Excavation and Additional Studies at the Haynie Site (5MT1905) by Crow Canyon Archaeological Center Annual Progress Report 2023

R. David Satterwhite, Susan C. Ryan, Kellam Throgmorton, Steve Copeland, Jamie Merewether, Kate Hughes, and Reuven Sinensky

With Contributions by:
Grant Coffey
Steve Uzzo
Benjamin Bellorado
Susan J. Smith
Jonathan Dombrowski
Ahna Feldstein

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Introduction

In 2016, the Crow Canyon Archaeological Center (Crow Canyon, or CCAC) 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 2023 as well as preliminary results of laboratory analyses.

The Northern Chaco Outliers Project

The Chaco cultural phenomenon was centered in Chaco Canyon, New Mexico and reached its greatest regional influence between A.D. 840 and 1140 (Judge 1979; Judge and Cordell 2006; Lekson 2006, 2015; Plog and Heitman 2010; Reed 2004; Saitta 1997; Sebastian 1992; Van Dyke 2007; Vivian 1990; Ware 2014). Archaeologically, Chaco culture was characterized by the construction of monumental masonry great houses with a preplanned layout, civic architecture such as great kivas and road segments, earthworks, nonlocal exchange networks, social inequality, a suite of ritual practices, and a recognizable stylistic architectural and ceramic style. 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). Archaeologists debate the level of social, cultural, or political control and influence 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 focus of the NCOP is 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. Multi-great house communities are a poorly understood facet of the Chaco and post-Chaco periods in the northern San Juan region. Regionally, 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 the Lakeview Group. The Haynie site contains the remains of two great house structures within the 5-acre property owned by The Archaeological Conservancy. The Wallace Ruin great house (5MT6970) is located 335 m south of Haynie (Bradley 1988, 1992, 1993; Bradley and Bradley 2019, 2020). 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. Additionally, other great houses are within relatively close proximity (e.g., Jensen great house site).

There is little research examining the relationships between monumental structures within multi-great house communities, and it is not clear how these clusters functioned within the adjacent community. Furthermore, the role of the northern multi-great house communities within the Chaco regional system is uncertain. To address these issues, Crow Canyon archaeologists, in consultation with Crow Canyon’s Pueblo Advisory Group, 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 or equality 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 Chaco period (ca. A.D. 1080-1140) and did they change during the post-Chaco period (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 utilize environmental and material culture data to address these research questions. This research will contribute to regional archaeological issues—such as the degree of political centralization present within Chaco society—and a suite of broader anthropological questions concerning culture and environment.

To answer these research questions, the NCOP is conducting both fieldwork and laboratory analysis. Crow Canyon's archaeological fieldwork in the Lakeview group focuses on the Haynie site (5MT1905). Staff and participants have conducted site testing excavation, remote sensing, architectural documentation, and artifact analyses at the site since 2016. Laboratory analysis of material excavated from the Haynie site is on-going.

Bruce Bradley has conducted excavation at the nearby 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). Furthermore, notes, maps, and artifact data exist from previous nonprofessional excavations at the Haynie site and are in possession of CCAC. Crow Canyon is integrating these data into a research database to augment new data collected through excavation at Haynie.

Project Area Location and Ownership

The Lakeview Group is 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 a significant nearby drainage and is located southeast of the Lakeview group. The majority of the Haynie site is located on a 5-acre property acquired by The Archaeological Conservancy from the Haynie Ranch, LLC. The easternmost portion of the Haynie site, including a portion of the east great house, is on private land not accessible to Crow Canyon. Bruce Bradly owns Wallace Ruin and Greenstone Pueblo, a small domestic habitation adjacent to Wallace Ruin. 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 that trends northeast, and just above a shallow broad valley associated with the Simon Draw drainage. The valley broadens just south of the site. The head of Simon Draw is located about 6 km north of the Haynie site and after bordering the Haynie site it continues south-southwest until feeding into McElmo Creek 4 km southwest of the Haynie site.

The soils of the Simon Draw valley located 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). According to Van West (1994:162-167), these soils are among those with the greatest agricultural potential in the entire region. Today the undeveloped areas of the valley bottom are plowed and irrigated and produce 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. A series of sandstone canyons and ridges lie north and northwest of the Haynie site and a series of low sandstone ridges flank the valley floor, these ridges support a pinyon-juniper woodland community.

Crow Canyon Excavation, Documentation, and Recording System

In 2009, Dr. Susan Ryan and other Crow Canyon archaeologists established a permanent, primary site datum. Subsequently, based on this datum, Crow Canyon used a total station to establish 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 original unit size and orientation based on the research needs in the field. Occasionally, the field crew conducted excavations that were less structured than typically used in a meter grid unit—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 2 provides a list of all prior and in progress excavation units at the Haynie site and 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 generally 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 previous 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*. Location of Areas A through F, Haynie site. 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 types of study unit designation: 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 defined as 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 distinct number.

2023 Excavations at the Haynie Site

This section describes major study units investigated by Crow Canyon during 2023. For the location of structures in Block 100, please see Figure 3.

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

Excavations conducted in Area C are described below by the study units. This area continues to be a focus of testing and research and an important component to understanding the Pueblo I village component, as well as the later Pueblo II overlying component.

Structure 1002 and Structure 1036

Work recommenced in Structure 1002 and Structure 1036 during 2023. Structure 1036 is an earthen-walled pit structure nested within a larger earthen-walled pit structure, Structure 1002. Based on sherds observed during excavation, both pit structures are thought to date to the Pueblo I period. In past seasons, the relationship between Structures 1036 and 1002 has been difficult to discern. Excavations this season helped clarify the chronology of the structures. Burned roof beams were collected from the south and north ends of the trench and are associated with Structure 1002. The in-house dendrochronology results yielded five datable samples for Structure 1002. These dates were A.D. 632p-671vv; post-A.D. 640; A.D. 842+,883vv, A.D. 857p-891vv, and A.D. 898p-937v incomplete. Three samples from Structure 1036 lacked the minimum number of rings and were not datable. Chronometric dating for Structure 1036 is pending the return of archaeomagnetic samples collected from a hearth (Feature 1) excavated into Surface 1. The 2023 excavations clarified Structure 1036 was cut into Structure 1002 following the decommissioning of Structure 1002 and following a relatively brief period of non-occupation during which fill deposits accumulated in Structure 1002. In the south end (3-x-1-m 451N 374E) of the test trench, Structure 1036, Surface 1 clearly cuts through two earlier surfaces from Structure 1002. On the north end (3-x-1-m, 454N 374E) Structure 1036 Surface 1 clearly cuts through at least one Structure 1002 surface. The north end of Structure 1036 Surface 1 will be explored more in the 2024 season to better understand the relationship between Structures 1002 and 1036. In both the south and north ends of the test trench, it appears that Structure 1036 cut through burned roof fall from Structure 1002. However, the lack of beam remains for Structure 1036 suggests the roof of that structure was recycled upon depopulation. As a result, there are no viable dendrochronology samples for Structure 1036.

There were approximately two dozen floor features identified in Structure 1036, Surface 1 (Figures 6 and 7). Seventeen features were excavated in 2023, including a hearth (Feature 1), two adjacent small pits (Features 2 and 3), and multiple other small features that include postholes and paho features. Pollen and sediment samples were collected from the features for additional analysis. A minimum of six additional floor features were identified and will be excavated in the 2024 season. Finally, an auger probe was placed in the center of Structure 1036 and indicated approximately 40 cm of cultural fill remains below Structure 1036, Surface 1. This lower fill is characteristic of another possible structure below Structure 1036; this will be explored during the 2024 season.

Structure 1101 and Structure 1102

Structure 1101 is the east half of a masonry lined room associated with a roomblock in the northern portion of Area A (Figure 9). In 2023, excavations exposed Surface 1 which included a hearth (Feature 1), an adjacent slab-lined pit (Feature 2), a feature with an undetermined function (Feature 3), and a posthole (Feature 4). Structure 1101, Surface 1was fully exposed in the study unit and all floor artifacts were point located (PL) and all PLs and features were mapped and documented. Sediment samples were collected from features and are awaiting processing in the CCAC lab.

Structure 1101, Feature 1 is a slab-lined hearth with an oxidized adobe rind. An archaeomagnetic sample was collected from the feature and will be sent to the Office of Contract Archaeology in Santa Fe, New Mexico in 2024. Feature 2 is comprised of a slab-lined pit feature immediately north of the hearth. The fill within this feature consists mostly of fine ash deposits. There is minimal evidence of oxidization within this feature. Feature 3 is an undefined feature type ("other" in the CCAC classification system). It is a small ovoid feature consisting of three upright stones embedded in Surface 1. The function is unknown, but one possibility is that the stones served as shims to help support a roofing post. Feature 4 is a posthole in the northeast corner of the structure.

Structure 1102 is the east half of a room immediately adjacent (south) to Structure 1101. It is divided from Structure 1101 by a low masonry wall and is constructed similarly to Structure

1101. In-field pottery analysis suggests the two rooms are likely contemporaneous. In 2023, Surface 1 was fully exposed and documented. One floor feature was partially exposed in the excavation unit, a small pit with an ashy fill (Feature 1). This feature had no directly associated artifacts. Multiple artifacts were in situ on the floor, and these were collected and PLs were documented. Subsurface testing will continue in 2024 to determine what type of sediments this structure was constructed on.

Nonstructures 1132 and 1104 and Arbitrary Unit 1133

A 1-x-1-m unit, and all of Feature 2, were excavated and fully documented. Pollen and bulk flotation samples were collected from the surface and features for analyses. The northwest corner of Feature 1 was outside of the test units and thus, the entirety of the feature was excavated. Feature 1 fill consisted of adobe clasts, charred corn kernels, charcoal, faunal remains, and pottery sherds dating to late PI/early PII periods. The fill above was consistent with midden deposits. The base of Feature 1 is caliche and appears to have been partially excavated into, possibly for use as a mortar matrix. Nonstructure 1132 excavations were completed in 2023 (Figure 8) and the unit will be backfilled in 2024.

Nonstructural 1082

Nonstructure 1082 is a on the west of Area C. Aerial photos suggest this portion of the site is a heavily looted midden. In addition to the midden being heavily looted prior to the 1960s, in the late 1980s and early 2000s it was again disturbed by mechanical excavations conducted by a previous landowner. Despite mechanical disturbance, the western edge of the midden 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 2023. In the 1-x-1-m units listed below, Nonstructure 1082 is much deeper than would be expected given the surrounding topography and in the past two seasons it was believed there may be some kind of natural topographic anomaly here, possibly a small drainage channel. Two 1-x-1-m units (449N 374E; 451N 374E) were opened in previous seasons to assess the potential depth of the midden deposits. This season, excavation began in the 1-x-1-m unit (450N 374E) between the two previously opened units. 2023 testing determined these three units are likely within a pit structure. Below the midden deposits, the units contain post-occupational fill and roof fall. The roof fall was encountered and testing in all three units will resume in 2024.

Arbitrary Units 1134 and 1095 and 1096

These two 1-x-1-m units (448N 376E; 448N 369E) were opened in 2021 to test for potential midden deposits south of the Pueblo I roomblock and its associated pit structures (Structures 1003, 1003, 1036) in the northern portion of Area C. Testing revealed primarily disturbed deposits and in 2023 sterile sediment was reached. Testing in these units is complete.

Testing in Area D: West Great House Area

Structure 1115

In the late 2000s, local archaeologist, Joel Brisbin, tested a pit structure located beneath the northeast corner of the west great house. Ralph Haynie, a previous landowner, placed a backhoe trench diagonally across the structure and Brisbin documented the floor and the stratigraphy of the fill. His field notes indicate the preservation of burned roof beams laying on the floor and a potentially partially intact hearth. Sherds collected during excavation suggest the pit structure dates to the Pueblo I period. In 2022, Crow Canyon re-excavated the trench to potentially obtain dendrochronological samples and possibly obtain a chronometric date for this structure.

In 2022, three 2-x-4-m test units were laid out over the presumed location of the pit structure with the intention of excavating until the outline of the trench and pit structure became visible. A thick layer of redeposited sediment was encountered. The 2000s backhoe trench was located by excavating a small, east-west hand trench in the northernmost unit (2-x-4-m 448N 423E). Once locating the original backhoe trench boundaries, a hand trench was excavated along the north profile face until the wall in the northeastern corner was identified. Testing focused on identifying the trench to the southwest. In 2023, testing centered on removing the redeposited fill from the 2000s backhoe trench. Crow Canyon's college field school students conducted this work and re-exposed Surface 1. In 2024, work will continue in this study unit and will focus on documenting the floor surface and associated features as well as collecting dendrochronology and archaeomagnetic samples.

Segment 33 / Structure 1126

Hand-drawn maps from the mid-1980s depict a large, masonry-lined, subterranean structure northwest of the "paint shop." In 2019, a geophysical survey was conducted in this location. Electrical resistance data suggested a large circular anomaly was present. In 2021, a backhoe trench (Segment 33) was placed east-west across the anomaly to locate this potential structure and test for a series of rooms suggested to be present by a previous landowner. Segment 33 exposed a masonry wall corresponding to the east edge of the circular anomaly. In 2022, a hand trench (Segment 34) followed the wall segment to the north and south, confirming the anomaly was a curved, double-wythe wall. The subterranean structure appears to be a large masonry-lined kiva and was designated Structure 1126.

The east half of Segment 33 was mapped, documented, and covered this season. No evidence of the adobe rooms mapped in the 1980s, or any other structure or features, are evident and testing in the east half of Structure 33 is complete with no additional work planned. In 2023, college field school students excavated the west half of Segment 33 and exposed wall fall and an intact masonry wall on the eastern interior of Structure 1126. Approximately one meter of intact wall depth was exposed. Testing will continue in 2024.

Stabilization of the East Great House

In 2018 Crow Canyon conducted stabilization on the east great house (Diederichs 2018). The 2018 treatment primarily involved recapping walls and repointing their upper three-to-five courses of masonry. In addition, a trail was established so visitors and researchers can safely reach the top of the east great house with minimal impact to the structural integrity of the building. Additional limited stabilization has continued each field season as part of the intern training program. In 2024, The Archaeological Conservancy contracted Woods Canyon

Archaeological Consultants to conduct additional stabilization in three kivas (Structures 200, 201, and 219).

Following the methods established in 2018, Crow Canyon interns repointed and capped walls in Structure 201 (kiva) (Figure 10) during the 2023 season. A mortar mixture of 10 parts local sediment to one part Portland cement was used. Stabilization work occurred between July 17th and 19th, 2023 and August 3rd and 4th, 2023. Shanna Diederichs of Woods Canyon Archaeological Consultants provided an overview of the methods, rationale, and ethics of archaeological stabilization and Steve Copeland of Crow Canyon supervised the work.

Structure 201

The upper lining wall and pilasters of this kiva were inspected for loose stones. Loose stones were mortared in place and the upper two-to-four courses of the wall section were repointed. Approximately 15 buckets of mortar and 15 gallons of water were used, and pre- and post-work photos were taken. The stabilization focused primarily on the northeast and east upper lining walls.

Artifact and Sample Analysis

Lab Analysis

Crow Canyon staff, participants, and volunteers cataloged and analyzed the flaked stone, ground stone, ceramic artifacts, and environmental samples recovered during excavation. This year, participants in the College Field School and Internship Programs (laboratory and dendroarchaeology focused) assisted in laboratory analyses. Chronometric samples for radiocarbon or dendrochronological dating were analyzed. In-house cataloging and analyses of artifacts for the Haynie site is in progress. In total, staff, participants, and volunteers have catalogued more than 13,202 bags of artifacts and samples from the site to date. Analyses have included 32,556 flaked-lithic artifacts, 99,124 sherds, 162 pieces of ground stone, 47 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 primary use of the site during the early Pueblo I through Pueblo II Periods (A.D. 750–1150). A less substantial Pueblo III 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, Crow Canyon researchers continued to develop the Pueblo II design analysis protocols and dataset. To date, 854 bowl rim sherds from Cortez Black-on-white, Mancos Black-on-white and Pueblo II white painted sherds have been analyzed from the Lakeview community, including 68 sherds from Greenstone Pueblo (5MT6970), 182 sherds from Wallace great house (also 5MT6970), 105 bowl rim sherds from the Ida Jean site (5MT4126) and 499 from the Haynie site. The preliminary results of these analyses show 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 49 Pueblo III white ware bowls in our ongoing analyses of the Pueblo III white wares at the Haynie site. Additional special analyses of the sherds at the Haynie site consisted of the examination and identification of pottery temper of 1044 white ware and gray ware rim sherds. Projectile points, bifaces, and stone drills were examined in detail from the Lakeview group. Attributes from 514 of these tools were recorded to date from Haynie, 115 from Ida Jean, 28 from Wallace, and 44 from Greenstone. Ornaments including beads, pendants, bracelets, gaming pieces, rings, bone tubes, other modified stone, modified shell, shaped sherds, other modified bone, were analyzed in detail. A total of 443 were analyzed from the Lakeview group which includes: 95 from the Haynie site, 269 from Wallace, 69 from Ida Jean, and 10 from Greenstone Pueblo.

Archaeofaunal Analyses

Crow Canyon Environmental Archaeologist, Jonathan Dombrosky completed an analysis of the faunal specimens that have been catalogued as of August 2023. He was assisted in analysis by zooarchaeology intern and graduate student, Ahna Feldstein. For this report, Dombrosky and Feldstein examined a total of 1,949 specimens. Of these, 1,359 (27.98%) were identifiable (Dombrowsky and Feldstein 2023). The total faunal assemblage analyzed to date is 7,831 specimens with 2,191 that were identifiable and 5,640 that were unidentifiable (27.47 %). Mammals, birds, reptiles, and fish were all present. The Haynie assemblage has a low rate of identifiability and a high amount of fragmentation (Dombrowsky and Feldstein 2023). Given the degree of previous disturbance at the Haynie site, one primary question of the faunal analysis was to test if there was a significant difference in identifiability and fragmentation between disturbed and undisturbed contexts. Dombrowsky and Feldstein (2023) found about 78 percent of specimens from previously disturbed contexts are unidentifiable while approximately 67 percent of the specimens from undisturbed contexts were unidentifiable. A Pearson's chi-square test shows the association between identifiability and disturbance context is significant, yet Dombrowsky and Feldstein (2023) suggest it is of very little practical significance given the large sample size and inspection of the residuals (the difference between expected and observed counts). The complete report is included as Appendix D.

In addition to the in-house faunal analyses, five bison bones were sent to Beta Analytic for radiocarbon and isotopic analyses. The samples appear to be from two individuals and include two first phalanx, a metatarsal, a humerus, and a thoracic vertebra. Four of the samples are from Structure 1003 and the fifth is from Structure 1018. Three of the samples (two first phalanx and one metatarsal) from Structure 1003 date between A.D. 996 and 1158, and one (humerus) dates between A.D. 978 and 1151, at 95.4 percent confidence. The Structure 1018 sample (thoracic vertebra) dated between A.D. 1021 and 1158, at 95.4 percent confidence. The

Pollen Analysis

In early December 2023, the results of pollen analysis from 50 samples collected during the 2017 to 2022 field seasons were reported. The complete report is included as Appendix C. Susan J. Smith, consulting archaeopalynologist, conducted the analysis. Global Geolab in Alberta, Canada prepared the samples for analysis with chemical extraction. Thirty-six distinct pollen types are identified with Cheno-ams, Asteraceae (sunflower), *Pinus* (pinyon, ponderosa), *Zea* (maize), and Cupressaceae (juniper) being the most common occurrences as a percentage of the samples (Smith 2023:6). Maize, cholla, and prickly pear pollen are three resources that stand out in the data due to their high presence in the Haynie samples. Other notable pollen included smaller quantities of the carrot or parsley family, willow, sedge, walnut, and crane's bill. Carrot or parsley family pollen is consistently found in regional archaeological sites and serve as evidence for the presence of nearby wet meadows or riparian border areas (Smith 2023). Willow, sedge, and walnut are water indicators, but the frequency was lower than expected given the presence of a spring on the property (Smith 2023). The crane's bill pollen is suggested to be primarily an indicator of disturbance (Smith 2023).

The most significant results of the pollen analysis are the presence of two samples with cotton pollen. Smith (2023) states that even at the low representation of single grains in each sample, this is a significant find for the site, area, and region. This is significant in part because even though there is evidence of cotton textiles in the Northern San Juan and Upper San Juan Basin, there is an absence of remains that prove cotton agriculture in this region (Smith 2023). This is the first evidence of cotton pollen in the CCAC excavations database. The only known evidence of cotton macro remains archaeologically are concentrated in specific regions along the Colorado River, near the confluence of the Colorado and San Juan Rivers, Antelope House in Canyon de Chelle, and near Flagstaff, AZ (Wright 2000). In addition, the cotton pollen at the Haynie site may be one of the earliest known archaeobotanical records of cotton in the northern Colorado Plateau (Smith 2023).

Smith suggests the cotton pollen at Haynie infers some form of two probable scenarios. The first is that cotton may have been cultivated nearby in small, specialized plots. The second scenario is that cotton flowers were imported as trade items and utilized either directly for ritual or ceremonial purposes or used to create a special dye with the flowers.

Overall, the pollen analysis reveals that the high ubiquity of maize aligned with a high sample presence of squash, cotton, cholla, and prickly pear supports other studies (Van West 1994) that the location surrounding the Haynie site was especially productive farmland. The high sample levels of pinus suggests local intact woodlands at the time of the Haynie prehistoric habitations. These resources serve crucial needs for fuel, construction, and other subsistence needs (Smith 2023). In summary, it appears that, apart from maize and cotton, the Haynie pollen inventory is similar to other collections at regional archaeology sites. The level of maize, and particularly the presence of cotton pollen, suggests that Haynie stood out from other area sites.

Chronometric Dating

Dendrochronology

For 2023 a series of dendrochronology samples were examined at CCAC by intern Stephen Uzzo and Benjamin Bellorado for the Area C2 pit structures (STRs 1002, 1003, and 1036). Seventeen samples from Structure 1002, three from Structure 1036, and three from Structure 1003 were analyzed in 2003. Only five samples from Structure 1002 proved viable for dating. Table 1 provides the most likely dates for the related structures. For the five datable 2023 samples from Structure 1002, it is important to note that all samples, excluding one, are vv or vv++ dates. The fifth is a v-incomplete date.

In total, 41 dendrochronology samples were submitted in 2023 for dating. Six samples were complete enough for dating. As stated earlier, five of these samples were from Structure 1002 and the remaining tree-ring date from 2023 is from Arbitrary Unit 1030 dating to A.D. 648p-697vv++. ARB 1030 is a 2-x-4-m unit (452.4N 394.5E) excavated in 2021 to investigate the foundations of the west great house. The unit was completed and backfilled in 2021.

Archaeomagnetic Dating

In the 2023 field season, two hearth features were sampled by Kay Barnett for archaeomagnetic dating. These samples were collected from hearths within Structure 1002 (Feature 1) and Structure 1032 (Feature 1). Samples will be sent to the Office of Archaeological Studies in Santa Fe, New Mexico for dating in 2024.

Supplemental Studies

College Field School Auger Testing Project

Crow Canyon's 2023 College Field School was sponsored by the National Science Foundation Research Experiences for Undergraduates program. All ten students from the field school conducted auger testing adjacent immediately south and west of the manufactured home on the property. The goal of the project was to determine whether intact subsurface deposits were present in the front yard and west side yard of the existing manufactured home, with the ultimate purpose of determining the appropriate recommendations prior to the removal of the manufactured home from the property.

Four students --- Alan Bradley, Shaan Vernenker, Nora Downing, and Denali Cook --- created a poster (Appendix B) describing the project and its results and they presented the poster at the 2023 Pecos Conference at Flagstaff, Arizona. There are disturbed and redeposited cultural deposits in the upper 30-60 cm of all test probes. These deposits are likely impacted from the previous landowner's earth moving activities to make a level pad for the manufacture home. Four test units exhibited midden-like deposits between 60-100 cm below modern ground surface. One test probe contained definitive midden deposits between 60 and 140 cm below modern ground surface. Relatively shallow bedrock or a water line pvc pipe for the trailer were encountered in the remaining six test pits.

College Field School Pottery Design Analysis Project

Three students from the 2023 College Field School—Aiden Keener, Adriana Sarduy, and Zee Fleak—completed a project on Mancos Black-on-white pottery designs and social identity in the Lakeview community (including the Haynie site) and sites in the Chaco regional system (e.g., Pueblo Alto, Bis Sa'Ani, and Salmon Pueblo) in northern New Mexico (Appendix B). The study found the design styles developed for Mancos and Cortez Black-on-white pottery were broadly comparable to the pottery typologies developed at sites in northern 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 other Chaco-style sites in the San Juan Basin of New Mexico, but it is uncommon at Pueblo Alto within Chaco Canyon. The authors suggest there was an interaction sphere among outlying communities that did not entirely overlap with great houses within the canyon. While the Dogoszhi design style is far more common within Chaco Canyon, it is present in the Lakeview community, indicating Lakeview residents participated in a broader social sphere related to that style. The Black Mesa and Sosi/Black Mesa styles are relatively common at the Haynie site, but uncommon in many other nearby communities.

Curation Agreement

Crow Canyon entered into an agreement with the Canyons of the Ancients Visitors Center and Museum (formerly the Anasazi Heritage Center), 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 for the NCOP (Ryan 2016).

Participant Programs, the Intern Educational Program, and College Field School

Two participatory educational programs took place at the Haynie site in 2023 (Table *4*4). The two school groups, one from Old Orchard High School and one from Keystone Preparatory School, participated in a one-day field program at the Haynie site. Numerous high school and college students toured the Haynie site during excavation season as part of either an education program through Crow Canyon, or as part of an educational tour or field class from their university. These groups included tribal school groups from the Southern Ute Tribe, Acoma Pueblo, and Laguna Pueblo that were led by AII manager Rebecca Hammond.

There were two 10-week sessions of the Field Internship Program, each with two interns (Jorge Barcelo, Zion Palacios, Summer Brown, and Tyrien Fixico). Finally, ten students in the College Field School participated in lab, excavation, and survey analyses and training.

Research Presentations and Public Outreach

Two posters were presented by College Field School students at the 2023 Pecos Conference in Flagstaff, Arizona on data collected at the Haynie Site. Four students—Alan Bradley, Shaan Vernenkar, Nora Downing, and Denali Cook—created a poster (Appendix B) describing the augering project and its results. Three other students from the 2023 College Field School—Aiden Keener, Adriana Sarduy, and Zee Fleak—completed a comparative analysis project comparing Mancos Black-on-white pottery designs and social identity in the Lakeview Community (including the Haynie site) to sites in the Chaco regional system.

Over 100 people visited the Haynie site during the 2023 field season. Visitors included individuals and groups from the CCAC Adult Research Program and Cultural Explorations trips, multiple college, secondary, and elementary school groups, Acoma and Laguna Pueblos and the Southern Ute Tribe school groups, independent scholars, previous CFS students, the local Colorado Archaeological Society chapter, local community members, and the Archaeological Conservancy.

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Figures and Tables

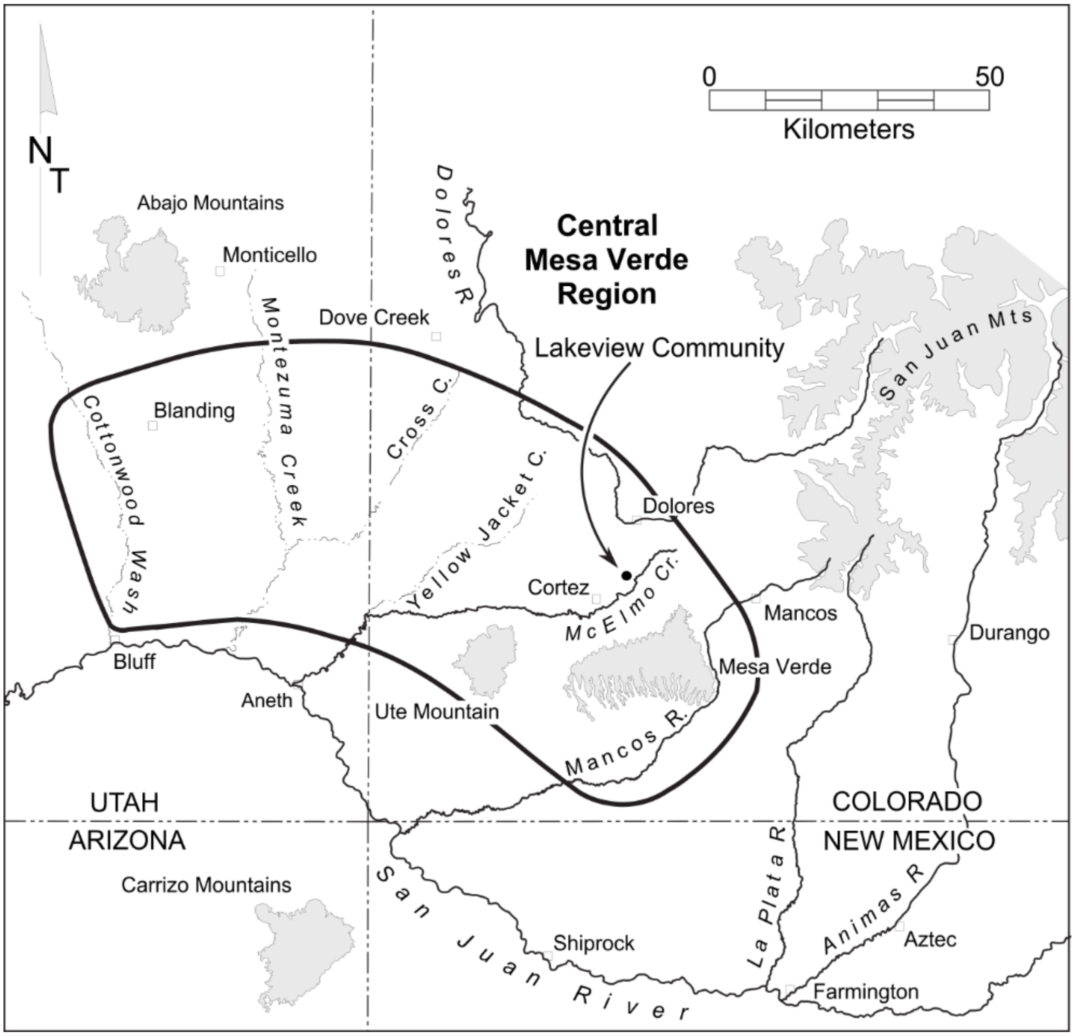

Figure 1. Location of the Lakeview Community in the central Mesa Verde Region.

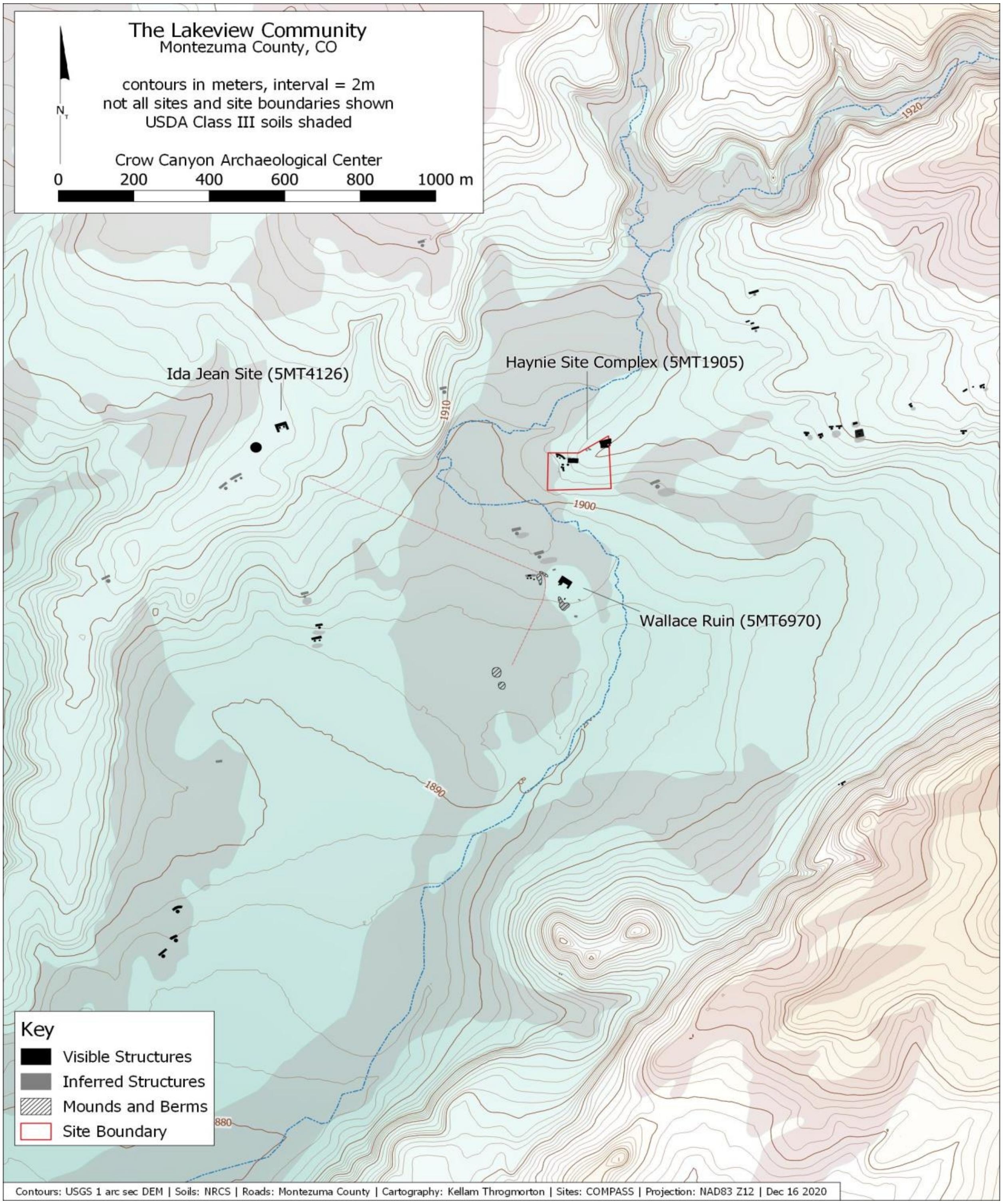

Figure 2. The Lakeview Community showing the location of great houses and known or suspect smaller habitations.

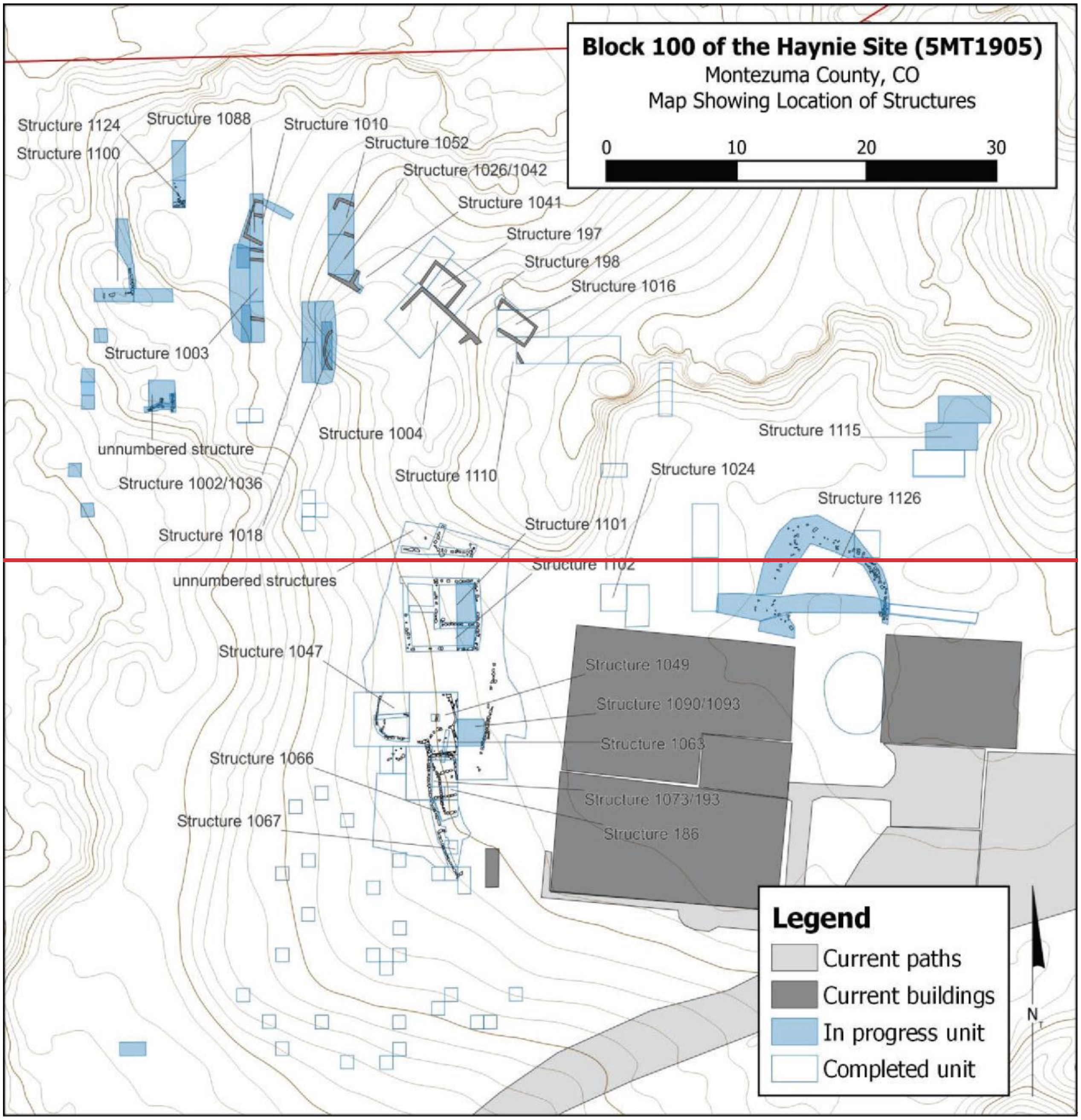

Figure 3. Location of structures, Haynie site.

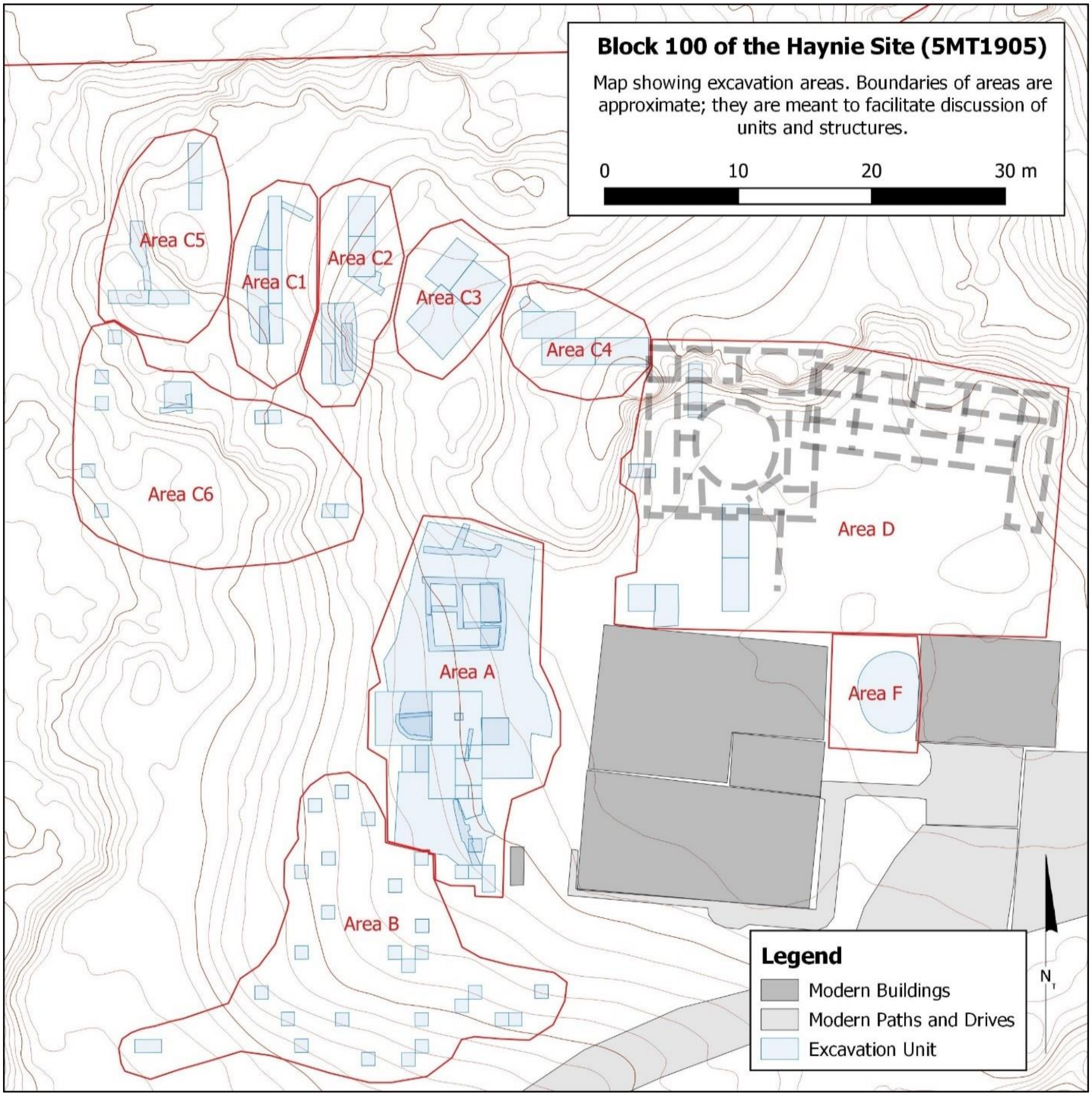

Figure 4. Location of Areas A through F, Haynie site.

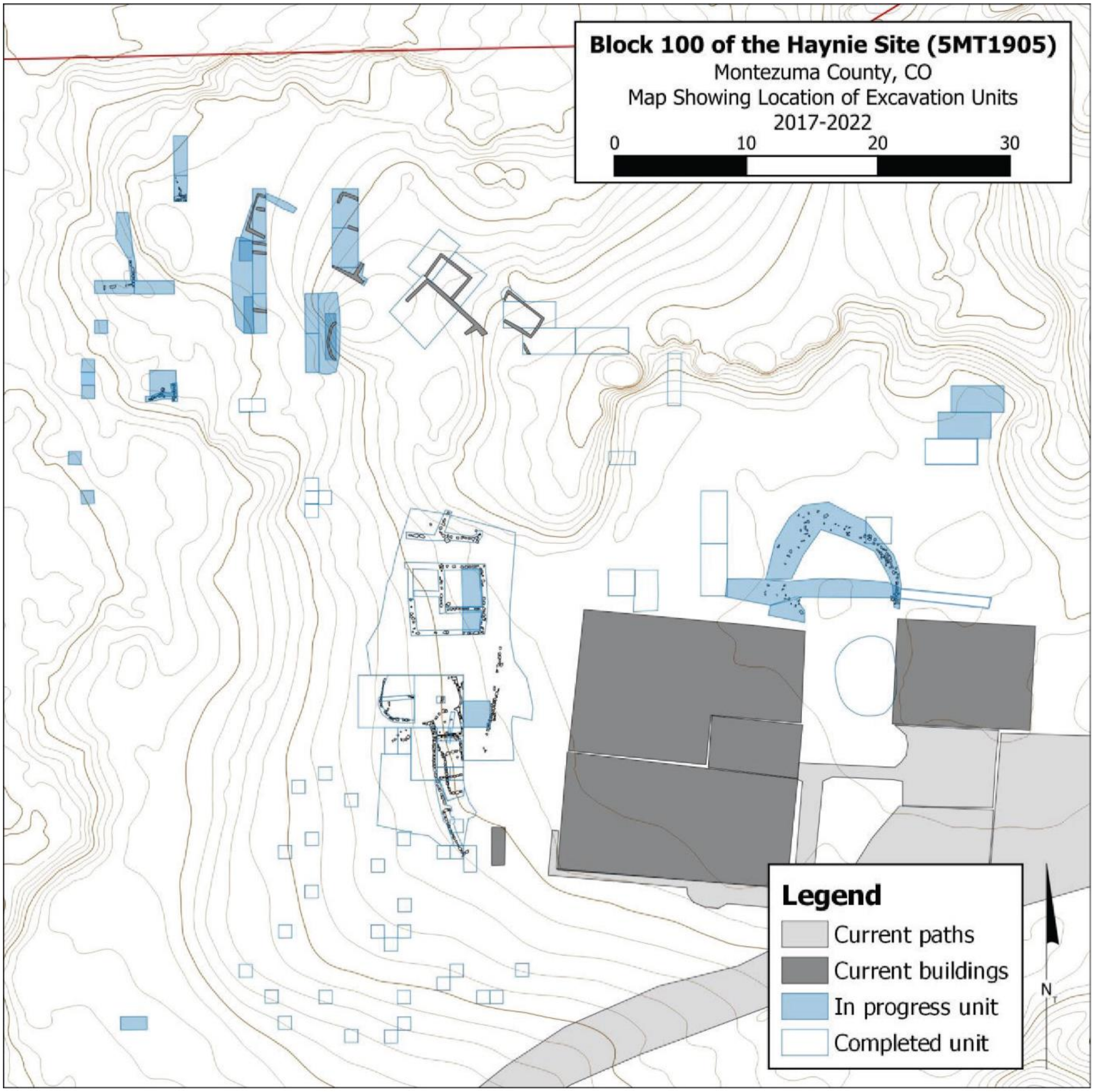

Figure 5. Location of all in progress units, Haynie site.


Figure 6. Structure 1036, Surface 1 prior to excavation, Haynie site.

Figure 7. Structure 1036, Surface 1 prior to excavation, Haynie site.


Figure 8. Nonstructure 1132 and 1104 and Arbitrary Unit 1133, Surface 1, Features 1 and 2 post-excavation, Haynie site.


Figure 9. Structure 1101, Surface 1 prior to feature excavation, Haynie site.

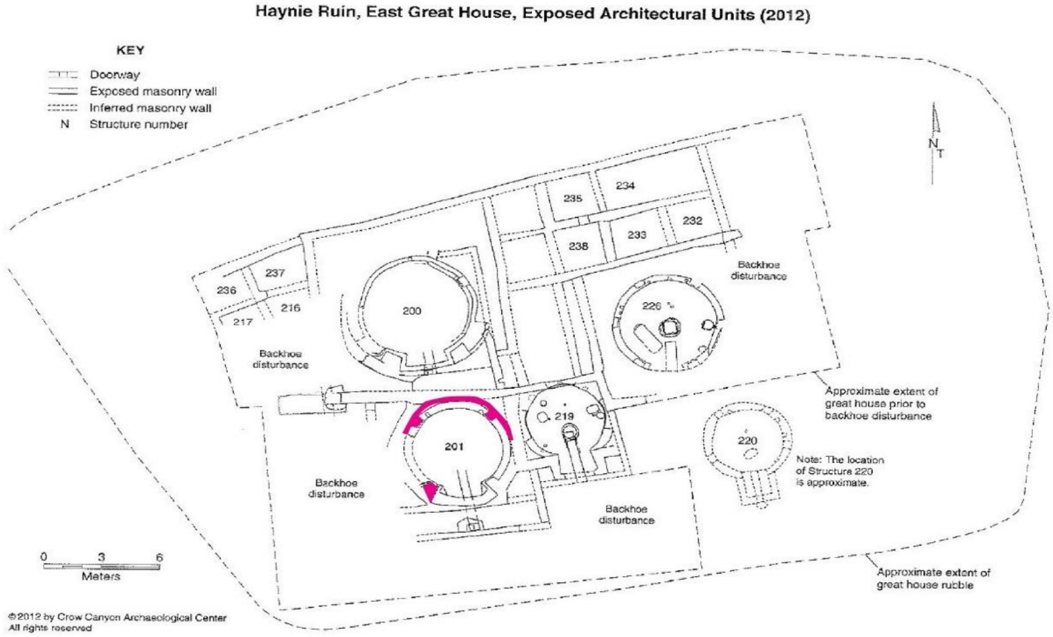

Figure 10. Plan map of east great house with highlighted areas showing location of stabilization work in 2023, Haynie site.

Table 1. Dendrochronology Dates from Structures 1002, 1036, 1018, 1003 at 5MT1905, east trench.

STR	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*	*Dated Sample (A.D.)*		*Range (A.D.)*
STR 1002	640-671	775-906	804-842	842-883	857-891	898-937	916-968		640-968
STR 1036		*Archaeomagnetic dates are pending*							
STR 1003	993-1058	1046-1081	1070-1154	1092-1120					993-1154
STR 1018	968-994	991-1026							968-1026
NST 1017 (midden fill 1002/1036)	862-994	893-970							

Table 2. 2023 Radiocarbon Dating of Five Bison Bones, Haynie Site

Sample No.	**Skeletal Element**	**Structure**	**95.4% Cal. Date Range (A.D.)**
1905_480_4_1	First phalanx	1003	996–1158
1905_480_4_2	Metatarsal	1003	996–1158
1905_1265_9_1	First Phalanx	1003	996–1158
1905_505_14_1	Thoracic vertebra	1018	1021–1158
1905_489_8_1	Humerus	1003	978–1151

Table 3. List of all excavation units and status, Haynie site

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.

Area	Unit Number	Date Opened	Date Closed	Comments
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 the 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 1/2	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 1/2	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.
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. Finished unit, awaiting backfill.
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.

Area	Unit Number	Date Opened	Date Closed	Comments
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.
C2	3-x-1-m 451N 374E	6/1/2017		Test trench placed to investigate anomaly identified during remote sensing. Structure 1036. In progress.
C2	3.5-x-1-m4 52N 375.5E	5/29/2019		Unit expands on test trench to expose architecture. In progress.
C2	3-x-1-m 454N 374E	6/1/2017		Test trench placed to investigate anomaly identified during remote sensing. Structure 1036. 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.

Area	Unit Number	Date Opened	Date Closed	Comments
C4	2-x-4-m 452.40N 394.50E	4/26/2017	11/9/2021	Unit placed to investigate the 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 the 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-m.5 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	5/2/2022	Test trench to identify wall alignments. Excavation complete.
C5	Segment 30	7/27/2021	4/18/2023	Hand trench to identify walls of STR 1100. Excavation complete.
C6	1-x-1-m 441N 375E	8/31/2021	9/ 23/2023	Unit expands on adjacent 1x1 after a possible floor surface identified. Excavation complete, awaiting backfill.
C6	1-x-1-m 441N 374E	5/20/2021	9/ 23/2023	Judgmental test unit to investigate cultural deposits between Areas A and C suspected to be a midden. Excavation complete, awaiting backfill.
C6	1-x-1-m 442N 374E	5/20/2022	9/ 23/2023	Unit placed to sample midden deposits identified in adjacent units. Excavation complete, awaiting backfill
C6	1-x-1-m 441N 357E	5/20/2021	4/21/2023	Unit placed to test presumed midden deposits. Excavation complete, awaiting backfill.
C6	1-x-1-m 444N 356E	5/20/2021	5/17/2023	Unit placed to test presumed midden deposits. Excavation complete, awaiting backfill.
C6	1-x-1-m 448N 370E	8/31/2021	10/15/2023	Expanding adjacent unit after possible pitstructure fill identified. Excavation complete, awaiting backfill.
C6	1-x-1-m 448N 369E	5/20/2021	10/15/2023	Unit placed to test presumed midden deposits. Excavation complete, awaiting backfill.
C6	1-x-1-m 449N 357E	5/20/2021		Unit placed to test presumed midden deposits. In progress.
C6	1-x-1m 450N 357E	5/1/2023		Unit placed to test presumed midden deposits. In progress.
C6	1-x-1-m 451N 357E	5/20/2021		Unit placed to test presumed midden deposits. In progress.
C6	2-x-2-m 449.19N 362.21E	6/30/2021	4/17/2023	Unit placed to investigate several wall segments identified by Segment 28. Excavation complete.
C6	1-x-1-m 454N 358E	6/15/2021	11/1/2023	Unit placed to test presumed midden deposits. Excavation complete, awaiting backfill.
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.

Area	Unit Number	Date Opened	Date Closed	Comments
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	10/30/2023	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. Excavation complete, awaiting backfill.
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 pit structure identified by auger testing. Gas line encountered. Backfilled.

Table 4. K-12 participant programming at the Haynie site in 2023.

Group Name	Dates	Number of Participants
Keystone Preparatory School	May 9, 2023	7
Old Orchard High School	May 10, 2023	18

Appendix A – Personnel

Mission Staff
R. David Satterwhite– Field Director
Steve Copeland – Senior Field Archaeologist
Reuven Sinensky– Laboratory Director
Jamie Merewether – Collections Manager
Kate Hughes – Laboratory Analyst
Susan Montgomery – Laboratory Analysis
Rebecca Hammond – Educator and American Indian Outreach Manager
Rebecca Renteria – American Indian Initiatives Outreach Coordinator / AII Intern (2023)
Jonas Kurronen – Education Manager
Paul Ermigiotti – Educator, emeritus
Tyson Hughes – Educator
Alicia Benally – Educator
Jon Ghahate – Educator
Jeremy Grundvig – Mission Associate

Research Institute at Crow Canyon Staff
Susan Ryan – Executive Vice President
Grant Coffey – Research Database Manager
Jonathan Dombrosky – Post Doctoral Scholar

IT Support Staff
Robbin Laws – Director of Information Technology

Social Media and Outreach
Sarah Payne – Chief Outreach Office
Emphasis Marketing, LLC. – Marketing and Advertising
Taylor Hasbrouck – Community Outreach Manager

Interns (2023)
Jorge Barcelos – Field Intern
Zion Palacios– Field Intern
Summer Brown – Field Intern
Tyrien Fixico – Field Intern
Steve Uzzo– Dendrochronology Intern
Ahna Feldstein – Zooarchaeology Intern
Will Koehler – Lab Intern
Nick Long – Lab Intern
Clarice McKee– Lab Intern

Appendix B

Please See Next Page

Appendix B – College Field School Auger Testing Project, 2023 Pecos Poster

CROW CANYON ARCHAEOLOGICAL CENTER

Auger Testing at the Haynie Site (5MT1905): Locating and Identifying Cultural Deposits

Alan B. Bradley, Shaan B. Vernenkar, Nora Downing, Denali Cook

University of Colorado Boulder · SIERRA COLLEGE · Mizzou University of Missouri · HOBART AND WILLIAM SMITH COLLEGES

I. Introduction

In 2023, the Crow Canyon College Field School conducted auger testing around the modern house at the Haynie site (5MT1905). The intent was to characterize the cultural deposits surrounding the structure and make appropriate recommendations on the removal of the house.

II. Site Background

The Haynie site (5MT1905) is a multicomponent village dating to AD 750-1250 with two Pueblo II great houses, a Pueblo I-early Pueblo II village, and a small Pueblo III component (Fig 1). The site was heavily disturbed by mechanical excavation in the 1980s and construction of a manufactured home in the 1990s. Crow Canyon has conducted research at the Haynie site since 2016 as part of the Northern Chaco Outliers Project (Ryan 2016). The site was acquired by the Archaeological Conservancy in 2019. In 2022, auger testing was conducted in the backyard of the mobile home, which yielded evidence of pitstructure roof fall and midden deposits extending to 140 cm in depth (Throgmorton et al. 2022:11).

Figure 1. Location of the Haynie site (5MT1905) in southwestern Colorado.

III. Research Questions

The project aimed to answer three questions:

1. Are there intact archaeological deposits on the west and south sides of the house?
2. If so, what kind of deposits are present?
3. What management recommendations should be considered if the home is moved off the property?

IV. Methods

Testing was conducted on the west and south sides of the home. Each auger test unit was spaced two meters apart (Fig. 2). The soil color, texture, and inclusions were recorded. Once the auger reached a depth of about 140 cm and observations were recorded, the sediment was redeposited. Eleven auger test units were completed.

Figure 2. Location of auger test units within Block 100 of the Haynie site.

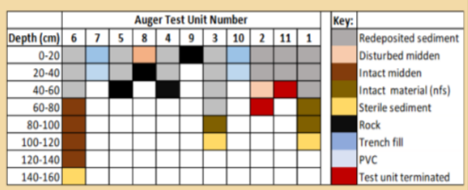

Figure 3. Diagram of fill type by depth within auger test units.

References

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V. Results

- The upper 30-60 cm of all units was disturbed and redeposited material (Fig 3).
- Test Units 1, 2, 3, and 11 identified midden-like deposits between 60-100 cm below the surface.
- Test Unit 6 contained midden deposits (layers of ash between layers of loam with caliche, burned adobe, and artifacts) 60-140 cm below the surface.
- Impenetrable rock was common in the upper 20-60 cm around the southwest corner of the house (Test Units 4, 5, 8, 9).
- Test Units 7 and 10 encountered PVC water lines

VI. Discussion and Conclusions

A midden-filled pitstructure may be present at the northwest corner of the house associated with pitstructures identified in the backyard in 2022. The southern edge of the house likely rests on disturbed midden deposits which are atop sterile sediment or within pitstructures. This suggests that pitstructures exist north and west of the house and a midden is located to the south.

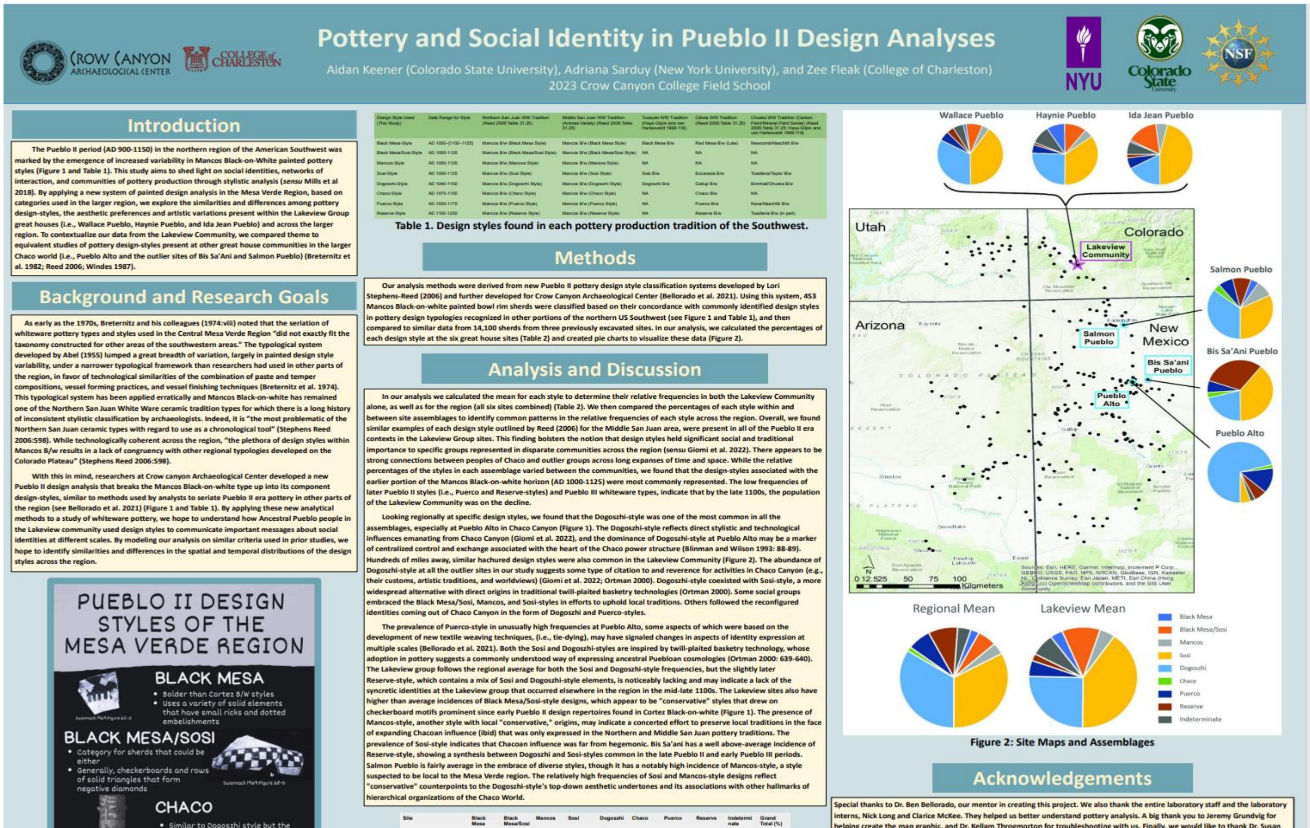
VII. Recommendations

Remove the home from the east, via the graveled driveway; monitor all ground-disturbing activities in the upper 40 cm of disturbed sediment; avoid intact subsurface deposits below 40 cm in depth north, west, and south of the house; monitor for unmarked utilities.

The Crow Canyon Archaeological Center (CCAC) acknowledges the Pueblo, Ute, Diné (Navajo), Jicarilla Apache, and Paiute people on whose traditional homelands this institution sits. We are grateful to all Indigenous people who continue to preserve and protect cultural traditions, maintain ancestral relationship, and steward these lands

We personally thank the CCAC staff for their teachings, the NSF for funding our research, and our mentor, Dr. Kellam Throgmorton.

Appendix B - College Field School Pottery and Social Identity Project, 2023 Pecos Poster



Appendix C – Pollen Analysis Report

Please See Next Page

Haynie Site (5MT1905) Pollen Analysis

Submitted by: Susan J. Smith
Consulting Archaeopalynologist
8875 Carefree Ave., Flagstaff, AZ 86004
Phone: 928-202-8078, Email: frogfarms4@gmail.com

Submitted to: Susan Ryan, Crow Canyon Archaeological Center
and Samantha Fladd Samantha.Fladd@colorado.edu
Anthropology Department, University of Colorado, Boulder

December 5, 2023

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INTRODUCTION

Analysis results are presented here from 50 pollen samples collected in the western portion of the Haynie site (5MT1905) during the 2017 through 2022 Crow Canyon Archaeological Center excavations as part of the Northern Chaco Outliers Project. The Haynie site contains two of four Great Houses within a one km radius that form the Lakeview Community (Throgmorton et al. 2022). The pollen samples consist of five controls and 45 samples from 13 Pueblo period structures and an extramural surface (Table 1). There is a long history preserved in the site sediments in the Pueblo I-II archaeology and deeper cultural deposits. Structures were constructed on top of middens and material from earlier structures or in some cases within and over structures. Beginning in the 1970's, the Haynie family added another layer of disturbance to the site from heavy equipment excavations, earth moving, and construction. It is surprising given the prehistoric and historic impacts to the site that the recovered pollen spectra reported here has preserved a rich archive of Pueblo plant use.

Table 1. Haynie pollen samples by structures and context. Color-shaded, paired rows note superimposed structures or structures built within and over earlier structures.

Block 100 Areas	Ceramic Age	Context	Number of Pollen Samples	Surfaces, Floor, Floor, Fill	Interior Features	Roof Fall	Wall Fall
Surface	Modern	Controls	5				
C	PII	Extramural Surface - Nonstructure1094	2	2			
	PII	Kiva Structure 1003	12	3	6	2	1
	PI	Structure 1002 Surface Room	1	1			
	PI	Structure 1036	1			1	
	PII	Structure 1026 Surface Room	5	2	3		
	PII	Structure 1042 Room	2	2			
	PII	Structure 197 Surface Room	1	1			
	PII	Structure 1016 Surface Room	2	2			
D	PI	Structure 1024 Pit Structure	3	3			
A	PII	Structure 1047 Pit Structure	2		2		
	PI	Structure 1063 Surface Room	5	5			
	PI	Structure 1073 Surface Room	5	5			
	PI	Structure 193 Surface Room	1	1			
	PI	Structure 186 Surface Room	3	3			
Total Samples			**50**	**29**	**11**	**3**	**1**

Unraveling Archaeo-Pollen

Archaeological pollen assemblages are difficult to interpret. Plant pollination systems differ by species resulting in uneven production of pollen which is further distorted by various biological and physical vectors of transport and deposition. The key to archaeological palynology is that pollen is linked to flowers and each plant species has evolved unique reproductive strategies that determine the amount of pollen produced, how it is dispersed, and the probability that grains will preserve in soil (Fægri and van der Pijl 1979; Fægri et al. 1989).

Once biological filters are considered, the next interpretive level is the confounding complexity of human-plant interactions. Cuisine and the technologies employed to acquire, consume, and store foods, dictate which plant parts are preserved and where, including the types and quantity of pollen (Adams and Smith 2011; Geib and Smith 2008). Plant products removed in space and time from flowering structures, for example tubers and roots, are essentially invisible through the pollen lens, while other resources can overwhelm a sample, such as ritual use of corn pollen or a flush of Cheno-am weeds across a midden. Context strongly influences pollen preservation. Storage and cooking features often yield ambiguous evidence of economic plants because at this stage of food processing, little pollen persists on stripped seeds and other cleaned products (Geib and Smith 2008), whereas house floors represent surfaces where pollen from everyday human activities was more likely to accumulate. Structure floors are emphasized in the Haynie samples selected for analysis. The history of features is another factor that will sculpt the archaeobotanical record. Intensely used and reused features from sites with persistent occupations have a greater potential to contain botanical materials than contexts from sites of short occupations. And features that were burned, flooded, and/or looted will have lost pollen signatures to deterioration and churned sediments.

METHODS

The samples were sent to Russ Harms at Global Geolab, Medicine Hat, Alberta, Canada, for chemical extraction. Before processing, samples were spiked with a known concentration of club moss spores (*Lycopodium*) to monitor degradation from laboratory chemicals and to enable concentration calculations. The laboratory procedure uses acid treatments (hydrochloric and hydrofluoric) to reduce carbonates and silicates followed by a heavy liquid flotation (zinc bromide, specific gravity 2.0) to separate and concentrate pollen grains. The finished residues are stored in glycerol.

The processed samples were analyzed on a Reichert Microstar compound microscope at 400x magnification. Pollen grains were identified and counted to sums of 200 or greater grains, if possible, and then an entire microscope slide per sample was scanned at lower magnification (100x). Low magnification scans are adequate to identify larger grains including cultigens, agave, and many herbaceous species. Pollen identifications were made to the lowest taxonomic level possible based on published keys (Fægri et al. 1989; Kapp et al. 2000). Clumps of grains of the same taxon, referred to as *aggregates*, are added to the pollen sum as one grain per occurrence and the size of the largest clump documented. For example, the Cheno-am notation 2(10+) represents two aggregates of Cheno-am grains with the largest aggregate containing greater than 10 grains. The interpretive convention is that aggregates represent on-site plants because clumps are less likely to be dispersed by wind than single grains.

Three numerical measures were calculated from the data: pollen percentages, taxon richness, and pollen concentration. Percentages represent the relative importance of each pollen type per sample ([taxon count/pollen sum] *100) and richness is the number of taxa identified per sample. Concentration is an estimate of the absolute abundance or soil density of pollen grains and is calculated by taking the ratio of the sample pollen count to the tracer count and multiplying by the initial tracer concentration. Dividing this result by the sample weight yields the number of pollen grains per gram of sediment, abbreviated gr/gm.

RESULTS

The pollen data are documented in Appendix A which includes sample provenience, summary measures (concentration and taxon richness), and the taxon raw counts from each sample. Most of the Haynie sample assemblages were easily counted to sums exceeding 200 grains which is the convention for archaeological samples, but three samples were counted to sums of 102 grains. These low-count samples are all from intramural features in Structure 1003 (two hearths and a slab-lined pit) and are characterized by minimum calculated concentrations of 666 to 1125 gr/gm reflecting low soil density of pollen grains. The median pollen concentration from all 45 archaeological samples is 2,391 (range 558 to 52,111 gr/gm). The Haynie site taxon richness or number of pollen types identified is moderate with an average of 10 taxa per sample (range 3 to 17 taxa per sample).

In Figure 1, a summary diagram of the pollen percentage data is presented. Results are discussed below organized into three sections: pollen types identified and interpreted economic taxa, comparison of archaeological and modern pollen spectra, and comparisons between structures.

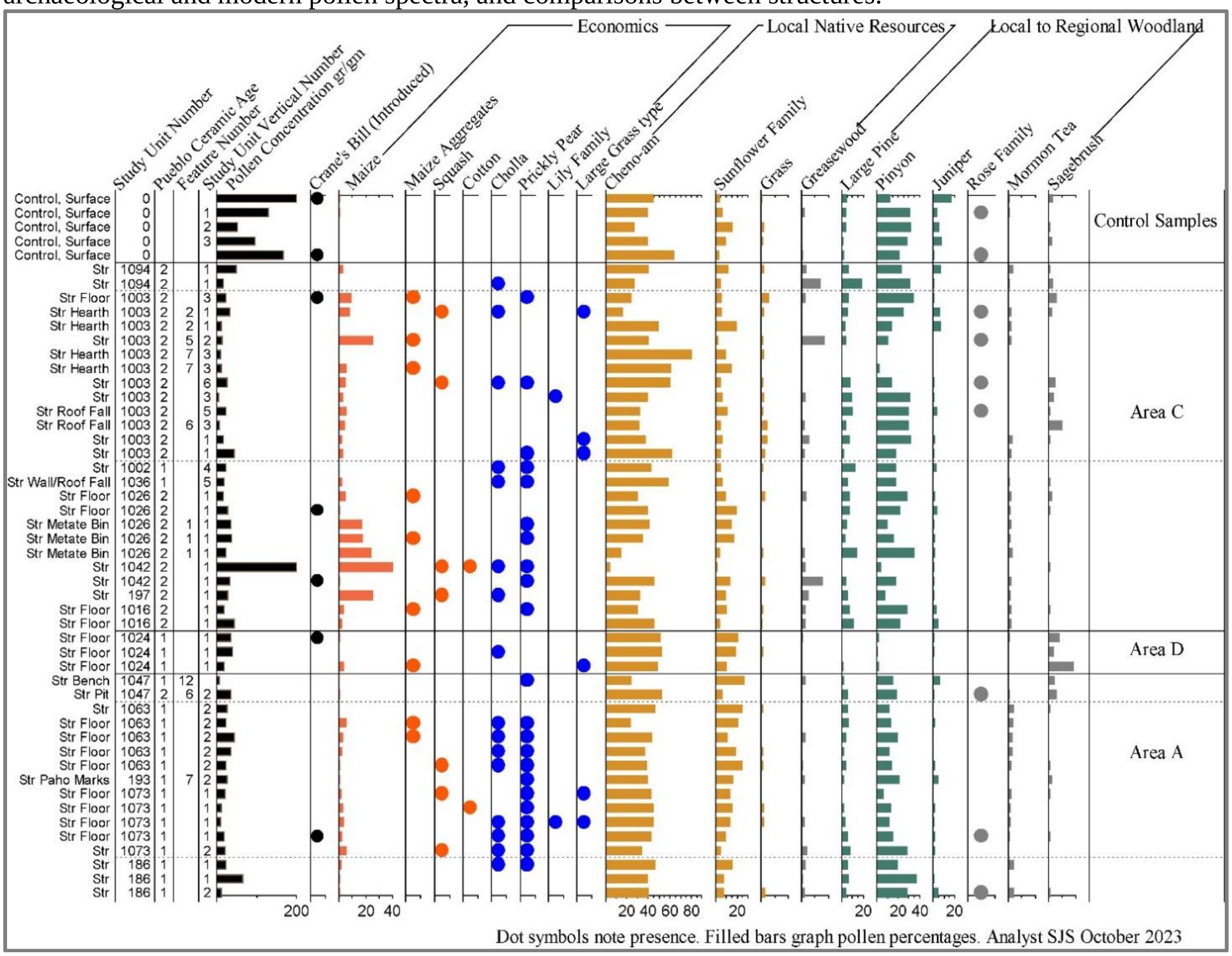

Figure 1. Summary pollen diagram for the Haynie site.

Pollen Types Identified and the Interpreted Economic Taxa

Thirty-six distinct pollen types are identified (Table 2) the majority of which are present at low counts in only a few samples. Cheno-am is the most common and abundant taxon in all 50 samples. The calculated project Cheno-am average is 40% of sample pollen sums (range 4 to 80%, n=50), and aggregates of Cheno-am pollen are common (32 of the 50 project samples preserved Cheno-am aggregates). Other common taxa include pinyon pine (average 18%) and sunflower family (average 11%).

The modern vegetation is dominated by Cheno-am plants that include four-wing saltbush (*Atriplex canescens*), winterfat (*Krascheninnikovia lanata*), and annual weeds of goosefoot (*Chenopodium* spp.), pigweed (*Amaranthus* sp.), and tumbleweed (*Salsola* sp.). These Cheno-am plants are wind-pollinated and produce abundant pollen that swamps the natural pollen rain deposited on sediment surfaces. Based on the Cheno-am percentages in the archaeological samples (Figure 1), the prehistoric environment was similar to the modern.

Table 2. Pollen types identified organized by interpretive categories.

Interpretive Categories	**Taxon Name**	**Common Name**	**Occurrence as Percent of 50 Samples**
Economic Plants	*Zea*	Maize	82
	Cucurbita	Squash	14
	Gossypium	Cotton	4
	Cacti, *Cylindropuntia*	Cholla	32
	Cacti, *Platyopuntia*	Prickly Pear	44
	Liliaceae, possible *Yucca*	Lily Family	4
	Poaceae, *Large*	Large Grass type	12
	Apiaceae	Carrot Family	4
	Portulaca	Purslane	2
Water Indicators	*Salix*	Willow	2
	Juglans	Walnut	2
	Cyperaceae	Sedge	2
Native Plants from Local Area	Asteraceae	Sunflower Family	100
	Asteraceae, *Ambrosia type*	Ragweed/ Bursage	26
	Brassicaceae	Mustard Family	4
	Cheno-am	Cheno-am	100
	Eriogonum	Buckwheat	4
	Euphorbiaceae	Spurge Family	6
	Fabaceae	Pea Family	6
	Malvaceae, *Sidalcea* type	Malvaceae Sidalcea type	2
	Malvaceae, *Sphaeralcea*	Globemallow	4
	Nyctaginaceae	Four O'Clock Family	2
	Onagraceae	Evening Primrose	2
	Poaceae	Grass Family	56

	Sarcobatus	Greasewood	54
Local to Regional Woodlands and Forests	*Abies*	Fir	6
	Artemisia	Sagebrush	56
	Cupressaceae	Juniper	78
	Ephedra	Mormon Tea	64
	Picea	Spruce	4
	Pinus edulis type	Pinyon type	98
	Pinus spp.	Ponderosa pine & Other Pines	94
	Quercus	Oak	2
	Rosaceae	Rose Family	18
Exotic Introduced	*Erodium*	Crane's Bill	14
Unknown	Unknown Sage type	Unknown Small Sage	6

It would be easy to dismiss the robust archaeological Cheno-am expression as natural or as an artifact of weeds on disturbed soils, except for the number of ethnographic references to Cheno-am plants as reliable staples for edible seeds and greens (Dunmire and Tierney 1995, 1997; Rainey and Adams 2004). In the Southwest, Cheno-am pollen and charred seeds are the most common and abundant non-wood plant remains recovered at archaeological sites across all time periods (Adams and Fish 2011; Huckell and Toll 2004), and there are clear examples of Cheno-am seed storage and cooking (Toll and McBride 1998; Hunter et al. 1999). In this analysis, the Haynie site Cheno-am is interpreted as a mixed signal composed of natural pollen rain from on-site saltbush and weeds and some unknown component reflecting prehistoric subsistence activities. Even four-wing saltbush was likely utilized for fuel and for the salty seeds that could be milled and mixed with ground maize and other foods to add texture and a salty spice.

Nine pollen types are evaluated as representing the core economic resources (Table 2). Cultural use is obvious for three cultigens, maize, squash, and cotton (Figure 2), whereas interpretation of native plants is less sure. For most of the local resources, use is inferred based on ethnographic accounts (see Rainey and Adams 2004) and consistent recovery in archaeobotanical samples from a variety of sites investigated by the Crow Canyon Archaeological Center as well as other large projects in the region, for example Salmon Ruin (Reed 2006).

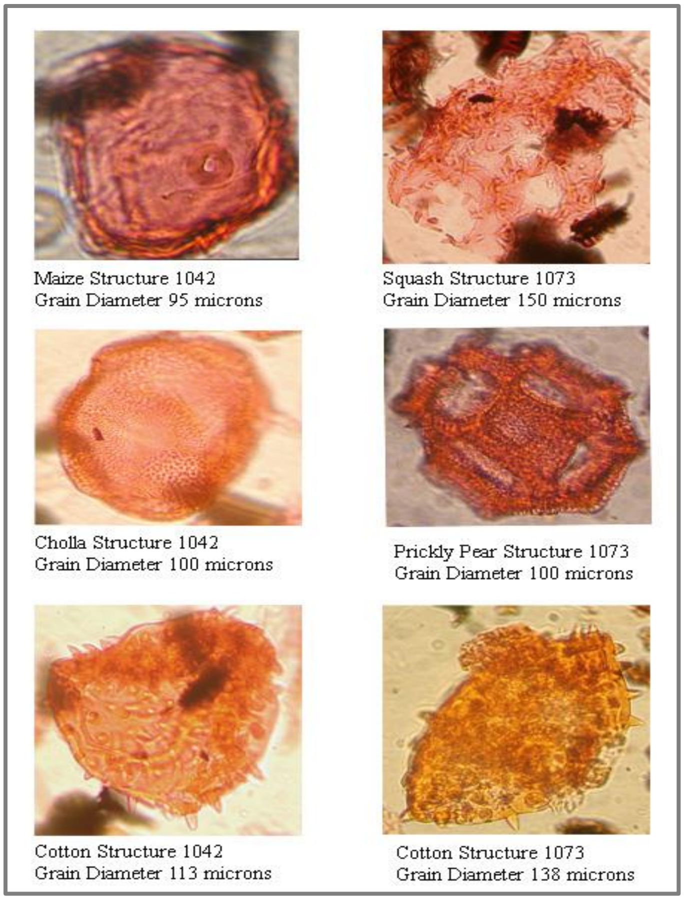

Figure 2. Haynie site cultigen and cacti pollen. Photographer Susan J. Smith.

The recovery of cotton pollen in two samples is an archaeological first for Crow Canyon as well as archaeobotanical studies across the four corners region and the San Juan Basin. The cotton story is discussed in detail in a following section. Two native resources that stand out in the Haynie data are cholla and prickly pear that occur in greater than a third of the 45 archaeological samples and with high counts in specific samples. Both cacti provide dependable foods and sweet tastes that could be ingredients in a variety of products. Prickly pear fruits were harvested by most Indian tribes (Moerman 1998) and the pads and flowers are also edible. Young prickly pear pads are relished in modern cuisines, especially in the Southwest and Mexico, where grocery stores offer *nopales* in the produce aisles. Vegetative parts of cholla could be used throughout the year, but the most important product is the flower buds just before opening. The buds are gathered in late spring and prepared by pit roasting, steaming, or drying. Traditional uses include beverages and syrups and as a vegetable added to the stew pot and there is also a rich ethnographic record of cholla's role in ceremony and ritual (Dunmire and Tierney 1997; Moerman 1998).

A large grass pollen type is missing from the control samples but was identified in six of the archaeological samples. Large grass is used to distinguish a grain that is between 40 to 60 µm in diameter. Grasses generally cannot be identified to genera, except for maize, which is a big grain with diameters exceeding 60 µm. However, based on size, potential genera include rice grass (*Achnatherum hymenoides*), wild barley (*Hordeum* spp.), panic grass (*Panicum*), or an introduced cereal grass, such as rye or wheat. A likely candidate for the Haynie large grass pollen is Indian rice grass which is a common native species that was harvested for grain. Recently, the first identification from Southwest Colorado of charred grains of little barley grass (*Hordeum pusillum*) was documented in flotation samples from a late Basketmaker III site

(Graham et al. 2017) not far from the Haynie site which suggests another possibility for the large grass type. Little barley grows in broad ecological ranges across the United States and Canada, produces a hull-less grain that was easily harvested and milled, and is a suspected prehistoric cultivar (Adams 2014; Graham et al. 2017).

Pollen identified as carrot or parsley family (Apiaceae) is interpreted as an economic resource. Although it was only found in two samples, this taxon is recovered consistently from archaeological sites in the region (e.g., Smith 2020a). Most carrot family plants grow in wet meadows or along riparian borders, for example sweet root (*Osmorhiza* spp.), licorice root (*Ligusticum* spp.), and Queen Anne's lace (*Daucus* spp.); all three plants are sources of important medicinal and food products (Moerman 1998). In the pinyon and juniper woodland of Southwest Colorado, there are dryland species, notably a resource called waferparsnip, wild celery, or springparsley (*Cymopterus* and *Pseudocymopterus*). These ground-hugging perennials are almost invisible except in the early spring when the yellow or purple flowers poke up above the soil. The roots were eaten raw or baked by Southwest tribes and the aromatic leaves widely used as a spice (Dunmire and Tierney 1995; Moerman 1998).

Two other possible economic plants are the lily family and purslane, both of which were rare. Lily family was identified in two samples and purslane in one sample. The lily family designation subsumes several plants widely used for food, medicine, and other products, such as wild onion (*Allium*), death camas (*Zigadenus*), and mariposa lily (*Calochortus*), but yucca (*Yucca* sp.) is the most probable plant as it is common in the local woodlands. Yucca leaves and fibers provided important textile and cordage materials and the fruits could be harvested and processed into storable foods. A piece of an open-twinned mat from Structure 1024 was identified by Laurie Webster as made of bulrush (*Schoenoplectus*) or cattail leaves (*Typha)* twined with yucca cord (Throgmorton et al. 2019:29-30). Seeds of the annual purslane (*Portulaca*) are common in macrobotanical and flotation samples from archaeological sites in the region including one example of a seed cache in a Chapin gray jar from a Basketmaker III site (5MT10709) (Adams 2020a:594). Purslane provided seasonal greens and seeds and was apparently an important food.

Other notable pollen types include single-sample identifications of three water indicators – willow, sedge, and walnut. This is extremely low sample frequencies given the presence of a spring on the Haynie property and the site's location on the toe of a ridge that separates McElmo Creek and Simon Draw. The number of structures constructed with extensive use of mortar and clay adobe, which requires water for mixing, and the long occupation and farming history indicates water was not a limited resource. A more robust wetland and riparian pollen signature may be masked by the overwhelming flood of Cheno-am pollen that dominates sample assemblages.

All of the native and woodland pollen types listed in Table 2 encompass plants that were used for food, medicine, fuel, and other practical products. Of the several taxa in these categories, rose family is worth mentioning as one of the more important for specialized woods and seasonal fruits and berries. Native shrubs that grow in the nearby woodlands and canyons include serviceberry (*Amelanchier*), *Peraphyllum*, cliff rose (*Purshia*), and mountain mahogany (*Cerecocarpus*).

Crane's bill pollen occurs in two of the controls, both from surface sediment, and five of the archaeological samples. There are two species of crane's bill in the Southwest, the native *Erodium texanum* and the more abundant introduced *E. cicutarium*. In this analysis, crane's bill pollen is evaluated to represent primarily the exotic plant and therefore, an indicator of disturbance and potential mixing of soil profiles. Three of the five structure samples with crane's bill pollen are in Area C (Structures 1003, 1026, and 1042), one is in Area D (Structure 1024), and one is in Area A (Structure 1073).

Haynie Site Controls versus Archaeological Assemblages

Five samples were collected away from buried structures and deposits to provide an analog of natural pollen deposition which can be helpful to discriminate culturally influenced taxa. The dominant taxa and select other taxa from the controls and archaeological samples are compared in Table 3. The five control samples are from two spots: one surface sample collected west of the apple tree and a set of four samples taken along the east fence line in the southeast portion of the property in order to define a vertical profile from the surface through three strata. Maize was identified in two of the control samples from the east fence line, the surface and stratum 1, which indicates this location was impacted by historic disturbance that mixed prehistoric sediment with modern.

The main contrast between the controls and the archaeological samples is the exponentially higher pollen concentrations in the control samples. The absolute greater abundance of pollen is driven by Cheno-am which, as an average percentage, is only slightly higher than the archaeological samples (42 versus 40 percent), but considered as a proportion of sample pollen concentrations, it is more than five times higher. The median Cheno-am concentration from the five controls is 5,400 gr/gm in contrast to the 45 structure samples with a Cheno-am median concentration of 956 gr/gm. These measures from both controls and archaeological samples reflect the abundant Cheno-am pollen rain.

Table 3. Control versus archaeological samples.

Sample Types	**Control**	**Subsurface Archaeological Samples**
Number of Samples	5	45
Median Pollen Concentration gr/gm	12,858	2,391
Average Taxon Richness	9	10
Average Percentages		
Cheno-am	42	40
Sunflower	8	11
Grass	0	1
Large Pine	3	5
Pinyon type	25	18
Juniper	7	2
Other Taxa % Sample Frequency		
Crane's Bill probable historic introduction	40%	11%
Maize	40%	87%
Cholla		36%
Prickly Pear		49%

Slightly lower average percentages of the local woodland pinyon and juniper from the surface samples compared to subsurface samples is difficult to interpret. One theory is that the wooded ridge location of the Haynie site was a cleared, more open setting during the Pueblo period compared to the modern density of pinyon and juniper. The prehistoric woodlands would have provided fuel and construction wood in addition to materials for practical tools and could have been over-harvested during the long history of the Lakeview community. On the other hand, the archaeological samples are from structures that were protected beneath roofs and, after abandonment, by middens, roof and wall fall which would have sealed surfaces from natural pollen rain. In this analysis, the structure samples are evaluated as unreliable sensors of the composition of the past environments because of the bias inherent in samples taken from inside structures. What is clear from Table 3 is that during the Pueblo period the local woodlands were available and would have supplied several crucial resources for construction, fuel, and other subsistence needs.

The expressions of cholla and prickly pear in the structure samples is emphasized by the absence of these cacti in the controls. The same is true for the other cultigens and rare taxa and as a pattern, increases confidence that the structure samples preserved a sensitive record of subsistence.

Structures

One to 12 pollen samples were collected within 13 structures and a probable extramural surface (Nonstructure 1094). The samples were excavated from different types of contexts including floor surfaces, wall and roof fall, fill, and interior features (Table 1). The structures are from two general spatial groups, both west of the West Great House (Figures 3 and 4). Area C in the northwestern portion of the site is characterized by a large Pueblo I to mid-Pueblo II roomblock, associated pit structures, and an extensively remodeled kiva (Structure 1003, Area C1). Area A in the south portion of the site contains surface rooms that may connect in one or more roomblocks in addition to a defined Pueblo I roomblock with at least five contiguous surface rooms (Structures 1049, 1063, 1073/193, 1066, and 1067).

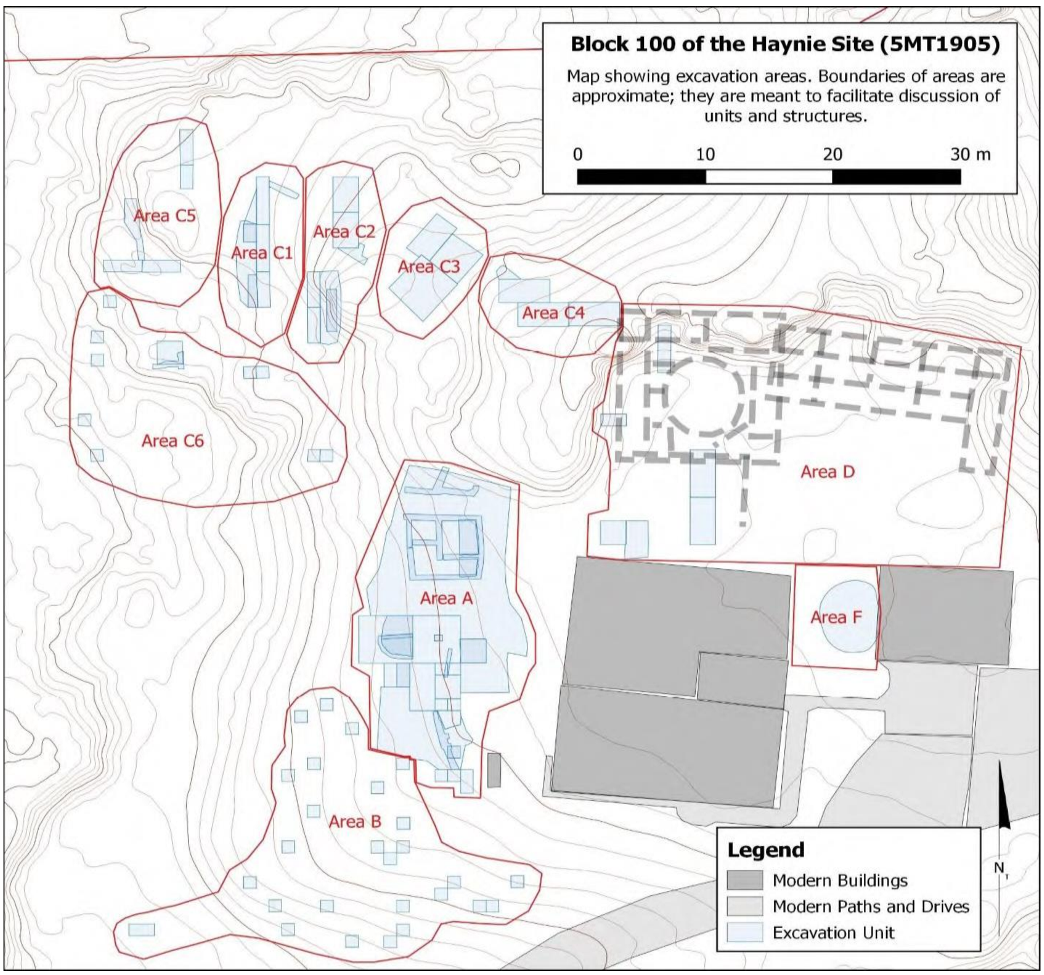

Figure 3. Haynie excavation Areas in Block 100 from Throgmorton et al. (2022: Figure 4).

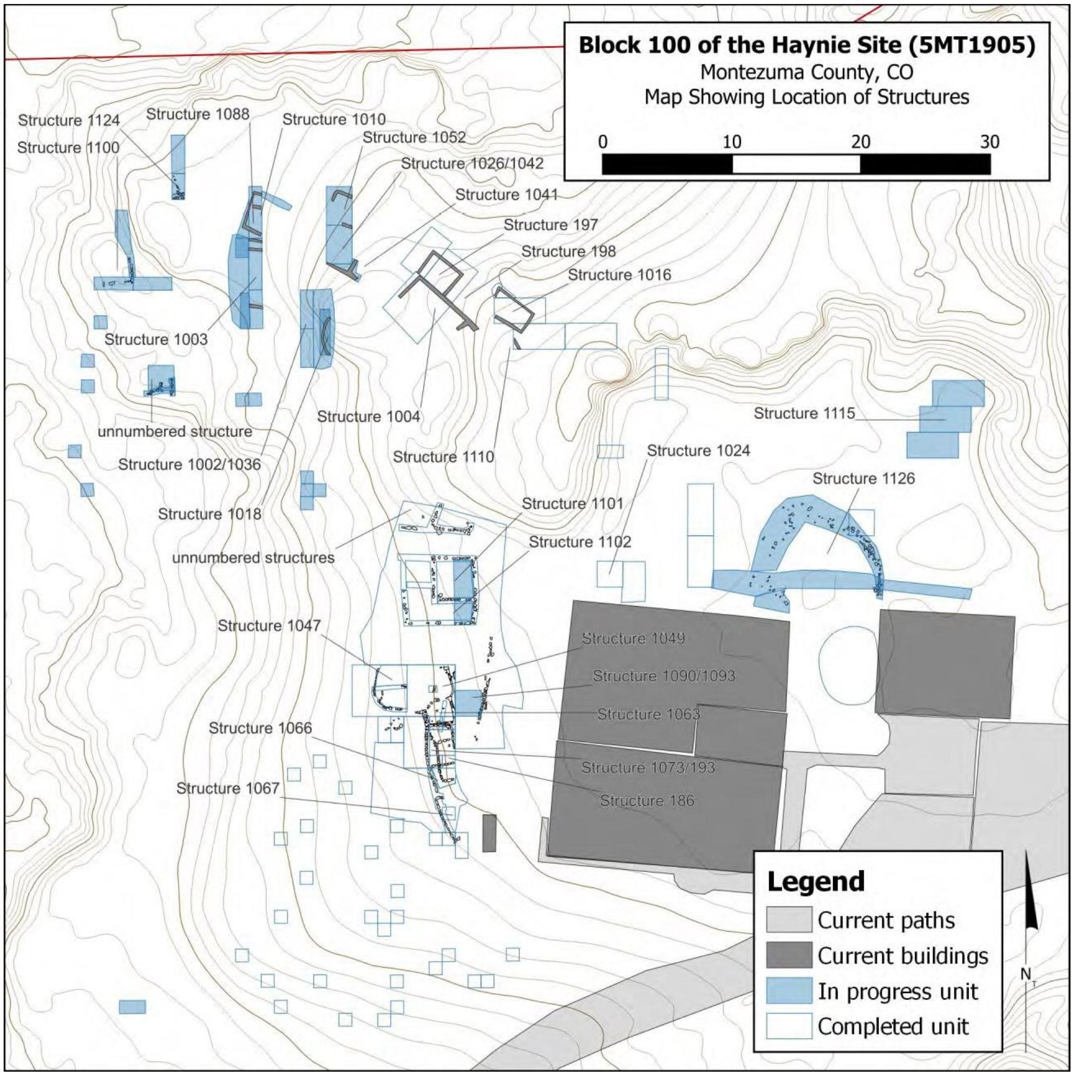

Figure 4. Haynie site structures from Throgmorton et al. (2022: Figure 5).

There are differences in the pollen results between structures that are best viewed through the distribution and abundance of economic pollen (Table 4). The approach used here is to set arbitrary filters to focus on high and exceptional expressions of economic taxa as well as emphasizing the low or background presence. Any occurrence of squash, cotton, large grass, and other rare types is interpreted as related to subsistence use, but for maize, cholla, and prickly pear, thresholds are defined based on the ranked counts for each taxon across all 45 subsurface samples. Where relevant, pollen percentage data are also evaluated for Cheno-am, pinyon pine, and other taxa. The following discussion is organized by the excavation areas defined in Block 100.

Table 4. Summary results of economic pollen representation by structure.

Areas	Pueblo Ceramic Age	Structure Study Unit Number	Structure Type	Number of Samples	Maize ≥ 7 grains. * = Aggregates	Cotton Presence	Squash Presence	Cholla ≥ 2 grains	Prickly Pear ≥ 2 grains	Other
C	PII	1094	Extramural Surface	2	X					
	PII	1003	Kiva with 3 remodeled floor surfaces	12	X*		X			Carrot Family with aggregate in Fea. 2 hearth; floors high grass percentages & Large Grass type in 2 of 3 floor samples, Lily Family in a roof fall sample, Rose Family notable
	PI	1002	Pit Structure	1				X	X	Water indicators Sedge & Willow
	PI	1036	1036 nested inside 1002	1				X	X	
	PII	1026	Surface Room built above 1042	5	X*				X	3 samples from Fea. 1 metate bin high pollen concentrations & maize counts
	Early PII	1042	Surface Room	2	X	X	X			Evening Primrose; high sample concentrations, project maximum maize count
	PII	197	Surface Room	1	X		X			
	Mid-Late PII	1016	Surface Room	2	X*					High Cheno-am in one floor sample

Areas	Pueblo Ceramic Age	Structure Study Unit Number	Structure Type	Number of Samples	Maize ≥ 7 grains. * = Aggregates	Cotton Presence	Squash Presence	Cholla ≥ 2 grains	Prickly Pear ≥ 2 grains	Other
D	PI	1024	Pit Structure with complex pattern of sand-filled pits surrounding a complex sipapu	3	X			X		Large Grass type, 9% Sagebrush in one sample, high Cheno-am
	PII	1047	Pit Structure, large and deep, ventilator shaft, bench, clusters of artifacts, dog burial, and turkey bones	2					X	Carrot Family (under groundstone on bench), 2-3% sagebrush in both samples
A	PI	1063	Room	5	X*		X	X	X	Walnut, Cholla Aggregate
	PI	1073	Room	5	X	X (1 sample from beneath vessel PL 45)	X	X	X	Large Grass type in two floor samples, Lily Family in one floor sample
	PI	193	Room	1						Purslane
	PI	186	Room	3	X			X		

Area C

Nonstructure 1094

Nonstructure 1094 was initially classified as a structure but after no bounding walls were found, it was reassessed as an extramural surface that contained a pit and a reconstructible vessel (Throgmorton et al. 2022:5). Nonstructure 1094 is adjacent to Structure 1124 which was a surface room. Two samples from primary refuse from the extramural surface did not produce any notable economic values, except for seven grains of maize pollen in one sample. In the second sample (PD 897, FS 6), there is a spike of wind-pollinated greasewood (7%), pine (18%), and pinyon (31%). These types might reflect pollen rain from the surrounding woodland ridges and regional forests falling on the extramural surface when it was exposed.

Pueblo II Structure 1003

Twelve samples were analyzed from the Pueblo II Structure 1003, a large and extensively remodeled kiva containing three floors. Five of the samples are from three superimposed hearths (Features 2 [latest], 5, and 7 [earliest]), one sample was collected from a slab-lined pit (Feature 6), two samples are listed as roof fall, one sample is from beneath wall fall, and three samples are from floor surfaces. High counts of maize (11 to 54 grains) were documented from the three hearth features and maize aggregates occur in two hearth samples. Squash pollen was found in the Feature 2 hearth in addition to 18 pollen grains of carrot family and a carrot family aggregate; only two project samples registered carrot family. There is a weak trend for enriched Cheno-am pollen in the earliest hearth (Feature 7). In the two Feature 7 hearth samples the Cheno-am is 71%, versus 40% from one Feature 5 sample, and 33% average Cheno-am from two Feature 2 samples.

The sample from below wall fall preserved the second occurrence of squash pollen in Kiva 1003, a single grain of cholla, and a scan-identification of prickly pear. One of the notable results from this structure is the relatively low representation of cacti pollen compared to other study units. There are two instances of cholla but at the low, background count of one grain each, and prickly pear was identified only during scans in three samples.

Grass frequencies are inflated in the kiva floor samples with 2-3% grass and presence of large grass in two of the three floor samples, compared to less than 1% grass in the other Structure 1003 samples with the exception of 2% grass from the slab-lined pit (Feature 6). The archaeological average for grass is 0.5% (n=45). Grass mats may have been used on the floors or grass thatch used in the roof. A high maize count (20 grains) and a maize aggregate were documented from the latest floor sample (vertical level 3). Rose family pollen is associated with Kiva 1003. Four of the seven project archaeological samples with rose are from the kiva samples and two of these are from hearths which may indicate fuel wood use.

Pueblo I Structures 1002 and 1036

Structure 1036 was built within pit structure 1002. Single samples were analyzed from both structures with sparse evidence of economic taxa. Maize pollen is present in the sample from Structure 1036 but at a low count of four grains. Cholla and prickly pear are notable in both structures and in Structure 1002, the only project identification of two water indicators, willow and sedge, is documented. The sample from Structure 1002 is described as from a post-abandonment deposit and the water indicators could reflect pollen blown in from local riparian and wetland environments or from adobe melt that contained pollen from plants growing around mud and/or water sources.

Pueblo II Structures 1026 and 1042

Structure 1026 was a surface room built over Room 1042. Five samples were analyzed from Structure 1026. Three samples were collected from one metate bin (Feature 1) and two samples were taken from the prepared floor surface. Some of the highest project counts of maize are from the bin samples (37 to 50 grains) and maize is high in one of the floor samples (10 grains). Maize aggregates were identified in one bin and one floor sample. Clearly, harvests of maize were processed and perhaps stored in this room. Prickly pear was present in two bin samples with a high count of three grains in one sample which could relate to processing prickly pear.

Two samples were analyzed from Structure 1042 both from an ephemeral or reuse surface in the structure fill (vertical stratum 1). A thin midden deposit in the fill indicates the structure accumulated trash before Structure 1026 was constructed. One of the Structure 1042 samples (PD 598 FS 1) is a pollen gold mine and contained maize, cotton, and squash. The sample is nearly pure maize pollen with the project maximum maize count of 198 grains out of a sample sum of 231 grains. The cotton and squash grains were identified during lower magnification scans. The only project identification of evening primrose was also documented from PD 598 FS 1. The second sample from Structure 1042 (PD 598 FS 2) did not yield any evidence of economic taxa. Cheno-am is high in the sample at 45% and crane's bill pollen is present indicating possible modern contamination.

Pueblo II Structure 197

A single pollen sample from an ephemeral or reuse surface was analyzed from this surface room. A high count of 51 maize grains and the presence of squash pollen were documented.

Mid-Late Pueblo II Structure 1016

Pollen assemblages were recovered from two samples collected from a prepared floor surface in Structure 1016 which was a surface room. One of the floor samples preserved high maize counts with a maize aggregate and the second sample did not contain any economic types but produced a high Cheno-am value of 45%.

Area D Pueblo I Structure 1024

This structure is a burned pit structure that had been filled with trash. Three samples were analyzed from a prepared floor surface which featured a complex pattern of a sipapu and cylindrical pits. Maize counts are high in one sample (8 grains) with a maize aggregate, presence of large grass type, the project maximum sagebrush (9%), high cholla in one sample, and in all three samples, high Cheno-am (49 to 52%).

Area A

PII Structure 1047

Structure 1047 is a large and deep pit structure with a ventilator shaft and bench that contained a dog burial and turkey bones. The structure was built over portions of the north end of the Area A Pueblo I roomblock (Structures 1049 and 1063, Figure 4). Two samples were analyzed – one from beneath groundstone that was set on the bench and the second from a slab-lined pit (Feature 6). There was little evidence of economic pollen. Two exceptions are relatively high percentages of sagebrush in both samples (2-3%) and, in the sample collected from beneath the groundstone, the second project occurrence of carrot family and two grains of prickly pear pollen. Maize is present at a low count (two grains) in the pit sample.

Pueblo I Roomblock, Structures 1063, 1073, and 193

At least five rooms are part of a Pueblo I roomblock in Area A (Structures 1049, 1063, 1066, 1067, and 1073/193) and appear to have been back rooms (Throgmorton et al. 2021). Pollen samples were analyzed from three of the rooms and two of these rooms (Structures 1063 and 1073) preserved the richest economic record from all of the project pollen samples.

<u>Room 1063</u> Five pollen samples were analyzed from Structure 1063, four from the prepared floor surface and one from a surface contact and the fill above (PD 799 FS 3). The sample from the surface plus fill registered maize pollen only as a scan-identification which contrasts with the prepared floor samples where high maize counts were documented in three of the four samples, high counts of cholla in all four samples, including the project maximum of 10 cholla grains in two prepared floor samples, and presence of squash in one of the prepared floor samples. The only project identification of walnut pollen, a riparian indicator, was also documented from one of the floor samples.

<u>Room 1073</u> Room 1073 was built during the earliest constructure phase of the Pueblo I roomblock. Five pollen samples were analyzed this room: two from a prepared floor surface, two from beneath artifacts on the floor, and one from a deeper (stratum 2) ephemeral or reuse surface (PD 834 FS 1). The sample from the ephemeral or reuse surface produced two grains of squash pollen and high counts of maize, cholla, and prickly pear. The four prepared floor surface samples are characterized by high maize counts (three to seven grains) and prickly pear (three to 12 grains). The prickly pear in this room is the project maximum in terms of both counts and sample frequency. The second site occurrence of cotton pollen is from sample PD 762 FS 2 which was collected from beneath a reconstructible Moccasin gray jar (PL 45) (Figure 5). The second project identification of lily family is from beneath PL 38 on the prepared floor surface (PD 762 FS 4). Crane’s bill pollen was identified in one floor sample (PD 762 FS 5).

Figure 5. Moccasin Gray jar excavated with Structure 1073 from Surface 1 (from Throgmorton et al. 2020: Figure 7, p. 26).

Room 193 A single sample was analyzed from Room 193 which was built into Room 1073. The sample is described as taken from Paho marks and was extremely small at five grams weight compared to the general 30 grams processed from other archaeological samples. Despite the small sample size, an assemblage was recovered that included two grains of maize, presence of prickly pear, and the only project identification of purslane pollen. The results suggest a general floor assemblage and not ceremonial plants.

Structure 186

Structure 186 is a masonry surface room with two remodeled floors superimposed over Rooms 193/1073. The pollen results are from three samples collected from ephemeral or reuse surfaces. Overall, the economic signature from this room is muted compared to the Area A roomblock. Maize occurs in all three samples (counts of one to three grains) and in one sample, cholla is high and prickly pear present.

COTTON POLLEN FROM THE HAYNIE SITE

Two samples with cotton pollen from the Haynie site is a significant find, even at the low representation of single grains in each sample. The sample from beneath a reconstructible Moccasin Gray jar excavated in Pueblo I Room 1073 is interpreted as coming from a sealed context that lends a degree of confidence to the assessment that the cotton is not due to contamination. The second sample is less secure coming from an ephemeral or reuse surface within the cultural fill of Structure 1042, an early Pueblo II surface room in Area C. However, both rooms were remodeled and disturbed and crane's bill pollen, the inferred historic indicator of mixed sediment, was identified from samples in both rooms, although not in the same samples as the cotton.

One of the more fascinating archaeobotanical stories from the northern Colorado Plateau and the San Juan Basin is the evidence for cotton textiles and the absence of macrobotanical remains or pollen that would prove cotton agriculture. Fragments of cotton cloth and worked fiber are especially visible in the well-documented records from Chaco Canyon Great Houses and north of Chaco at the large San Juan River communities of Salmon and Aztec (Webster 2006, 2008, 2012). Yet, no cotton seeds, boll fragments, or pollen have been recovered from decades of research and 1000's of samples analyzed from the Great Houses and smaller sites around Chaco Canyon (Clary 1984; Cully 1982, 1985; Toll 1985, 1987), as well as from more recent investigations at Pueblo Bonito in Chaco Canyon (Adams 2020b; Smith 2020b; Wills et al. 2016) and from the extensive Salmon Ruin archaeobotanical studies (Bohrer and Doebley 2006; Reed

2006). Furthermore, with two exceptions discussed below, there is no evidence of cotton from pollen and/or macrobotanical analyses completed over the past several decades from several large data recovery projects across the four corners region, as well as all of the Crow Canyon Archaeological Center excavations that include Sand Canyon Pueblo, Shields Pueblo, Goodman Point Pueblo, Albert Porter Pueblo, the Basketmaker Communities Project, and other sites (see Research at CrowCanyon.org). At Hovenweep National Monument, 285 pollen samples were analyzed from suspected field areas near Hackberry, Square Tower, and Horseshoe House with zero cotton recovered (Woolsey 1976); however, maize pollen was identified in 64 percent of the Hovenweep field samples and squash was present in a few samples.

Karen Wright examined the distribution of cotton macro remains recovered from archaeological sites on the Colorado Plateau in addition to growing heritage cotton varieties in experimental plots along an elevation gradient between Flagstaff and Wupatki National Monument, Arizona (Wright 2000). The compiled archaeobotanical record shows that by the Pueblo II period, cotton remains were concentrated within specific regions or communities along the Colorado River, the confluence of the Colorado and San Juan rivers, Antelope House in Canyon de Chelle, and surprisingly, because of the higher elevations, around Flagstaff, Arizona (Figure 5). There is growing evidence for cotton farming near Flagstaff at elevations above 5000 ft (Biddiscombe 2003) perhaps as early as the A.D. 900's. The cotton variety grown was probably the Hopi short-stapled variety (*Gossypium hirsutum* var. *hirsutum* [formerly var. *punctatum*]), which can produce a crop in less than 100 days if conditions are favorable (Wright 2000:26-27).

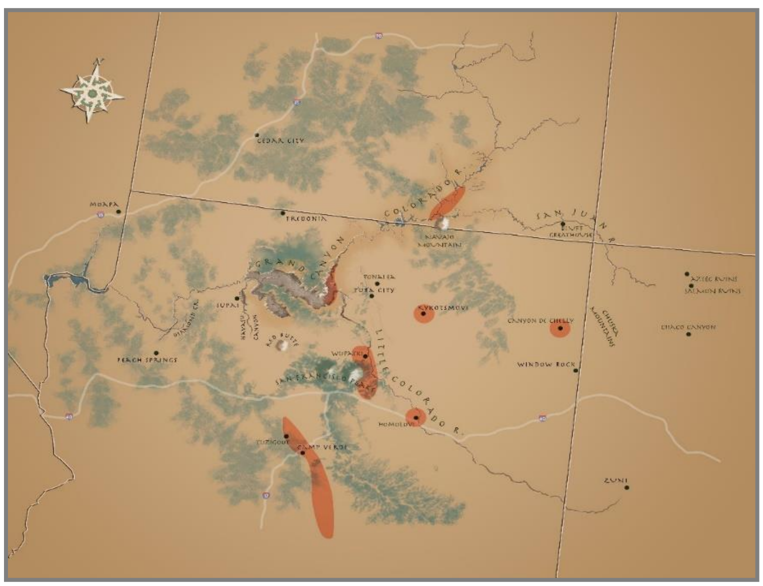

Figure 6. Pueblo II cotton growing regions on the Northern Colorado Plateau based on the archaeobotanical record.

The age of the Pueblo I roomblock at the Haynie site is early for northern cotton. Radiocarbon AMS results from Surface 2 in Room 1073 document a range of intercepts between 770 to 944 cal A.D. (Throgmorton et al. 2022: Table 2, p. 34) which would make the Room 1073 cotton pollen one of the oldest archaeobotanical records from the northern Colorado Plateau, although there is a visible Pueblo I trail of cotton textiles in the northern Southwest. Webster's (2012) comprehensive synthesis of cotton textiles includes the following summary.

> The major textile innovation of the late Pueblo I period was the growing use of cotton. Based on the Kana-a and Wepo ceramics associated with Burial 2, Cave 1 in Tsegi Canyon (AD 850-1000) and the reported dates of the Pueblo occupation at Antelope House in Canyon del Muerto (A.D. 825-850 to 950; Morris 1986:44), we can say with relative certainty that cotton fabrics were made and used in limited quantities in the Tsegi and Chinle drainages (including Canyon del Muerto and the

> western slope of the Chuska Mountains) and probably other well-watered tributaries of the lower San Juan River by the early A.D. 900s, if not earlier. The recovery of cotton seeds, bolls, and weaving implements from Pueblo I contexts at Antelope House indicates the limited cultivation and weaving of cotton by this time, although Magers (1986:272) suggests that much of this cotton was acquired in trade from the south. And what of cotton production outside this region? At this point, the evidence is nil. If cotton cultivation or weaving was occurring or if cotton textiles were being used to any extent east of the present Colorado-New Mexico line during the Pueblo I period, one would expect the carbonized remains of such activities to be preserved in the substantial DAP [Dolores Archaeological Project], ALP [Animas La Plata Project], Rocky Mountain Expansion Loop Pipeline Project, or Navajo Reservoir Project collections. What we seem to be seeing is the inception of a cotton-growing and cotton-weaving industry in the well-watered tributaries of the lower San Juan River by the late Pueblo I period, one that continued into the later Pueblo periods but was never developed to a significant extent in the Mesa Verde, Aztec, or Chaco regions (Webster 2008:186).

In the Southwest, the oldest date from cotton macro remains is A.D. 390-240 from the Eagle Ridge Site in southern Arizona (Elson and Lindeman 1994). There are, however, examples of cotton *pollen* from southern Arizona sites in contexts dated as early as 1250-800 B.C. (Table 5). Pollen evidence from dated features is less reliable than direct dates on seeds but seeds are less likely to preserve for several millennia except for special situations. The growing number of sites with cotton pollen in Late Archaic features suggests that cotton agriculture was part of the economy of some of the first farming communities in the Southwest and knowledge of cotton and cotton products were probably traded throughout the Southwest.

Table 5. Early cotton from Arizona archaeological sites.

Location	Site	Cotton Material	Chronology	Reference
Southeastern Arizona	Christiansen Wash FF:9:10 (ASM)	pollen from extramural pit Feature 132	820-510 cal BC from maize cupule or 1310-1050 cal BC date from mesquite wood	Adams and Smith 2009
Santa Cruz River, Southeastern Arizona	Valley Farms AA:12:736 (ASM)	pollen from dated contexts	San Pedro Phase 1250-800 BC	Cummings and Moutoux 2000
	Santa Cruz Bend	pollen from dated contexts	Cienega Phase 800 BC-AD 100	Fish 1998
Gila River, Central Arizona	Kearney V:13:201 (ASM)	pollen from dated contexts	Cienega Phase 800 BC-AD 100	Phillips 2000
	Snaketown trash mounds dated to Sweetwater Phase	cotton seeds in dated features	AD 300-100	Bohrer 1970
Roosevelt Basin, Central Arizona	Eagle Ridge Site	directly dated cotton seeds	AD 390-240 (C^{14} date 1725 ±65)	Elson and Lindeman 1994
Northern Arizona	Antelope House, Canyon del Muerto	seeds	AD 500	from Wright 2000
	Elden Pueblo, Flagstaff	seeds and hulls	AD 900	Biddiscombe 2003:60

The lack of botanical cotton remains in the San Juan Basin cannot be due to a preservation bias or related to the technology of cotton agriculture and processing, as cotton seeds and pollen are visible at small and large sites where cotton was cultivated. For example, one-house farmsteads along the Colorado River in Grand Canyon National Park have produced both cotton seeds and pollen in fewer than six samples (Adams et al. 2016), and at the large Homolovi site near Winslow, Arizona, Karen Adams identified cotton seeds in greater than 50 percent of flotation samples (Adams 1996). Late Coalition gravel mulched fields along the northern Rio Grande River in New Mexico produced cotton pollen in 39 percent of the 215 samples analyzed (Camilli et al. 2019:34). These considerations and the geographic patterns of textiles indicate that a lively trade of cotton cloth and weaving fiber was flowing into the San Juan Basin, a speculation forwarded by several researchers, for example Bohrer and Doebley (2006:739), Magers (1986), Webster (2012), and Wright (2000).

There are glimpses of cotton pollen at two archaeological sites from the northern Colorado Plateau documented from relatively recent research. One is the Vidal Great Kiva (A.D. 1100-1140's) (LA 16254) located north of Gallop, New Mexico, near the Heaton Canyon and Rio Puerco confluence, where cotton pollen was recovered in one sample out of 11 samples analyzed from the Great Kiva floor (Smith 2020c). The second site is the Bluff Great House along the San Juan River, Utah where cotton pollen was identified in two samples out of 57 samples analyzed, but no cotton macro remains were found in 26 macrofloral samples (Cummings and Puseman 2009). Both of the Bluff samples with cotton pollen are from kivas – the antechamber of the Great Kiva and the center of the Northeast Kiva.

These two sites with cotton pollen in kivas complement Webster's (2008) direct comparison of Salmon Ruin and Chaco Canyon textiles that documented woven cotton fragments and weaving tools, such as battens and spindle whorls, were exclusively from kivas, rooms associated with kivas, and burials. This pattern must reflect the ceremonial role of cotton including a special connection with burials which is also important to contemporary Indian cultures. For example, the Hopi placed cotton over the faces of deceased persons as a symbol of their transformation into clouds (see Huckell 1993:177). Clouds bring the blessing of rain to the arid Southwest, and cotton as a symbol for clouds is referenced in several ethnographic accounts.

There are several possible scenarios to explain the source of the Haynie cotton pollen, but first and foremost flowers are indicated because of cotton's unique pollination ecology. Cotton is an insect-pollinated plant that flowers in a spiral pattern from the lower to top branches over the course of about two months (McGregor 1976:172). Each mature flower is receptive to pollination for only one day, opening in the morning, closing in the evening, and dropping to the ground soon after, apparently retaining most of the pollen produced within the withered flower (Hasbargen 1997:39). From the pollen perspective, the best context to find evidence of cotton is in old fields. The boll is the harvested part which is full of fibers that evolved to protect the seeds. If cotton flowers were introduced into structures at the Haynie site, then cotton may have been cultivated nearby perhaps in small, specialized plots. It is also possible cotton flowers were imported as a trade item. The evidence suggests direct use of flowers for ritual or ceremony, and another possibility is painting with a special dye made from the flowers (Glenna Dean, personal communication).

CONCLUSIONS

The pollen results from the Haynie site contribute insights about the people who lived at the Pueblo I-II roomblocks and pit structures surrounding two Chacoan Great Houses. It is no surprise that Haynie was a community of farmers as agriculture was the economy of prehistoric Southwest Colorado, as it is today. What is impressive is the abundance of maize pollen that indicates the site's location between two drainages, McElmo Creek and Simon Draw, was especially productive farm land. Comparing the Haynie site to just four of the larger regional pollen projects completed by Crow Canyon Archaeological Center (Table 6), the Haynie samples register the highest sample ubiquity of maize, as well as four other key economic plants – squash, cotton, cholla, and prickly pear.

Table 6. Representation of the Haynie site core economic pollen types compared to four large sites in the region.

Site	**Haynie 2023 Analysis**	**Sand Canyon Pueblo**	**Goodman Point Pueblo**	**Shields Pueblo**	**Dillard Site 5MT10647**
Reference	This Report	Gish 1988, 1990; Scott and Aasen 1985	Smith 2017	Adams 2015	Smith 2020a
Chronology	PI-PII, A.D. 900's-1100's	A.D. 1250-1280	A.D. 1260-1280	A.D. 770-1245	BMIII
Number of Pollen Samples Analyzed. Excludes Control Samples	45	39	20	37	72
Taxon Ubiquity as % of Samples Analyzed Per Site					
Maize	87	62	85	51	52
Squash	16	0	5	0	1
Cotton	4	0	0	0	0
Cholla	36	10	15	0	8
Prickly Pear	49	10	0	5	10

The occurrence of cholla pollen in greater than a third of the Haynie structure samples and prickly pear in nearly half of the samples, and the absence of any cacti in control samples, highlights the importance of these resources. Cacti pollen is a common element in regional archaeobotanical studies but occurs typically at low counts that could be attributed to natural background pollen rain or wild-harvested resources. There is a rare macrobotanical example from Salmon ruin where charred cholla flower buds were documented from the floor of the Tower Kiva (Room 64W) (Adams 2006:801) indicating cultural, perhaps ceremonial use. The cholla and prickly pear frequencies from the Haynie site are matched by high pollen counts in specific contexts and the overall representation suggests something more than foraged harvests. Direct cultivation of these easy to grow cacti in plots near the site or managed local populations seems indicated. Several researchers have suggested that deliberate cholla cultivation or management was widespread throughout the Southwest (Hodgson 2001:115-116 and see Doolittle 2000:70).

Other interpreted Haynie subsistence plants that were identified at low counts in few samples are carrot family, a large grass type that is probably Indian ricegrass but could represent little barley grass as another cultivar, lily family (probably yucca), and purslane. Relative abundance of pinyon pine pollen and low, but consistent, juniper confirm presence of these trees which undoubtedly supplied wood and other useful products for everyday life. The dominant Cheno-am representation is evidence of other readily accessible foods that included four wing salt bush seeds and the late summer greens and seeds from weeds of goosefoot and pigweed.

The comparison between Haynie site structures showed differences in the distribution and abundance of economic pollen. Maize pollen was most abundant in two rooms that had been intensely used based on the evidence of remodeling and rebuilding. These are the Area C Pueblo II Rooms 1026/1042 and the Area A

Pueblo I Rooms 1073/193. One of the two samples from Room 1042 (PD 598 FS 1) was almost pure maize pollen. The pollen results from these rooms also included cotton and squash. The concentration of cultigens suggest these rooms were centers of activity for processing harvests. In the Pueblo I roomblock, contiguous rooms 1063 and 1073 preserved high maize counts but not as high as the Pueblo II Rooms 1026/1042. Cacti was most abundant in the Pueblo I roomblock where the project maximum cholla is from Room 1063 and the project maximum prickly pear from Room 1073.

Twelve samples from Kiva 1003 in Area C were characterized by moderate maize and less cacti than other structures but more grass pollen and the large grass type. The grass could reflect a food resource or more likely thatch materials for roofs and possibly floor mats. Pit structures 1024 and 1047 stand out with the least maize of the sample set. Sagebrush was notable in both Structures 1024 and 1047 which could relate to ceremonial activities. Both structures contained complex floor assemblages and features.

The exciting pollen results from Haynie is the recovery of cotton pollen in two samples which is a significant find as there is essentially a black hole of botanical cotton remains in the San Juan Basin, peripheral areas, and the Four Corners region, despite analyses of several 1000's of pollen, flotation, and macrobotanical samples collected from archaeological projects over the past 50 years. The lack of archaeobotanical cotton even at sites where textiles and weaving tools have been found has led researchers to conclude cotton fiber and cloth was imported (see Webster 2012).

The pattern opens a Pandora's box of speculations about which cultures and geographic regions were growing cotton and weaving textiles, who the traders were, and why people living in the San Juan Basin were not growing cotton. At the Haynie Site, because the cotton evidence is pollen, use of flowers is indicated, perhaps as a dye or for use in ceremonies. The cotton sample from Room 1073 was taken from beneath a reconstructible vessel which may have held cotton flowers. The low representation in just two of the Haynie samples suggests small-scale cultivation, possibly in special plots for ceremonial use, or alternatively, a trade in imported flowers. If there were a cotton industry at the Haynie site, there should be higher pollen representation based on research from sites where it is clear cotton was cultivated.

The consistent theme in the archaeological record of cotton artifacts from the San Juan Basin is a correlation with ceremonial structures and contexts. Webster's (2008) direct comparison of Salmon Ruin and Chaco Canyon textiles showed that woven cotton fragments and weaving tools, such as battens and spindle whorls, were recovered exclusively from kivas, rooms associated with kivas, and burials. This pattern is echoed in the glimpse of cotton pollen at two sites – from the Vidal Great Kiva near Gallop, New Mexico and in two kivas (one a Great Kiva) at the Bluff Great House at Bluff, Utah. In contrast, the Haynie site cotton is from roomblocks. It will take further research at the Haynie site to find stronger evidence to answer questions about how cotton might have been used and whether it was cultivated or imported.

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Appendix D – Archaeofaunal Report

Please See Next Page

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

Jonathan Dombrosky

Ahna Feldstein

December 13, 2023

Table of Contents

1 Introduction

The Crow Canyon Archaeological Center initiated the Northern Chaco Outliers Project (NCOP) in 2016 (Ryan 2016), and fieldwork began in earnest in 2017 (Simon et al. 2017). The NCOP's main purpose is to study the Lakeview Community, which is a collection of four neighboring Chaco period Great Houses located in southwestern Colorado. The four Great Houses are subsumed by three archaeological sites: the Haynie site (5MT1905), Ida Jean (5MT4126), and Wallace Ruin (5MT6970).

Excavations at the Haynie site (5MT1905) have comprised the vast majority of NCOP-related fieldwork over the last six years. Haynie is a complex, multicomponent ancestral Pueblo archaeological site intermittently occupied between roughly A.D. 800 and 1175 (Throgmorton et al. 2022, 2023). It includes two Great Houses, a large Pueblo I-II roomblock, and numerous other structures and contexts dating to the Pueblo I and II time periods.

Examining archaeofaunal remains from the Haynie site is one important part of the Northern Chaco Outliers Project. In the first year of archaeofuanal analysis, Dombrosky and Gilmore (2023) reported three different findings worth summarizing here. First, the Haynie fauna has a low rate of identifiability associated with a high amount of fragmentation. Preliminary predictive models indicated that thick cortical bone (from medium mammals and larger) fragments are highly associated with unidentifiabiltiy. However, those preliminary models did not take into account whether unidentifiable remains are associated with disturbed contexts, which is a conspicuous feature of the Haynie site. Second, identification rate estimates suggested that new identification types were still quickly added as we progressed through the analysis. Those results indicated that our estimations of taxonomic diversity were still incomplete, but that the Haynie site was still likely not notable in terms of taxonomic diversity compared to other sites in the central Mesa Verde region. Finally, the first year of archaeofaunal analysis also focused on two different rare taxa recovered from the Haynie site: wolf (*Canis lupus*) and bison (*Bison bison*). We developed a highly accurate model used to classify wolf, coyote (*Canis latrans*), fox (*Urocyon* spp. and *Vulpes* spp.), and domesticated dog (*Canis familiaris*) from mandibular measurements using a massive reference database provided by Welker et al. (2021). The model we developed was 100% confident in identifying the mandible specimen from Haynie as wolf. Additionally, we illustrated how we identified bison remains and discussed the clear importance of medium-to-large game procurement at the site.

In this report, we revisit and expand some of these previous topics all while reporting on a year's worth of new identifications. In the identification section (Section 3), we repeat some of the information presented before, but have provided a new subsection that focuses on summarizing the contexts that dogs (genus *Canis*) have been recovered from in the central Mesa Verde region and how the Haynie site compares. The new section called Taxonomic Abundance by Study Unit (Section 4.1) works to identify excavation contexts that are most likely disturbed, and the taphonomy section (Section 4) incorporates this new information into a new model to tease apart factors driving unidentifiablity. Finally, we re-estimate identification rates at the site to gauge taxonomic representativeness and compare these estimates to all of the faunal assemblages in the Crow Canyon database. Our larger goal is to document the quality of zooarchaeological data produced from May 2023 to August 2023; we firmly believe that a focus on data quality is essential to valid archaeological interpretation. Data quality underlies almost every facet of archaeological research.

2 Materials and Methods

There are three analysts associated with the data described here: Jonathan Dombrosky, Eric Gilmore, and Ahna Feldstein. Jonathan Dombrosky has approximately 12 years of experience with archaeofaunal analysis, and he analyzed new specimens associated with this report from May 2022 to August 2023. Eric Gilmore had approximately 3 years of experience with archaeofaunal analysis, and he analyzed specimens as a Crow Canyon Zooarchaeology Intern in the summer of 2022. Ahna Feldstein has 4 years of experience with faunal analysis and was a Crow Canyon Zooarchaeology Intern from May 2023 to July 2023. Jonathan, Eric, and Ahna are respectively referred to as Analyst 1, Analyst 2, and Analyst 3 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), as well as fish, amphibian, and reptile bones (Olsen 1964). 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, 2019; 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 Unique Identification Types (UITs) to estimate taxonomic diversity (Section 5). In the last report, we called this unit the Number of Unique Identifications (NUIDs). The way this unit is calculated is exactly the same. We have simply changed the name after conversations with colleagues.

All statistical analyses and figures were produced with R version 4.3.1 (R Core Team 2023). 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 logistic regression and random forest as the engines for our predictive models. Logistic regression is a powerful modeling engine designed for binary classification (Kuhn and Johnson 2013, 282). Random forest models predict classes based on one or more variables through a large assortment (a forest) of small decision trees (Kuhn and Johnson 2013, 198). Random forest models sometimes outperform more traditional predictive models (Cole et al. 2022).

3 Identified Taxa

There are 2191 identifiable and 5640 unidentifiable specimens so far in the Haynie archaeofaunal assemblage. We have added 590 identifiable and 1359 unidentifiable specimens—for a total of 1949 specimens—since our last report. Our identification rate is still low at 27.98%, which has practically gone unchanged. Of all of the large faunal assemblages that Crow Canyon has analyzed over the years, Haynie currently has the lowest identification rate (Figure 1). Analyst 1 analyzed 62.47% of the assemblage, Analyst 2 analyzed 20.6%, and Analyst 3 analyzed 16.93%. There are 4 classes of animals present:

Mammalia (mammals), Aves (birds), Actinopterygii (ray-finned fishes), and Reptilia (reptiles). There are 4 orders of mammals present, 7 orders of birds, 1 order of ray-finned fishes, and 1 order of reptile. In total, we used 61 identification types (Figure 2).

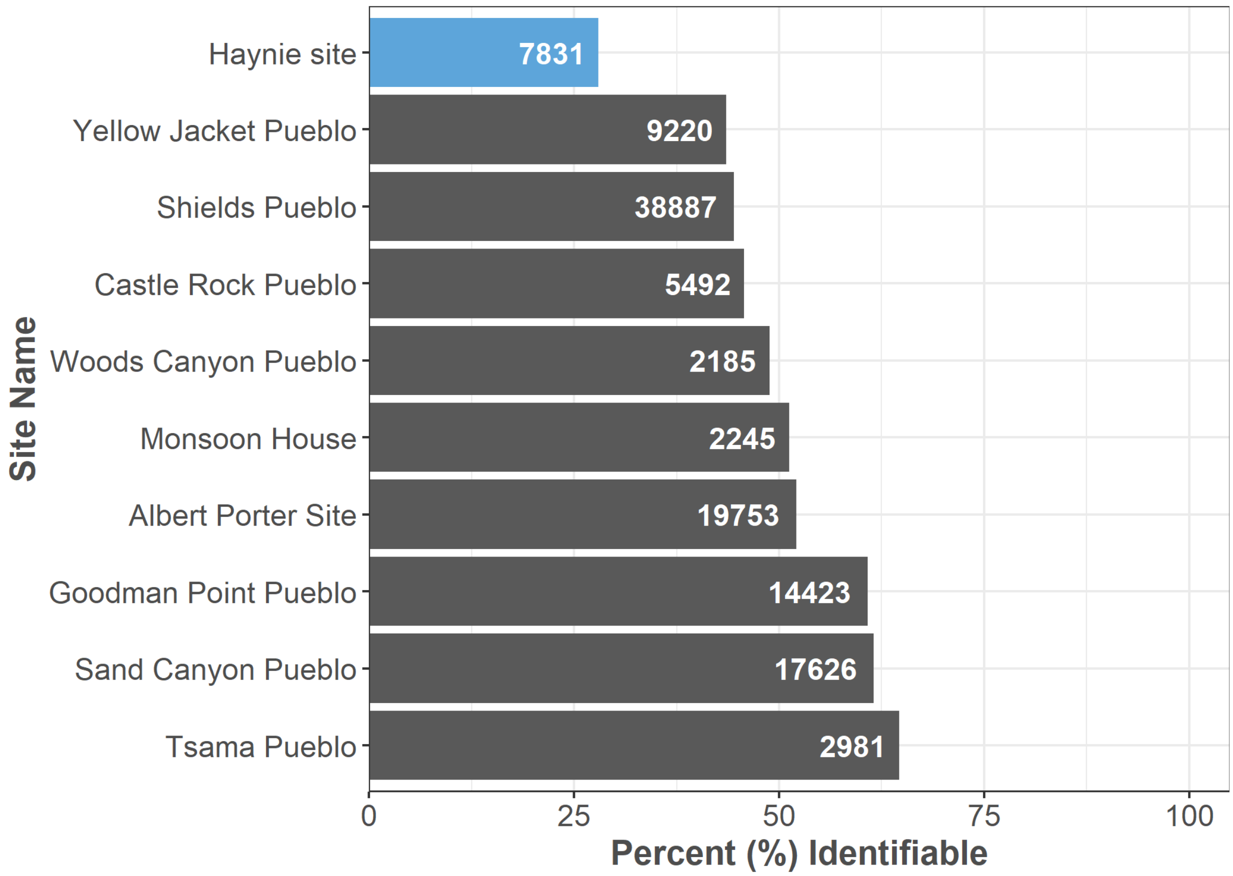

Figure 1: The Haynie site (highlighted in light blue) currently has the lowest identifiablity rate of Crow Canyon faunal assemblages that exceed 1000 Number of Identified Specimens (NISP). Percent identifiable is the ratio of identifiable specimens to all specimens in a faunal assemblage. Number of Specimen (NSP) values for each site are located within each bar. It currently ranks as the 48th lowest identifability rate in the enitre Crow Canyon database among 52 sites.

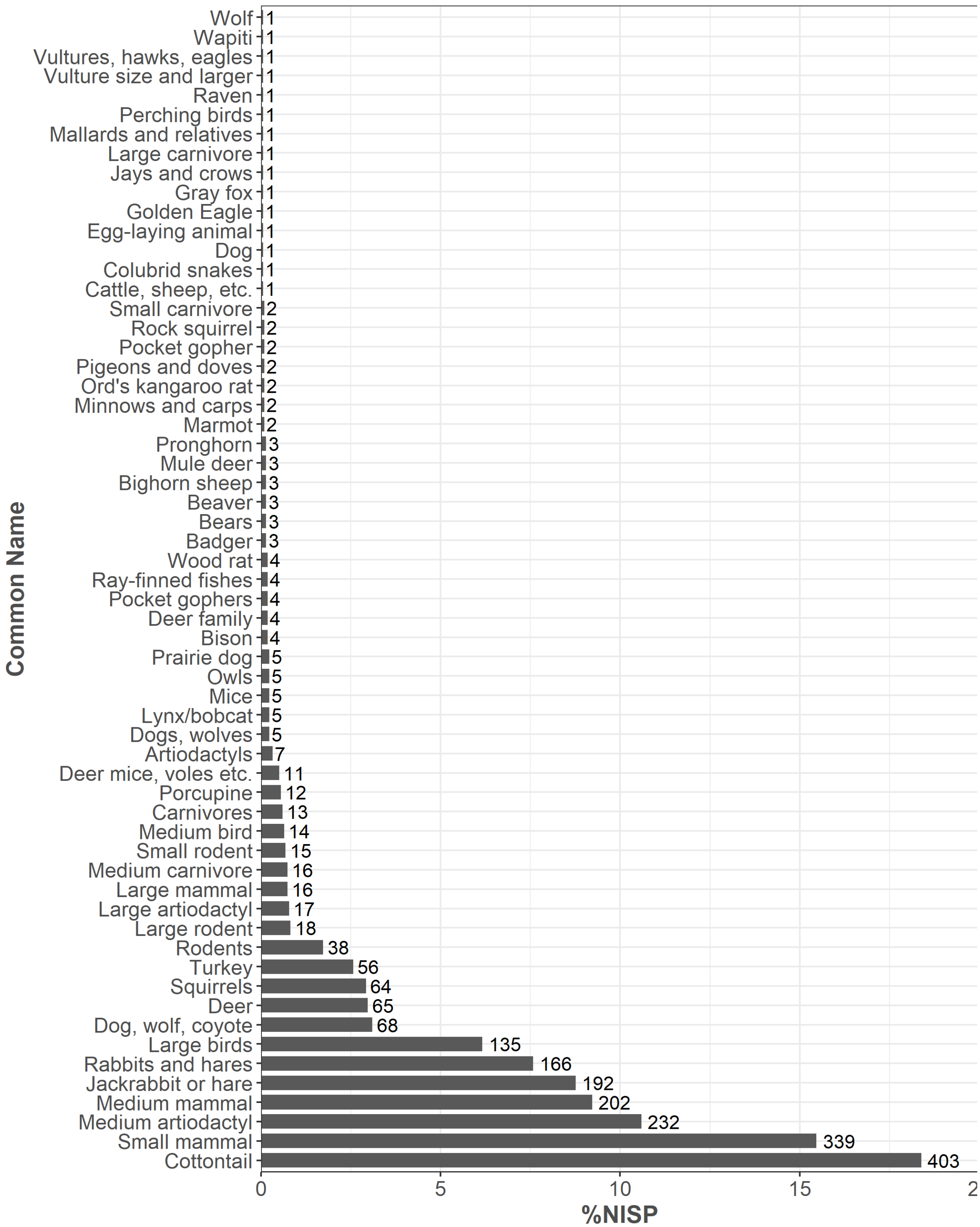

Figure 2: Relative taxonomic abundance at the Haynie site using percent Number of Identified Specimens (%NISP). Raw NISP values are reported next to each bar. Total NISP = 2191.

3.1 Mammalia (n = 1964)

3.1.1 Lagomorpha (n = 761)

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 34.73% 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 western North America in general (Driver and Woiderski 2008). The Lagomorph Index at the Haynie site is 0.68, which indicates a fairly equal relationship between the abundance of cottontails and jackrabbits. Haynie currently has the lowest Lagomorph Index of all the large (greater than 1000 NISP), central Mesa Verde faunal assemblages in the Crow Canyon database (Figure 3). 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).

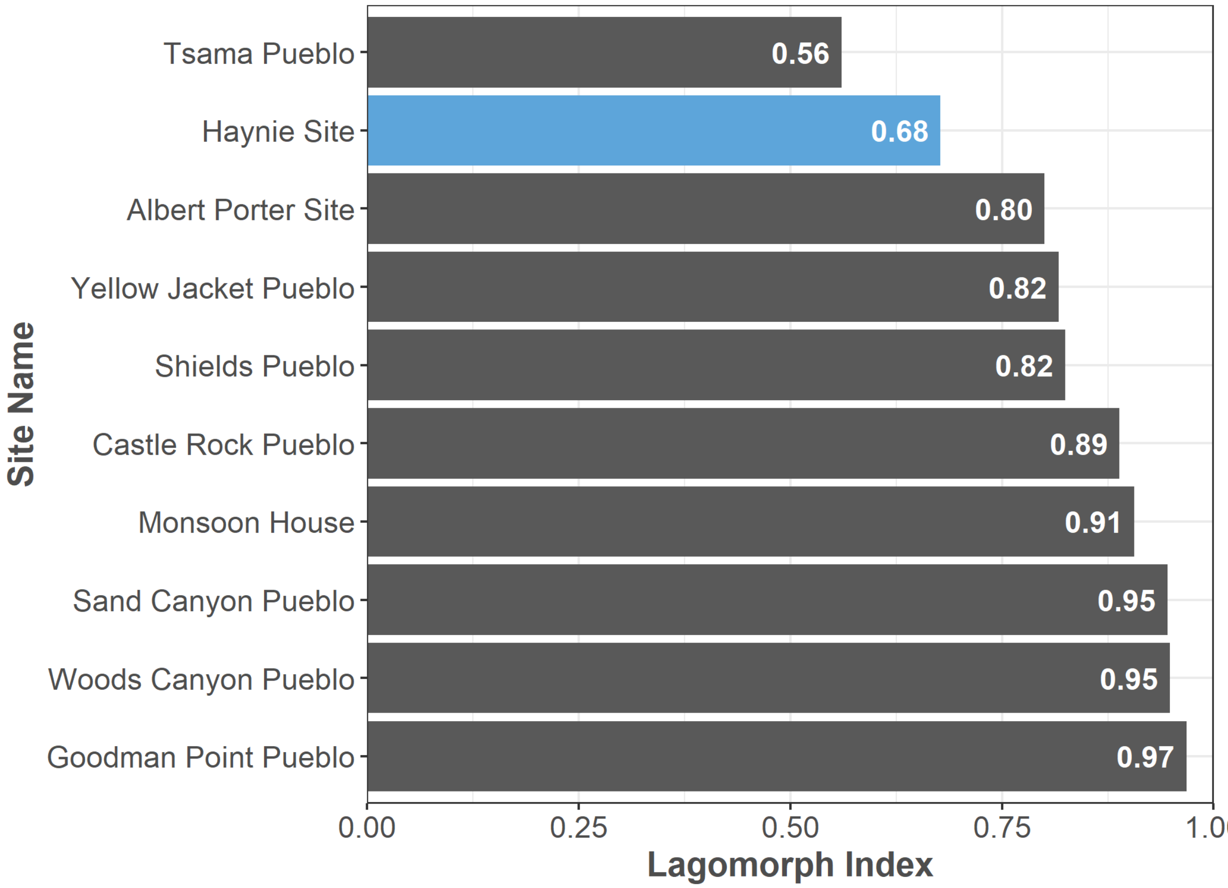

Figure 3: The Lagomorph Index across all faunal assemblages exceeding 1000 Number of Identified Specimens (NISP) in the Crow Canyon database. Currently, the Haynie site has the lowest Lagomorph Index of all the central Mesa Verde assemblages (Tsama Pueblo is a Pueblo IV Northern Rio Grande site).

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 (*sensu* Dombrosky et al. 2023) 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 Small Mammal (n = 339)

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. This identification group will be incorporated into final comparisons of size-based abundance indices through time, between areas of the Haynie site, or between sites. The goal will be to gauge the impact this identification group has on final interpretations of the Lagomorph Index.

3.1.3 Artiodactyla (n = 340)

Even-toed hoofed animals make up the order Artiodactyla, and they are currently 15.52% of identified specimens at Haynie. Substantial zooarchaeological evidence 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 0.31. This value may seem somewhat low, but in reality it is quite high. The Haynie site has the highest Artiodactyl Index of all the large (exceeding 1000 NISP) faunal assemblages in the Crow Canyon Research Database, the only exception is a Pueblo IV site from the Northern Rio Grande called Tsama Pueblo (Figure 4).

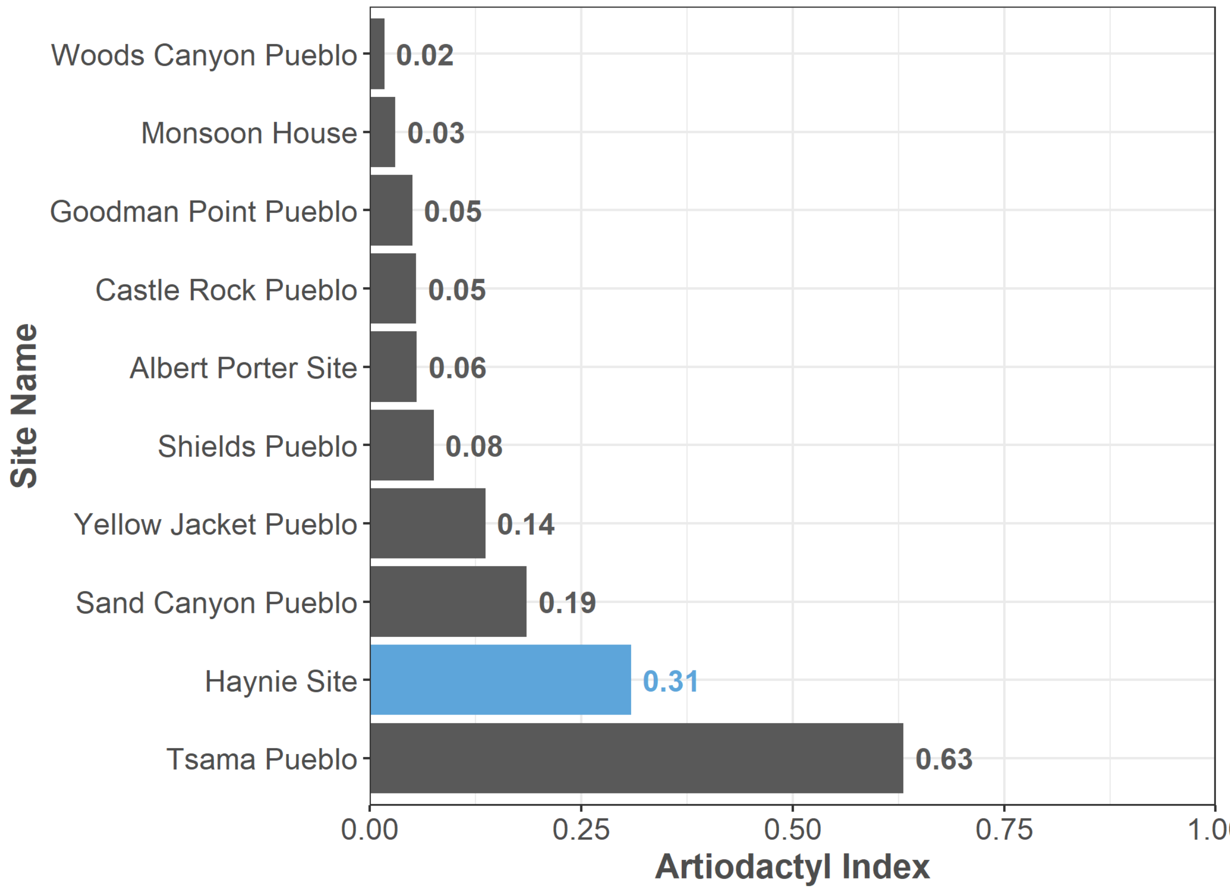

Figure 4: The Artiodactyl Index across all faunal assemblages exceeding 1000 Number of Identified Specimens (NISP) in the Crow Canyon database. Currently, the Haynie site has the highest Artiodactyl Index of all the central Mesa Verde assemblages (Tsama Pueblo is a Pueblo IV Northern Rio Grande site).

Large artiodactyls—elk (*Cervus canadensis*) and bison (*Bison bison*)—are also notable parts of the Haynie archaeofaunal assemblage. These specimens comprise 6.47% of artiodactyls. There are currently 4 bison specimens, and Dombrosky and Gilmore (2023) reported on these specimens in detail. It is worth noting that stable isotope and radiocarbon analysis are planned for these specimens within the next few months. The goal is to determine whether there is more than one bison individual present at the Haynie site.

3.1.4 Medium Mammal (n = 202)

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 = 187)

Rodents are 8.53% 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 39.04% (n = 73) 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. 2023). 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 18.72% 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 = 119)

Carnivores are a small portion of currently identified specimens at the Haynie site (5.43%), but a number of canid specimens were discussed in detail in last year's report (Dombrosky and Gilmore 2023). There are currently 76 specimens from the family Canidae in the Haynie site fauna. Many of the specimens come from an articulated domestic dog offering and one specimen is a wolf mandible. We provide a contextual analysis of *Canis* spp. deposition across all Crow Canyon projects considering the importance of this group of animals to the Northern Chaco Outliers Project.

3.1.6.1 Spatial Context of *Canis* spp. Specimens

Domestic dogs and their wild counterparts filled many roles within the Ancestral Pueblo world; dogs were used for companionship, raw materials, subsistence, and in ritual practices such as dedicatory offerings in burials, and artistic depictions (Monagle and Jones 2020). Recent investigations from Arroyo Hondo Pueblo suggest that, contrary to our modern interpretations of domestication, no such dichotomy existed between domestic and wild canids in Pueblo society (Monagle et al. 2018). Coyotes and dogs often swapped or shared roles within their communities, and both species were included in instances of ritual deposition (Monagle et al. 2018).

It is clear that canid remains offer great insight into past human lifeways (Semanko and Ramos 2022), and they hold an especially important space within the cultural landscape of the central Mesa Verde region. Aside from the turkey (*Meleagris* spp.), dogs are commonly cited as the only domesticated animal within this region prior to Spanish colonization. Ethnographic research on historic and modern Pueblo communities suggests that canids fulfilled specific roles as protectors, warriors, companions, hunting assistants, spirits, messengers, pests, trash-eaters, food, witches, and sometimes even substitutes for humans (Monagle and Jones 2020). The time-depth and spatial patterning of canine deposition is highly diverse in this region (Hill 2000). The Haynie faunal assemblage contains specimens attributed to domestic dogs, coyotes (*Canis latrans*), and wolves (*Canis lupus*), meaning that human-canid relationships are especially complex at this site.

For estimating the relative abundance of canid specimens at Haynie, NISP was chosen as our basic unit of analysis. As an additive measurement of taxonomic abundance, NISP avoids those issues of aggregation which often accompany derived units such as MNI (Minimum Number of Individuals). NISP and MNI

nonetheless often share a strong correlation which may be examined to address issues of fragmentation and interdependence (Grayson and Frey 2004).
There are currently 70 specimens from the genus *Canis* in the Haynie archaeofaunal assemblage. The genus *Canis* includes domestic dogs, coyotes, and wolves. Taxonomic classification beyond the genus level is notoriously difficult based on post-cranial morphology, but select specimens from Haynie have been identified to the species level. Taxonomic identifications based on unique Provenience Designation (PD) are represented by Figure 6.

Canid specimens are relatively rare across the entire Crow Canyon archaeofaunal database, contributing less than 8% of total NISP at all sites (Figure 5). Canid remains at the Haynie site comprise a mere 0.89% to the total raw NISP of 7831. Given the established role of dogs, coyotes, and wolves within Pueblo society, the overall scarcity of canine remains indicates a selective process of canine deposition.

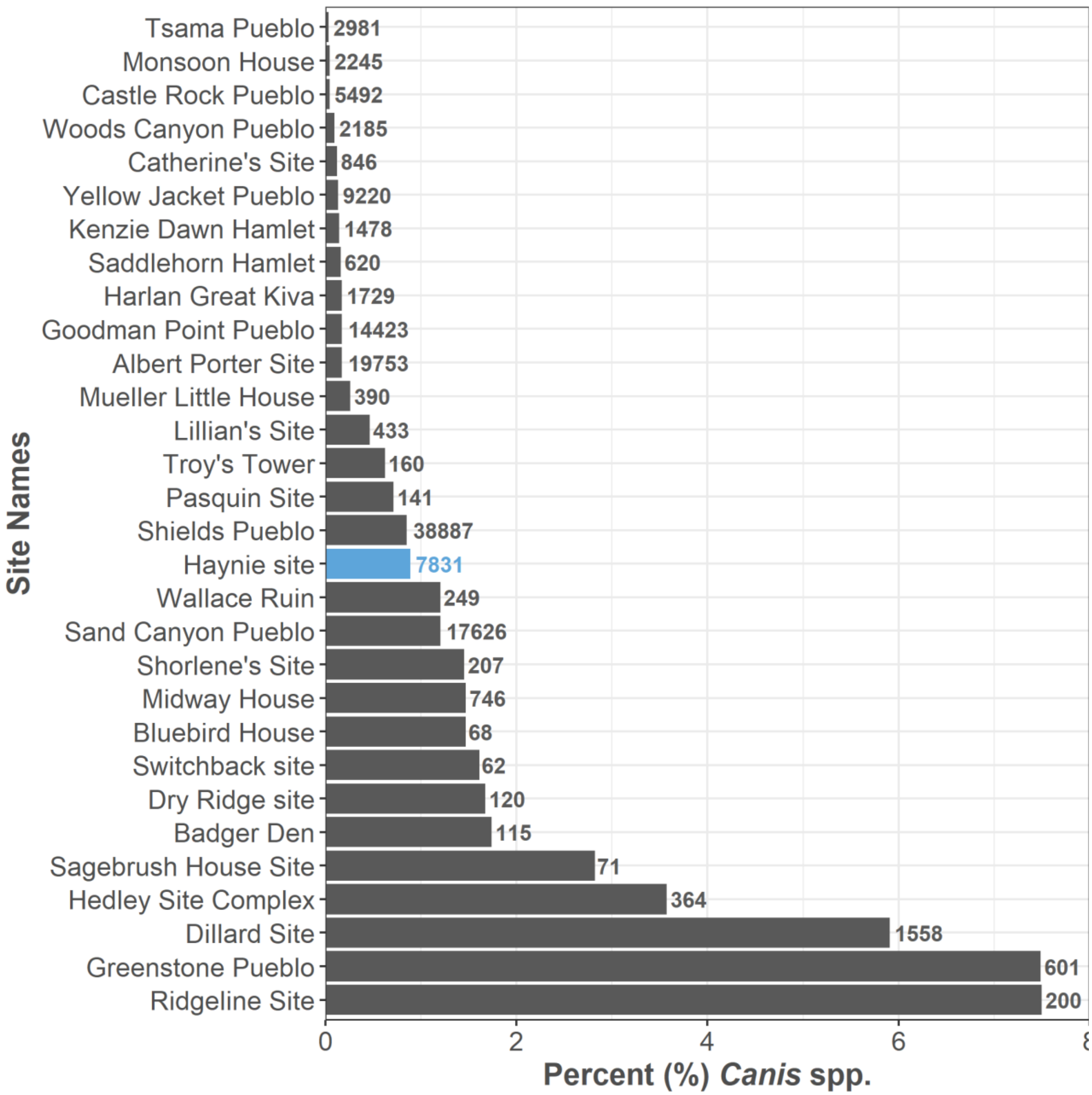

Figure 5: Relative abundance of all specimens identified to the genus Canis across the Crow Canyon faunal database. Raw total NISP values per site are reported next to each bar.

An initial spatial analysis of canine deposition at Haynie helps untangle the complex relationship between humans and dogs within Ancestral Pueblo society. By observing the abundance and spatial distribution of their remains, we begin to understand key associations between canine individuals and the built environment. A canid's transition from life to death is preserved in its deposition, allowing us to glean information on how these individuals were felt, seen, and treated by their human counterparts. Continued contextual analysis of canid remains offers greater potential to understand how the Haynie site may adhere to or diverge from local trends of animal management within the broader Mesa Verde region.
To evaluate the spatial distribution of canid remains, we first pursue analysis based on provenience designations (PD) for each specimen at Haynie. According to the Crow Canyon Field Manual (Center (2001)), an artifact's PD is assigned based on its mode of deposition and stratigraphic position.

The Haynie assemblage contains two important instances of canid deposition from the first year of archaeofaunal analysis (Dombrosky and Gilmore 2023). The first specimen, a wolf mandible, was recovered from the fill between two floors of a surface room (Throgmorton et al. 2022). The mandible from year one is currently the only specimen identified to *Canis lupus* (see Figure 6), confirmed through the application of predictive modeling with mandible biometrics.

The second set of specimens belong to a single individual, likely a small domestic dog. 56 of the total 70 canine specimens at Haynie belong to this domestic dog, all sharing one distinct PD. The dog's upper half was uncovered from the floor of a pitstructure, and its lower half was deposited outside of the unit (Throgmorton et al. 2022).

During this year's archaeofaunal analysis at Haynie, another domestic dog mandible was added to the database. The mandible was identified to *Canis familiaris* based upon mandibular body width, small overall size, and lack of elongation compared to coyote, wolf, and fox (*Vulpes vulpes*).
Specimens classified as *Canis* spp. are designated to the genus *Canis*, but cannot be identified to domestic dog, coyote, or wolf based on morphological characteristics. Specimens in this category may originate from any of the aforementioned *Canis* species. Coyote remains are likely represented by the *Canis* spp. category, though no specimens from Haynie have currently been identified to *Canis latrans*.

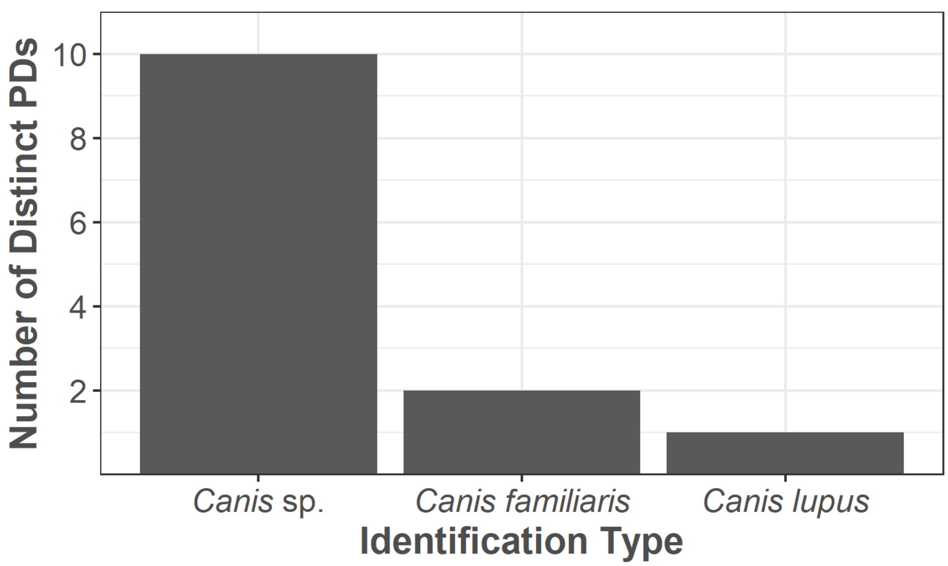

Figure 6: Number of Identified Specimens (NISP) identified to the genus Canis from the Haynie Site (5MT1905). The genus Canis includes domestic dogs (Canis familiaris), coyotes (Canis latrans), and wolves (Canis lupus). A majority of specimens at Haynie are attributed to one instance of domestic dog deposition, recovered from the floor of a pitsctructure (Throgmorton et al. 2022; Dombrosky and Gilmore 2023). The Haynie faunal asseblage also features a rare instance of wolf deposition, and a domestic dog mandible added during the most recent year of faunal analysis.

To begin to examine depositional trends at Haynie, we employ descriptive categories established by Erica Hill to understand general trends across all sites within the Crow Canyon faunal database. The three main descriptive categories of canid deposition include ceremonial trash, dedicatory offering, and simple interment (Hill 2000). For this analysis, we apply the term deposition as opposed to interment to avoid assumptions of intentionality. We also change ceremonial trash to ceremonial discard in the following analysis, in adherence with historic and current Pueblo perspectives. We suggest the future use of ceremonial discard as opposed to Hill’s original terminology, the problematic nature of which is discussed below.

Dedicatory offerings dominate, with the highest NISP counts coming from surface burials (Figure 7). However, specimen interdependence is driving this trend: the articulated remains of a single dog comprise the majority of identified canid specimens at Haynie (Throgmorton et al. 2022; Dombrosky and Gilmore 2023). The small dog’s remains contribute to an inflated NISP count and MNI of 1. Greater overall NISP counts within surface burials may not, therefore, suggest the presence of more dogs; but instead the careful deposition and preservation of select individuals.

The domestic dog’s skeletal articulation and placement adhere to the key characteristics of dedicatory offerings, as outlined by Hill (2000). Dedicatory offerings feature deposition within ritual spaces, often representing the ceremonial closure of architectural features such as kivas. Similar deposition practices have been observed at sites within Mancos Canyon (Monagle and Jones 2020), and from Basketmaker III/Pueblo I period sites in Dolores, Colorado (Hill 2000), illuminating a broader pattern of ritual deposition across the Mesa Verde region.

The deposition of a singular domestic dog mandible in midden reflects our expectations for ceremonial discard. Ceremonial discard involves the ritual dispatch of an individual and their subsequent burial outside habitation areas, usually in a sacred space or shrine. Hill (2000) states that dogs suspected of witchcraft may appear as ceremonial trash. Midden deposits are often regarded as sacred spaces in Pueblo communities (Fladd et al. 2021), and the deposition of objects within middens is considered an important rite-of-passage between the lived and spiritual worlds (Walker and Berryman 2023). This mandible is the most recently-identified domestic dog specimen, and the lone example of ceremonial discard in the Haynie assemblage.

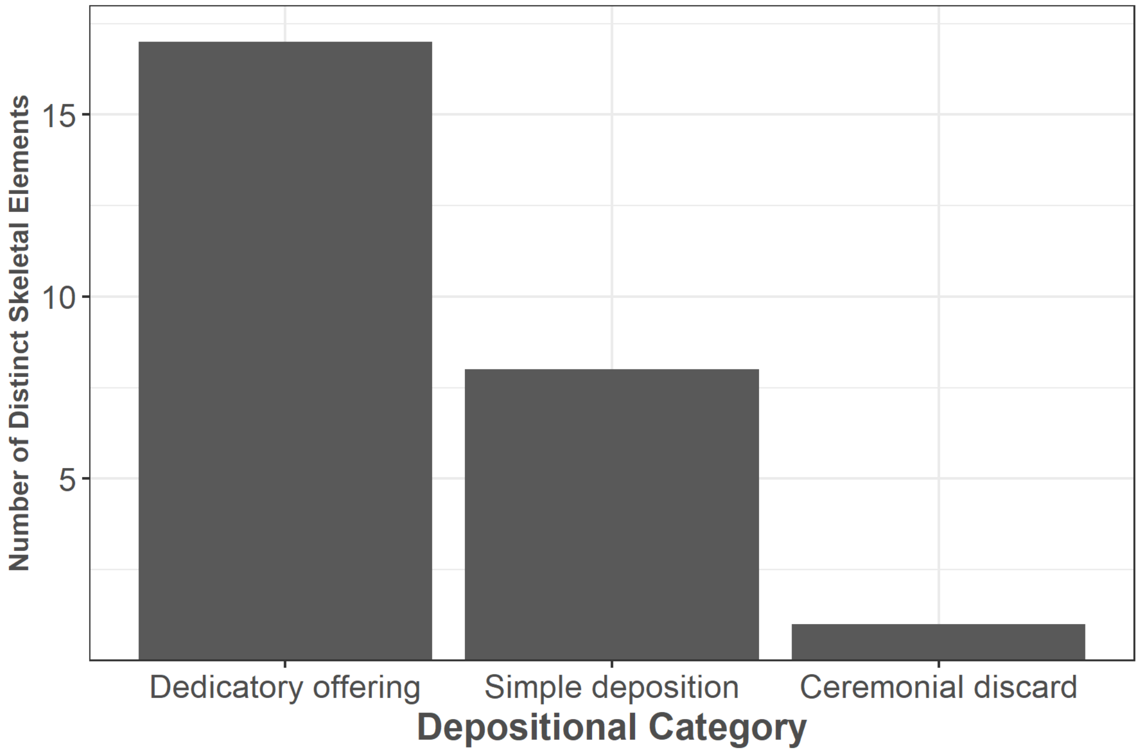

Figure 7: Spatial distribution of canid remains at the Haynie site, according to skeletal part frequency and deposition type.

Hill's descriptive categories offer an avenue for distinguishing patterns within a complex system of human-animal interaction. To gauge how Haynie compares to other sites within the Mesa Verde region, the relative abundance of canid remains per depositional category is assessed across the entire Crow Canyon database (Figure 8).

Across all sites in the database dedicatory offerings are most abundant, followed closely by simple deposition. Simple deposition denotes instances of canid deposition lacking the characteristics of both ceremonial discard and dedicatory offerings. Remains within this category may indicate expedient disposal, focused on the discard of sick or burdensome canines (Hill 2000). Simple deposition may also contain particular forms of deposition which involve ritual behavior, but do not adhere to Hill's classifications (Hill 2000).

NISP values for dedicatory offerings and simple deposition do not differ substantially, though instances of ceremonial discard remain scarce. Less than 2% of canid specimens across all sites fall into the category of ceremonial discard (Figure 8). Limited occurrences of ceremonial discard may imply the limited deposition of canine remains in middens, or their use in depositions outside the scope of Hill's categories. The wolf mandible deposited between two floors is included in simple deposition, and is further discussed below.

Despite small sample size, depositional trends at the Haynie site generally align with those maintained across all sites in the Crow Canyon archaeofaunal database. Overall, dedicatory offerings are most abundant, followed by simple deposition and ceremonial discard. Unlike at Haynie, where NISP values for dedicatory offerings are significantly inflated and contribute less than 75% to the overall sample, no one type of deposition dominates across the entire Crow Canyon database (Figure 8).

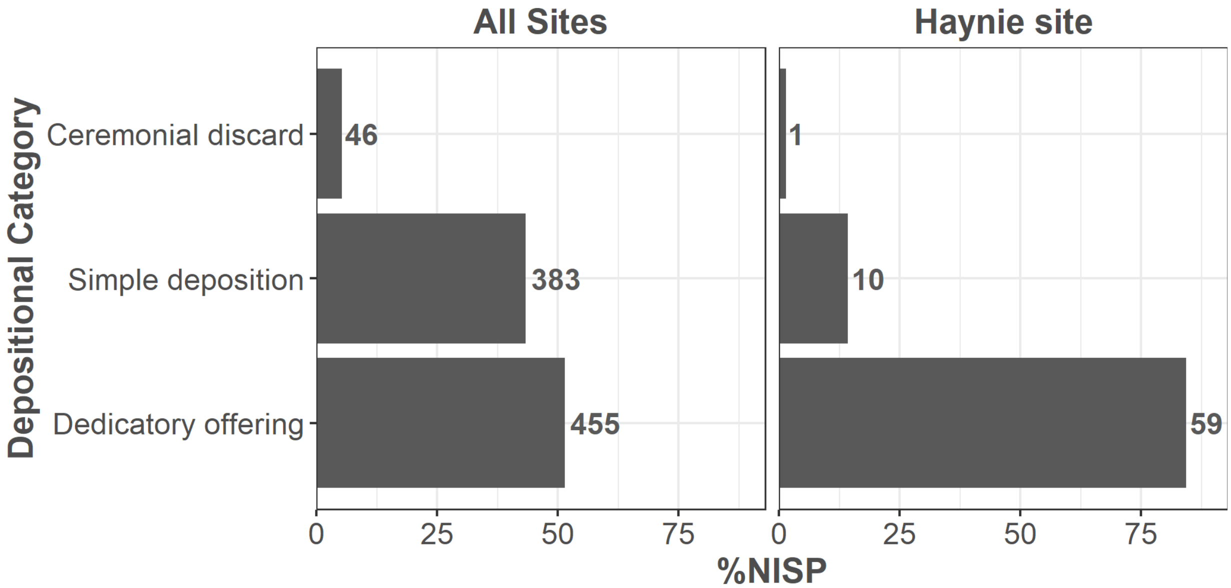

Figure 8: Spatial distribution of canid remains across all sites included in the Crow Canyon archaeofaunal database. Relative abundance of canid specimens (%NISP) per depositional category are presented to visualize inter-site trends. Raw NISP counts are displayed beside each bar.

It is possible that some instances of canid deposition cannot be classified, or have been inappropriately classified according to the aforementioned three categories. Given the sheer volume and diversity of canine specimens in the Crow Canyon database, it is necessary to address the potential pitfalls of Hill's interpretive approach. Some zooarchaeological research calls into question the breadth and scope of Hill's descriptive frameworks. Monagle and Jones (2020) applied these categories to an analysis of Puebloan canid deposition, and found the archaeological data are contradicted by ethnographic accounts which blur the lines between ceremonial trash and dedicatory offerings.

Hill (2000) suggests that dedicatory offerings are differentiated from ceremonial trash based upon the function of the individual in death; dogs who have been ritually dispatched and deposited of as ceremonial trash serve no further role beyond that which they play in life, whereas dogs interred as dedicatory offerings continue to function as social and spiritual actors in death (Hill 2000). On the other hand, Pueblo groups consider discard a integral stage in the life of an object, welcoming its transition from one role in society to the next (Fladd et al. 2021; Walker and Berryman 2023). Hopi people, for instance, place particular emphasis on the intentional retirement of objects with important personal or ancestral connections (Walker and Berryman 2023).

The wolf mandible recovered in year one of archaeofaunal analysis (Dombrosky and Gilmore 2023) represents one such intersection between ceremonial discard and dedicatory offerings. The specimen is classified as simple deposition according to Figure 8, despite its recovery from surface room fill. The mandible cannot be classified as an element of ceremonial discard nor dedicatory offering according to Hill's classification criteria (Hill 2000). The specimen nonetheless represents an intriguing instance of canid deposition. The wolf's mandible may illustrate a specialized process of deposition by its very presence.

Pueblo ideas of canid deposition, both current and historic, offer an important avenue for unraveling the nature of human-canid interaction at Haynie. Moving forward, it is crucial to address the problematic nature of the term "trash" when discussing animal deposition in Pueblo society, as this terminology suggests a sense of indifference toward discarded materials following their deposition (Walker and Berryman 2023). The deposition of canid remains in midden deposits can reflect a range of personal and collective choices, enacted as a way to express, preserve, and commemorate key aspects of the living community (Fladd et al. 2021). We have therefore chosen to employ the term "ceremonial discard" in this analysis, and suggest that this term replace original terminology introduced by Hill (2000) to characterize discard in midden deposits.

Given these perspectives, it is apparent that dog deposition at the Haynie site is highly complex; colored by a vast and nuanced system of human-canid interaction. The application of frameworks such as Erica Hill's (Hill 2000), which employ general descriptive categories, are useful for broader understandings of canine life in Pueblo society. For future analysis, it is crucial that Indigenous perspectives are prioritized as the primary interpretive framework for understanding canine life in the Mesa Verde region.

3.1.7 Large Mammal (n = 16)

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 = 219)

3.2.1 Large Birds (n = 135)

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. As a result, this group is frequently used as it represents a conservative identificaiton.

3.2.2 Galliformes (n = 56)

All Galliformes specimens identified so far in the Haynie assemblage are Turkey, but it is still 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 0.07, 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 0.20. This value is within the normal range for Pueblo I/Pueblo II sites in the central Mesa Verde region (Badenhorst and Driver 2009), but it is the lowest Modified Turkey Index for large assemblages in the Crow Canyon Research Database (Figure 9). Also worth noting, there appears to be an abundance of turkey specimens yet to be identified. It is doubtful that this low index value will remain constant as the faunal sample increases. How Turkey husbandry was managed at the community-level is an essential future area of research for the Northern Chaco Outliers Project. This line of inquiry is one way to delve deeper into aspects of cooperation and identity at the Lakeview Community.

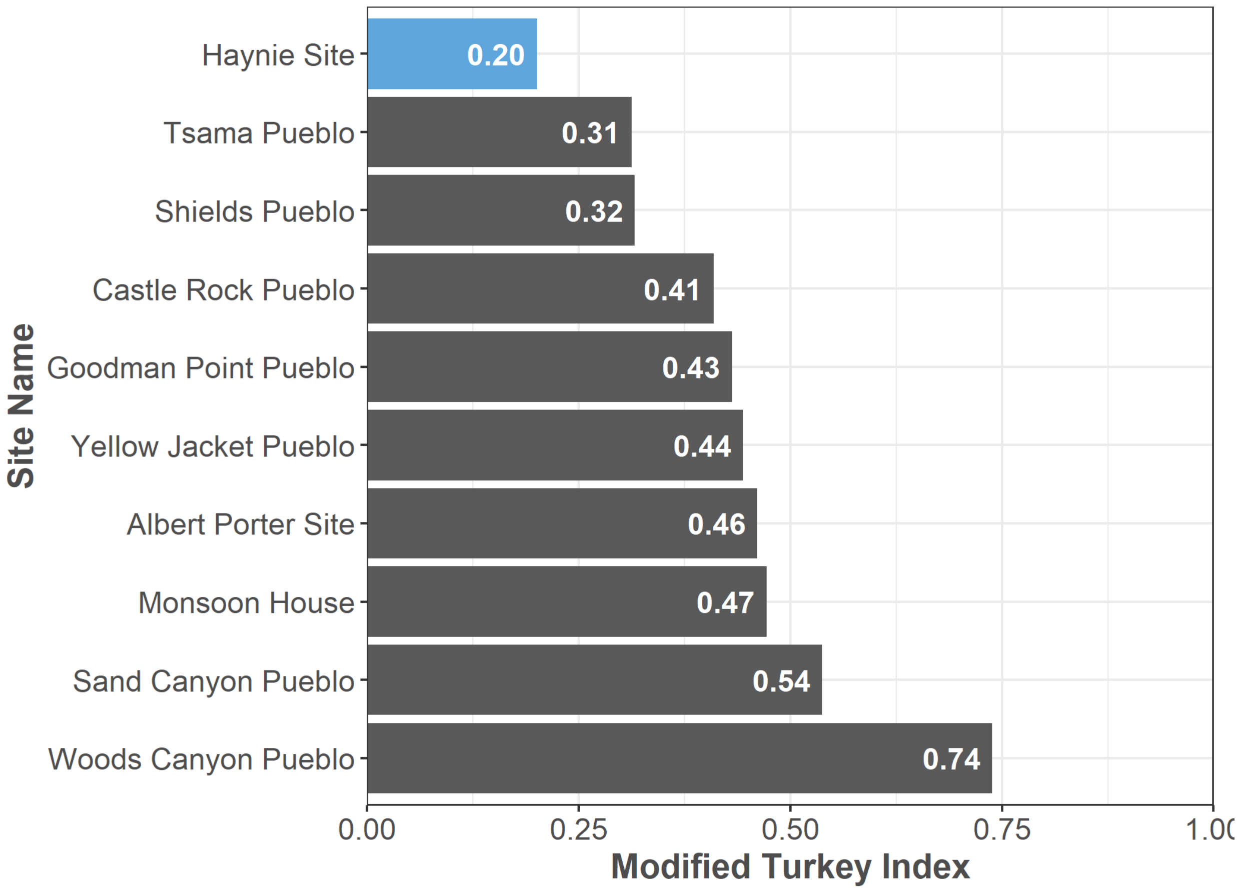

Figure 9: The Modified Turkey Index across all faunal assemblages exceeding 1000 Number of Identified Specimens (NISP) in the Crow Canyon database. Currently, the Haynie site has the lowest Modified Turkey Index of all the central Mesa Verde assemblages (Tsama Pueblo is a Pueblo IV Northern Rio Grande site).

3.2.3 Medium Birds (n = 14)

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 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*).

3.2.6 Columbiformes (n = 2)

Pigeons and doves are in the order Columbiformes, and one ulna fragment and one sternum fragment were recovered from Haynie. These specimens are 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.

3.2.7 Accipitriformes (n = 3)

Two specimens were identified as general members of the order Accipitriformes: one general foot phalanx and one terminal phalanx that compared favorably to a Turkey Vulture (*Cathartes aura*). The other 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).

3.2.8 Anseriformes (n = 1)

One complete carpometacarpus was identified to the genus *Anas* spp. (mallards and other relatives) from the Haynie site. While this specimen could likely represent the common mallard (*Anas platyrhynchos*), Hargrave (1965) mentions the likely presence of Mexican Duck (*Anas diazi*) in the Four Corners region in the past. He based this assertion on the recovery of Mexican Duck feathers associated with Tusayan Polychrome sherds from Glen Canyon. The presence of different mallards and ducks is of potential biogeographic significance and the different members of this genus represent difficult-to-separate taxa.

3.3 Actinopterygii (n = 6)

This taxonomic class includes the ray-finned fishes. Six specimens have been identified to this general class: two ribs and three fragmented vertebrae centra (of which two of these specimens can be identified to the order-level, see below). 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 two specimens are small intact vertebrae. 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 Reptilia (n = 1)

3.4.1 Squamata (n = 1)

One colubrid (family Colubridae) vertebra was identified from Haynie. This specimen was identified to the family-level using Olsen (1964). It likely represents a bullsnake (*Pituophis catenifer sayi*), which is one of the most common colubrids in Cortez, CO.

3.5 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

The most important taphonomic question surrounding the Haynie archaeofauna is: what is causing such a high degree of unidentifiability (Figure 1)? Last year, we posed the hypothesis that the high unidentifiability rate might be related to a high degree of artiodactyl exploitation (Dombrosky and Gilmore 2023). It could be that Haynie site occupants not only obtained a larger than average amount of artiodactyls (Figure 4), but that they intensively and extensively processed artiodactyl skeletal elements for within-bone nutrients as well (*sensu* Wolverton 2002). Haynie site occupants might have caused the high unidentifiability rate through their subsistence practices.

To support this hypothesis, we created a predictive model to test whether or not combinations of taphonomic variables could predict identifiable or unidentifiable specimens. Using logistic regression, we could confidently predict whether specimens were unidentifiable. The model we created indicated that one of the most important variables in predicting unidentifiability was whether a specimen had thick cortical bone. Considering that long bone shaft fragments have the highest incidence of thick cortical bone in our sample, we reasoned that these specimens are most likely linked to the most abundant medium-sized mammals recovered from the Haynie site (i.e., artiodactyls).

However, a crucial variable was left out of the predictive model we created: whether or not specimens come from areas of recent disturbance. This variable is crucial because the Haynie site exhibits extensive evidence for recently disturbed deposits, whether it be through mechanical disturbance, looter's pits, or yard modification (Throgmorton et al. 2022, 2023). Unidentifiability could be linked to a high degree of artiodactyl fragmentation caused by recent disturbance. Here, we explore the relationship between unidentifiability through simple data visualization and hypothesis testing, we then add a new disturbance variable to the logistic regression model we developed last year. We also go a step further and compare our results to a different model type called random forest. This helps answer an additional question: could we develop more predictive accuracy—and clearer variable importance estimations—from using different model engines?

4.1 Identifiability by Recently Disturbed Contexts

There is a surprisingly similar ratio of unidentifiable to identifiable specimens from across disturbance contexts at Haynie given that almost half of the analyzed specimens are from contexts of recent disturbance (Figure 10). Approximately 78% of the specimens from recently disturbed contexts are unidentifiable, and about 67% of the specimens from undisturbed contexts are unidentifiable. Is this 11% difference significant given the sample sizes in each category? To test this question, we conducted a Pearson's chi-square test of independence. It appears there is an association between identifiability and disturbance context ($\chi 2 = 111.86$, $p < 0.01$), with a low effect size (Cramér's V = 0.12).

Inspecting the residuals (the difference between expected and observed counts) reveals an interesting pattern. There are larger residuals for the number of identifiable specimens in both disturbed and undisturbed contexts, while there are smaller residuals for unidentifiable specimens in each context (Figure 11). This suggests that unidentifiable specimens do not deviate from expected counts in each of the disturbance contexts.

Given the large sample size and the inspection of residuals, the association between identifiability and disturbance contexts is of very little practical significance. There is a non-random association, but it is of little magnitude or weight (see Wolverton et al. 2016). These results indicate that recently disturbed contexts will likely have little influence on predicting whether specimens are unidentifiable.

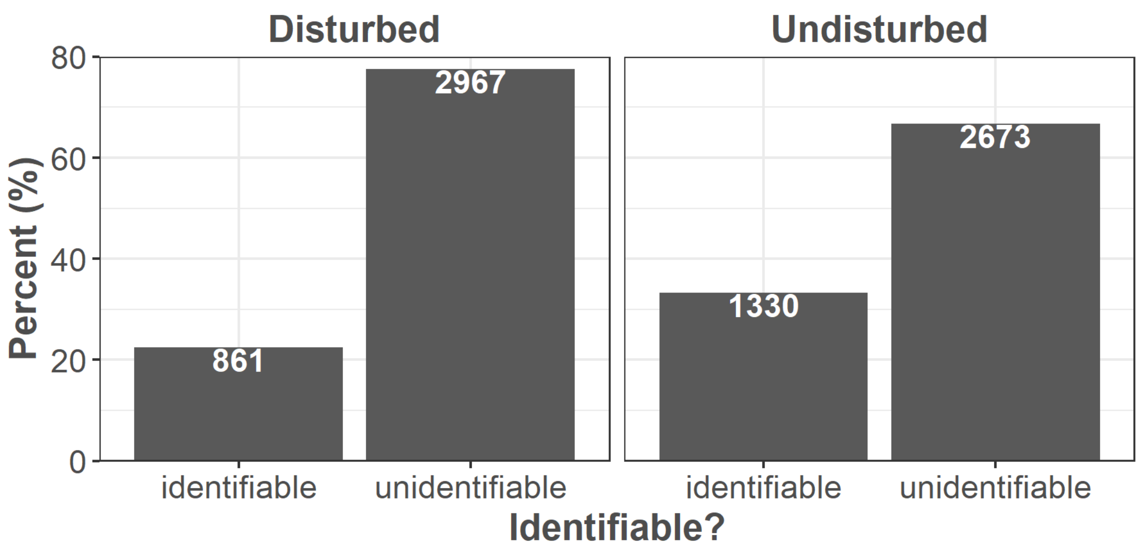

Figure 10: Percent of specimens that are unidentifiable and identifiable between recently disturbed and undisturbed contexts. Raw Number of Specimen (NSP) is reported within each bar.

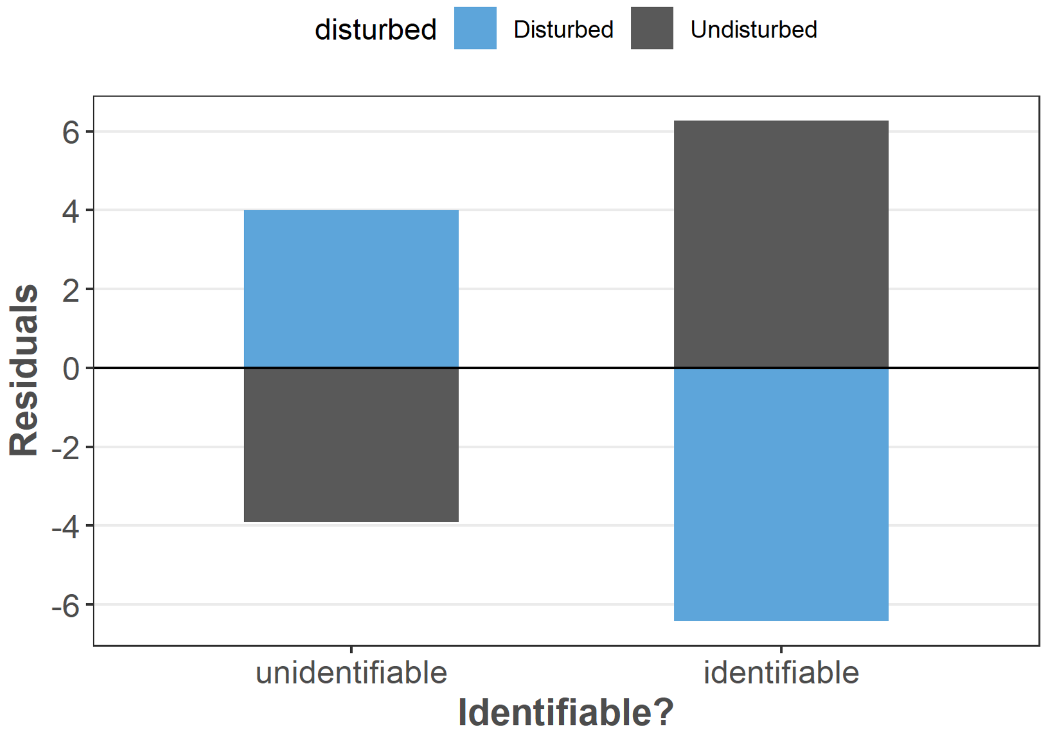

Figure 11: Residuals (difference between expected and observed counts in each category) of identifiability between disturbance contexts. These residuals are an interesting reflection of one another. Residuals are similarly large (though in opposing directions) for identifiable specimens across contexts, and unidentifiable specimens have similarly moderate residuals (though again in opposing directions).

4.2 Updated Taphonomic Model

4.2.1 The Penalized Logistic Regression Model

Similar to last year, we randomly split our data into a training and test set, which comprises 80% and 20% of the data respectively. Our validation set consists of 80% of the data from the training set. This year, we stratified our training, test, and validation sets so that equal portions of identifiable and unidentifiable specimens are within each group. We compare penalized logistic regression and random forest models to predict unidentifiable specimens from this year's sample. Dombrosky and Gilmore (2023) details the logic of creating a predictive model to understand taphonomic variable importance, we do not provide further justification here. The models are supplied with 17 predictor variables for every specimen: if it 1) came from an area of recent disturbance, if it had 2) thick cortical bone, 3) excavation damage, 4) carnivore damage, 5) at least one intact end, 6) a spiral fracture, 7) a transverse fracture, 8) an irregular break, if it was 9) a shaft fragment, 10) made into an artifact, 11) eroded, 12) gnawed by rodents, 13) splintered, 14) root etched, 15) burned, 16) who the analyst was, and 17) its maximum length.

The penalty term in the logistic regression model safeguards against highly correlated predictor variables, which can cause poor model performance. We used grid search on the validation set to tune 40 candidate penalty values, and we picked the one with the highest area under the Receiver Operator Curve (ROC) for our final model (Figure 12). The subsequent model was 87.37% accurate on the training set. Like last year, there was a large discrepancy between two other accuracy metrics. The Matthews correlation coefficient for the trained model is 0.68 while its F1 metric is 0.92. The F1 metric is markedly higher—indicating a model with high performance—because it describes how an event of interest is predicted. In this case, the event of interest is how well the model predicts unidentifiable specimens rather than identifiable ones (Figure 13). The model's accuracy on our test set is remarkably similar, at 87.36%. As such, the logistic regression model fulfills the purpose of this analysis.

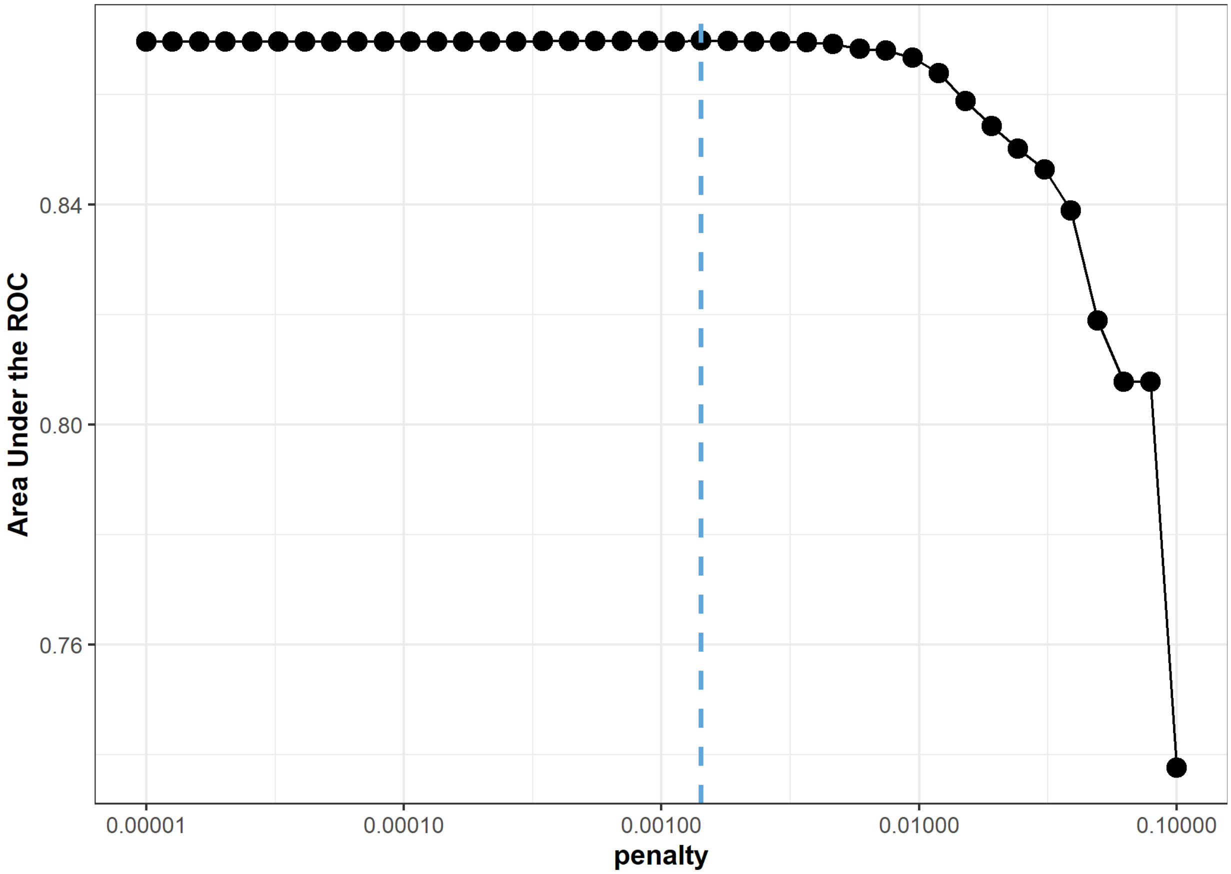

Figure 12: Area under the ROC (Receiver Operator Curve) for 40 penalized logistic regression models fit to our validation test set. The highest area under the ROC is highlighted with a blue dashed line.

Figure 13: 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 number of unidentifiable specimens.

4.2.2 Random Forest Comparison

Though the penalized regression model is generally high performing, it is possible that other predictive model types could provide higher accuracy and performance in different ways. We compare the logistic regression model to a random forest. Random forest models sometimes perform better than logistic regression models as the number of predictor variables increase in a dataset (Kirasich et al. 2018). Our model consists of a number of variables of unknown quality for prediction (i.e., noise versus explanatory variables), which underscores the need for optimal tuning parameters and model performance comparisons.

We tune two parameters in our random forest model: number of predictors randomly sampled at each tree and the minimum number of data points in a node required for further splitting. Parameters were selected using the highest area under the ROC (Figure 14). The tuned random forest model is 87.79% accurate on the training set, and there is a large discrepancy between the Mathews correlation coefficient (0.69) and F1 metric (0.92). These classification metrics for the trained random forest model are almost identical to those from logistic regression. And, indeed, the results are almost identical when comparing the two models' performance on the test set (Figure 15). The random forest model does not increase or decrease predictive accuracy when compared to the logistic regression model.

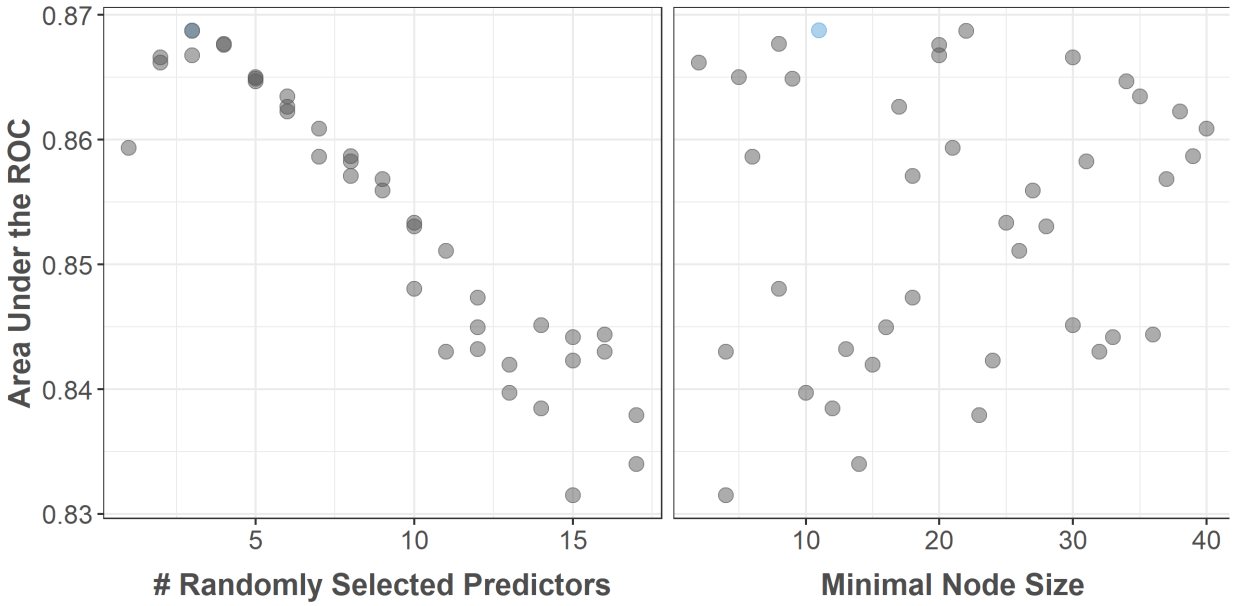

Figure 14: Area under the ROC (Receiver Operator Curve) for two different tuning parameters (number of randomly selected predictors and minimal node size) for 40 different random forest models. Blue points represent the selected tuning values.

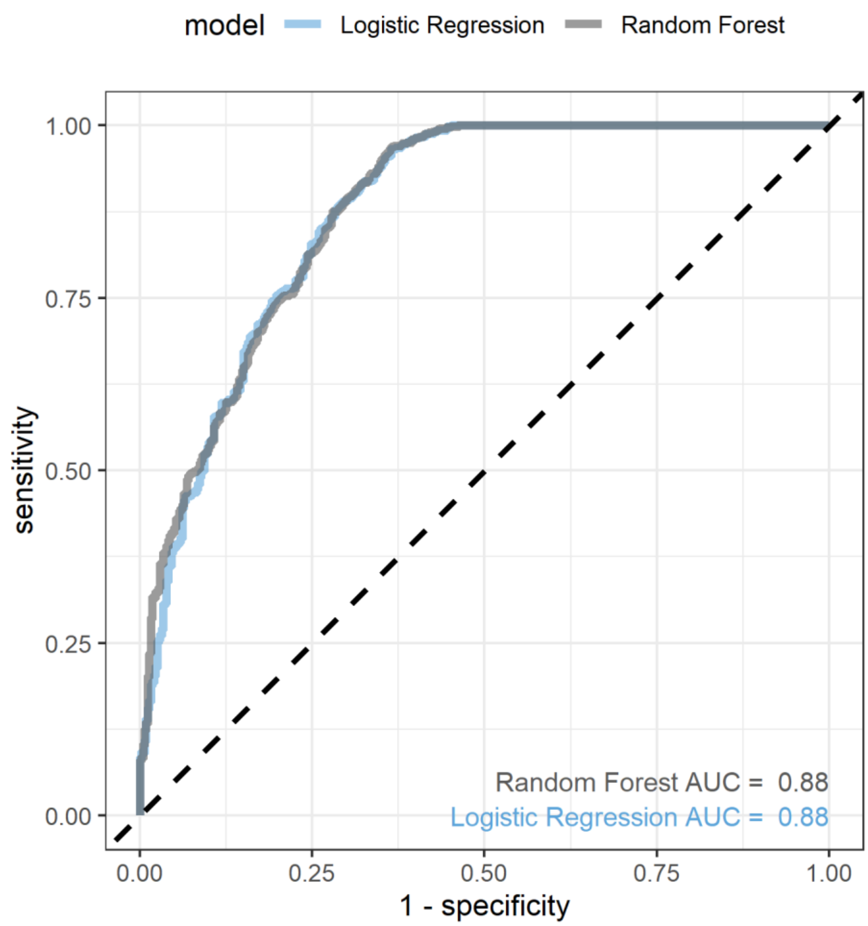

Figure 15: Receiver Operator Curve (ROC) comparing the tuned logistic regression and random forest models' performance on the test set. Sensitivity is the true positive rate, which is how well the models classify truly unidentifiable specimens. The false positive rate (1 - specificity) is the probability that an identifiable specimen will get classified as an unidentifiable specimen. The dashed line represents the area at which a model will have random performance. Area Under the Curve (AUC) is a metric for model performance, where a model with an AUC of 1 equals perfect performance. Both the random forest and the logisitc regression models have an AUC of 88; they are nearly identical.

The random forest model does, however, provide a different view of variable importance, because it uses a series of drastically different steps to predict whether a specimen is unidentifiable or not (Figure 16). Disturbance context is the 7th most important variable in the logistic regression model. The two most important variables, which detract from unidentifiability, are whether or not a specimen has one intact end and the specimen's length. The two most important variables adding to unidentifiability are whether the specimen has thick cortical bone or whether the specimen has a spiral fracture. For the random forest model, disturbance context is the 10th most important variable. The top three most important variables are whether or not there is an intact end, the length of the specimen, and/or whether it is a shaft fragment.

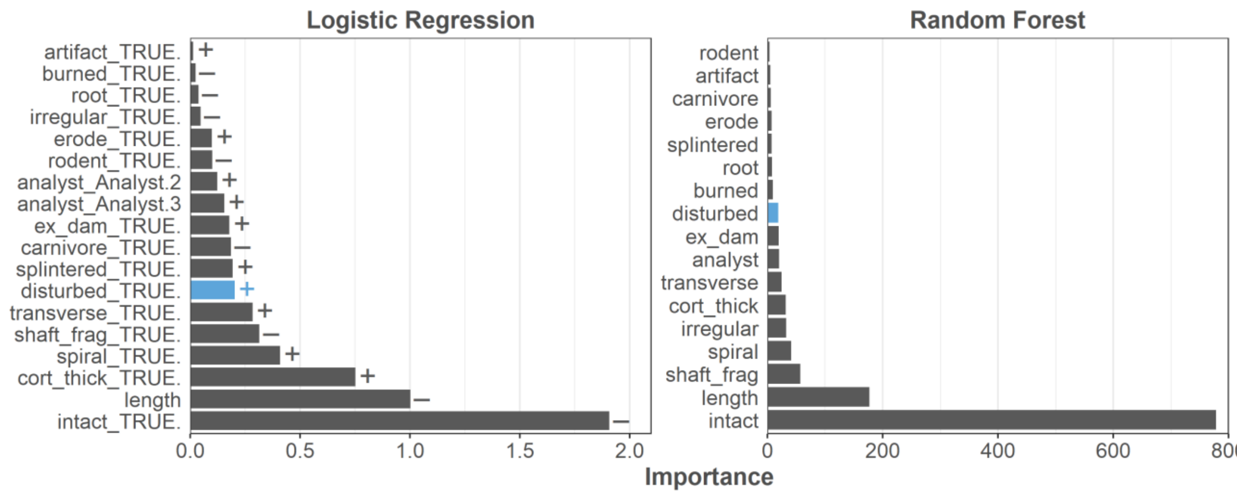

Figure 16: Variable importance plot for the unidentifiability model developed here (Greenwell and Boehmke 2020). The sign of the coefficient is plotted next to each bar for the logistic regression model, which indicates whether the variable adds or subtracts from unidentifiability (the event of interest). The blue bar highlights where recently distrubed contexts fall out in predicting unidentifiability. Disturbance does not significantly impact unidentifiability.

The most important variable across both models is whether or not a specimen has at least one intact end. The more intact a specimen is the more identifiable it is. We believe this result is a sign of high data quality. An assemblage with high identifiability on specimens lacking morphologically distinct features (i.e., intact ends) would be alarming.

Our new models further support the hypothesis that medium-to-large mammal fragmentation is a key taphonomic feature of this assemblage. However, the above results also indicate that disturbance context does not heavily influence unidentifiability. We believe artiodactyl exploitation mixed with intensive and extensive within bone nutrient processing could be the cause of the high unidentifiability rate.

High numbers of artiodactyl specimens relative to other staple hunted animals (lagomorphs) paired with high fragmentation pose a potential conundrum. On one hand, these specimens could indicate efficient foraging practices, where Haynie hunters were able to consistently acquire high-ranked prey. On the other hand, foraging efficiency could have been low since large game were so thoroughly processed. The calculation of fragmentation rates per skeletal part and across the skeleton of individual artiodactyls will help resolve this issue (*sensu* Wolverton 2002). Understanding these patterns through time will be especially important to consider. Future effort should be focused on assessing whether artiodactyl fragmentation increases through time or if the amount of fragmentation remains stable through Haynie's occupational sequence. It could be that culinary practices were thorough—requiring high levels of processing—and remained stable through time.

This future analysis will also help address a glaring and basic issue: is fragmentation artificially inflating NISP values, obscuring the relatively high artiodactyl index at Haynie? Next year's report will focus explicitly on this issue. We will calculate the Minimum Number of Individuals (MNI), Minimum Number of Elements (MNE), %whole, and NISP:MNE at Haynie and across sites in the Crow Canyon Research Database.

5 Taxonomic Diversity and Representative Sampling

Last year, we wanted to understand whether or not Haynie had a more diverse fauna compared to other sites. The Lakeview Community is located in a natural corridor (Simon Draw) that could have facilitated the movement of both birds and large game, supplying highly diverse wild resources to Haynie site residents. We compared rarefaction curves across three other archaeological sites to test this hypothesis (Shields Pueblo, Sand Canyon Pueblo, and Ponsipa'akeri). Rarefaction curves allow us to compare taxonomic diversity across multiple sites (while controlling for sample size) and to assess whether sampling efforts have been sufficient enough to provide accurate taxonomic representation. In our initial analysis we found that Haynie was not remarkably diverse and that sampling still was not suffecient enough to provide an accurate estimation of taxonomic diversity. Here, we update the rarefaction curves with sites across the entire Crow Canyon Research Database that exceed 2000 NISP.

This analysis relies on a non-standard quantitative unit to estimate taxonomic richness called Unique Identifications Types (UITs). 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 (Dombrosky and Gilmore 2023, fig. 18).

Taxonomic diversity accumulates fastest within the Haynie site fauna compared to six other large assemblages from the central Mesa Verde region (Figure 17). However, we do not yet consider the rate of accumulation significantly different enough to argue that species diversity at Haynie is somehow anomalous. One new identification type is added every 116 NISP at Haynie, while the other sites usually add a new identification type about every 162 NISP. Future work will focus on factoring in the duration of site occupation at each site (*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. Additionally, we view analyzing 116 identifiable specimens for every new identification type low sampling effort. Based on these findings, we also conclude that sampling effort has not yet been sufficient enough to accurately capture all of the taxonomic diversity at Haynie. The final word on taxonomic diversity will have to wait until we analyze more specimens. If the rate of change continues its upward trajectory, and does not level-off, Haynie may indeed be interpreted as anomalously diverse faunal assemblage in the central Mesa Verde region.

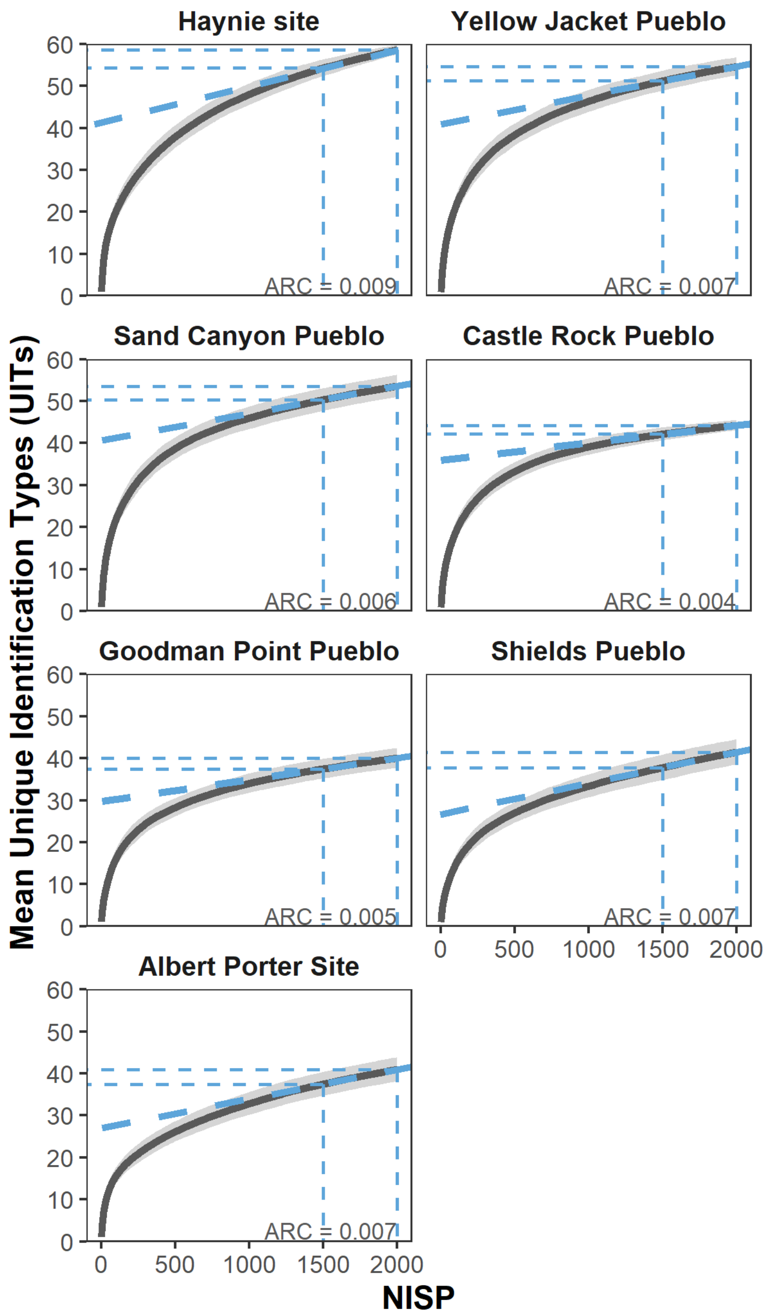

Figure 17: Rarefied species accumulation curves. We randomly selected 2000 identified specimens from each archaeofaunal assemblage and replicated this 500 times, then calculated the mean Unique Identification Types (UITs) as specimens accumulate, along with standard deviation (the gray ribbon). We calculated the Average Rate of Change (ARC) for each curve from 1500 to 2000 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.

6 Conclusion

Archaeofaunal analysis at the Haynie site continues to point to new and exciting areas of research. Inter- and intrasite analysis of canid deposition reveals a complex system of human-canine interaction at Haynie and across the central Mesa Verde region, challenging conventional conceptualizations of domestication. Further analysis will consider canine age profiles and associations with non-canid taxa, painting a more vivid picture of canine-human relationality in Ancestral Pueblo society. Haynie also currently has one of the highest artiodactyl index values in the region, and some of the lowest lagomorph and turkey indices. Taphonomic analysis continues to suggest that high numbers of artiodactyls and the processing of their skeletal parts is a primary cause of the high unidentifiability rate at the site, even when recently disturbed contexts are considered. Next year's report will explicitly include an in-depth analysis of fragmentation patterns at Haynie and across assemblages in the Crow Canyon Research Database. Taxonomic diversity showed that the Haynie archaeofaunal assemblage is not significantly diverse compared to other sites, but that it is likely the most diverse faunal assemblage in the Crow Canyon database. If the rate of accumulation for new identification types continues, then it is possible the Haynie site could be one of the most diverse faunal assemblages in the central Mesa Verde region. Continued sampling will help clarify this possibility. Zooarchaeology is a crucial component of the Northern Chaco Outliers Project and will continue to provide exciting information to the archaeology of human-environment interaction in the U.S. Southwest and beyond.

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