Santa Fe: School for American Research Press.

Lipe, William
2006 Notes from the North. In *The Archaeology of Chaco Canyon: An Eleventh-Century Pueblo Regional Center*, 261–314. School of American Research Advanced Seminar Series. Santa Fe: School for American Research Press.

Plog, S., and C. Heitman
2010 Hierarchy and Social Inequality in the American Southwest, A.D. 800-1200. *Proceedings of the National Academy of Sciences* 107 (46): 19619–26.

Reed, Paul F
2004 *The Puebloan Society of Chaco Canyon.* Westport: Greenwood Press.

2008 *Chaco's Northern Prodigies: Salmon, Aztec, and the Ascendancy of the Middle San Juan Region after 1100 AD.* Salt Lake City: University of Utah Press.

Ryan, Susan C.
2008 Constructing Community and Transforming Identity at Albert Porter Pueblo. In *The Social Construction of Communities: Agency, Structure, and Identity in the Prehispanic Southwest*, edited by Mark D. Varien and James M. Potter, 69–87. Lanham: Rowman and Littlefield Publishers, Inc.

2016 *The Northern Chaco Outliers Project: A Proposal to Conduct Archaeological Testing at the Haynie site, Southwestern Colorado*. Proposal submitted to the Colorado State Historic Preservation Office, Denver, Colorado. Manuscript on file, Crow Canyon Archaeological Center, Cortez, Colorado.

Saitta, Dean J
1997 Power, Labor, and the Dynamics of Change in Chacoan Political Economy. *American Antiquity* 62 (01): 7–26.

Sebastian, Lynne
1992 *The Chaco Anasazi: Sociopolitical Evolution in the Prehistoric Southwest*. Cambridge: Cambridge University Press.

Smith, R. Linda Wheeler
2009 The Mitchell Springs Ruin Group: Further Investigations of a Large Community in the Middle Montezuma Valley. Electronic document, http://www.fourcornersresearch.com/Mitchell_Springs_Report_1998-2004.pdf. Accessed December 19, 2019.

Throgmorton, Kellam, Kari L. Schleher, Susan C. Ryan, Samantha G. Fladd, Rebecca Simon, Steven R. Copeland, Timothy D. Wilcox, Laurie D. Webster, Cynthia M. Fadem, and Grant D. Coffey
2019 *The Northern Chaco Outliers Project Annual Report, 2019 Field Season.* Cortez: Crow Canyon Archaeological Center. Electronic document, https://www.crowcanyon.org/wp-content/uploads/2021/08/ncop_annual_report_2019_final-1.pdf. Accessed January 31, 2023.

Throgmorton, Kellam, Susan C. Ryan, Benjamin Bellorado, Steven R. Copeland, and Timothy D. Wilcox.
2022 *Excavation and Additional Studies at the Haynie Site (5MT1905) by the Crow Canyon Archaeological Center Annual Report 2021.* Cortez: Crow Canyon Archaeological Center. Electronic document, http://www.crowcanyon.org/ncop2022

Turner, Michelle
2015 Ceramics of Aztec North and the Terrace Community, Aztec Ruins National Monument. Unpublished MA Thesis, Department of Anthropology, Binghamton University.

2019 Becoming Chacoan: the Archaeology of the Aztec North Great House. Unpublished PhD Dissertation, Department of Anthropology, Binghamton University.

Van Dyke, Ruth M
2007 *The Chaco Experience: Landscape and Ideology at the Center Place*. Santa Fe: School for Advanced Research Press.

1999 The Chaco Connection: Evaluating Bonito-Style Architecture in Outlier Communities. *Journal of Anthropological Archaeology* 18 (4): 471–506.

Vivian, R. Gwinn
1990 *The Chacoan Prehistory of the San Juan Basin*. New York and San Diego: Academic Press.

Ware, John A.
2014 *A Pueblo Social History: Kinship, Sodality, and Community in the Northern Southwest*. Santa Fe: School for Advanced Research Press.

Figures and Tables

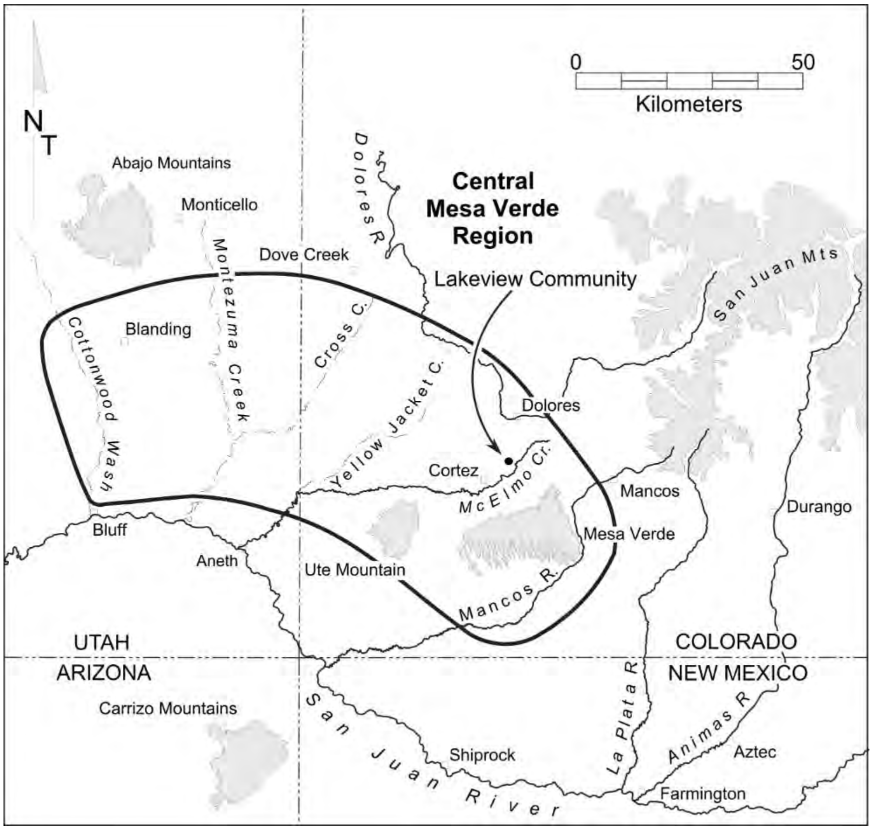


Figure 1. Location of the Lakeview Community in the central Mesa Verde region.

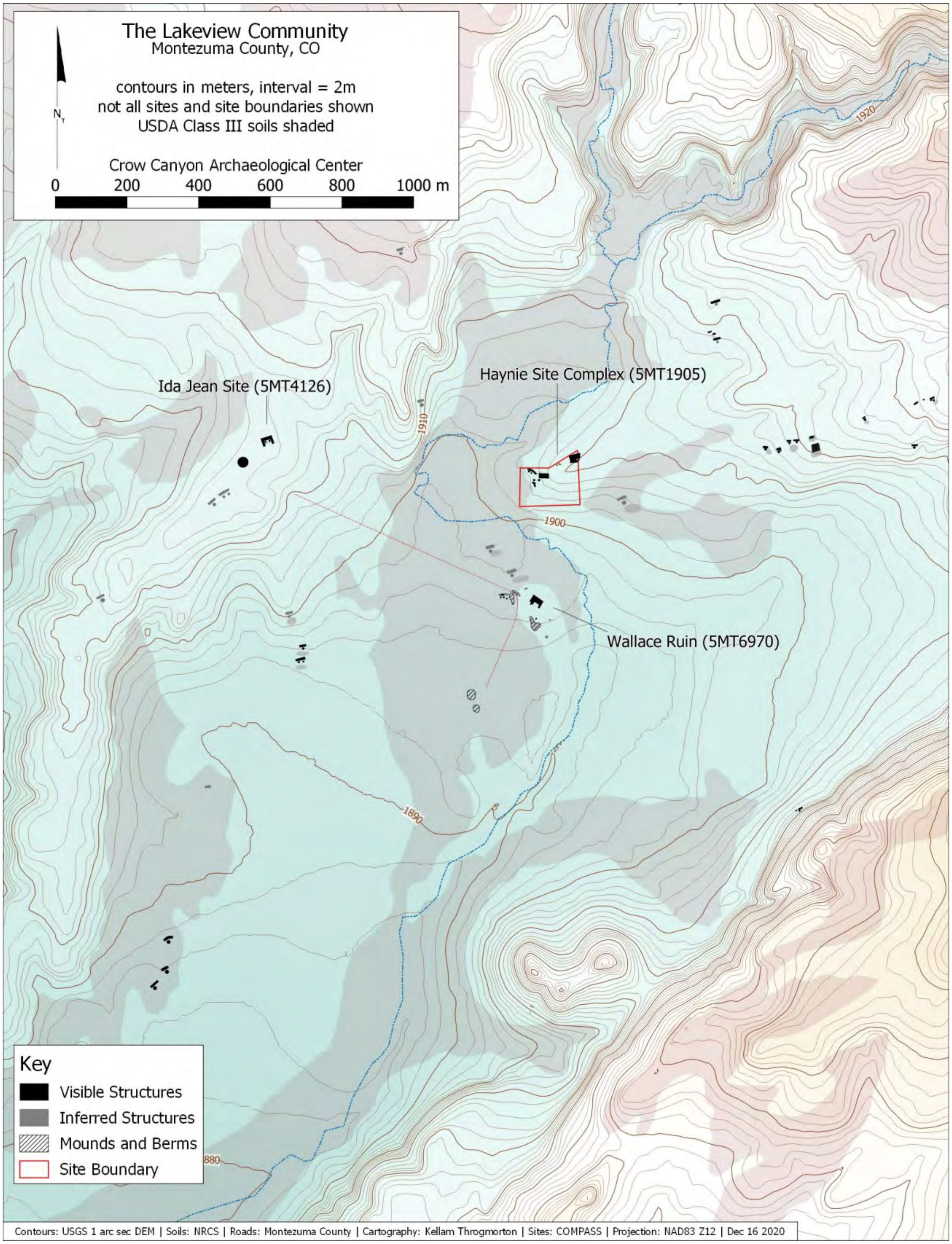


Figure 2. The Lakeview Community with locations of great houses and known or suspect smaller habitations.

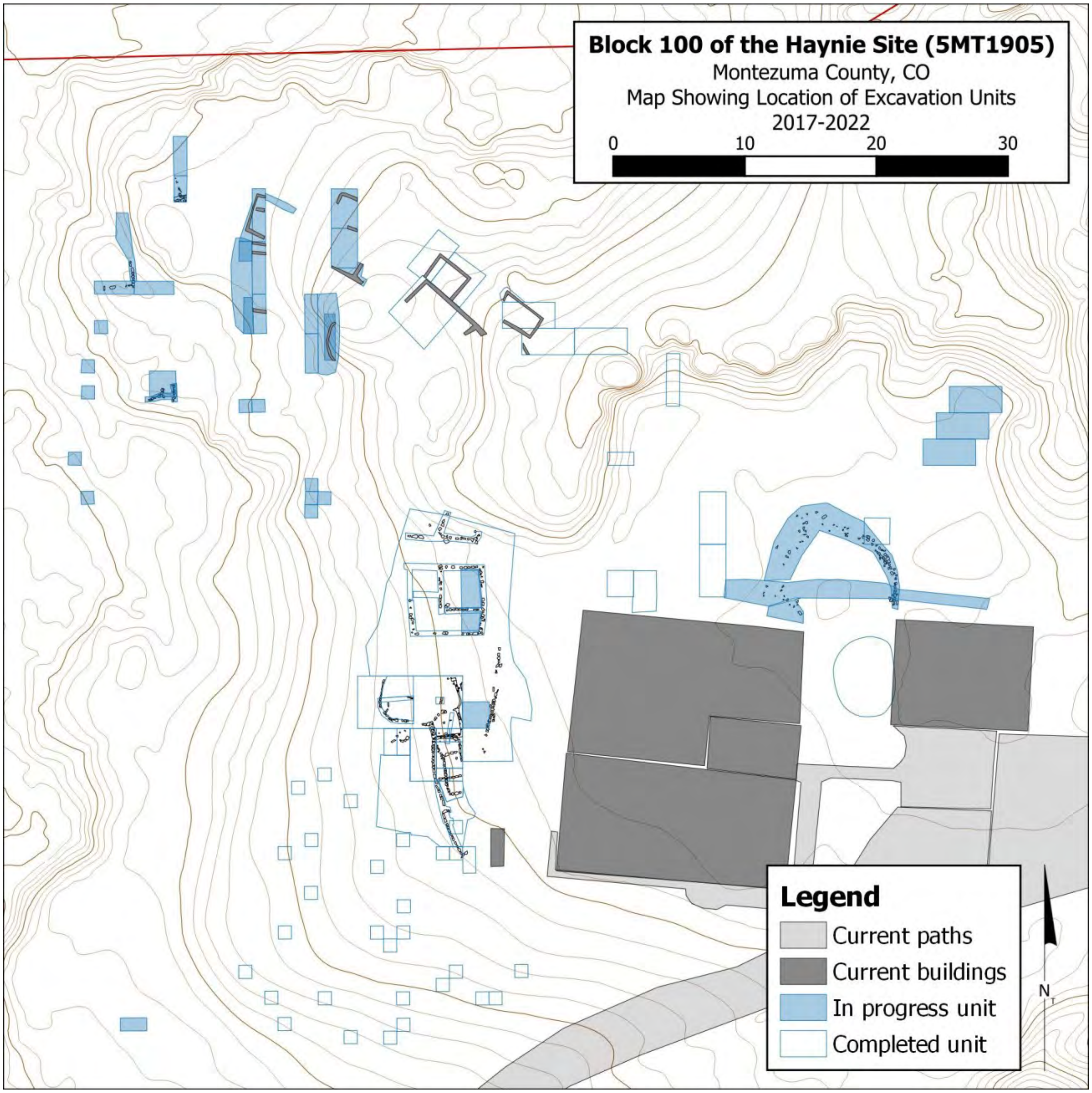


Figure 3. Location of in-progress excavation units, Haynie site.

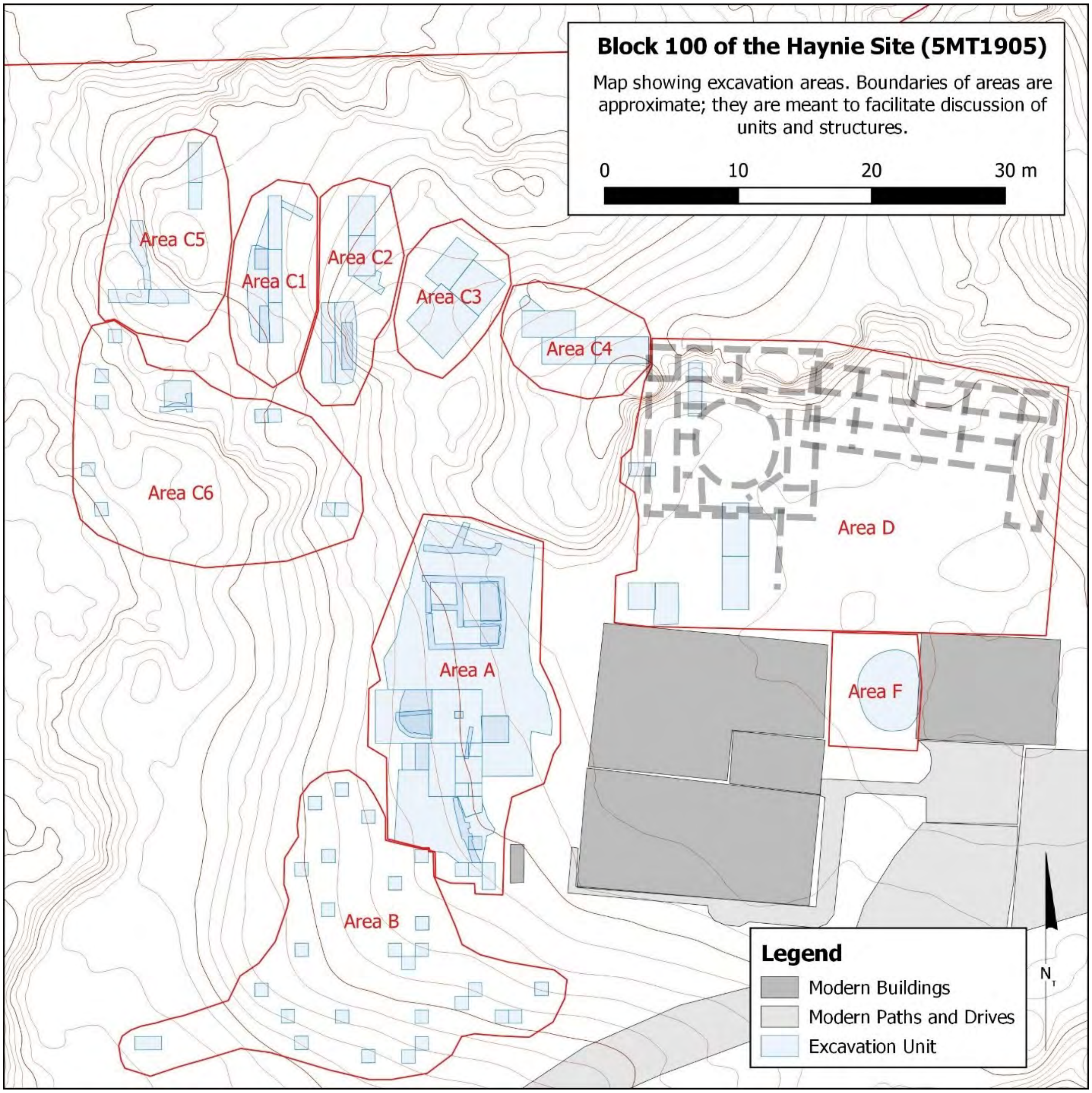


Figure 4. Location of Areas A through F at the Haynie site.

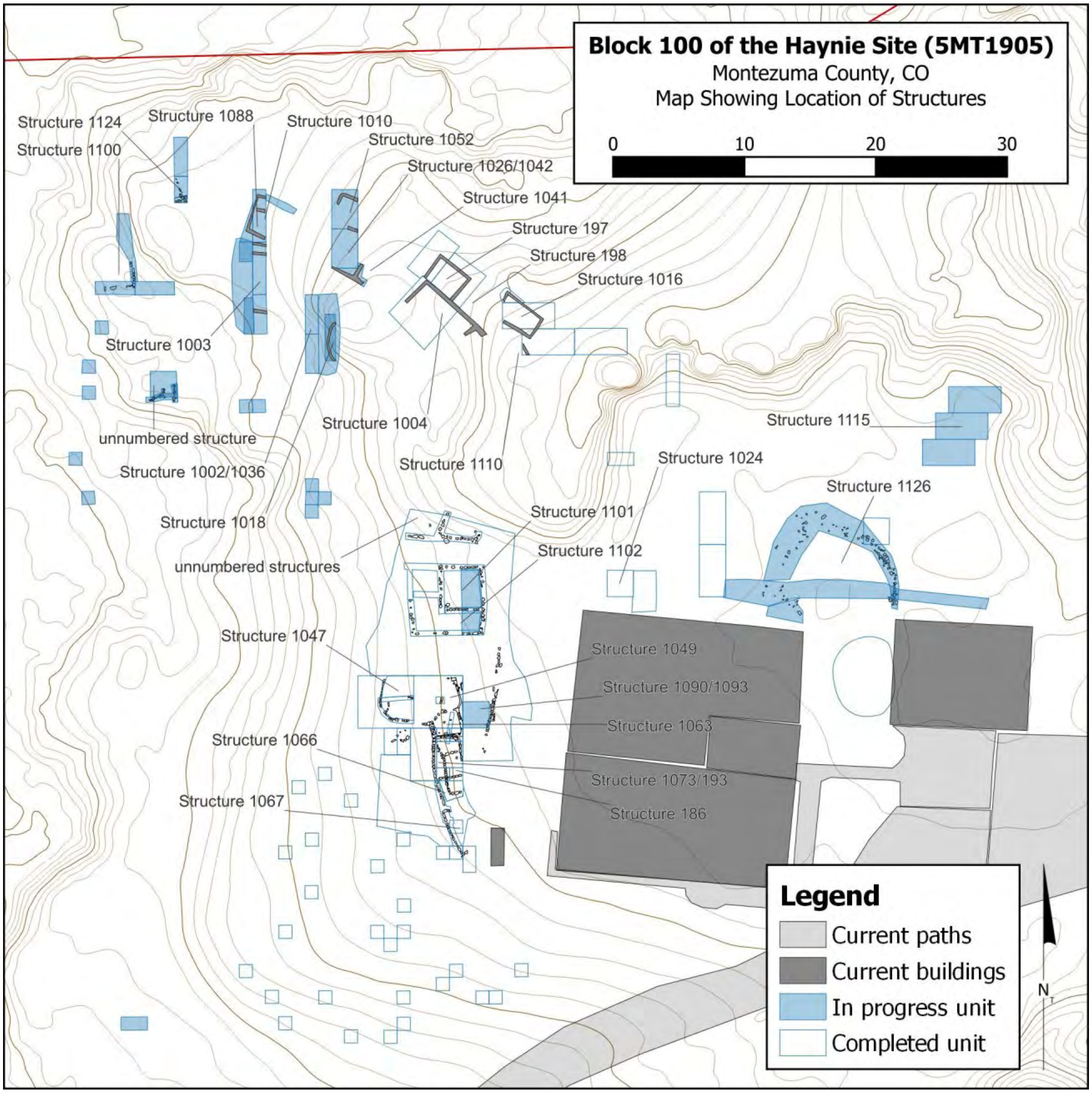


Figure 5. Location of structures, Haynie site.

Figure 6. Oblique view of Structure 1003, Surface 3, Haynie site.

Figure 7. Patterned burned roof beams (probably in Structure 1002), Haynie site.

Figure 8. In progress photo showing possible edge of Structure 1036 within Structure 1002, Haynie site.

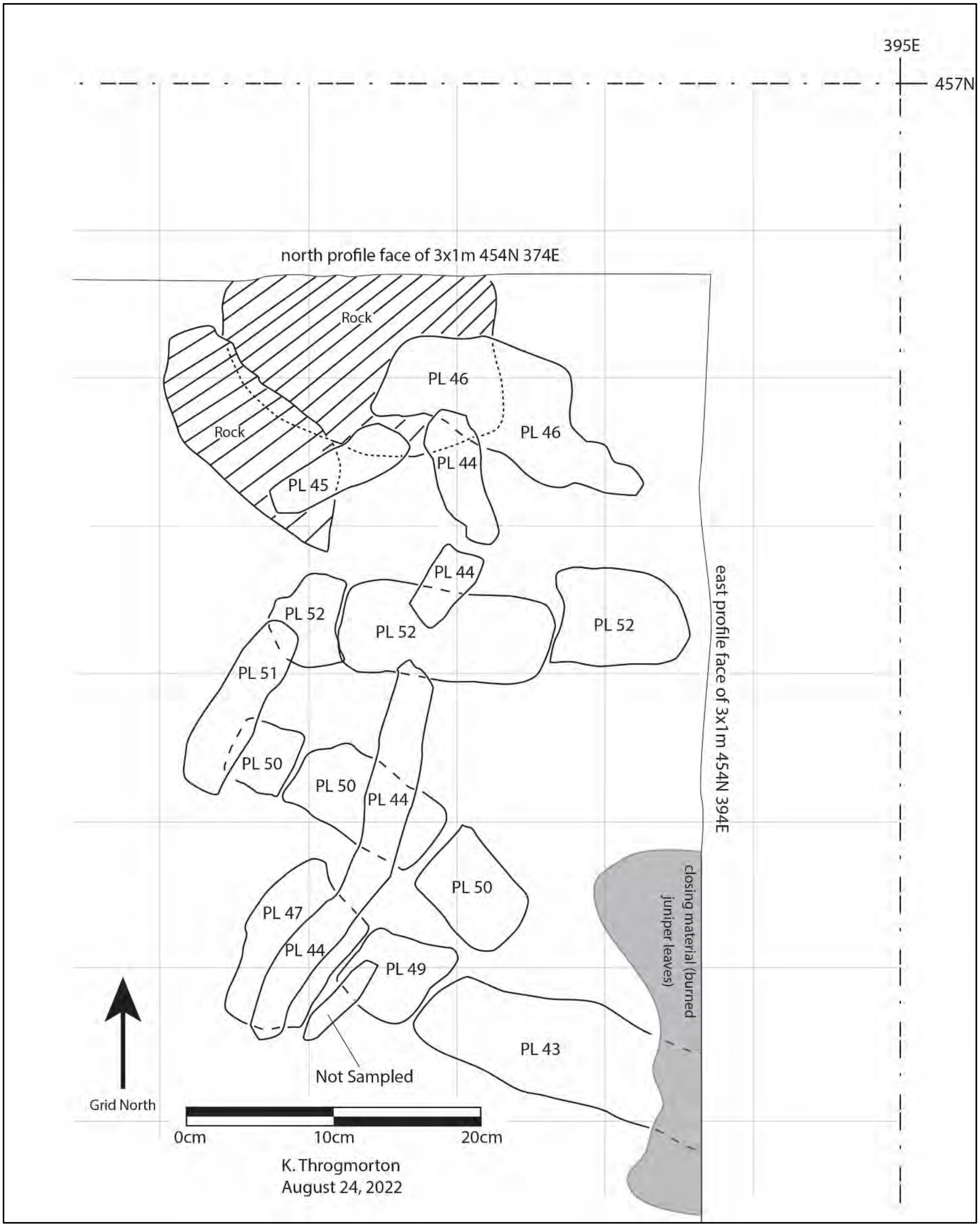


Figure 9. Illustration of patterned burned roof beams (probably in Structure 1002), Haynie site.

Figure 10. In progress photo showing Structure 1124 and associated floor surface (exposed in test window), Haynie site.

Figure 11. Floor surface and posthole in Structure 1100, Haynie site.

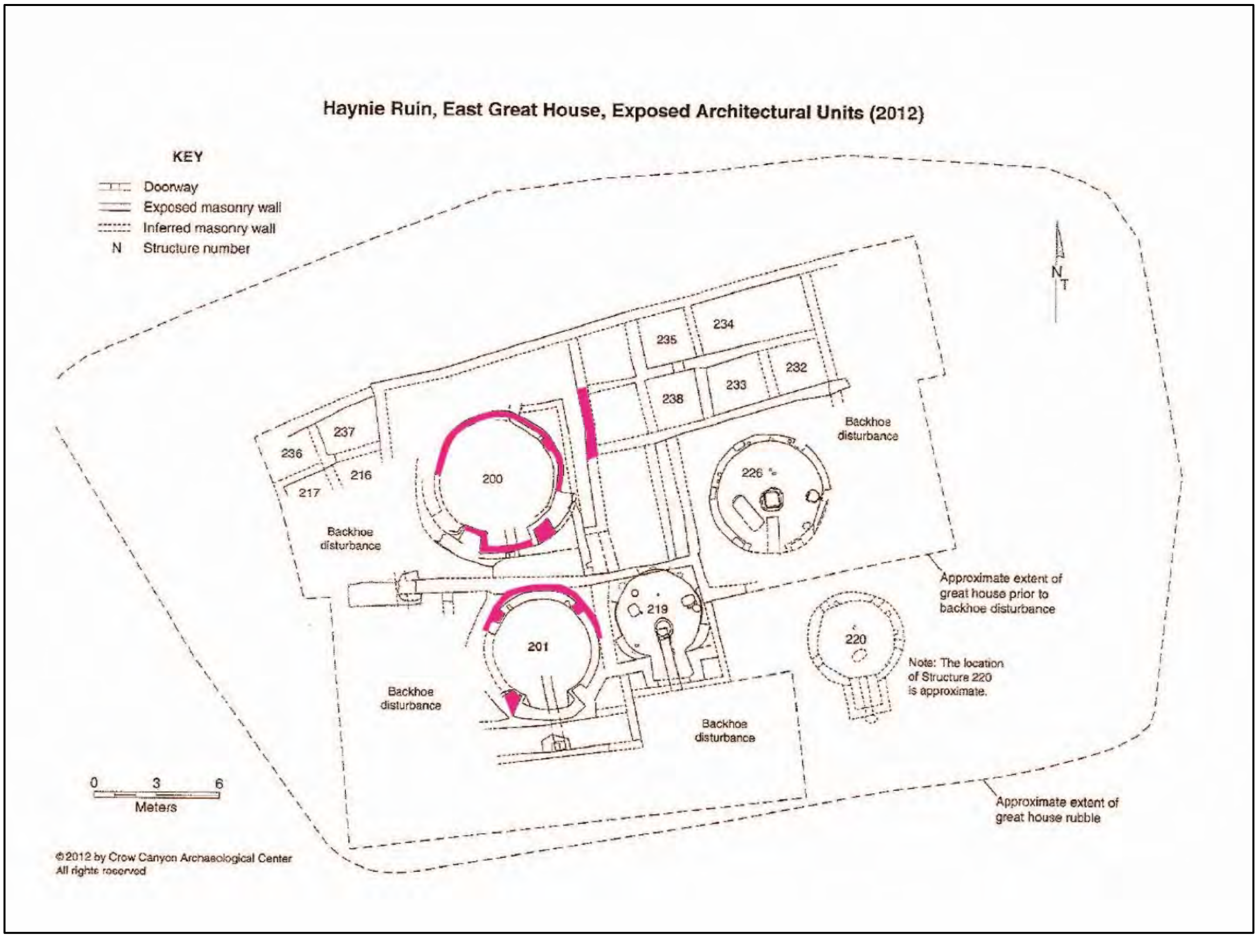


Figure 12. Plan map of the east great house showing areas stabilized in 2022, Haynie site.

Table 1. List of all excavation units at the Haynie site and their completion status.

Area	Unit Number	Date Opened	Date Closed	Comments
A	1-x-1-m 416N 385E	4/13/2017	7/24/2018	Probability test unit. Unit encountered a PVC leach field pipe. Backfilled.
A	1-x-1-m 420N 385E	9/6/2017	4/31/21	Sterile identified. Backfilled.
A	4x2 420N 382E	9/7/2017	10/4/2021	Unit closed after test windows confirmed stratigraphy of deposits. Backfilled.
A	1-x-1-m 420N 384E	4/13/2017	5/5/2021	Probability test unit. Sterile identified. Backfilled.
A	2x2 421N 384E	5/3/2017	10/5/2021	Sterile identified. Backfilled.
A	2x2 422N 380E	8/5/2020	10/6/2021	Unit placed to identify ventilator of STR 1047, and replaces 2x1 422N 381E after backhoe stripping. Unit closed after ventilator identified and mapped. Backfilled.
A	2x1 422N 381E	6/26/2019	7/17/2020	Unit created to explore possible extramural surface and suspected ventilator of STR 1047. Unit closed prior to backhoe stripping and replaced by 2x2 422N 380E. Backfilled.
A	1-x-1-m 423N 385E	4/13/2017	5/6/2021	Probability test unit. Sterile identified. Backfilled.
A	1-x-1-m 423N 384E	5/3/2017	10/29/2020	Sterile identified. Backfilled.
A	4x8 424N 378E	5/23/2018	11/5/2021	Unit placed to explore anomaly identified during electrical resistivity testing. Sterile identified, testing of STR 1047 completed. Backfilled.
A	2x2 424N 386E	5/20/2021		Unit created to explore a feature visible in east wall of 4x8 424N 378E, and to investigate wall segment identified during backhoe stripping. In progress.
A	1-x-1-m 427N 388E	4/18/2017	10/11/2018	Probability test unit. Unit encountered a PVC leach field pipe. Backfilled.
A	Segment 14	9/17/2020	11/5/2021	Segment created to test western portion of STR 1047. Testing of STR 1047 completed. Backfilled.
A	Segment 22	7/24/2020	11/3/2020	Hand trench to chase walls after backhoe stripping. Segment closed after mapping location of wall segments and structures. Backfilled.
A	Segment 23	7/24/2020	11/3/2020	Segment used for backhoe stripping. Backhoe stripped area closed at end of season. Backfilled.
A	Segment 13	9/17/2020	9/29/2020	Exploratory hand trench in west part of STR 1047 Testing of STR 1047 complete Backfilled.
A	Segment 25	9/24/2020	9/24/2020	Hand trench to identify and map east wall of STR 1047. Segment closed upon identification of STR 1047 east wall. Backfilled.
A	Segment 21	7/21/2020	7/22/2020	Segment used for backhoe stripping. Backhoe stripped area closed at end of season. Backfilled.
A	Segment 10	8/13/2019	7/7/2020	Hand trench used to identify south wall of STR 186. Segment 10 closed in 2019 because of human remains. Segment 10 expanded in 2020 to include fill within STR 186 (area with human remains left untouched). Closed on completion of STR 186. Backfilled.
A	STR 1101 E ½	9/10/2021		Unit created to test the east half of STR 1101, then to look for underlying walls. In progress.
A	STR 1102 E ½	9/10/2021		Unit created to test the east half of STR 1102. In progress.
A	2x1 413N 386E	9/16/2019	7/17/2020	Unit created to expand on adjacent unit after wall segment found. Deposits overlying architecture were mostly redeposited overburden, unit closed prior to backhoe stripping. Backfilled.
A	1-x-1-m 414N 384E	4/13/2017	7/17/2020	Probability test unit. Deposits overlying architecture were mostly redeposited overburden, unit closed prior to backhoe stripping. Backfilled.

Area	Unit Number	Date Opened	Date Closed	Comments
A	1-x-1-m 414N 385E	4/13/2017	7/17/2020	Probability test unit. Deposits overlying architecture were mostly redeposited overburden, unit closed prior to backhoe stripping. Backfilled.
B	1-x-1-m 400N 380E	4/17/2017	7/9/2018	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 400N 377E	4/17/2017	9/19/2017	Probability test unit. Bedrock and sterile identified. Backfilled.
B	1-x-1-m 401N 381E	4/17/2017	7/25/2018	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 401N 372E	4/17/2017	7/9/2018	Probability test unit. Bedrock identified. Backfilled.
B	1-x-2-m 401N 360E	5/23/2018		Unit placed to test nature of deposits at southwest edge of site. In progress.
B	1-x-1-m 403N 381E	4/17/2017	8/23/2018	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 403N 375E	4/17/2017	7/26/2018	Probability test unit. Bedrock and sterile identified. Backfilled.
B	1-x-1-m 403N 371E	4/18/2017	7/18/2018	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 403N 387E	4/17/2017	5/7/2018	Probability test unit. Human remains density exceeded limit. Backfilled.
B	1-x-1-m 403N 388E	4/17/2017	5/7/2018	Probability test unit. Human remains density exceeded limit. Backfilled.
B	1-x-1-m 404N 384E	4/17/2017	8/23/2018	Probability test unit. Bedrock and sterile identified. Backfilled.
B	1-x-1-m 405N 385E	4/17/2017	6/19/2019	Probability test unit. Bedrock and sterile identified. Backfilled.
B	1-x-1-m 405N 369E	4/20/2017	6/12/2019	Probability test unit. Large sandstone slabs blocked further progress. Backfilled.
B	1-x-1-m 405N 390E	4/17/2017	8/29/2018	Probability test unit. Large quantity of rodent burrows and potential leach field line. Backfilled.
B	1-x-1-m 407N 380E	4/13/2017	8/28/2019	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 408N 380E	9/9/2019	9/26/2019	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 408N 379E	4/17/2017	8/22/2019	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 408N 381E	4/13/2017	8/22/2019	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 408N 372E	4/20/2017	6/7/2019	Probability test unit. PVC pipe encountered. Backfilled.
B	1-x-1-m 410N 381E	4/13/2017	8/28/2019	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 411N 374E	4/20/2017	10/22/2020	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 413N 379E	4/13/2017	6/3/2019	Probability test unit. PVC pipe encountered. Backfilled.
B	1-x-1-m 414N 372E	4/20/2017	11/3/2020	Probability test unit. Bedrock identified. Backfilled.
B	1-x-1-m 415N 374E	4/20/2017	11/5/2020	Probability test unit. Bedrock identified. Backfilled.
C1	2.75-x-0.65-m 454N 369.35E	5/28/2019	11/8/2022	Unit expands on test trench to expose architecture. Backfilled.
C1	3-x-1-m 454N 370E	6/1/2017	11/8/22	Test trench placed to investigate anomaly identified during remote sensing. Backfilled.
C1	4-x-1-m 457N 370E	4/21/2017	11/8/22	Test trench placed to investigate anomaly identified during remote sensing. Backfilled.
C1	1.5-x-1-m 459.5N 369E	5/28/2019	10/04/22	Unit expands on test trench to expose architecture. Backfilled.
C1	4-x-1-m 461N 370E	5/29/2018		Test trench placed to investigate rubble north of anomaly identified during remote sensing. In progress.
C1	Segment 9	6/26/2019		Segment placed to identify corner of structure just beyond adjacent grid unit. In progress.
C1	Segment 5	5/28/2019	11/8/22	Segment was a backhoe cut to step back a deep excavation unit. Backfilled.
C1	Segment 4	10/30/2018		Hand trench to identify orientation of wall segment. In progress.

Area	Unit Number	Date Opened	Date Closed	Comments
C2	3-x-1-m 451N 374E	6/1/2017		Test trench placed to investigate anomaly identified during remote sensing. In progress.
C2	3.5-x-1-m 452N 375.5E	5/29/2019		Unit expands on test trench to expose architecture. In progress.
C2	3-x-1-m 454N 374E			Test trench placed to investigate anomaly identified during remote sensing. In progress.
C2	3-x-2-m 459N 376E	5/29/2019		Test trench placed to investigate rubble north of anomaly identified during remote sensing. In progress.
C2	3-x-2-m 462N 376E	9/3/2019		Expands on adjacent test trench to include additional architecture. In progress.
C2	Segment 11	8/26/2019		Used to identify corner of structure just beyond grid unit In progress.
C2	Segment 6	5/28/2019		Segment was a backhoe cut to step back a deep excavation unit. In progress.
C3	Segment 1	5/4/2017	8/16/2018	Segment placed atop a visible masonry surface room. In situ human burial identified in room suite. Backfilled.
C3	Segment 3	4/21/2017	10/18/2017	Segment placed atop a visible masonry surface room. In situ human burial identified in room suite. Backfilled.
C3	Segment 2	6/28/2017	10/5/2017	Segment placed atop a visible masonry surface room. In situ human burial identified in room suite. Backfilled.
C4	2-x-4-m 452.40N 394.50E	4/26/2017	11/9/2021	Unit placed to investigate foundations of West great house. Sterile identified. Backfilled.
C4	2-x-4-m 452.40N 390.50E	4/26/2017	11/2/2021	Unit placed to investigate foundations of West great house. Sterile identified. Backfilled.
C4	2-x-4-m 454.40N 389E	7/22/2019	7/27/2021	Unit placed to investigate masonry surface room identified in adjacent unit. Testing of STR 1016 completed. Backfilled.
C4	Segment 12	9/2/2019	9/2/2019	Segment placed to identify corner of structure just beyond adjacent grid unit. Testing of STR 1016 completed. Backfilled.
C5	1-x-3-m 457N 361E	5/17/2021		Test trench to identify wall alignments. In progress.
C5	1-x-3-m 457N 358E	5/17/2021		Test trench to identify wall alignments. In progress.
C5	1-x-1.5-m 458N 359.50E	8/31/2021		Unit placed to identify a floor surface of STR 1100, noticed in adjacent unit (but badly disturbed there). In progress.
C5	2-x-1-m 464N 364E	5/17/2021		Test trench to identify wall alignments. In progress.
C5	3-x-1-m 466N 364E	5/17/2021		Test trench to identify wall alignments. In progress.
C5	Segment 30	7/27/2021		Hand trench to identify walls of STR 1100. In progress.
C6	1-x-1-m 441N 375E	8/31/2021		Unit expands on adjacent 1x1 after a possible floor surface identified. In progress.
C6	1-x-1-m 441N 374E	5/20/2021		Judgmental test unit to investigate cultural deposits between Areas A and C suspected to be a midden. In progress.
C6	1-x-1-m 440N 374E	5/20/2022		Unit placed to sample midden deposits identified in adjacent units. In progress.
C6	1-x-1-m 442N 374E	5/20/2022		Unit placed to sample midden deposits identified in adjacent units. In progress.
C6	1-x-1-m 441N 357E	5/20/2021	Finished, not backfilled	Unit placed to test presumed midden deposits. In progress.
C6	1-x-1-m 444N 356E	5/20/2021		Unit placed to test presumed midden deposits. In progress.
C6	1-x-1-m 448N 370E	8/31/2021		Expanding adjacent unit after possible pitstructure fill identified. In progress.
C6	1-x-1-m 448N 369E	5/20/2021		Unit placed to test presumed midden deposits. In progress.
C6	1-x-1-m 449N 357E	5/20/2021		Unit placed to test presumed midden deposits. In progress.

Area	Unit Number	Date Opened	Date Closed	Comments
C6	2-x-2-m 449.19N 362.21E	6/30/2021		Unit placed to investigate several wall segments identified by Segment 28. In progress.
C6	1-x-1-m 451N 357E	5/20/2021		Unit placed to test presumed midden deposits. In progress.
C6	1-x-1-m 454N 358E	6/15/2021		Unit placed to test presumed midden deposits. In progress.
C6	Segment 28	5/28/2021	8/5/2021	Segment created to clear overburden from around an exposed wall segment. Placed a grid unit after extent of wall was better defined.
D	2-x-2-m 434N 397E	5/26/2017	10/22/2019	Unit placed to determine whether anything remained of southwest corner of West great house. Testing of STR 1024 completed, sterile identified. Backfilled.
D	4-x-2-m 434N 404E	4/26/2017	10/5/2017	Unit placed to determine whether any foundations remained from West great house. Active leach field encountered. Backfilled.
D	4-x-2-m 438N 404E	4/26/2017	10/23/2017	Unit placed to determine whether any foundations remained from West great house. Active leach field encountered. Backfilled.
D	1-x-2-m 444N 397E	5/26/2017	11/2/2017	Unit placed to determine whether any foundations remained from West great house. Sterile identified. Backfilled.
D	4-x-1-m 448.50N 401.50E	9/20/2018	9/24/2019	Unit placed to determine whether any foundations remained from West great house. Sterile identified. Backfilled.
D	Segment 7	9/2/2019	10/22/2019	Backhoe excavation to step back deep unit. Sterile identified. Backfilled.
D	Segment 33	5/23/2022		Backhoe trench excavated at end of 2021 to identify structures thought to lie north of the “paint shop.” Expanded with mechanical excavator in November 2022. In progress.
D	Segment 34	5/23/2022		Hand trench placed to follow masonry wall identified in Segment 33. Expanded with a mechanical excavator in November 2022. In progress.
E	2-x-1-m 388N 410E	5/13/2018	8/29/2020	Unit placed to determine nature of deposits in area south of driveway. Unit deemed unlikely to reveal much without significant unnecessary effort. Backfilled.
F	Segment 8	6/3/2019	6/5/2019	Segment created for backhoe stripping atop a possible pitstructure identified by auger testing. Gas line encountered. Backfilled.

Table 2. AMS results received in 2022 from samples taken at the Haynie site.

Lab Num	Grid Unit	SU	STLV	Context Interpretation	Calibrated Dates (95.4%)
623974	2x2 434N 397E	NST 190	4-2	midden filling STR 1024	770-894 cal AD (88.3%); 706-736 cal AD (4.9%); 928-944 cal AD (2.1%)
623975	SE Half	STR 197	Strat 5	fill below a surface, interpreted as collapsed structure	820-978 cal AD (83.9%); 772-790 cal AD (10.2%); 804-810 cal AD (1.3%)
623976	4x1 457N 370E	NST 192	4-2	midden filling STR 1003	992-1050 cal AD (56.8%); 1080-1154 cal AD (38.6%)
623977	4x8 424N 378E	STR 1063	Strat 4	wall fall filling a surface room	771-884 cal AD (67.1%); 682-744 cal AD (27.5%)
623978	4x8 424N 378E	STR 1063	Strat 7	construction deposit beneath a floor	770-894 cal AD (88.3%); 706-736 cal AD (4.9%); 928-944 cal AD (2.1%)
623979	2x2 421N 384E	STR 1073	Surface 2	surface room floor	770-896 cal AD (87.9%); 922-952 cal AD (5.8%); 708-722 cal AD (1.6%)
623980	2x4 452.4N 394.5E	NST 1078	6-2	early PII midden	770-894 cal AD (88.3%); 706-736 cal AD (4.9%); 928-944 cal AD (2.1%)
623981	4x1 457N 370E	STR 1003	SR00-01	feature 2 (hearth) north half	1028-1172 cal AD (95.4%)
623982	2x1 464N 364E	STR 1094	SR00-01	floor in storage room	978-1048 cal AD (81.7%); 1082-1130 cal AD (11.4%); 1137-1151 cal AD (2.3%)
623983	2x4 452.4N 394.5E	NST 1027	SR00-01	feature 5 (pit other) Level 1	870-992 cal AD (82.2%); 827-862 cal AD (8.9%); 776-788 cal AD (4.3%)
623983	2x4 452.4N 394.5E	NST 1027	SR00-01	feature 5 (pit other) level 4	820-978 cal AD (83.9%); 772-790 cal AD (10.2%); 804-810 cal AD (1.3%)

Table 3. Result of archaeomagnetic sample from Structure 1003.

Sample ID	Context	Date Range(s)
ETSU-452	Structure 1003, Feature 2	A.D. 935-1150; A.D. 1100-1265; A.D. 1435-1690

Table 4. Participant programming at the Haynie site in 2022.

Group Name	Dates	Number of Participants
Old Orchard High School	May 11 – 12	22
National Science Foundation Research Experiences for Undergraduates College Field School	May 15 – July 2	10
Field Internship Program Session 1	May 15 – July 23	2
Field Internship Program Session 2	Aug 7 – October 15	2
National Endowment for the Humanities Teachers Institute	July 26 – 27	28

Table 5. Research presentations focused on the Haynie site, 2022.

Author	Venue	Date	Presentation Title
Jonathan Dombrosky	SAA Conference	March 2022	Preliminary Findings from the Haynie Site (5MT1905) Fauna (Poster)
Benjamin Bellorado	Pecos Conference	August 13 2022	Breaking Up Cortez and Mancos: Refining the Chronologies of Pueblo II White Ware Design Systems in the Mesa Verde Region.
Kellam Throgmorton	Pecos Conference	August 13 2022	Alternative Strategies for Ritual Closing Deposits
Brooke Prevedel, Lauren Bowlin, Ashley Bravo	Pecos Conference	August 12 2022	Auger Testing at the Haynie site (5MT1905): Identifying Pitstructures and Estimating Population (Poster)
Annie Cooper, Delancey Griffin, Carine Rofshus, Sarah Stohl	Pecos Conference	August 12 2022	Dots and Dashes: Pottery Designs as Indicators of Social Connections in the Chaco World

Table 6. Social media posts referencing the Haynie site or the Northern Chaco Outliers Project in 2022.

Social Media Platform	No. of Posts
Facebook	18
Instagram	11
Twitter	18
YouTube	1
Blog Posts	4
Interviews	2

Table 7. Visits to the Haynie site in 2022.

Date	Group	Number of People
May 2 2022	Leslie Masson and friends	4-5
May 4 2022	The Archaeology Conservancy	3
May 7 2022	La Plata Open Space Conservancy	25
May 16 2022	Eastern Wyoming College	15
May 17 2022	Hopi Leadership Program	12
May 25 2022	High School Group	15
June 6 2022	Crow Canyon Donor Tour	10
June 15 2022	Ft Lewis College Field School	12
June 21 2022	University of Georgia Field School	25
July 14 2022	Hart Award Open House	25-30
Sept 1 2022	Cultural Explorations Tour	13
Sept 20 2022	Cultural Explorations Tour	13
Oct 7 2022	Tom Motsinger and friends	5
Oct 14 2022	Crow Canyon Board of Trustees	6
Oct 24 2022	Cultural Explorations Tour	12

Appendix A – Personnel

Mission Staff

Benjamin Bellorado, PhD – Laboratory Director
Grant Coffey, MA – Research Database Manager
Steve Copeland – Field Archaeologist
Jonathan Dombrosky, PhD – Postdoctoral Scholar
Paul Ermigiotti – Educator
Jeremy Grundvig – Mission Associate
Rebecca Hammond – American Indian Outreach Manager and Educator
Daniel Hampson – Laboratory Analyst
Kate Hughes, MA – Laboratory Analyst
Tyson Hughes – Education Manager
Jamie Merewether – Collections Manager
Susan Montgomery – Laboratory Analyst
Susan Ryan, PhD – Executive Vice President of the Research Institute
Kellam Throgmorton, PhD – Field Director
Mark Varien, PhD – Research Associate

IT Support Staff

Robbin Laws – Director of Information Technology

Social Media and Outreach

Sarah Payne – Chief Outreach Office
Strategies 360 – Marketing and Advertising
Taylor Hasbrouck – Community Outreach Manager

Interns

Connor Ball – Field Intern
Katie Kemp – Field/Lab Intern
Liv Winnicki – Field Intern
Janelle Scarritt – Field Intern
Catherine Gagnon – Education Intern
Julia Coverdale – Lab Intern
Lily Domenici – Lab Intern
Johnna Oliver – Lab Intern
Rebecca Renteria – Lab Intern
Esry Mora – Dendrochronology Intern
Eric Gilmore – Zooarchaeology Intern
Emerson McDaniel – American Indian Initiatives Intern
Richie Sahneyah – American Indian Initiatives Intern

Appendix B – College Field School Auger Testing Project Poster

The Archaeological Conservancy
Preserving the past…for the future.

Auger Testing at the Haynie Site (5MT1905): Identifying Pit Structures and Estimating Population

Ashley Bravo (California State University Northridge)
Brooke Prevedel (Mary Washington University)
and Lauren Bowlin (West Virginia University)

HISTORY Colorado STATE HISTORICAL FUND

University of Mary Washington

West Virginia University

Introduction

The Haynie site has two ancestral Pueblo great houses that date to the Chaco Period (A.D. 1080-1150) and other structures dating ca. A.D. 750-1225. The West Great House and earlier structures beneath it were removed with heavy equipment in 1985. Previous landowner Claudia Haynie drew maps while the work was being conducted that indicated there may be unidentified pit structures north of the modern house (Fig 1).

Research Questions

Can we identify pit structures north of the modern house; if so, how many are there and where are they located; can we estimate population based on the results; how do the results affect interpretations of the Haynie site?

Methods

Auger test methods were based on Chuipka (2008). We used an EOS Arrow Gold+ to create a 2-x-2 m sampling grid. We sampled 28 auger holes using 1 ½" and 3" bucket augers, recording sediment consistency, color, and inclusions in 20 cm increments (Figs 2-3).

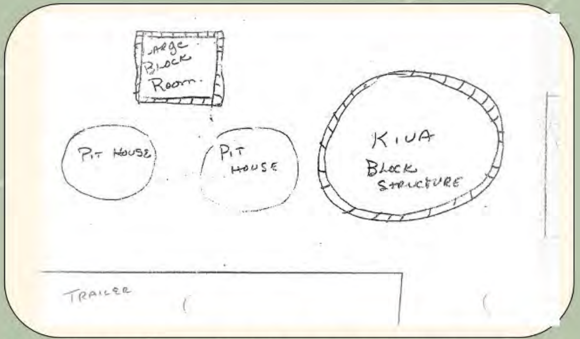


Fig 1. Claudia Haynie Sketch Map of Back Yard Area, 1985

Fig 2. Example of Soil Stratigraphy

Fig 3. Pottery Sherds in Auger Test 28

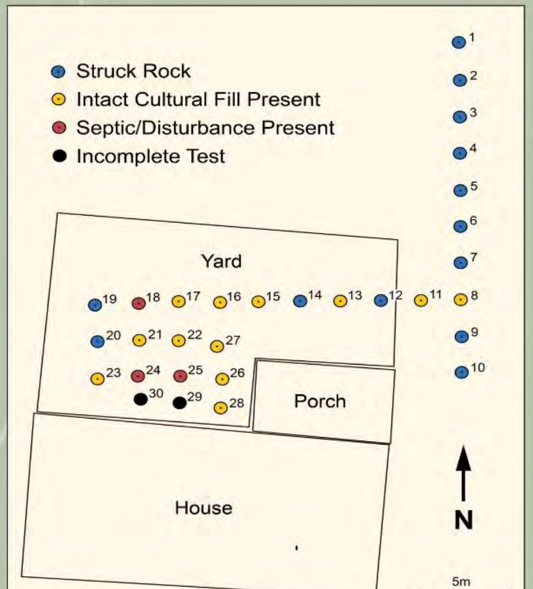


Fig 4. Location and Interpretation of Auger Tests

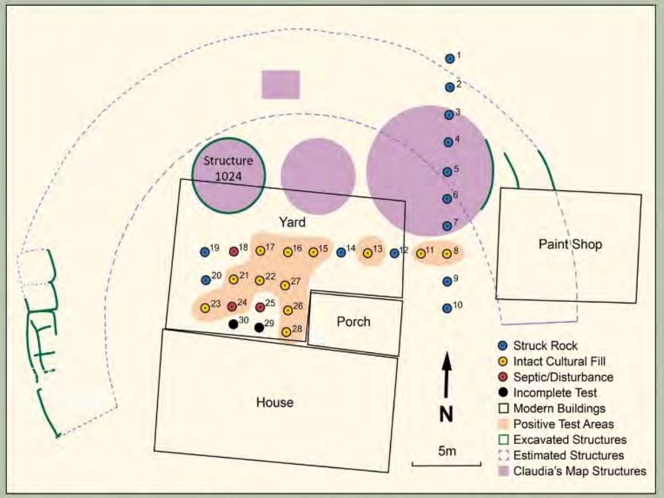


Fig 6. Auger Results Compared with Prior Testing Results and Documentary Research

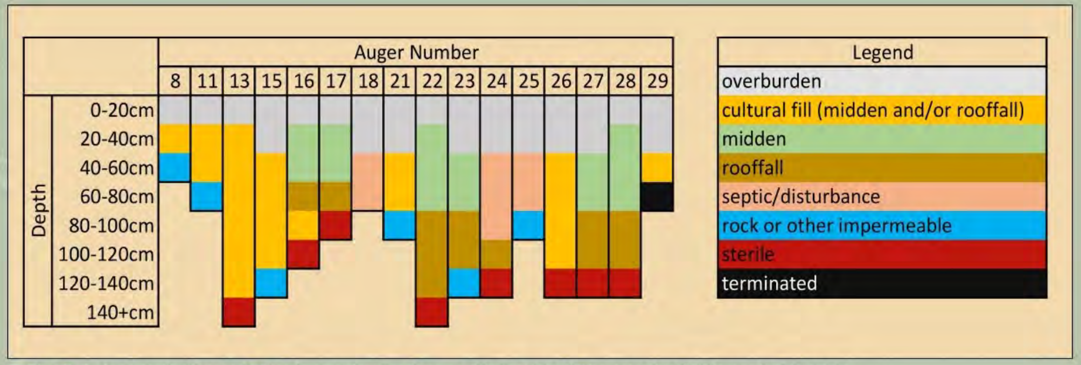


Fig 5. Interpretation of Stratigraphy in Auger Holes that Exceeded 40 cm in Depth

Acknowledgements

The Crow Canyon Archaeological Center acknowledges the Pueblo, Ute, Diné (Navajo), Jicarilla Apache, and Paiute people on whose traditional homelands this land sits. Our work on the Haynie site would not be possible without Indigenous people of the past, present, and future, and we strive for our results, in collaboration with Crow Canyon, to be accessible and relevant. We also thank the Crow Canyon Archaeological Center for facilitating our research at the Haynie site, The National Science Foundation, The Archaeological Conservancy, and our mentor, Kellam Throgmorton.

Results

We encountered rock and a septic line in several locations and intact cultural deposits throughout the area north of the modern house (Fig 4).

Auger tests 13, 15, 16-17, 22-24, and 26-28 had stratigraphy suggesting the presence of pit structures: midden and rooffall deposits resting above sterile sediment (Fig 5).

In-field observations identified plain greyware, Moccasin and Mancos Grey, Piedra B/W, and Cortez B/W, a pre-A.D. 1020 assemblage.

Discussion

The extent of deposits indicates more than one pit structure is present. Their location suggests additional pre-A.D. 1020 structures not identified on the 1985 map are located south of previously tested pit structure 1024, which dates to A.D. 787-803 (Fig 6).

We could not estimate population due to an inability to differentiate individual pit structures. Pit structures are frequently superimposed elsewhere on the site.

Combined with previously identified wall alignments, rooms, and pit structures (Throgmorton et al. 2021), the results of auger testing support the inference of a large, U-shaped roomblock with a plaza-oriented layout (Fig 6).

Rock encountered in auger tests 1-7 may be from a large masonry-lined kiva indicated on the 1985 map (Fig 1). Testing has confirmed the existence of a curving, masonry wall cutting through early rooms in this location (Fig 6).

Conclusions

Auger testing may be an ineffective way to identify individual structures and estimate population at long-occupied sites with superimposed structures.

Wilshusen et al. (2012) argue that U-shaped roomblocks were "proto-great-houses" within hierarchically organized villages. While additional testing is required, confirming the presence of a Pueblo I proto-great house will provide social and historical context for the development of Chaco-style great houses at the Haynie site.

There may be a previously unidentified intact masonry-lined kiva associated with the West Great House.

References

Chupika, Jason
2008 Exploring Village Organization in the Northern San Juan Region of the American Southwest, A.D. 750-840. Masters Thesis. Department of Anthropology, University of Colorado, Boulder

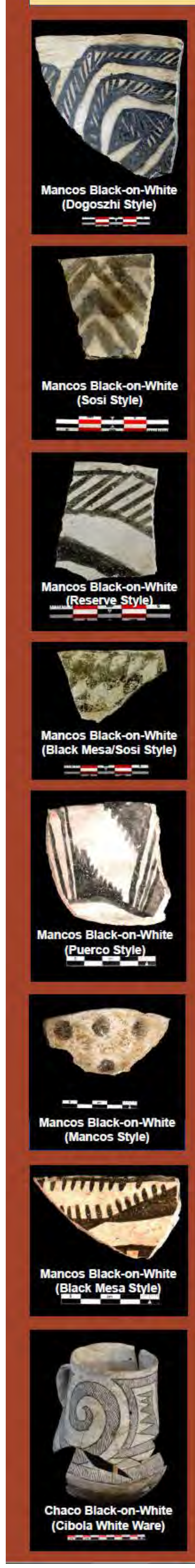
Throgmorton, Kellam and Susan C. Ryan, Benjamin Bellorado, Jeremy Grundvig, Steve Copeland, and Timothy Wilcox
2021 Excavating and Additional Studies at the Haynie Site (5MT1905) by the Crow Canyon Archaeological Center. Electronic document, http://www.crowcanyon.org/ncop2022.

Wilshusen, Richard H., Scott G. Ortman, Shanna Diederichs, Donna M. Glowacki, and Grant Coffey.
2012 Heartland of the Early Pueblos: The Central Mesa Verde. In *Crucible of Pueblos: The Early Pueblo Period in the Northern Southwest*, edited by Richard H. Wilshusen, Gregon Schachner, and James R. Allison, pp. 14-34. Cotsen Institute of Archaeology, University of California, Los Angeles.

Appendix C – College Field School Pottery Design Analysis Poster

Dots and Dashes: Pottery Designs as Indicators of Social Connections in the Chaco World

Annie Cooper – California State University, Sacramento; Delancey Griffin – Columbia University; Carine Rofshus – St. Olaf College; Sara Stohl – Ithaca College



Introduction

White ware pottery design analysis is an important diagnostic tool that can tell archaeologists when Ancestral Pueblo sites were occupied and how they were connected to other sites. Within the Ancestral Pueblo World, design styles can show local and regional connections, especially during the era of Chaco Canyon's regional influence.

Prior research methodologies have prevented researchers from understanding the extent of the Chaco World's interconnectedness due to inconsistencies between regional typologies. Lumping of Pueblo II white ware designs has been the standard for analysts in the Central Mesa Verde Region, specifically within the Cortez Black-on-white and Mancos Black-on-white types. This method types sherds based on low-visibility technological attributes irrespective of the higher-visibility designs used to decorate them (Able 1955; Breternitz et al. 1974). The Lakeview Community serves as a case study to show how similar designs were used throughout the Chaco region; thus, demonstrating social connections extended from Chaco Canyon's center and across large expanses of the Colorado Plateau.

Research Questions

Using painted white ware design style analysis as a proxy for social connections between pottery traditions, we hope to answer three research questions aimed at understanding:

1. Were painted pottery design styles used in the Lakeview Community sites similar to those made on pottery types present at other Chaco-style great houses?
2. What does the use of similar or different design styles indicate about connections between the Lakeview great houses and those found in other parts of the region?
3. If similar designs were present, did they occur in similar proportions at great houses in the Lakeview Group as they did in other parts of the region?

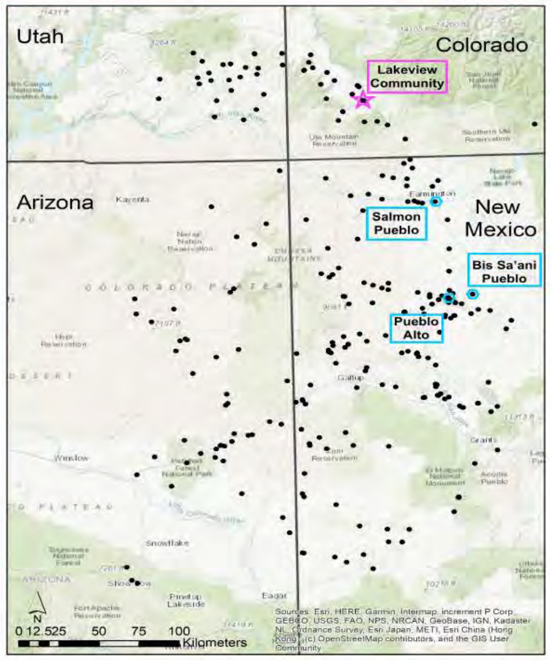


Figure 1. Distribution of great houses across the four corners region.

Design Style Used in this Study	Northern San Juan WW Tradition (Stephens-Reed 2006:Table 31.25)	Middle San Juan WW Tradition (Animas Variety) (Stephens-Reed 2006:Table 31.25)	Tusayan WW Tradition (Hays-Gilpin and van Hartesveldt 1998:119)	Cibola WW Tradition (Stephens-Reed 2006:Table 31.25)	Chuska WW Tradition (Carbon Paint/Organic Paint Series) (Stephens-Reed 2006:Table 31.25; Hays-Gilpin and van Hartesveldt 1998:119)
Black Mesa	Mancos B/w (Black Mesa Style)	Mancos B/w (Black Mesa Style)	Black Mesa B/w	Red Mesa B/w (Late)	Newcomb/Naschitti B/w
Mancos	Mancos B/w (Mancos Style)	Mancos B/w (Mancos Style)	NA	NA	NA
Sosi	Mancos B/w (Sosi Style)	Mancos B/w (Sosia Style)	Sosi B/w	Escavada B/w	Toadlena/Taylor B/w
Dogoszhi	Mancos B/w (Dogoszhi Style)	Mancos B/w (Dogoszhi Style)	Dogoszhi B/w	Gallup B/w	Birmhall/Chuska B/w
Chaco	Mancos B/w (Chaco Style)	Mancos B/w (Chaco Style)	NA	Chaco B/w	NA
Puerco	Mancos B/w (Puerco Style)	Mancos B/w (Puerco Style)	NA	Puerco B/w	Nava/Naschitti B/w
Reserve	Mancos B/w (Reserve Style)	Mancos B/w (Reserve Style)	NA	Reserve B/w	Toadlena B/w (in part)

Figure 2. Design styles found in each pottery production tradition of the Southwest.

Methods

Drawing from Stephens Reed's (2006) methodology, which identified design analogs between several Ancestral Pueblo pottery white ware traditions (i.e., the Northern San Juan, Middle San Juan, Cibola, Tusayan, and Chuska), Crow Canyons' laboratory team developed a modified typology for white ware bowl rims for the Pueblo II white ware types from 2019–2022 (i.e., Cortez B/W and Mancos B/W) (Bellorado et al. 2020). Crow Canyon's assemblage was collected from ongoing excavations at Haynie Pueblo (5MT1905) and previously excavated materials at the neighboring great houses of Wallace (Bradley 2019a, 2019b) and Ida Jean (Brisbin 1973). During Crow Canyon's 2022 REU College Field School, students assisted in these analyses.

Stephens Reed's (2006) refinements to the Middle San Juan pottery tradition allowed for the classification of design elements on Cortez and Mancos B/W bowl rims into design styles previously identified for other pottery traditions in the region. In this poster, our discussion is limited to Mancos B/W styles, though similar data is available for Cortez B/W designs. The Lakeview Group pottery assemblage was then compared to three Chaco-style Great Houses: Salmon Ruins, Bis Sa'ani, and Pueblo Alto. Data on the sherds found at Salmon Pueblo, came from Stephens Reed's (2006) analyses of Pueblo II era pottery, originally excavated by Cynthia Irwin-Williams in the 1970s. Data on Pueblo Alto was assembled using publications of the Chaco Project from 1969–1979 (Wolcott and Mckenna 1987: 21). Data from Bis Sa'ani Pueblo was ascertained from Breternitz's (1982) excavation report.

The raw data on counts for each style from each site were converted to percentages to normalize the data. This method allowed for the development of tables, graphs, and pie charts in Microsoft Excel and "R" to statistically display the proportions of design styles across the San Juan region. The mean of the Lakeview Group and larger dataset were also calculated for each design style. The percentages of each style at the sites were then compared to determine the relative frequencies of the styles across within the Lakeview Community and the larger region.

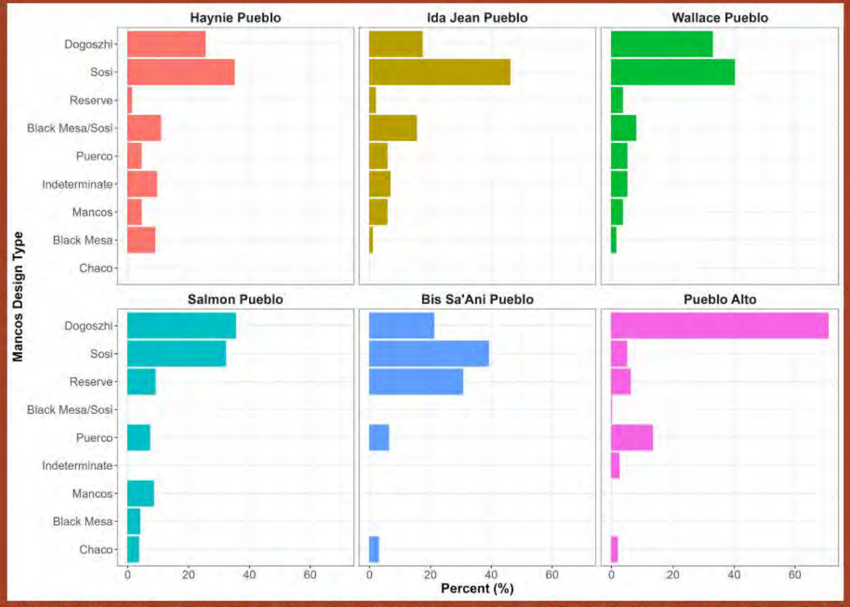


Figure 3. Distribution of design styles in percentage rates on sherds found during excavation at the Lakeview Community great houses as well as Pueblo Alto, Salmon Pueblo, and Bis Sa'ani Pueblo.

Results of Analysis

The data indicates all sites contained proportions of Dogoszhi or Sosi style pottery that made up 25%-40% of the assemblage; thus, demonstrating a shared design system across the region. In contrast, the remaining 60-75% of the assemblage across sites shows style differentiation within geographic regions, expressing individuality within sites.

Discussion

The distribution of pottery design indicates distinct but overlapping spheres of social connections across the San Juan region. Including Pueblo Alto, the mean for Sosi style ranges from 27.25% to 40.63%. The high proportion of Sosi style ceramics across the Lakeview community and other Chaco outliers, except for Pueblo Alto, indicates some level of shared social identity across the San Juan Region. Throughout all the sites analyzed, the mean for Dogoszhi style ranges from 25.42% to 37.99%. Dogoszhi style is the second highest proportion within the Lakeview community, but is the highest at sites closest to Chaco Canyon, further demonstrating a shared social sphere between these communities. In comparison, Chaco style design styles are present at all sites closest to Chaco, but to date, are not present this sample of sherds analyzed from the Lakeview Community. In contrast, Black Mesa/Sosi styles makeup half and Black Mesa makes up a quarter of the pottery assemblage at Lakeview, but these styles are not present at Bis Sa'ani, Salmon, and Pueblo Alto. These distributions show Chaco had a direct sphere of influence on sites in its proximity and that there is a second sphere of influence on the Lakeview community that is not present in Chaco's vicinity.

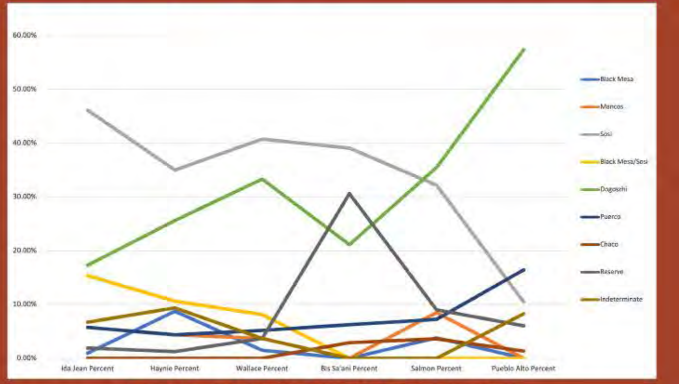


Figure 3. Line graph of Pottery Design Style Distribution (percentages).

Conclusion

Despite different excavation methods and sample sizes, our methods show that a stylistic comparison of pottery designs across the Four Corners area is possible and can inform us about social and economic connections across the region. This project demonstrates that the design styles found in the Lakeview community are comparable with assemblages of different types from other Chaco outliers, and provides clues about the scale of Chaco's region-wide influence. Further research must be done to refine the typology on a regional scale. These analyses will allow for future exploration of distinctions of social identity between individual sites, including the development of social structures such as moieties and clans, and migration patterns throughout the region.

References

Abel, Leland J.
1955 Pottery Types of the Southwest, Wares 5A, 10A, 10B, 12A, San Juan Ware, Mesa Verde Gray Ware, Mesa Verde White Ware, San Juan White Ware. Museum of Northern Arizona Ceramic Series No. 3. Museum of Northern Arizona, Flagstaff.

Bellorado, Benjamin A., Michelle I. Turner, and Kari L. Schleher
2021 Pueblo II Design Analysis from Wallace Ruin (5MT6970) and Greenstone Pueblo (5MT006970). Lakeview Community Archaeological Project. Letter Report submitted to the Colorado State Historic Fund. Crow Canyon Archaeological Center, Cortez, Colorado.

Bradley, Bruce A., and Cindy S. Bradley
2019a Annual Report on Excavations at the Wallace Great House (5MT6970) 2018. Cortez, Colorado.
2019b Annual Report on Excavations at the Wallace Great House (5MT6970) 2019. Cortez, Colorado.

Breternitz, Cory Dale; Doyel, David E.; Marshall, Michael P.
1982 Bis Sa'ani: A Late Bonito Phase Community on Escavada Wash, Northwest New Mexico. Appendices and References. Navajo Nation Papers in Anthropology No.14.

Brisbin, Joel M., Brisbin, Charlotte J.
1973 Contribution to the Sites Being Excavated in the North McElmo Drainage Area of Southwestern Colorado. Manuscript on file, Ida Jean Site, Crow Canyon Archaeological Center.

Hays-Gilpin, Kelley, and Eric van Hartesveldt
1998 Prehistoric Ceramics of the Puerco Valley: the 1995 Chambers-Sanders Trust Lands Ceramic Conference. Museum of Northern Arizona Ceramic Series No. 7. Museum of Northern Arizona, Flagstaff.

Stephens Reed, Lori
2006 Middle San Juan Typological and Chronological Perspective. In Thirty-Five Years of Archaeological Research at Salmon Ruins, New Mexico, Vol. 2: Ceramic Studies, edited by Paul F. Reed, pp. 593–633. Center for Desert Archaeology, Tucson, Salmon Ruins Museum, Bloomfield, New Mexico.

Toll, H. Wolcott, Mckenna, Peter J.
1987 The Ceramography of Pueblo Alto, in Investigations at the Pueblo Alto Complex: Chaco Canyon, New Mexico (1975-1979) edited by Mathien, Frances Joan and Windes, Thomas C. Publications in Archaeology 18F: Chaco Canyon Studies Vol. 3, Pt. 1, Chapter 1, pp. 19-24, 42. National Park Service, Santa Fe, New Mexico.

Acknowledgments

We would like to thank the Crow Canyon Archaeological Center, Dr. Ben Bellorado, Kate Hughes, Jamie Merewether, Dr. Jonathan Dombrosky, Daniel Hampson, Dr. Susan Ryan, Drs. Bruce and Cindy Bradley, the National Science Foundation Research Experience for Undergraduates program, the Colorado State Historical Fund, the Archaeological Conservancy, our collegiate institutions, and the descendent communities of the ancestral Puebloans.

Appendix D – Faunal Report

Please see next page

Year One of Archaeofaunal Analysis at the Haynie Site (5MT1905)

Jonathan Dombrosky Eric Gilmore

10/19/22

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1 Introduction

The Haynie Site (5MT1905) is a multicomponent Ancestral Pueblo archaeological site, located in southwestern Colorado, occupied between roughly A.D. 800 and 1200 (Throgmorton et al. 2022). It includes two Chaco period Great Houses. Material recovered from Haynie represents an unparalleled way to examine how Chaco outliers formed, were sustained, and integrated within the larger Chaco world.

The Lakeview Community encompasses the Haynie Site and two other Great Houses, all of which are located within 1 km of each other. The additional Great Houses are Ida Jean (5MT4126) and Wallace Ruin (5MT6970). Studying the Lakeview Community is the purview of the Northern Chaco Outliers Project. Crow Canyon initiated this project in 2016 (Ryan 2016), and it has four research domains: human-environment relationships, social inequality, the role of public architecture in Chaco Outlier communities, and identity formation. The excavation and analysis of material culture from Haynie is one of the prime ways these research domains will be addressed.

Studying archaeofaunal remains is an integral part of the Northern Chaco Outliers Project, as this class of material fits within each research domain. How humans interact with animals represents a significant portion of how they generally interact with environments. Animal foods can also help detect social equality or inequality (Badenhorst et al. 2019; Muir and Driver 2002), are integral to the use of public architecture (Potter 2000; Potter and Ortman 2004), and can be an important identity marker (Potter 2004; Twiss 2007). Further, animal parts were used for purposes other than food that can be applied to these research domains. Animal parts were used in the manufacture of tools and ornaments that were incorporated into rituals, ceremonies, and domestic activities (Brown 1967; Muir and Driver 2004; Olsen 1979, 1980; Payne 1991; Watson and Gleason 2016). The Haynie archaeofauna represents a way to directly understand how and why Chaco Outlier community members obtained and used animals.

This report, however, focuses on three areas that undergird these research domains: the identification, taphonomy, and representative sampling of the Haynie Site archaeofauna. We detail how remains were identified, their condition, and how the diversity of animals recovered compares to various sites in the northern U.S. Southwest. In the identification section, we especially emphasize the research potential of artiodactyl and canid remains (Section 3). The taphonomy section emphasizes fragmentation, as its effects were conspicuous (Section 4). Finally, the section on sampling compares the structure of taxonomic diversity at Haynie and other sites (Section 5). This section is especially essential considering that representative sampling underlies almost every facet of zooarchaeological interpretation (Grayson 1984, 1978, 1981; Lyman 2008). Overall, the goal of this report is to document the quality of zooarchaeological data produced from August 2021 to August 2022. Tracking data quality is fundamental to understanding the range of research applications for the Haynie Site archaeofauna. Such a focus highlights strengths and weaknesses of these data, which will help legitimately address the research domains of the Northern Chaco Outliers Project in the future.

2 Materials and Methods

We are the sole analysts of the data described herein. Currently, Jonathan Dombrosky has approximately 11 years of experience with archaeofaunal analysis, and he analyzed specimens from August 2021 to August 2022. Eric Gilmore has approximately 3 years of experience with archaeofaunal analysis, and he analyzed specimens as a Crow Canyon Zooarchaeology Intern from May 2022 to July 2022. Jonathan Dombrosky and Eric Gilmore are respectively referred to as Analyst 1 and Analyst 2 in all subsequent interanalyst comparisons.

The main comparative collection used for the analysis of the Haynie Site archaeofauna is housed in Crow Canyon Archaeological Center's Laboratory. Three cottontail (*Sylvilagus* spp.) specimens and one black-tailed jackrabbit (*Lepus californicus*) specimen were loaned from the Laboratory of Zooarchaeology at the University of North Texas. We took specimens that were difficult-to-identify to the Museum of Southwestern Biology's Division of Mammals and Division of Birds located in Albuquerque, New Mexico. Various osteological guides, manuals, atlases, and keys aided identification. Several publications assisted with the identification of mammal remains (Adams and Crabtree 2012; Chavez 2008; Gilbert 1980; Hillson 1986, 1996; Jacobson 2003; Olsen 1964; Smart 2009). Bird remains were identified with other works (Cohen and Serjeantson 1996; Gilbert et al. 1981; Hargrave and Emslie 1979; Olsen 1979). Some consulted references helped identify both avian and mammalian remains (Broughton and Miller 2016; Elbroch 2006). Yet other works verified nonhuman from human remains (Baker et al. 2005; France 2009; White et al. 2012).

We followed identification protocols explicitly designed to enhance data quality (Driver 1992, 2011; Wolverton 2013; Wolverton and Nagaoka 2018), and used the coding system by Driver (2006). Briefly, analysts adopted a conservative approach to identifying zooarchaeological specimens at the Haynie Site. It is an almost impossible task for analysts to understand how all diagnostic skeletal criteria change through time, among species, within different age classes, between sex, and across geographic areas on a fragment-by-fragment basis. It has been argued that identifications become less taxonomically specific when analysts have more experience, greater access to diverse comparative materials, and a specific focus on data quality (Gobalet 2001; Lyman 2002; Wolverton and Nagaoka 2018). This lack of taxonomic specificity likely increases identification accuracy in situations where assemblages contain an abundance of fragmented remains from closely related taxa.

We use the Number of Identified Specimens (NISP) to report taxonomic abundance, and this quantitative unit is a tally of all archaeofaunal specimens within a given taxonomic classification. NISP is the most basic quantitative unit from which most others are derived, such as the Minimum Number of Individuals (MNI). NISP is preferred because it is often highly correlated with measures like MNI. It is also devoid of errors in additive calculation that plague minimum number units (Grayson 1984; Lyman 2008). We also rely on a non-standard unit called the Number of Unique Identifications (NUIDs) to estimate taxonomic diversity (Section 5).

All statistical analyses and figures were produced with R version 4.2.0 (R Core Team 2022). Our statistical analyses are structured with `tidyverse` packages and syntax (Wickham et al. 2019). All graphs were produced with `ggplot2` (Wickham 2010). We built predictive taxonomic and taphonomic models using a supervised learning workflow (Hastie et al. 2009; James et al. 2013; Kuhn and Johnson 2013); this included using the `tidymodels` metapackage to split our data and implement basic model features (Kuhn and Silge 2022). We rely on Linear Discriminant Analysis (LDA) and logistic regression as the engines for our predictive models. LDA is a procedure designed to maximize the linear separation of multiple classes based on given predictors (Kachigan 1991), such as length-based measurements. Logistic regression is a popular modeling engine designed for binary classification (Kuhn and Johnson 2013, 282).

3 Identified Taxa

There are 1601 identifiable and 4281 unidentifiable specimens so far in the Haynie archaeofaunal assemblage. This leads to an identification rate of 27.22%, which is low and likely driven by fragmentation issues (Section 4). Analyst 1 analyzed 72.58% of the assemblage, and Analyst 2 analyzed 27.42%. There are 3 classes of animals present: Mammalia (mammals), Aves (birds), and Actinopterygii (ray-finned fishes). There are 4 orders of mammals present, 6 orders of birds, and 1 order of ray-finned fishes. In total, we used 54 identification types (Figure 1).

3.1 Mammalia (n = 1435)

3.1.1 Lagomorpha (n = 507)

Cottontails (*Sylvilagus* spp.) and jackrabbits (*Lepus* spp.) are the main taxa in the order Lagomorpha at the Haynie Site. Lagomorphs are currently the most abundant animals identified, comprising 31.67% of the identified specimens. It has been hypothesized that populations of larger-bodied jackrabbits decreased through time in the central Mesa Verde region, and that this decrease is likely due to human overhunting (Driver 2002; Ellyson 2014). Thus, the ratio of cottontails to jackrabbits—commonly referred to as the Lagomorph Index—is a basic quantitative unit of general interest in the area, and in the broader U.S.

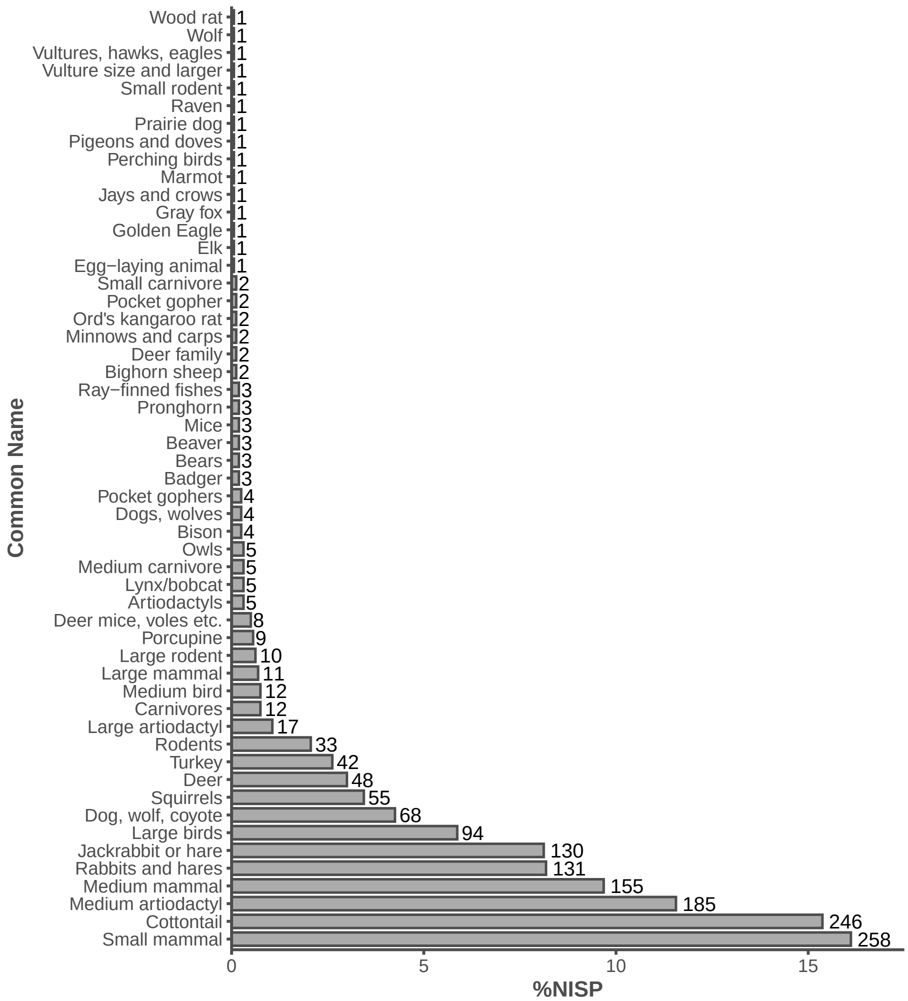

Figure 1: Relative taxonomic abundance at the Haynie Site using percent Number of Identified Specimens (%NISP). Raw NISP values are reported next to each bar.

Southwest (Driver and Woiderski 2008). The Lagomorph Index at the Haynie Site is 0.65, which indicates a fairly equal relationship between the abundance of cottontails and jackrabbits. This number is similar to the Lagomorph Index from some Pueblo II components of Shields Pueblo (5MT3807). Shields serves as an important point of comparison—here and in subsequent analyses—considering that it and Haynie both have similar site features (i.e., Great Houses) and general occupation histories (Rawlings 2006).

Garden hunting is an important subsistence practice to consider at the Haynie Site, and the moderate Lagomorph Index value is also interesting in this regard. Researchers argue that higher ratios of cottontails to jackrabbits indicates a higher reliance on garden hunting in the central Mesa Verde region (Driver 2011). What could the more even relationship of cottontail and jackrabbit abundance indicate about garden hunting at the Haynie Site? Future work using stable isotope analysis might help shed light on whether garden hunting was prevalent at the site, and it also might help describe the relationship between the Lagomorph Index and garden hunting in general.

3.1.2 Artiodactyla (n = 267)

Even-toed hoofed animals make up the order Artiodactyla, and they are 16.68% of identified specimens at Haynie. There is substantial zooarchaeological evidence that indicates artiodactyls—mostly mule deer (*Odocoileus hemionus*), pronghorn (*Antilocapra americana*), and bighorn sheep (*Ovis canadensis*)—were severely overhunted in the central Mesa Verde region (Badenhorst and Driver 2009). Some models suggest that deer populations might have been so low that any observable deer was immediately hunted after A.D. 1000 (Bocinsky et al. 2012). For this reason, the Artiodactyl Index is another basic quantitative unit of general interest in the region and in the larger northern U.S. Southwest. It measures the ratio of large-bodied artiodactyls to small-bodied lagomorphs in an archaeofaunal assemblage (Broughton et al. 2011). The current Artiodactyl Index at Haynie is 0.34. This value may seem somewhat low but the majority of Pueblo I and Pueblo II sites in the central Mesa Verde region have Artiodactyl Index values between 0.00 and 0.20 (Badenhorst and Driver 2009, Table 5). The value at Haynie is moderate.

Large artiodactyls—elk (*Cervus canadensis*) and bison (*Bison bison*)—are notable parts of the Haynie archaeofaunal assemblage. These specimens comprise 8.24% of artiodactyls. There are 4 bison specimens firmly identified: a complete first phalanx (Figure 2), a proximal metatarsal (Figure 3), a distal humerus, and a spinous process fragment from a thoracic vertebra. There are also other specimens that compared favorably to bison but did not retain enough morphological characteristics for firm identification: a thoracic vertebra neural arch fragment and a rib shaft fragment (Figure 4).

Bison remains are rare in the central Mesa Verde region. Only 4 specimens have been identified by Crow Canyon analysts. Two specimens, an ulna and

Figure 2: Three first phalanges of comparative bison (*Bison bison*) on the right, specimen from the Haynie Site to the left of those, and elk (*Cervus canadensis*) comparative at furthest left. All comparative specimens come from the Museum of Southwestern Biology's Division of Mammals.

Figure 3: Proximal view of a left metatarsal from bison (*Bison bison*) on the left, specimen from the Haynie Site in the middle, and elk (*Cervus canadensis*) on the right. This specimens was identified to bison based off of the breadth of the posterior portion as well as the general shape of the lateral facet. All comparative specimens are from the Museum of Southwestern Biology's Division of Mammals.

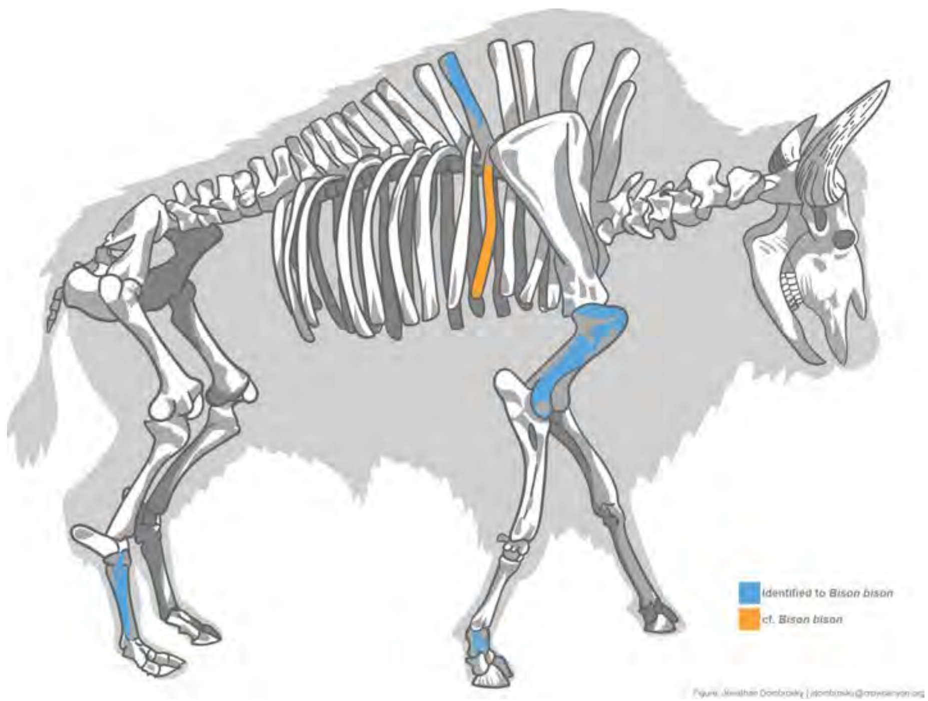

Figure 4: Skeletal element representation of *Bison bison* at the Haynie Site.

rib fragment, were identified from Albert Porter (5MT123) by Badenhorst and Driver (2015). The other two, a complete first phalanx and a fragmented second phalanx, were recently identified by Cates (2020) from Greenstone Pueblo (5MT6970), which is located close to the Haynie Site. Bison are also reported from the Badger House community in Mesa Verde National Park (Hayes and Lancaster 1975; Martin et al. 2017). The presence of bison remains at Haynie leads to a number of questions about how resources were obtained. Was the bison hunted locally, non-locally, or was it traded in? Skeletal element representation indicates elements of various utility are present, which might suggest bison parts were taken in bulk close to the Haynie Site (*sensu* Binford 1978). Analyzing medium artiodactyls may be another indicator of the prevalence of local versus non-local hunting practices.

Specifically, it might help to assess the number of mule deer relative to pronghorn at the site. More mule deer may suggest that hunting locally was common, while more pronghorn would suggest non-local hunting practices prevailed. Given the habitat preferences of these two taxa, mule deer are assumed to have been procured near the Lakeview Community while pronghorn would require further travel to the south. Such a comparison, however, relies on accurate identification of mule deer and pronghorn specimens.

Analyst 2 measured the tarsals of 17 mule deer and 30 pronghorn from the Museum of Southwestern Biology's Division of Mammals to build an accurate predictive taxonomic model. We used Linear Discriminant Analysis (LDA) as the engine, where it classifies a set of archaeological tarsal measurements as pronghorn or mule deer. Separate LDAs were used to create more accurate models for the astragalus, calcaneus, and cubonavicular. The astragalus model is 97% accurate, the calcaneus model 95%, and the cubonavicular is 93% accurate. The models identified 1 pronghorn and 12 mule deer when applied to Haynie, which indicates substantially more mule deer than pronghorn tarsals in the assemblage (Figure 5).

Interestingly, Analysts 1 and 2 did not originally identify pronghorn from this sample of tarsals (Figure 6). The predictive model only assigns elements to mule deer or pronghorn and the medium artiodactyl classification is only used with visual identifications. The model developed here improved taxonomic resolution at Haynie.

These results are one line of preliminary evidence suggesting that animal procurement was likely mostly local at the Haynie Site. The original visual identifications indicated animals were solely procured locally, as the medium artiodactyl identification group kept the possibility of non-local procurement vague. Biometric analysis suggests that local procurement is still likely the predominate method, but that some long distance procurement did indeed occur. Applying these conclusions to the presence of bison remains suggests that bison were procured close to the Lakeview Community, but that long distance hunting and trade cannot be ruled out yet. Further analyses—including radiocarbon, stable isotope, and ancient DNA—may help address this issue.

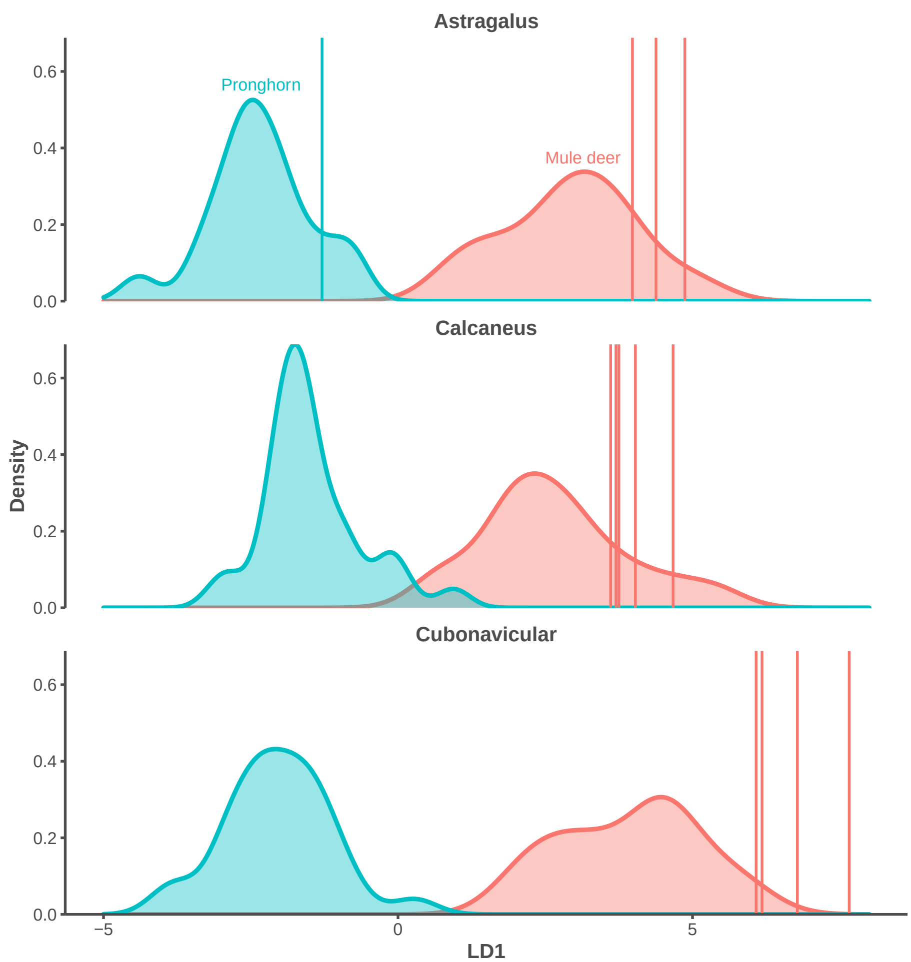

Figure 5: Classifying select tarsals of pronghorn (*Antilocapra americana*) and mule deer (*Odocoileus hemionus*) using separate LDAs based on eight different skeletal measures. Each archaeological element from the Haynie Site is represented by a vertical line.

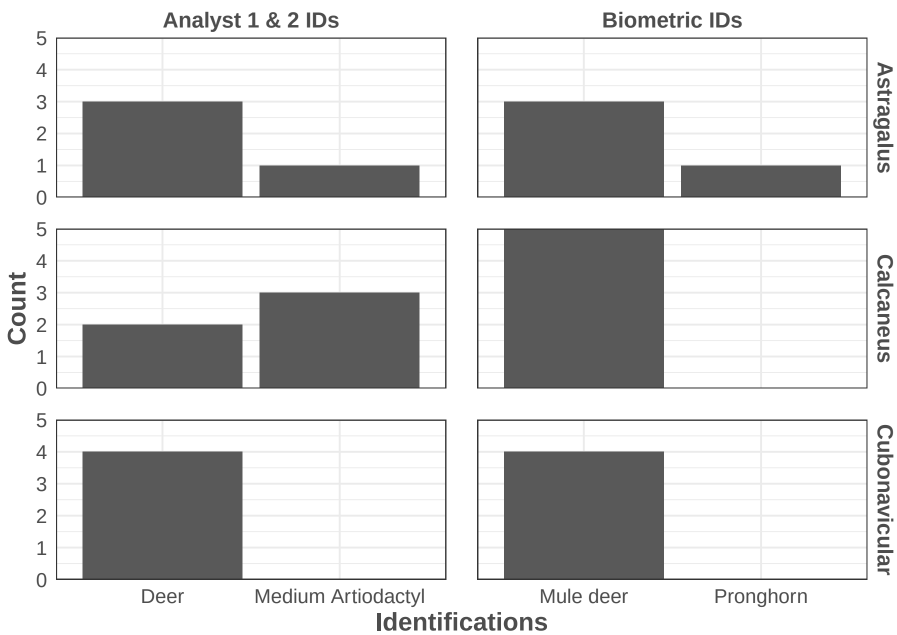

Figure 6: Comparing the accuracy of visual identifications and the biometric predictive model developed here.

3.1.3 Small Mammal (n = 258)

This identification group includes those mammals jackrabbit size and smaller. This non-standard identification includes all small mammal specimens lacking morphological features required for more specific taxonomic levels. Consequentially, it has a high likelihood of incorporating many lagomorph specimens since they are exceedingly abundant in southwestern archaeofaunas. It is crucial to incorporate this identification group in any rigorous comparison of size-based abundance indices through time, between areas of the Haynie Site, or between sites. It should be incorporated in a sensitivity analysis to assess whether or not it impacts final interpretation of measures like the Lagomorph Index.

3.1.4 Medium Mammal (n = 155)

Mammals larger than a jackrabbit and up to deer size are considered medium mammals. There is a high probability this identification group incorporates many artiodactyl specimens since they are one of the most common medium mammals in southwestern archaeofaunas. It should be incorporated in sensitivity analyses that rigorously assess final conclusions relying on size-based abundance index values, such as the Artiodactyl Index.

3.1.5 Rodentia (n = 133)

Rodents are 8.31% of identified specimens, which is a small component of the overall assemblage. The ratio of sciurids to rodents can help gauge the impact of intrusive species. Members of the squirrel family (Sciuridae) are notorious intruders of archaeological deposits, especially prairie dogs (*Cynomys* spp.). The majority of prairie dog skeletal fragments are identified to the family level, as it is extremely difficult to skeletally distinguish prairie dogs from ground squirrels. This means that the Sciuridae identification has the highest potential for accumulating prairie dog specimens. And, indeed, we can confirm that the vast majority of sciurid specimens compare favorably to prairie dogs. Sciurids make up 42.86% (n = 57) of the rodent assemblage. Given that rodents comprise a small portion of the overall assemblage, it does not appear that rodent intrusions pose a significant problem for interpretation at the site. We will, however, closely track the taxonomic composition of rodents as the Northern Chaco Outliers project progresses. Importantly, rodents could have been actively hunted (Badenhorst et al. In press). One way to disentangle intrusive from non-intrusive rodents is through radiocarbon dating (Guiry et al. 2021). This could prove useful if prairie dog specimens preclude clear interpretation of the Haynie archaeofaunal assemblage in the future.

Large rodents, those larger than a woodrat (*Neotoma* spp.), comprise 17.29% of the total rodents currently identified. Beaver (*Castor canadensis*) and porcupine (*Erethizon dorsatum*) specimens are the most notable. Beavers prefer aquatic habitats while porcupines take refuge in trees along active floodplains (Baker and Hill 2003; Roze and Ilse 2003). The presence of these species might suggest hunting activities that were focused in riparian habitat close to the site.

3.1.6 Carnivora (n = 104)

Carnivores are a small portion of currently identified specimens at the Haynie Site (6.5%), but there are a number of specimens worth detailed attention.

The first specimen is a wolf mandible (*Canis lupus*; Figure 7). It was recovered from the fill between two floors of a surface room in Structure 1026/1042 (see Throgmorton et al. 2022, fig. 6). It likely dates somewhere between A.D. 940 and 1040 based on associated artifacts. The second set of specimens are from the articulated remains of what is likely a small domestic dog (*Canis familiaris*). The upper half of this individual was uncovered from the floor of a pitstructure, Structure 1047 (Throgmorton et al. 2022, fig. 6). Its lower half was deposited outside of the unit. This individual likely dates to around the A.D. 1050s based on associated artifacts. Canids are known components of dedicatory offerings for room closing rituals (Hill 2000), and are recovered from room surfaces throughout the Pecos chronology (Burger 2021; Frisbie 1967; Lang and Harris 1984; Strand 1998). Interestingly, this individual was also found in association with an articulated turkey, which is another noted pattern (Burger 2021; Hill 2000). All analyses were conducted *in situ* for this individual dog given its cultural relevance. Exposed specimens (Figure 8) were identified and various mandibular measures taken.

These specimens are likely *Canis lupus* and *Canis familiaris* based on visual inspection and comparison. We, however, wanted to know the level of confidence in our identifications considering the large amount of morphological overlap in members of the family Canidae (Wayne et al. 1997). Developing confidence-based taxonomic identification is an critical future avenue for zooarchaeology (Lyman 2019). Luckily, Welker et al. (2021) provided a robust (n = 543) database of North American canid mandibular measures.

We built a model to classify canid mandible specimens from the Haynie Site using this database. First, we isolated all species that can be found in the central Mesa Verde region: domestic dog, wolf, western coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), kit fox (*Vulpes macrotis*), and red fox (*Vulpes vulpes*) specimens (n = 400). We then designed a model to classify domestic dogs, wolves, coyotes, and foxes (*Urocyon* sp. and *Vulpes* spp. were grouped together) by a set of five predictors: the length of p2, p3, p4, m1, and the height of the mandible behind m1 (see von den Driesch, Angela 1976, 60; Welker et al. 2021, 199). We trained the model on a random 80% split of the data. The model correctly classified 94.69% of the training dataset. We used 10-fold cross validation to evaluate model performance and gauge overfitting (Figure 9), and model performance was acceptable. We then applied it to the testing dataset,

Figure 7: Left wolf mandible recovered from the Haynie Site (top) compared to a modern left wolf mandible from the Museum of Southwestern Biology's Division of Mammals (bottom).

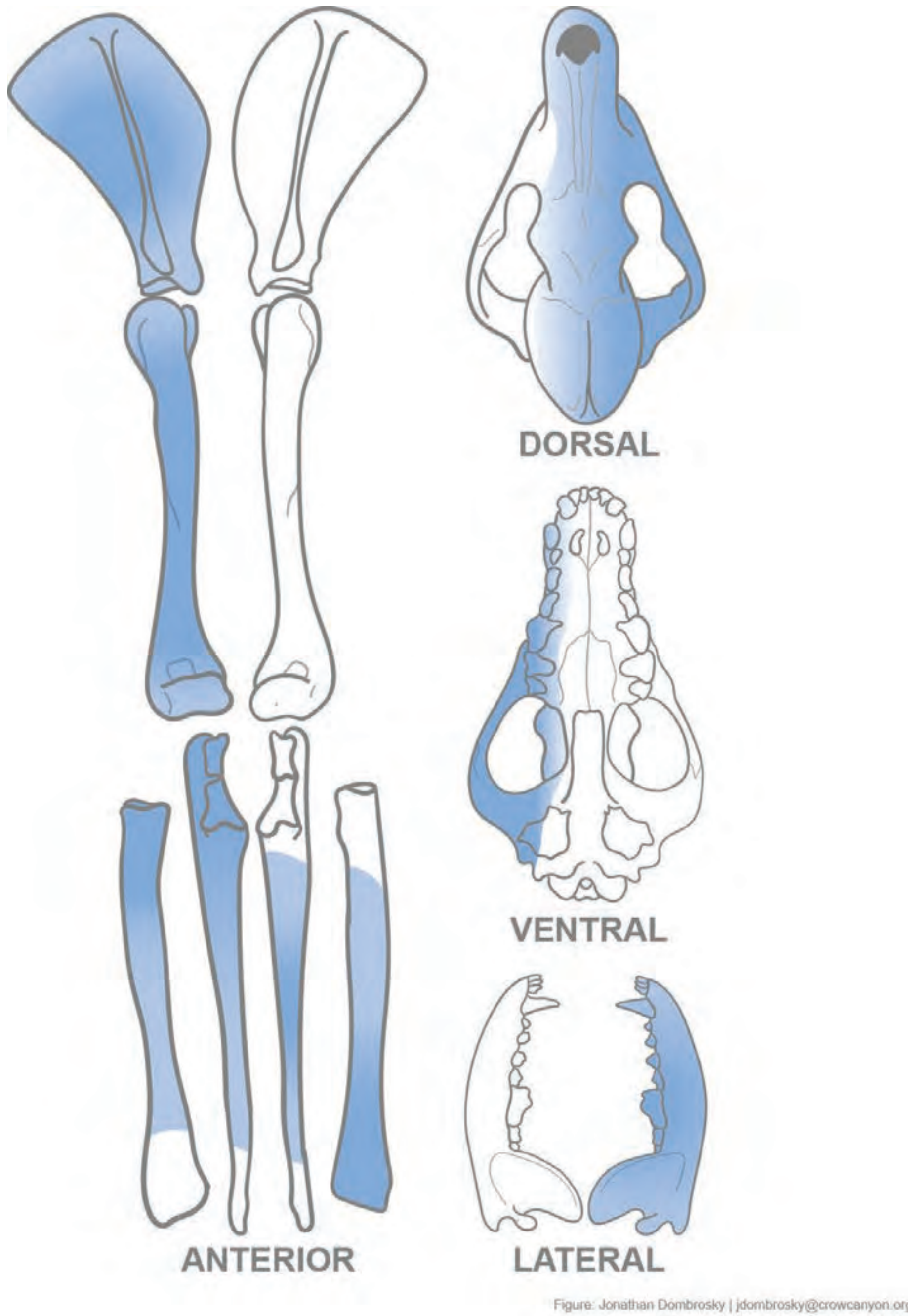

Figure 8: Domestic dog recovered from the floor of Structure 1047 with exposed portions highlighted in blue.

which consists of the remaining 20% of data from our initial split. We found that it correctly classified 88.75% of test data. This level of accuracy is considered generally high (Kuhn and Johnson 2013, 254).

As anticipated by visual identification, the model predicts that the mandible specimens recovered from Structure 1026/1042 and 1047 respectively belong to wolf and domestic dog (Figure 10). But, returning to the question at hand, how confident can we be in these identifications? The posterior probability—or the likelihood of an identification occurring given the model—for the wolf specimen is 100%. In other words, the model is certain the specimen from Structure 1026/1042 is from a wolf. The posterior probability for the likely domestic dog specimen is slightly more complicated: there is a 44% likelihood the specimen is a domestic dog, 38% chance it is fox, and 18% probability it is coyote. It is unsurprising that the model has a more difficult time predicting domestic dogs (see Figure 9) given their extreme morphological plasticity. This concept is well-illustrated in Figure 10. Though there is a level of uncertainty, we feel confident in this model's final classification of domestic dog. The cranium articulating with this mandible was not as gracile as a fox nor was it as elongated as a coyote. The depositional context also helps bolster the domestic dog identification, given that articulated domestic dogs are commonly recovered on room floors (Hill 2000).

The wolf specimen is also of particular interest because they are rarely recovered in the central Mesa Verde region. Crow Canyon zooarchaeologists have only identified four wolf specimens: a fragmented radius and complete atlas from Albert Porter along with a fragmented sphenoid and a femur with a healed fracture from Shields Pueblo (Badenhorst and Driver 2015; Rawlings and Driver 2015). This is not to say these are the only specimens in other assemblages, but wolf specimens identifiable beyond *Canis* sp. are extremely rare. This single specimen from Haynie represents an unprecedented way to study human-wolf relationships in the region and in the northern U.S. Southwest considering how complete it is. For instance, toothwear suggests this individual was old, likely somewhere between 8 and 10 years old following the guidelines provided by Gipson et al. (2000). It is also possible this individual could be greater than 12 years old considering the intense wear on the posterior portion of m1 (see Figure 7). This locus of intense wear is certainly interesting, but any definite interpretation must consider bite variation among individual gray wolves. Regardless, the mean age at death for wolves in the wild is approximately 3.76 years old, which suggests the Haynie specimen reached a particularly old age despite the range in toothwear estimates (Figure 11). Preliminary modeling also suggests the individual was a male. This particular model was 80.95% accurate with training data, but only 63.63% accurate with test data. These conclusions are certainly not definitive, but the male posterior probability for this specimen is 88.78%. Future work with this specimen will focus on strengthening models to predict sex, and may likely include analysis of radiocarbon, stable isotopes, and ancient DNA.

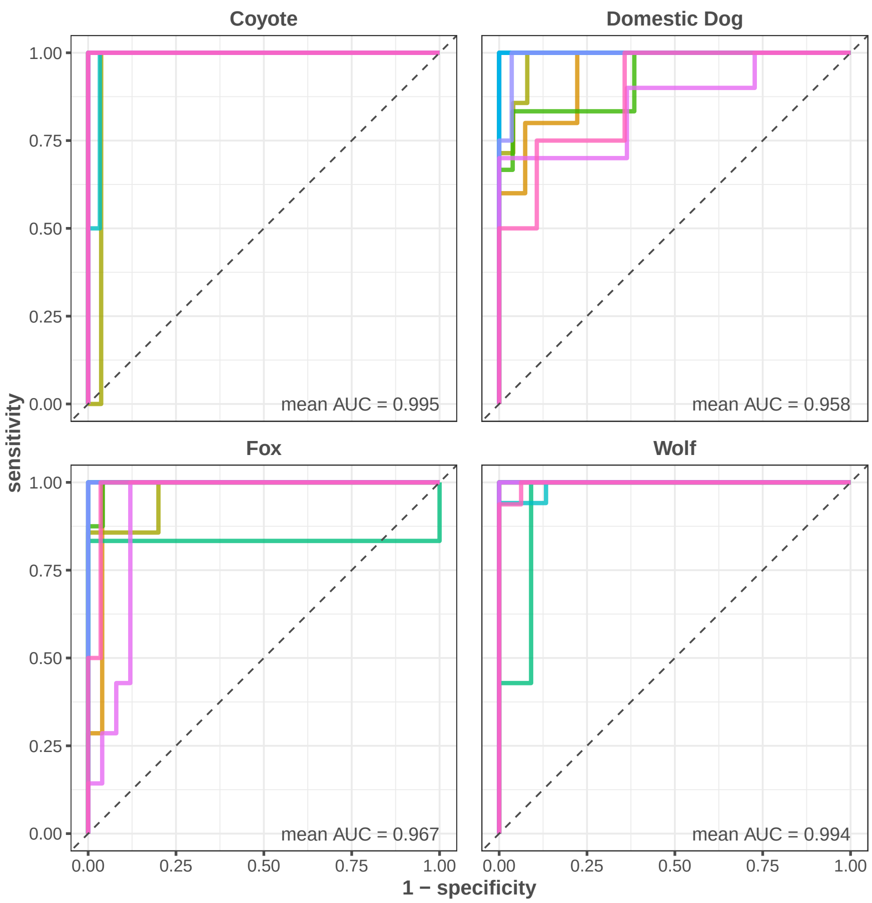

Figure 9: Multiclass Reciever Operator Curve (ROC) plotting the mandible model's false positive rate (1 - specificity) by true positive rate (sensitivity). The model was evaluated using 10-fold cross-validation, where each fold is a different color line. Area Under Curve (AUC) of 1 describes a model with perfect accuracy. The mean AUC value, among the 10 different resamples, for the entire model is 0.941. The values at the bottom right of each facet are mean one-vs-all AUC calculations. The mandible model predicts coyote and wolf specimens with near perfect accuracy. The model also does fairly well with domestic dogs and foxes. The dashed line represents random performance at all classification thresholds.

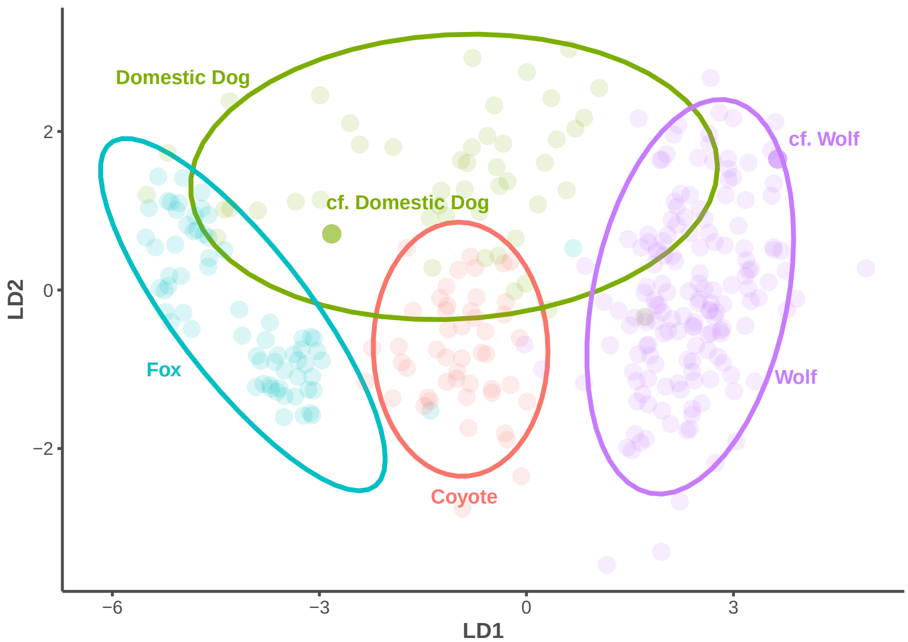

Figure 10: Classifying two canid mandibles (highlighted points) recovered from the Haynie Site using a Linear Discriminant Analysis (LDA) model developed with select data from Welker et al. (2021). The cf. Wolf specimen was recovered from Structure 1026/1042 and the cf. Domestic Dog specimen was recovered from Structure 1047. Faint points in the background are specimens from the training dataset used to build the model and their dispersion is illustrated with a 95% confidence ellipse.

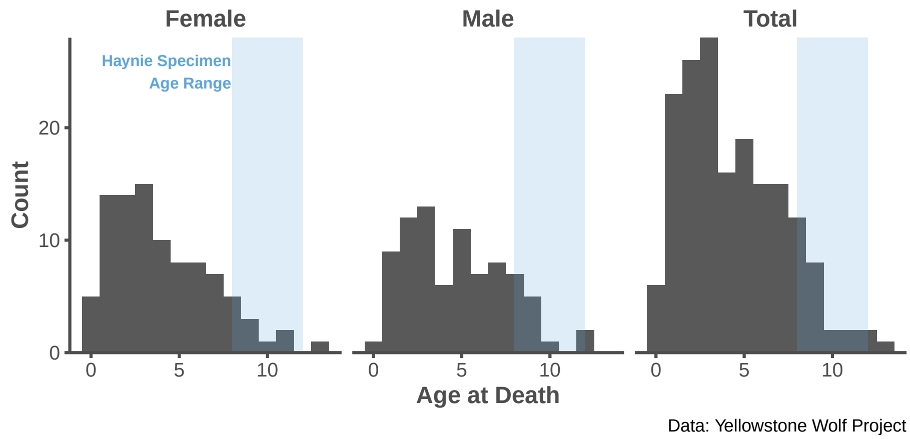

Figure 11: Gray Wolf (*Canis lupus*) mortality from Yellowstone National Park. There are 175 individuals (93 females and 82 males) that died of natural causes. These data were recorded from 1985–2022. The age range (8–12) of the wolf specimen from the Haynie site is highlighted in blue. This graph illustrates the Haynie specimen is from a rather old individual.

There are also interesting carnivore specimens beyond the wolf and individual domestic dog. One of the clearest signs of pathology comes from a bent transverse process on a *Canis* sp. atlas (Figure 12). Vertebral deformation is common in domestic dogs from Ancestral Pueblo contexts (Monagle and Jones 2020), and this type of pathology could be indicative of mechanical compression. Potential causes for this type of compression include tethering or possibly even carrying a pack with a heavy load. However, natural variation in vertebral morphology as domestic dogs age should be assessed too.

Figure 12: *Canis* sp. atlas exhibiting pathology on the right transverse process. The process is dorsally bent upwards.

Other carnivore specimens worth noting include a drilled bobcat (*Lynx rufus*) terminal phalanx, and a bear terminal phalanx (Figure 13). Human-carnivore relationships are an exciting area of future study at Haynie and will focus on how these animals were procured and cared for.

Figure 13: *Ursus* sp. terminal phalanx.

3.1.7 Large Mammal (n = 11)

The large mammal identification includes mammals larger than deer, and it includes specimens lacking morphological features required for more specific taxonomic levels. It is likely that it could incorporate large artiodactyls like elk and bison specimens. It should be incorporated in sensitivity analyses that rigorously assess conclusions based on these animals.

3.2 Aves (n = 160)

3.2.1 Large Birds (n = 94)

Birds larger than a mallard are considered large birds. This identification group is most likely dominated by Turkeys (*Meleagris gallopavo*) as they are one of the most frequent birds recovered from Ancestral Pueblo sites. A high proportion of Turkey specimens are assigned to this group considering that there is considerable skeletal morphological overlap between Sandhill Crane (*Grus canadensis*) and Turkey (Hargrave and Emslie 1979). The Crow Canyon comparative collection does not, as of yet, include Sandhill Crane skeletal material.

3.2.2 Galliformes (n = 42)

All Galliformes specimens identified so far in the Haynie assemblage are Turkey, but it is surprising how few Turkey specimens there seem to be. For instance, Spielmann and Angstadt-Leto (1996) proposed the Turkey Index, which is the ratio of Turkeys to lagomorphs in an assemblage. The current Turkey Index for Haynie is 0.08, which is notably low. However, Driver (2002) proposed the Modified Turkey Index where the large bird identification group is included in the calculation. The current Modified Turkey Index value for Haynie is 0.23, which is within the normal range for Pueblo I/Pueblo II sites in the central Mesa Verde region (Badenhorst and Driver 2009). Also worth noting, there appears to be more turkey specimens yet to be identified. How Turkey husbandry was managed at the community-level is an essential future area of research for the Northern Chaco Outliers. This line of inquiry is one way to delve deeper into aspects of cooperation and identity at the Lakeview Community.

3.2.3 Medium Birds (n = 12)

Medium birds are considered larger than a robin and the size of a mallard or smaller. It is difficult to attribute the majority of this identification group to a single taxon, as it contains a variety of difficult-to-identify fragmented skeletal parts that could belong to numerous taxa.

3.2.4 Strigiformes (n = 5)

The owl specimens identified at the Haynie Site are a terminal phalanx, second phalanx, first phalanx, femur, and ulna. Owl feathers are known to have been incorporated into dance paraphernalia and prayer sticks (Ladd 1963). It is, however, important to keep in mind that owls can be active taphonomic agents. Luckily, their signatures are well-known and include the presence of pellets, small mammal remains with little to no fragmentation, and visible signs of digestion on specimens (Andrews and Cook 1990; Fernández-Jalvo and Andrews 2016). Owls do not appear to be a taphonomic agent of concern at Haynie (Section 4).

3.2.5 Accipitriformes (n = 3)

Two specimens were identified as general members of the order Accipitriformes: one foot phalanx and one terminal phalanx that compared favorably to a Turkey Vulture (*Cathartes aura*). The final specimen was a distal tibiotarsus fragment identified to Golden Eagle (*Aquila chrysaetos*). This specimen was taken to the Museum of Southwestern Biology's Division of Birds and identified with their skeletal comparative collection. It was distinguished from Bald Eagle (*Haliaeetus leucocephalus*) based off the morphology of the supratendinal bridge, which is more convex and more proximally robust in Golden Eagles compared to Bald Eagles. Eagles are acutely significant in Pueblo culture and their feathers are extremely valued (Beaglehole 1936; LaZar and Dombrosky 2022; Tyler 1991).

3.2.6 Passeriformes (n = 3)

Three passeriform specimens have been identified so far in the Haynie assemblage: one small fragmented humerus generally identified to the order-level, a tibia fragment identified to Corvidae (the family comprising jays and crows), and one large carpometacarpus identified as Raven (*Corvus corax*).

3.2.7 Columbiformes (n = 1)

Pigeons and doves are in the order Columbiformes, and one ulna fragment was recovered from Haynie. This specimen is most likely a Mourning Dove (*Zenaida macroura*). An order-level identification was used because the Crow Canyon comparative collection does not include a Band-tailed Pigeon (*Columba fasciata*), which is the only other member in the order Columbiformes to consider in the region.

3.3 Actinopterygii (n = 5)

This taxonomic class includes the ray-finned fishes. Three specimens have been identified to this general class: two ribs and one fragmented vertebra centrum. Following Nelson (2006, 35), fish specimens should no longer be referred to as pisces, as it is an antiquated taxonomic term. Similarly, for fishes of inland North America, the use of osteichthyes should no longer be used (Nelson 2006, 83). This is so for two interrelated reasons. First, this term has been replaced by the Euteleostoma designation. It successfully describes a monophyletic clade that includes tetrapods. Secondly, since Euteloestoma includes tetrapods, it includes lobe-finned fishes (Sarcopterygii). Lobe-finned fishes—like the coelacanth (Actinistia)—are not native fishes in inland North America during the late Holocene (Cloutier and Forey 1991). The use of osteichthyes should be accordingly abandoned. Instead, Actinoptergygii (ray-finned fishes) should be used because it is a more accurate class-level designation for archaeofaunas from the U.S. Southwest/Mexican Northwest.

3.3.1 Cypriniformes (n = 2)

This order includes carps, minnows, and suckers, which are common fishes in the aridland streams of the U.S. Southwest (Minckley and Marsh 2009; Sublette et al. 1990). These specimens are small intact vertebra. The lateral ridge morphology of centra can be used to identify vertebrae of fishes from U.S. Southwestern archaeofaunas to the order-level. Common orders of fishes found in rivers in the U.S. Southwest include Cypriniformes, Siluriformes, Lepisosteiformes, and Salmoniformes, and each of these orders have distinct vertebral morphology. These specimens are also notably small. It is possible inhabitants of the Haynie Site used non-targeted methods to capture fishes, such as seining (Dombrosky et al. 2022). A focus on fishing practices offers a basic way to understand aquatic habitat use associated with the Simon Draw watershed.

3.4 Oviparous Animal (n = 1)

Eggshell specimens were identified as oviparous animal. These specimens are likely from Turkey, but a general identification was given because a scanning electron microscope could not be used to assess mammillary cone morphology (Beacham and Durand 2007; Conrad et al. 2016; Lapham et al. 2016). It is possible, though unlikely, that this eggshell could be from a lizard.

4 Taphonomy

Taphonomy is the study of how the material remains of organisms transition from the living world, to the lithosphere, and how they are subsequently recovered and studied by researchers (Lyman 1994). The most pressing taphonomic question for the Haynie archaeofaunal assemblage is: why are there so many unidentifiable specimens?

There are many interrelated factors that could lead to low identifiability, recall that the current identifiability rate at the Haynie Site is 27.22%. The typical identifiability rate is 40–60% from previous Crow Canyon projects (Rawlings and Driver 2015; Driver et al. 1999). One of the most important taphonomic processes to consider here is fragmentation. Specimens retain fewer morphologically distinct features when an assemblage is highly fragmented (Cannon 2013). Humans are a prime taphonomic agent responsible for low identifiability considering that access to within-bone nutrients is facilitated by fragmentation (Wolverton 2002). Another agent to consider is poor bone preservation, which is caused by the degradation of organic and inorganic tissue. Poor preservation leads to brittle bone that crumbles when removed from its archaeological context, often leaving a distinctly bright breakage surface known as excavation damage. Many variables can contribute to poor bone preservation, and they include bone weathering, soil acidity, or the age of the archaeological deposit itself. Another critical taphonomic agent to consider are archaeofaunal analysts themselves. Analysts can influence identifiability by the amount of experience they have or by the identification protocols they follow (Gobalet 2001). Disentangling how these these taphonomic agents influence an assemblage is difficult, but many multivariate methods are specifically designed to systematically sort through just such a morass of data.

Predictive modeling is an effective tool in these circumstances. If a model can successfully predict unidentifiable specimens based on many different taphonomic variables, then an analyst can evaluate why the model behaves the way it does while accounting for every variable at once. The most important variables would drive unidentifiability in this scenario. Here, we use logistic regression to help achieve this goal. We supplied our logistic regression model with 16 predictor variables for every specimen: if it had 1) thick cortical bone, 2) excavation damage, 3) carnivore damage, 4) at least one intact end, 5) a spiral fracture, 6) a transverse fracture, 7) an irregular break, if it was 8) a shaft fragment, 9) made into an artifact, 10) eroded, 11) gnawed by rodents, 12) splintered, 13) root etched, 14) burned, 15) who the analyst was, and 16) its maximum length.

We included a penalty term in the model to safeguard against highly correlated predictor variables. We used grid search on a validation set to tune 30 candidate penalty values, and we picked the one with the highest area under the Receiver Operator Curve (ROC) for our final model (Figure 14). This model was 86.44% accurate on the training set, which is generally good. Interestingly, there was a large discrepancy between two further accuracy metrics. The Matthews correlation coefficient for the trained model is 0.64 while its F1 metric is 0.91. The F1 metric is markedly higher—indicating a model with high performance—because it describes how well the model predicts an event of interest. In this case, the event of interest is how well the model predicts unidentifiable specimens rather than identifiable ones (Figure 15; Figure 16). As such, this model fulfills the purpose of the current analysis.

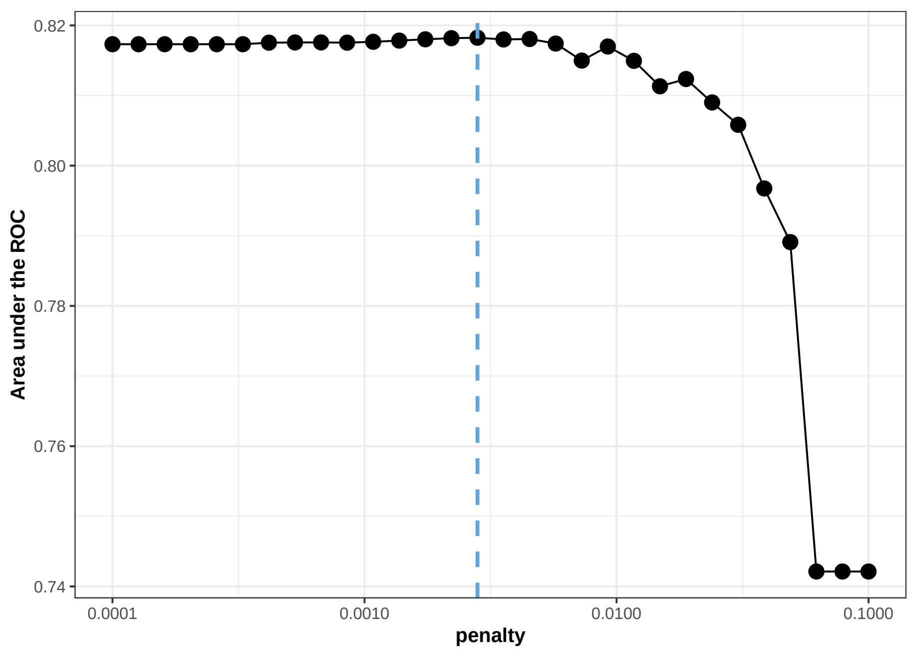

Figure 14: Area under the ROC (Receiver Operator Curve) for 30 penalized logistic regression models fit to our validation test set. The highest area under the ROC is highlighted with a blue dashed line.

There are two main variables that explain why there are so many unidentifiable specimens at the Haynie Site (Figure 17). The most important variable is whether or not a specimen has at least one intact end. This variable detracts from unidentifiability. In other words, the more intact a specimen is the more identifiable it is. This result indicates that the analysts and the identification

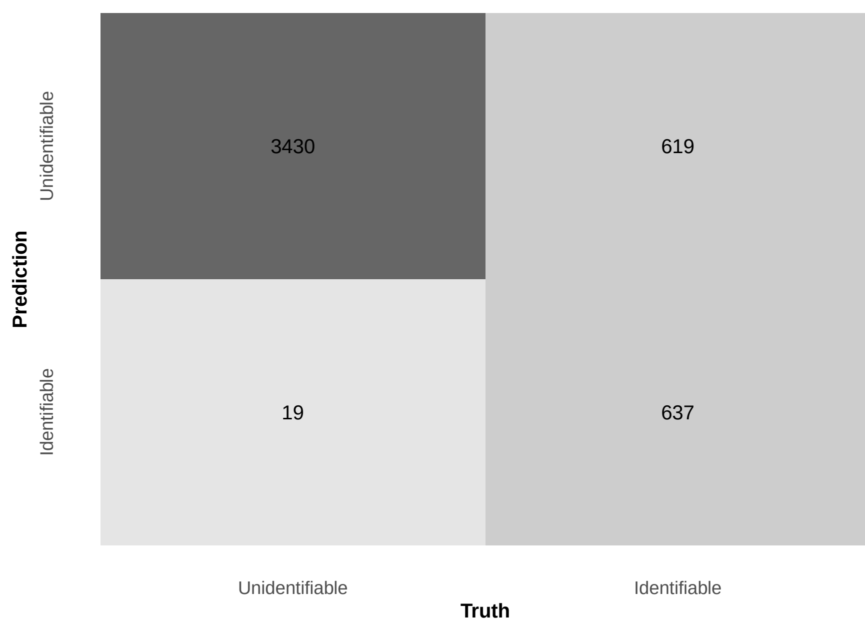

Figure 15: Confusion matrix for the trained logistic regression model. This model accurately predicts unidentifiable specimens, but it performs poorly with identifiable specimens. This model was retained because we are most interested in what is driving the high number of unidentifiable specimens.

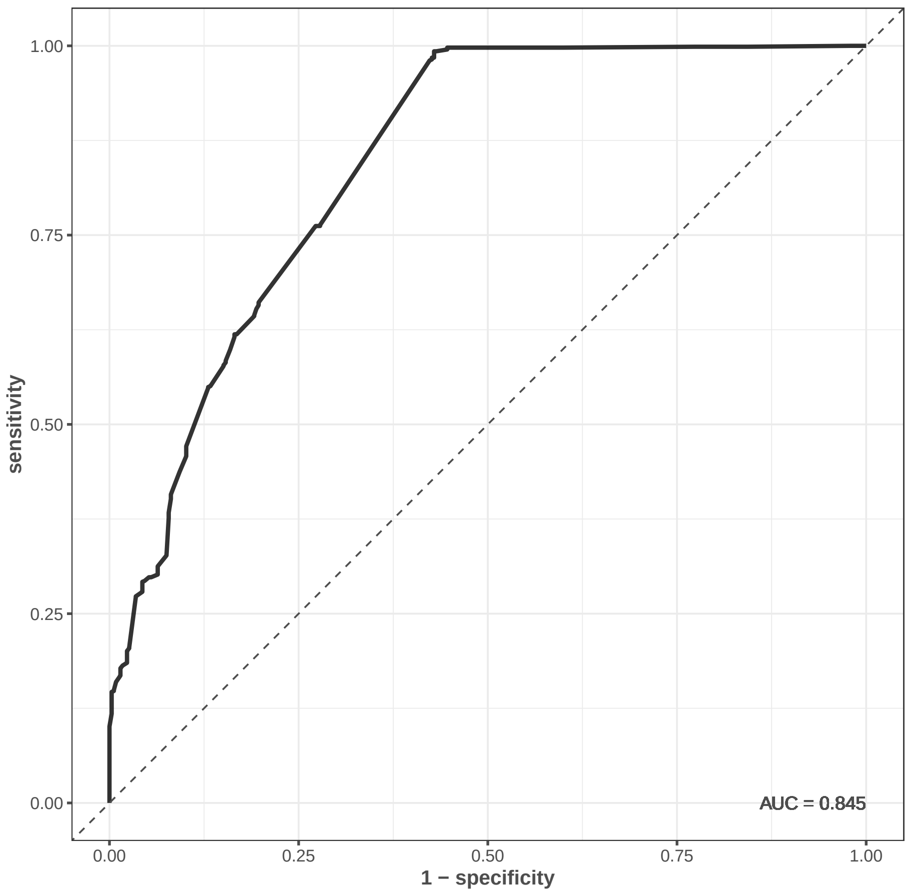

Figure 16: Binary Reciever Operator Curve (ROC) plotting the mandible model's false positive rate (1 - specificity) by true positive rate (sensitivity). Area Under Curve (AUC) of 1 describes a model with perfect accuracy. This model predicts unidentifiable specimens well. The dashed line represents random performance at all classification thresholds.

protocol have a heavy influence on this data, but they do so in a way that enhances data quality. An assemblage with high identifiability on specimens lacking morphologically distinct features (i.e., intact ends) would be a red flag. The most important variable contributing to unidentifiability—the main variable of interest for the purposes here—is whether or not the specimen has thick cortical bone. This results suggests that specimens lacking intact portions but possessing thick cortical bone are overwhelmingly unidentifiable. Thus, the main taphonomic agents responsible for low identifiability are likely the inhabitants of the Haynie Site.

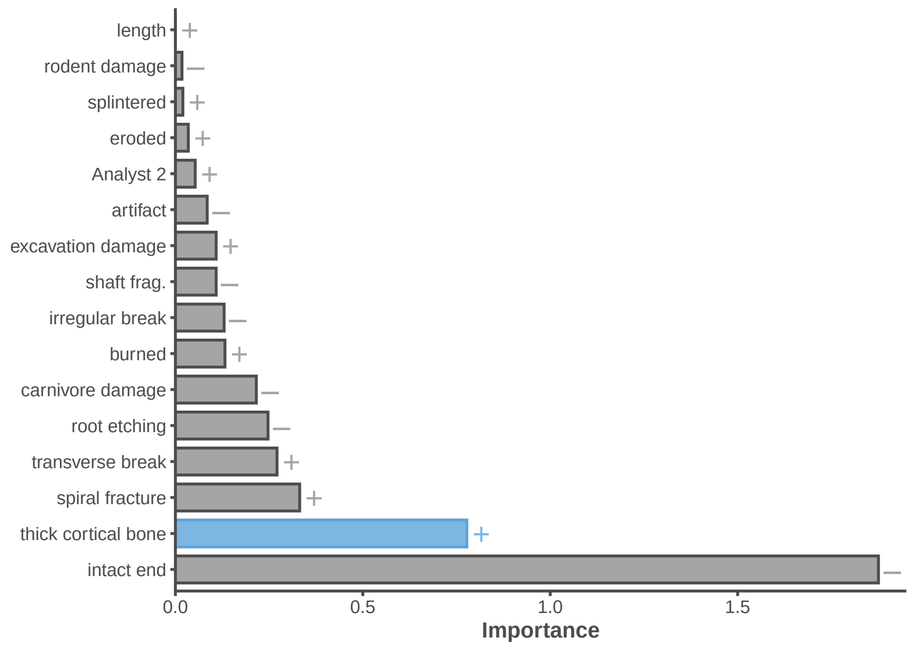

Figure 17: Variable importance plot for the unidentifiability model developed here (Greenwell and Boehmke 2020). The sign of the coefficient is plotted next to each bar, which indicates whether the variable adds or detracts from unidentifiability (the event of interest). The blue bar highlights the main variable that adds to unidentifiability at the Haynie Site.

Medium-to-large mammal fragmentation is a key taphonomic feature of this assemblage, and will be vital to incorporate into future zooarchaeological work. Evaluating the extent and intensity of fragmentation per skeletal element of medium and large mammals is of particular interest (*sensu* Wolverton 2002). The presence of many unidentifiable specimens with thick cortical bone could be related to many medium and large mammals at the site. In this scenario, these specimens could indicate efficient foraging practices, where Haynie hunters were able to consistently acquire high-ranked prey. Another possible interpretation is that foraging efficiency was low and that large prey were intensively and extensively exploited for nutrients. The calculation of fragmentation rates per skeletal part and across the skeleton of individual artiodactyls will help resolve this issue. For either of these scenarios to be true, the current somewhat moderate Artiodactyl Index (0.34) would have to be a sampling anomaly. Another critical factor to add to future models is whether specimens come from intact or disturbed deposits, as the Haynie Site does include clear looter's pits and areas of mechanical disturbance (Throgmorton et al. 2022).

5 Taxonomic Diversity and Representative Sampling

The Lakeview Community is located in a shallow, wide valley that is part of the Simon Draw watershed. Simon Draw itself flowed close to the site (Throgmorton et al. 2022). As such, the Lakeview Community was likely located close to marshy habitat in the past. A natural corridor like this could have facilitated the movement of both birds and large game, supplying highly diverse wild resources to the Haynie Site residents. Here, we test this hypothesis by modeling identification accumulation rates and evenness. We compare these estimations to three other sites in the northern U.S. Southwest and control for sample size effects using rarefaction. This analysis serves multiple purposes at once. Not only can we accurately gauge and compare taxonomic diversity across sites, we may also assess whether sampling efforts have been sufficient enough to provide accurate taxonomic representation.

This analysis relies on a non-standard quantitative unit to estimate taxonomic richness called the Number of Unique Identifications (NUIDs). It is a tally of the different identification types present in a specific context, meaning it can include standard taxonomic identifications (e.g., *Odocoileus* sp.) and non-standard identifications (e.g., medium artiodactyl). This unit serves as a proxy for taxonomic richness to help gauge patterns in sampling and recovery. We prefer this unit over the common Number of Taxa (NTAXA) for three reasons: 1) it is simpler to calculate when dealing with large mixed assemblages identified to a variety of taxonomic levels, 2) it does not require the selection of an arbitrary taxonomic group from which to aggregate all lower units within, and 3) it is strongly correlated with NTAXA when calculated at multiple levels of taxonomic resolution (Figure 18).

We compared how the number of new identifications accumulate as NISP increases at Haynie to three other archaeofaunal assemblages: Sand Canyon Pueblo (5MT765), and Ponsipa'akeri (LA 297), Shields Pueblo (Figure 19). The Haynie Site is not particularly diverse compared to other assemblages in the northern U.S. Southwest. Taxonomic richness at Haynie is similar to terminal Pueblo III sites in the same region (Sand Canyon) or even Pueblo IV sites from the Northern Rio Grande (Ponsipa'akeri). Shields Pueblo, a nearby contempo-

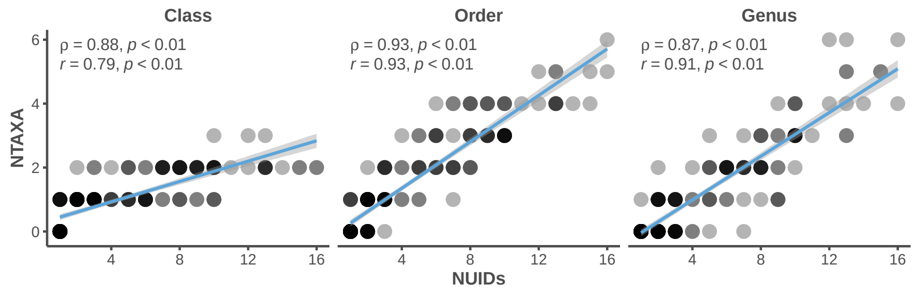

Figure 18: Relationship between Number of Unique Identifications (NUIDs) and Number of Taxa (NTAXA) for each Provenience Designation (PD) number at the Haynie Site. NTAXA was calculated at the class, order, and genus levels considering these were the most common taxonomic identification levels used. Spearman's *rho* (ρ) and Pearson's r indicate a significantly strong relationship between NUIDs and NTAXA at each taxonomic level.

rary Great House site, has lower than expected diversity. The distribution of Haynie taxonomic abundance is unlike Great House sites in the same region, but it is like later sites (Figure 20). Perhaps control of wild resources and foodways is leading to lower-than-expected diversity measures in such a potentially diverse environmental setting. Additionally, the duration of site occupation could impact accumulation rates (*sensu* Varien and Potter 1997; Varien and Mills 1997; Varien and Ortman 2005). Controlling for site occupation and increasing sample size will clarify these patterns.

Increasing sample size is crucial, because our sampling effort is not yet sufficient enough to provide accurate taxonomic representation. The Average Rate of Change (ARC) is high at each site when the sample is beyond an NISP of 1,000, but it is highest at Haynie. A new identification is added every 111 to 125 identified specimens at the other sites, and a new identification type is added for every 83 specimens at Haynie. We consider 83 identified specimens low sampling effort for every new identification type gained. Any final word on Haynie taxonomic diversity must wait until the accumulation of new identifications levels-off as sampling intensity increases.

6 Conclusion

We have demonstrated that data produced during the first year of archaeofaunal analysis at the Haynie Site is high quality, and it points to three specific areas of future research. First, artiodactyl exploitation could be a significant component of the Haynie archaeofaunal assemblage. The ratio of mule deer to pronghorn suggests that local hunting practices dominated, which is interesting to think about when contemplating how bison were procured at the site. The

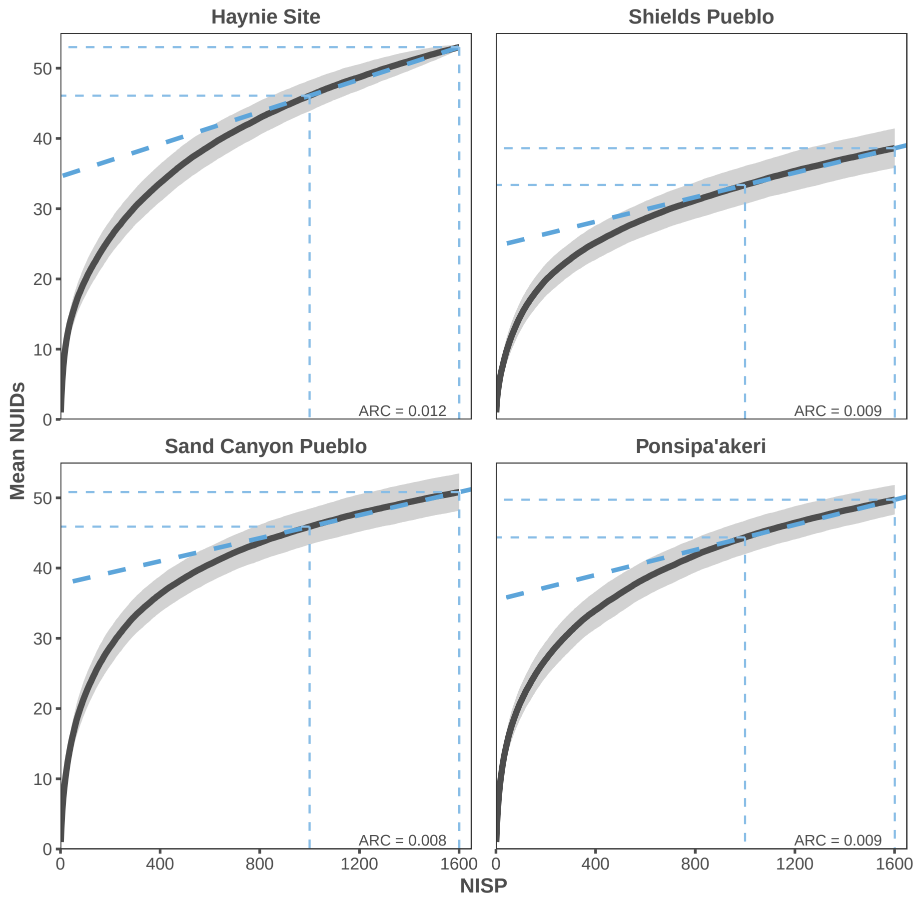

Figure 19: Rarefied species accumulation curves. We randomly selected 1601 identified specimens from each archaeofaunal assemblage and replicated this 1,000 times, then calculated the mean Number of Unique Identifications (NUIDs) as specimens accumulate, along with standard deviation (the gray ribbon). We calculated the Average Rate of Change (ARC) for each curve from 1,000 to 1,601 NISP, which serves to inidicate whether sampling efforts have been sufficient at this point in the analysis. ARC is represented by the slope of the thick, blue dashed line.

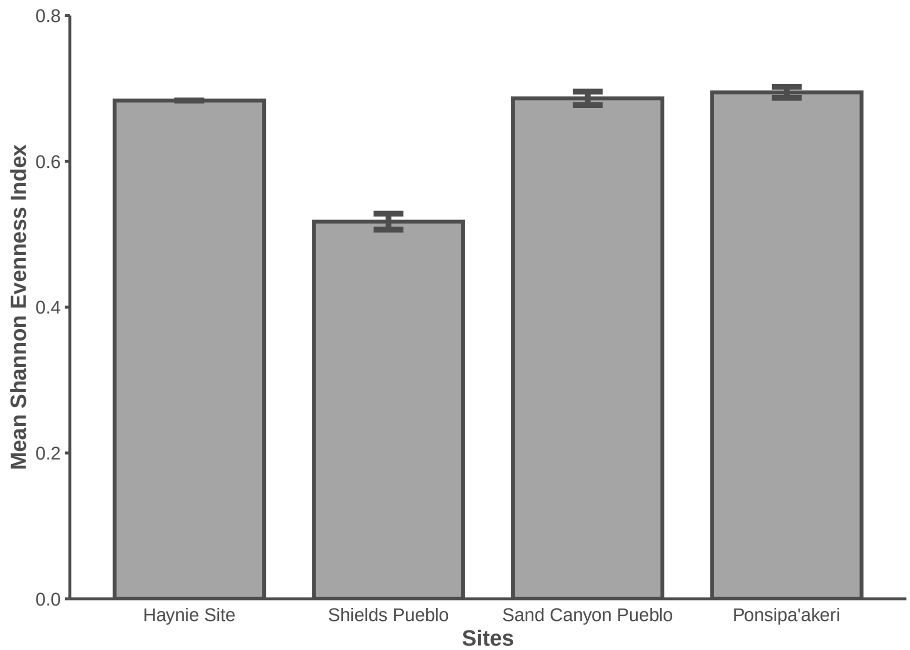

Figure 20: Rarefied Shannon Evenness Index values. We randomly selected 1601 identifiable specimens from each archaeofaunal assemblage and replicated this 1,000 times. Per each replicate, we calculated the Shannon-Weiner heterogeneity index (H) and converted it to an evenness measure (H / ln[NUIDs]). Mean values per site are displayed along with plus and minus one standard deviation.

local or non-local procurement of bison will be important for understanding the economic structure of the Lakeview Community, while also helping to reconstruct the historical ecology of bison on the Colorado Plateau. The taphonomic analysis also suggested that artiodactyl processing is a prime reason there are so many unidentifiable bones, but predictors related to disturbance context need to be added to the taphonomic model. Second, the presence of an intact wolf mandible—from an advanced age class—points to a number of future questions about resource procurement and the nature of human-carnivore interactions: was the mandible intentionally placed, was the individual cared for in anyway, and was the wolf local to the site? Finally, the analysis of taxonomic diversity showed that the Haynie archaeofaunal assemblage is not significantly diverse compared to other sites, but that more data is needed to acquire a representative picture of taxonomic composition. Zooarchaeological material is poised to answer a number of questions relevant to the Northern Chaco Outliers Project and to the archaeology of human-environment interaction in the U.S. Southwest and beyond.

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8 References

Adams, Bradley J., and Pam J. Crabtree. 2012. *Comparative Osteology a Laboratory and Field Guide of Common North American Animals*. Boston, MA: Elsevier/Academic Press.

Andrews, Peter, and Jill Cook. 1990. *Owls, Caves and Fossils: Predation, Preservation and Accumulation of Small Mammal Bones in Caves, with an Analysis of the Pleistocene Cave Faunas from Westbury-Sub-Mendip, Somerset, UK*. Chicago, IL: University of Chicago Press.

Badenhorst, Shaw, and Jonathan C. Driver. 2009. "Faunal Changes in Farming Communities from Basketmaker II to Pueblo III (A.D. 1-1300) in the San Juan Basin of the American Southwest." *Journal of Archaeological Science* 36 (9): 1832–41. https://doi.org/10.1016/j.jas.2009.04.006.

———. 2015. "Faunal Remains." In *The Archaeology of Albert Porter Pueblo (Site 5MT123): Excavations at a Great House Community Center in Southwestern Colorado*, edited by Susan C. Ryan, 448–75. Cortez, CO: Crow Canyon Archaeological Center.

Badenhorst, Shaw, Jonathan C. Driver, and Susan C. Ryan. 2019. "Desirable Meat: The Social Context of Meat Procurement at Albert Porter Pueblo, a Great House Community in the Central Mesa Verde Region." *KIVA* 85 (3): 191–213. https://doi.org/10.1080/00231940.2019.1579442.

Badenhorst, Shaw, Jonathan C. Driver, and Steve Wolverton. In press. "The Consumption of Small Rodents in the Ancestral Puebloan World of the American Southwest." In *Crow Canyon Archaeological Center 40th Anniversary Volume*, edited by Susan C. Ryan. Salt Lake City: The University of Utah Press.

Baker, Brenda J., Dupras Tosha L., and Matthew W. Tocheri. 2005. *The Osteology of Infants and Children*. Vol. 12. College Station, TX: Texas A&M University Press.

Baker, Bruce W., and Edward P. Hill. 2003. "Beaver (*Castor Canadensis*)." In *Wild Mammals of North America: Biology, Management, and Conservation*, edited by George A. Feldhamer, Bruce C. Thompson, and Joseph A. Chapman, 2nd ed., 288–310. Baltimore, MD: The Johns Hopkins University Press.

Beacham, E. Bradley, and Stephen R. Durand. 2007. "Eggshell and the Archaeological Record: New Insights into Turkey Husbandry in the American Southwest." *Journal of Archaeological Science* 34 (10): 1610–21. https://doi.org/10.1016/j.jas.2006.11.015.

Beaglehole, Ernest. 1936. *Hopi Hunting and Ritual*. Yale University Publications in Anthropology 4. New Haven, CT: Yale University Press.

Binford, Lewis R. 1978. *Nunamiut Ethnoarchaeology*. New York: Academic Press.

Bocinsky, R. Kyle, Jason A. Cowan, Timothy A. Kohler, and C. David Johnson. 2012. "How Hunting Changes the VEP World, and How the VEP World Changes Hunting." In *Emergence and Collapse of Early Villages: Models of Central Mesa Verde Archaeology*, edited by Timothy A. Kohler and Mark Varien, 145–52. Berkeley: University of California Press.

Broughton, Jack M., Michael D. Cannon, Frank E. Bayham, and David A. Byers. 2011. "Prey Body Size and Ranking in Zooarchaeology: Theory, Empirical Evidence, and Applications from the Northern Great Basin." *American Antiquity* 76 (3): 403–28. https://doi.org/10.7183/0002-7316.76.3.403.

Broughton, Jack M., and Shawn D. Miller. 2016. *Zooarchaeology and Field Ecology: A Photographic Atlas*. Salt Lake City: The University of Utah Press.

Brown, Donald Nelson. 1967. "The Distribution of Sound Instruments in the Prehistoric Southwestern United States." *Ethnomusicology* 11 (1): 71–90. https://doi.org/10.2307/850499.

Burger, Rachel. 2021. "Food Security in Ancestral Tewa Coalescent Communities: The Zooarchaeology of Sapa'owingeh in the Northern Rio Grande, New Mexico." Doctoral Dissertation, Dallas, TX: Department of Anthropology, Southern Methodist University. https://scholar.smu.edu/hum_sci_anthropology_etds/13/.

Cannon, Michael D. 2013. "NISP, Bone Fragmentation, and the Measurement of Taxonomic Abundance." *Journal of Archaeological Method and Theory* 20 (3): 397–419. https://doi.org/10.1007/s10816-012-9166-z.

Cates, Kari M. (Schmidt). 2020. "Faunal Remains from Greenstone Pueblo (5MT6970)." Manuscript on file Crow Canyon Archaeological Center, Cortez, CO.

Chavez, Angela Marie. 2008. "Comparative Vertebral Morphology in Medium-Sized North American Artiodactyla." *The Artifact* 46: 1–17.

Cloutier, Richard, and Peter L. Forey. 1991. "Diversity of Extinct and Living Actinistian Fishes (Sarcopterygii)." In *The Biology of Latimeria Chalumnae and Evolution of Coelacanths*, edited by John A. Musick, Michael N. Bruton, and Eugene K. Balon, 59–74. Springer.

Cohen, Alan, and D. Serjeantson. 1996. *A Manual for the Identification of Bird Bones from Archaeological Sites.* London: Archetype Publications.

Conrad, Cyler, Emily Lena Jones, Seth D. Newsome, and Douglas W. Schwartz. 2016. "One Isotopes, Eggshell and Turkey Husbandry at Arroyo Hondo Pueblo." *Journal of Archaeological Science: Reports* 10: 566–74. https://doi.org/10.1016/j.jasrep.2016.06.016.

Dombrosky, Jonathan, Thomas F. Turner, Alexandra Harris, and Emily Lena Jones. 2022. "Body Size from Unconventional Specimens: A 3d Geometric Morphometrics Approach to Fishes from Ancestral Pueblo Contexts." *Journal of Archaeological Science* 142: 105600. https://doi.org/10.1016/j.jas.2022.105600.

Driver, Jonathan C. 1992. "Identification, Classification and Zooarchaeology." *Circaea* 9 (1): 35–47.

———. 2002. "Faunal Variation and Change in the Northern San Juan Region." In *Seeking the Center Place: Archaeology and Ancient Communities in the Mesa Verde Region*, edited by Mark D. Varien and Richard H. Wilshusen, 143–60. Salt Lake City: The Univeristy of Utah Press.

———. 2006. *Crow Canyon Archaeological Center Manual for Description of Vertebrate Remains.* 8th ed. Cortez, CO: Crow Canyon Archaeological Center.

———. 2011. "Human Impacts on Animal Populations in the American Southwest." In *Movement, Connectivity and Landscape Change in the Ancient Southwest*, edited by Margaret C. Nelson and Colleen Strawhacker, 179–98. Boulder: University Press of Colorado.

———. 2011. "Identification, Classification and Zooarchaeology (Featured Reprint and Invited Comments)." *Ethnobiology Letters* 2: 19–39. https://doi.org/10.14237/ebl.2.2011.32.

Driver, Jonathan C., Michael J. Brand, Lianne Lester, and Natalie D. Munro. 1999. "Faunal Studies." In *The Sand Canyon Archaeological Project: Site Testing*, edited by Mark D. Varien. Cortez, CO: Crow Canyon Archaeological Center. https://www.crowcanyon.org/ResearchReports/SiteTesting/Text/Report.asp.

Driver, Jonathan C., and Joshua R. Woiderski. 2008. "Interpretation of the "Lagomorph Index" in the American Southwest." *Quaternary International* 185: 3–11. https://doi.org/10.1016/j.quaint.2007.09.022.

Elbroch, Mark. 2006. *Animal Skulls: A Guide to North American Species*. Mechanicsburg, PA: Stackpole Books.

Ellyson, Laura. 2014. "Resource Intensification of Small Game Use at Goodman Point, Southwestern Colorado." Master's Thesis, Denton: Department of Geography, University of North Texas. https://digital.library.unt.edu/ark:/67531/metadc699883/.

Fernández-Jalvo, Yolanda, and Peter Andrews. 2016. *Atlas of Taphonomic Identifications: 1001+ Images of Fossil and Recent Mammal Bone Modification*. Springer.

France, Diane L. 2009. *Human and Nonhuman Bone Identification: A Color Atlas*. Boca Raton, FL: CRC Press.

Frisbie, Theodore R. 1967. "The Excavation and Interpretation of the Artificial Leg Basket Maker III-Pueblo I Sites near Corrales, New Mexico." Master's Thesis, Albuquerque: Department of Anthropology, University of New Mexico.

Gilbert, B. Miles. 1980. *Mammalian Osteology*. Laramie, WY: B. M. Gilbert.

Gilbert, B. Miles, Larry D. Martin, and Howard G. Savage. 1981. *Avian Osteology*. Laramie, WY: B. M. Gilbert.

Gipson, Philip S., Warren B. Ballard, Ronald M. Nowak, and L. David Mech. 2000. "Accuracy and Precision of Estimating Age of Gray Wolves by Tooth Wear." *The Journal of Wildlife Management* 64 (3): 752–58. https://doi.org/10.2307/3802745.

Gobalet, Kenneth W. 2001. "A Critique of Faunal Analysis: Inconsistency Among Experts in Blind Tests." *Journal of Archaeological Science* 28 (4): 377–86. https://doi.org/10.1006/jasc.2000.0564.

Grayson, Donald K. 1978. "Minimum Numbers and Sample Size in Vertebrate Faunal Analysis." *American Antiquity* 43 (1): 53–65. https://doi.org/10.2307/279631.

———. 1981. "The Effects of Sample Size on Some Derived Measures in Vertebrate Faunal Analysis." *Journal of Archaeological Science* 8 (1): 77–88. https://doi.org/10.1016/0305-4403(81)90013-3.

———. 1984. *Quantitative Zooarchaeology: Topics in the Analysis of Archaeological Faunas*. Orlando, FL: Academic Press. https://www.sciencedirect.com/book/9780122972805/quantitative-zooarchaeology.

Greenwell, Brandon M., and Bradley C. Boehmke. 2020. "Variable Importance Plots—An Introduction to the vip Package." *The R Journal* 12 (1): 343–66. https://doi.org/10.32614/RJ-2020-013.

Guiry, Eric, Trevor J. Orchard, Suzanne Needs-Howarth, and Paul Szpak. 2021. "Isotopic Evidence for Garden Hunting and Resource Depression in the Late Woodland of Northeastern North America." *American Antiquity* 86 (1): 90–110. https://doi.org/10.1017/aaq.2020.86.

Hargrave, Lyndon L., and Steven D. Emslie. 1979. "Osteological Identification of Sandhill Crane Versus Turkey." *American Antiquity* 44 (2): 295–99. https://doi.org/10.2307/279079.

Hastie, Trevor, Robert Tibshirani, and Jerome H. Friedman. 2009. *The Elements of Statistical Learning: Data Mining, Inference, and Prediction*. Springer.

Hayes, Alden C., and James A. Lancaster. 1975. *Badger House Community, Mesa Verde National Park*. Wetherill Mesa Studies, Publication in Archeology 7E. Washington D.C.: U.S. Department of the Interior, National Park Service.

Hill, Erica. 2000. "The Contextual Analysis of Animal Interments and Ritual Practice in Southwestern North America." *KIVA* 65 (4): 361–98. https://doi.org/10.1080/00231940.2000.11758417.

Hillson, Simon. 1986. *Teeth*. New York: Cambridge University Press.

———. 1996. *Mammal Bones and Teeth: An Introductory Guide to Methods of Identification*. London: Institute of Archaeology, University College London.

Jacobson, Jodi A. 2003. "Identification of Mule Deer (*Odocoileus Hemionus*) and White-Tailed Deer (*Odocoileus Virginianus*) Postcranial Remains as a Means of Determining Human Subsistence Strategies." *Plains Anthropologist* 48 (187): 287–97. https://doi.org/10.1080/2052546.2003.11949269.

James, Gareth, Daniela Witten, Trevor Hastie, and Robert Tibshirani. 2013. *An Introduction to Statistical Learning: With Applications in R*. Springer.

Kachigan, Sam Kash. 1991. *Multivariate Statistical Analysis: A Conceptual Introduction*. 2nd ed. New York: Radius Press.

Kuhn, Max, and Kjell Johnson. 2013. *Applied Predictive Modeling*. Springer.

Kuhn, Max, and Julia Silge. 2022. *Tidy Modeling with R*. Sebastopol, CA: O'Reilly Media, Inc. https://www.tmwr.org/.

Ladd, Edmund J. 1963. "Zuni Ethno-Ornithology." Master's Thesis, Albuquerque: Department of Anthropology, University of New Mexico.

Lang, Richard W., and Arthur H Harris. 1984. *The Faunal Remains from Arroyo Hondo Pueblo, New Mexico: A Study in Short-Term Subsistence Change*. Arroyo Hondo Archaeological Series. Santa Fe, NM: School of American Research Press.

Lapham, Heather A., Gary M. Feinman, and Linda M. Nicholas. 2016. "Turkey Husbandry and Use in Oaxaca, Mexico: A Contextual Study of Turkey Remains and SEM Analysis of Eggshell from the Mitla Fortress." *Journal of Archaeological Science: Reports* 10: 534–46. https://doi.org/10.1016/j.jasrep.2016.05.058.

LaZar, Miranda, and Jonathan Dombrosky. 2022. "Exploring Raptor Exchange." *Archaeology Southwest Magazine* 35 (1 & 2): 29–31. https://www.archaeologysouthwest.org/product/asw35-1-2/.

Lyman, R. Lee. 1994. *Vertebrate Taphonomy*. Cambridge: Cambridge University Press.

———. 2002. "Taxonomic Identification of Zooarchaeological Remains." *The Review of Archaeology* 23 (2): 13–20.

———. 2008. *Quantitative Paleozoology*. Cambridge: Cambridge University Press.

———. 2019. "Assumptions and Protocol of the Taxonomic Identification of Faunal Remains in Zooarchaeology: A North American Perspective." *Journal of Archaeological Method and Theory* 26 (4): 1376–1438. https://doi.org/10.1007/s10816-019-09414-0.

Martin, Jeff M., Rachel A. Martin, and Jim I. Mead. 2017. "Late Pleistocene and Holocene *Bison* of the Colorado Plateau." *The Southwestern Naturalist* 62 (1): 14–28. https://doi.org/10.1894/0038-4909-62.1.14.

Minckley, Wendell L., and Paul C. Marsh. 2009. *Inland Fishes of the Greater Southwest: Chronicle of a Vanishing Biota*. Tucson: The University of Arizona Press.

Monagle, Victoria, and Emily Lena Jones. 2020. "Dog Life and Death in an Ancestral Pueblo Landscape." In *Dogs: Archaeology beyond Domestication*, edited by Brandi Bethke and Amanda Burtt, 45–71. Gainesville: University Press of Florida.

Muir, Robert J., and Jonathan C. Driver. 2002. "Scale of Analysis and Zooarchaeological Interpretation: Pueblo III Faunal Variation in the Northern San Juan Region." *Journal of Anthropological Archaeology* 21 (2): 165–99. https://doi.org/10.1006/jaar.2001.0392.

———. 2004. "Identifying Ritual Use of Animals in the Northern American Southwest." In *Behaviour Behind Bones: The Zooarchaeology of Ritual, Religion, Status, and Identity*, edited by Sharyn Jones O'Day, Wim Van Neer, and Anton Ervynck, 128–43. Oxford: Oxbow Books.

Nelson, Joseph S. 2006. *Fishes of the World*. Hoboken, NJ: John Wiley.

Olsen, Sandra L. 1979. "A Study of Bone Artifacts from Grasshopper Pueblo, AZ P:14:1." *KIVA* 44 (4): 341–73. https://doi.org/10.1080/00231940.1979.11757924.

———. 1980. "Bone Artifacts from Kinishba Ruin: Their Manufacture and Use." *KIVA* 46 (1-2): 39–67. https://doi.org/10.1080/00231940.1980.11757947.

Olsen, Stanley John. 1964. *Mammal Remains from Archaeological Sites*. Cambridge, MA: Peabody Museum.

Payne, Richard W. 1991. "Bone Flutes of the Anasazi." *KIVA* 56 (2): 165–77. https://doi.org/10.2307/30247265.

Potter, James M. 2000. "Pots, Parties, and Politics: Communal Feasting in the American Southwest." *American Antiquity* 65 (3): 471–92. https://doi.org/10.2307/2694531.

———. 2004. "Hunting and Social Differentiation in the Late Prehispanic American Southwest." In *Behaviour Behind Bones: Zooarchaeology of Ritual, Religion, Status and Identity*, edited by Sharyn Jones O'Day, Wim Van Neer, and Anton Ervynck, 285–92. Oxford: Oxbow Books.

Potter, James M., and Scott G. Ortman. 2004. "Community and Cuisine in the Prehispanic American Southwest." In *Identity, Feasting, and the Archaeology of the Greater Southwest*, edited by Barbara J. Mills, 173–91. Boulder: University Press of Colorado.

R Core Team. 2022. *R: A Language and Environment for Statistical Computing*. 4.2.0 ed. Vienna, Austria: R Foundation for Statistical Computing. https://www.r-project.org/.

Rawlings, Tiffany A. 2006. "Faunal Analysis and Meat Procurement: Reconstructing the Sexual Division of Labor at Shields Pueblo, Colorado." Doctoral Dissertation, Burnaby, BC: Department of Archaeology, Simon Fraser University. https://summit.sfu.ca/item/2374.

Rawlings, Tiffany A., and Jonathan C. Driver. 2015. "Faunal Remains from Shields Pueblo." In *The Archaeology of Shields Pueblo (Site 5MT3807): Excavations at a Mesa-Top Community Center in Southwestern Colorado*, edited by Susan C. Ryan, 186–221. Cortez, CO: Crow Canyon Archaeological Center.

Roze, Uldis, and Linda M. Ilse. 2003. "Porcupine (*Erethizon Dorsatum*)." In *Wild Mammals of North America: Biology, Management, and Conservation*, edited by George A. Feldhamer, Bruce C. Thompson, and Joseph A. Chapman, 2nd ed., 371–80. Baltimore, MD: The Johns Hopkins University Press.

Ryan, Susan C. 2016. "The Northern Chaco Outliers Project: A Proposal to Conduct Archaeological Testing at the Haynie Site, Southwestern Colorado." Manuscript on file Crow Canyon Archaeological Center, Cortez, CO. Submitted to Colorado State Historic Preservation Office, Denver, CO.

Smart, Tamela S. 2009. "Carpals and Tarsals of Mule Deer, Black Bear and Human: An Osteology Guide for the Archaeologist." Master's Thesis, Pullman: Department of Anthropology, Western Washington University. https://cedar.wwu.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1018&context=wwuet.

Spielmann, Katherine A., and Eric A. Angstadt-Leto. 1996. "Hunting, Gathering, and Health in the Prehistoric Southwest." In *Evolving Complexity and Environmental Risk in the Prehistoric Southwest*, edited by Joseph A. Tainter, and Bonnie B. Tainter, 79–106. Reading, MA: CRC Press.

Strand, Jennifer G. 1998. "An Analysis of the Homol'ovi Fauna with Emphasis of Ritual Behavior." Doctoral Dissertation, Tucson: Department of Anthropology, University of Arizona. https://repository.arizona.edu/handle/10150/288835.

Sublette, James E., Michael D. Hatch, and Mary F. Sublette. 1990. *The Fishes of New Mexico*. Albuquerque: University of New Mexico Press.

Throgmorton, Kellam, Susan C. Ryan, Benjamin Bellorado, Jeremy Grundvig, Steve Copeland, and Timothy Wilcox. 2022. "Excavation and Additional Studies at The Haynie Site (5MT1905) by the Crow Canyon Archaeological Center." Annual Report 2021. Cortez, CO: Crow Canyon Archaeological Center. https://www.crowcanyon.org/wp-content/uploads/2022/02/ncop-annual-report-2021-final-1.pdf.

Twiss, Katheryn. 2007. *The Archaeology of Food and Identity*. Center for Archaeological Investigations, Occasional Paper 34. Carbondale: Southern Illinois University.

Tyler, Hamilton A. 1991. *Pueblo Birds and Myths*. Flagstaff, AZ: Northland Publishing Company.

Varien, Mark D., and Barbara J. Mills. 1997. "Accumulations Research: Problems and Prospects for Estimating Site Occupation Span." *Journal of Archaeological Method and Theory* 4 (2): 141–91. https://doi.org/10.1007/BF02428057.

Varien, Mark D., and Scott G. Ortman. 2005. "Accumulations Research in the Southwest United States: Middle-Range Theory for Big-Picture Problems." *World Archaeology* 37 (1): 132–55. https://doi.org/10.1080/0043824042000329603.

Varien, Mark D., and James M. Potter. 1997. "Unpacking the Discard Equation: Simulating the Accumulation of Artifacts in the Archaeological Record." *American Antiquity* 62 (2): 194–213. https://doi.org/10.2307/282506.

von den Driesch, Angela. 1976. *A Guide to the Measurement of Animal Bones from Archaeological Sites*. Peabody Museum Press Bulletin 1. Cambridge, MA: Harvard University.

Watson, Adam S., and Matthew A. Gleason. 2016. "A Comparative Assessment of Texture Analysis Techniques Applied to Bone Tool Use-Wear." *Surface Topography: Metrology and Properties* 4 (2): 024002. https://doi.org/10.1088/2051-672x/4/2/024002.

Wayne, Robert K., Eli Geffen, Derek J. Girman, Klaus P. Koepfli, Lisa M. Lau, and Charles R. Marshall. 1997. "Molecular Systematics of the Canidae." *Systematic Biology* 46 (4): 622–53. https://doi.org/10.1093/sysbio/46.4.622.

Welker, Martin H., David A. Byers, and Sarah B. McClure. 2021. "'I Wanna Be Your Dog': Evaluating the Efficacy of Univariate and Multivariate Methods for Differentiating Domestic and Wild Canids in North America." *International Journal of Osteoarchaeology* 31 (2): 196–206. https://doi.org/10.1002/oa.2939.

White, Tim D., Michael T. Black, and Pieter A. Folkens. 2012. *Human Osteology*. 3rd ed. Cambridge, MA: Academic Press.

Wickham, Hadley. 2010. "A Layered Grammar of Graphics." *Journal of Computational and Graphical Statistics* 19 (1): 3–28. https://doi.org/10.1198/jcgs.2009.07098.

Wickham, Hadley, Mara Averick, Jennifer Bryan, Winston Chang, Lucy D'Agostino McGowan, Romain François, Garrett Grolemund, Alex Hayes, Lionel Henry, and Jim Hester. 2019. "Welcome to the Tidyverse." *Journal of Open Source Software* 4 (43): 1686. https://doi.org/10.21105/joss.01686.

Wolverton, Steve. 2002. "NISP:MNE and %Whole in Analysis of Prehistoric Carcass Exploitation." *North American Archaeologist* 23 (2): 85–100. https://doi.org/10.2190/egdq-cq1q-lld2-h3tp.

———. 2013. "Data Quality in Zooarchaeological Faunal Identification." *Journal of Archaeological Method and Theory* 20 (3): 381–96. https://doi.org/10.1007/s10816-012-9161-4.

Wolverton, Steve, and Lisa Nagaoka. 2018. “Zooarcheology: Investigating Past Interactions Between Humans and Other Animals.” In *Ethnozoology*, edited by Rômulo Romeu Nóbrega Alves and Ulysses Paulino Albuquerque, 25–43. Cambridge, MA: Academic Press.