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ADAIR-STEADMAN (41FS2) — SURVEY AT A FOLSOM SITE IN THE BRAZOS RIVER DRAINAGE ON THE SOUTHERN PLAINS

The 2015 through 2019 Work

Stance Hurst and Eileen Johnson

Lubbock Lake Landmark Quaternary Research Center Series
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Texas Historical Commission
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Dr. Stance Hurst, Principle Investigator

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ABSTRACT

Excavations led by Texas State Archeologist Curtis Tunnell from 1969-1974 identified Adair-Steadman (41FS2) as a Folsom period tool production workshop primarily aimed at producing Folsom points. The Lubbock Lake Landmark's regional research program continued the exploration of Adair-Steadman through five annual 1-day surveys from 2015-2019. An Unmanned Aerial Vehicle (UAV) drone was flown to document the site's surface using photogrammetry. Dating sediment samples collected in 2013, using the Optical Stimulated Luminescence (OSL) technique, was completed in 2016. Blossoming mesquite trees were treated with alcohol-based herbicides to maintain the natural landscape at Adair-Steadman in the absence of fire.

Results from pedestrian survey indicates that the exposure of new lithic objects from erosion has slowed down over the last five years. A new lithic cluster area was identified that could be an indicator of an activity area with a subsurface component. A 3D dense cloud, a high resolution digital elevation model, and a high resolution orthomosiac map was created from the overlapping images captured by the UAV. This information was useful in documenting the current surface at Adair-Steadman and monitoring changes in the future. Results from OSL dating indicated that the clay band (a lamellae layer) identified and sampled in 2013 may provide a reliable stratigraphic marker. The sediments above the lamellae layer were late Holocene in age. In contrast, the sediments below the lamellae layer dated to the middle Holocene.

INTRODUCTION

The Adair-Steadman (41FS2) site, on the Southern Plains, is situated on a high terrace north of the Clear Fork of the Brazos River in Fisher County, Texas (Figures 1, 2). The site lies within the margin of an extensive dune field containing active and stabilized dunes. Aeolian dune sands apparently buries the sites shortly after it was abandoned (Holliday, 1997:161).

As part of the continuing investigation into hunter-gatherer use of the Adair-Steadman site, fieldwork for the past five years (2015-2019) consisted of annual 1-day pedestrian surveys to map and collect newly exposed artifacts. An unmanned aerial vehicle (UAV) drone was flown over the site (2017) to create a detailed 3D model for future research and monitoring. Luminescence dating of sediment samples collected in 2013 was completed in 2016 (Hurst and Johnson, 2016a). Results of this work provided important clues to the impact of bioturbation at Adair-Steadman.

PHYSIOGRAPHIC SETTING

Adair-Steadman is situated on the Rolling Plains of Texas that is characterized by low topographic relief. The Brazos River is the largest drainage in the region and extends from the Llano Estacado to the northwest to the Gulf of Mexico in the south. Prior to historic farming, the area is characterized by short or mixed grass prairies with cottonwood and willow along streams and riverbanks. Drought resistant species of brush and scrubby woodland would have been found in the upland areas, away from water sources (Shelford, 1963).

Grey wolf and black bear once were common but were extirpated from the area, as was black-footed ferret. The carnivore guild also contained coyote, gray fox, mountain lion, bobcat, ringtail, raccoon, badger, and skunk. Bison, pronghorn, and deer were the most common large game herbivores (Schmidly, 2004; Jones et al., 1985). In addition to mammals, numerous species of lizard, reptile, and bird also could be found. The climate today is strongly continental, meaning it has large temperature ranges that are not influenced by large bodies of water. Currently, the region receives ~61cm of rainfall annually, most of which falls in the spring through autumn (Bomar, 1995). Summer rains occur primarily in the form of severe thunderstorms that arise as a result of daytime heating and the absence of high pressure. Summer droughts, however, also occur due to high pressure that can dominate the region (Barry, 1983; Haragan, 1983:67). Precipitation in the form of winter snowfall is minimal. Conditions are much wetter during the late Pleistocene with an increase in sea, river, and lake levels (Baker, 1983; Friedman, 1983; Smith and Street-Perrott, 1983). This rise is due to an increase in effective precipitation and a reduction in the rate of evaporation presumably due to climatic changes.

Figure 1. Location of Adair-Steadman (41FS2) on the Rolling Plains of Texas.

[redacted]

Figure 2. Location of Adair-Steadman (41FS2) in relation to the Quarry site (41JS12) and the Clear Fork of the Brazos River.

By the end of the Pleistocene, a drying trend was underway. Conditions still were much moister than those in the region today. Water levels, however, were beginning to drop and lakes were becoming seasonal (Smith and Street-Perrott, 1983; Reeves, 1973). Between 12,000 and 11,000 radiocarbon yrs BP, an equitable, humid, maritime-like paleoclimate existed that lacked season extremes, with a lower mean annual temperature than today, cooler summers, and warmer winters that lacked extended freezing conditions (Johnson, 1991). A winter rainfall pattern was coupled with cool dry summers. Savannas or scrub grasslands existed throughout the Southern Plains (Bryant, 1977; Lundelius et al., 1983).

The time of 11,000 radiocarbon yrs BP marks the biotic and ecosystemic end of the Pleistocene conditions on the Southern Plains (Baker, 1983; Lundelius et al., 1983; Johnson, 1986, 1987, 2017; Ferring, 2001). Available moisture and humidity levels continue to decrease, reflecting the intensification of the warming and drying trend and more marked seasonality. Mild winters persist with occasional periods of freezing conditions. Yearly precipitation is decreasing although enhanced winter rains appeared to have continued. Native trees form a component of the vegetation community, generally restricted to wooded waterways. The grassland is a mixed prairie, albeit with a different composition than today's mixed prairie (Humphrey and Ferring, 1994; Nordt et al., 1994; Holliday, 1995; Holliday et al., 2008; Fredlund et al., 2003; Johnson, 2007). Ancient bison emerges in the early Holocene fauna as the major grazing herd herbivore, with deer and pronghorn continuing as large browsers.

THEORETICAL PERSPECTIVE

The Lubbock Lake Landmark regional research approach is focused on people-land relationships (Johnson, 1987, 1991, 2002). The evolutionary ecology view of culture is through explanatory mechanisms of rational choice and natural selection as causal factors (Smith and Winterhalder, 1993:39; Winterhalder and Smith, 1992:21). Cultural changes have their basis in the actions of individuals within ecologically situated choices (Smith and Winterhalder, 1992:39; Winterhalder and Goland, 1997:126). Primary condition factors for determining adaptations, then, are the nature and distribution of resources (Kaplan and Hill, 1992:167). The underlying goal of the research is to understand the dynamics of the interface of culture, landscape, and climate reflected in adaptive responses.

Within the broader regional research program, cultural continuity and change within hunter-gatherer economic systems are being examined in relationship to changing ecosystems. The major hunter-gatherer subsystems reflected in the archaeological record are subsistence and technology. The basic cultural assumption is that inferences concerning hunter-gatherer technology and subsistence can be made from analysis of the lithic, faunal, and floral materials.

The approach to people-land relationships is in the context of a technological-environmental explanation given the concept that culture is a people's adaptation to the environment. The interaction, therefore, between culture and environment is facilitated by technology (Bettinger, 1980; Hayden, 1981). A landscape approach is used in examining the interaction between people and their environments and land use patterns as people generally are involved actively in a dynamic relationship with the landscape. This perspective is a mechanism to determine the way people perceive, interact with, and transform the environment (Savage, 1990). A landscape approach provides a framework in which to assess land use and regional patterns and examine resource exploitation (Rossignol and Wandsnider, 1992).

The continued exploration into the record of cultural occupations on the Southern Plains had at least one goal and several objectives.

GOAL 1: to understand the dynamics of the interface of culture and climate reflected in adaptive responses and climatic change detected in the archaeological record.

objective 1: to delineate the lifeways of the aboriginal hunter-gatherer peoples through landscape utilization and household maintenance tasks.

objective 2: to examine subsistence strategies through optimal foraging theory, risk management, and nutritional parameters by inferred behavioral patterns revealed in excavated materials using precise recovery techniques, mapping, and documentation.

objective 3: to analyze site type, landscape and resource utilization, movement patterns, and timing of activities to provide information on the structural organization of hunter-gatherers.

METHODOLOGY

Field Methodology

The areal extent of investigation at Adair-Steadman covered 2.92ha (7.22ac). The fieldwork consisted of 100% pedestrian survey. Lubbock Lake Landmark methodology (Johnson, 1987) was followed.

Pedestrian survey was completed by crew members walking ~2m linear transects across the entire site. Artifacts were flagged, their provenience recorded using a Trimble R8 GPS base station. The GPS data points contained sub-centimeter accuracy.
A UAV was used to document the Adair-Steadman landscape. A DJI Inspire 1 UAV carrying a high resolution 16 megapixel Zenmuse X5 camera was flown over the site at ~30 m. Images were captured across the entire site with a 70-80% overlap at an oblique angle. Agisoft Metashape software was used to convert the images into a 3D dense cloud model. The software also was used to create a digital elevational model and georeferenced orthomosiac image of the site's surface to delineate topographic features.

Analytical Methodology

Lithic material was sorted into two categories, either tool or debitage, and a basic analysis was completed. Tools were measured (length, width, and thickness) and material type and source were recorded. Diagnostic tools were identified and placed within the regional cultural typology. Non-diagnostic tools were categorized as uniface, biface, or core.

Debitage was divided further into flakes (debitage with intact platforms) and debris (debitage without intact platforms) (Crabtree, 1972; Cotterell and Kamminga, 1979; Sullivan and Rozen, 1985; Andrefksy, 1998). Regardless of the completeness of the flake, measurements of maximum length, width, and thickness were taken for all identified flakes. Platform maximum length and width measurements were obtained using digital calipers (Mitutoyo Corp. 0.01-150mm).

A basic nominal flake platform (adapted from Andrefksy, 1998) was followed. Platform type was assigned to one of five categories, these being flat, complex, abraded, cortical, or crushed. A flat platform was defined as a clear bulb of percussion being present with no evidence of platform preparation. A complex platform was defined as a clear bulb of percussion being present and flaked retouch associated with platform preparation. An abraded platform was defined as a clear bulb of percussion being present and a worn and roughened surface associated with platform preparation. A cortical platform was defined as a bulb of percussion being present and characteristics consistent with the outer cortical surface of the material type. A crushed platform was defined as a shattered bulb of percussion so that the platform no longer was recognizable.

Material type and source designation was based on macroscopic and microscopic inspection of individual pieces and assigned as resulting from one of several lithic source areas (Banks, 1990). Chert was the primary material type. Material not recognized to a source was assigned as “source unknown.” Additionally, Edwards

Formation and Edwards-like material was subjected to ultraviolet florescence at both short and long waves to aid in determination (Banks, 1990; Hillsman, 1992; Hofman et al., 1991).

The spatial distribution of the objects was compared with data from the previous 16 years of Landmark surveys at Adair-Steadman (1999-2014; MacEwen et al., 2006; Hurst and Johnson, 2012, 2016). This analysis was conducted to determine if intact activity areas were present at Adair-Steadman, and if a shift in erosional patterns had occurred in exposing lithic material at different parts of the site. The software Crimestat III was used for establishing clusters based on the Nearest Neighbor Hierarchial Spatial Cluster analysis. Clusters then were mapped within Quantum GIS. A cluster was defined arbitrarily as 10 or more lithics within a 5m area.

RESULTS

The 2015 through 2019 work consisted of an annual 1-day surface survey (Table 1). A total of five field workdays, therefore, was completed. The purpose of the field work was to map and recover any additional artifacts exposed over the year from erosion in order to investigate further the spatial distribution of artifacts.

Table 1. Summary data for the 2015 through 2019 field season at Adair-Steadman (41FS2).

Field Season	Total Number of Days Worked	Crew Size	Accession Numbers	Range of Catalog Numbers (TTU-A7-)	Count
2015	1	3	TTU2015-035	50082-50105	24
2016	1	4	TTU2016-043	67788-67796	10
2017	1	3	TTU2017-015	68697-68703	7
2018	1	4	TTU2018-022	69451-69456	5
2019	1	2	TTU2019-023	None	0
Total	**5**				**46**

2015 Field Season

A crew of three people completed a 100% pedestrian survey during the 1-day 2015 season. Two unifacial tools and 22 pieces of lithic debitage were mapped and collected throughout the Adair-Steadman site area (Figure 3; Tables 2-4). All 24 (100%) of the lithics collected were chert that was sourced to the Edwards Formation.

The debitage consisted of 15 flakes and seven pieces of debris. Most of the flake platforms were abraded (n=8; 53%), followed by flat (n=6; 40%), and crushed (n=1; 7%). The presence of both abraded and flat platforms indicated that these flaked were detached from both bifacial and blocky core types (e.g., Andrefsky, 1998).

Both unifaces are broken and consisted of only a segment of the tool. Uniface TTU-A7-50087 (Figure 4, Table 4) is a graver tip segment from a flake tool. Microflaking is present on the dorsal surface of the graver tip. Fine flaking often is present on flake grave tools present within Folsom assemblages (Osborn, 2014).

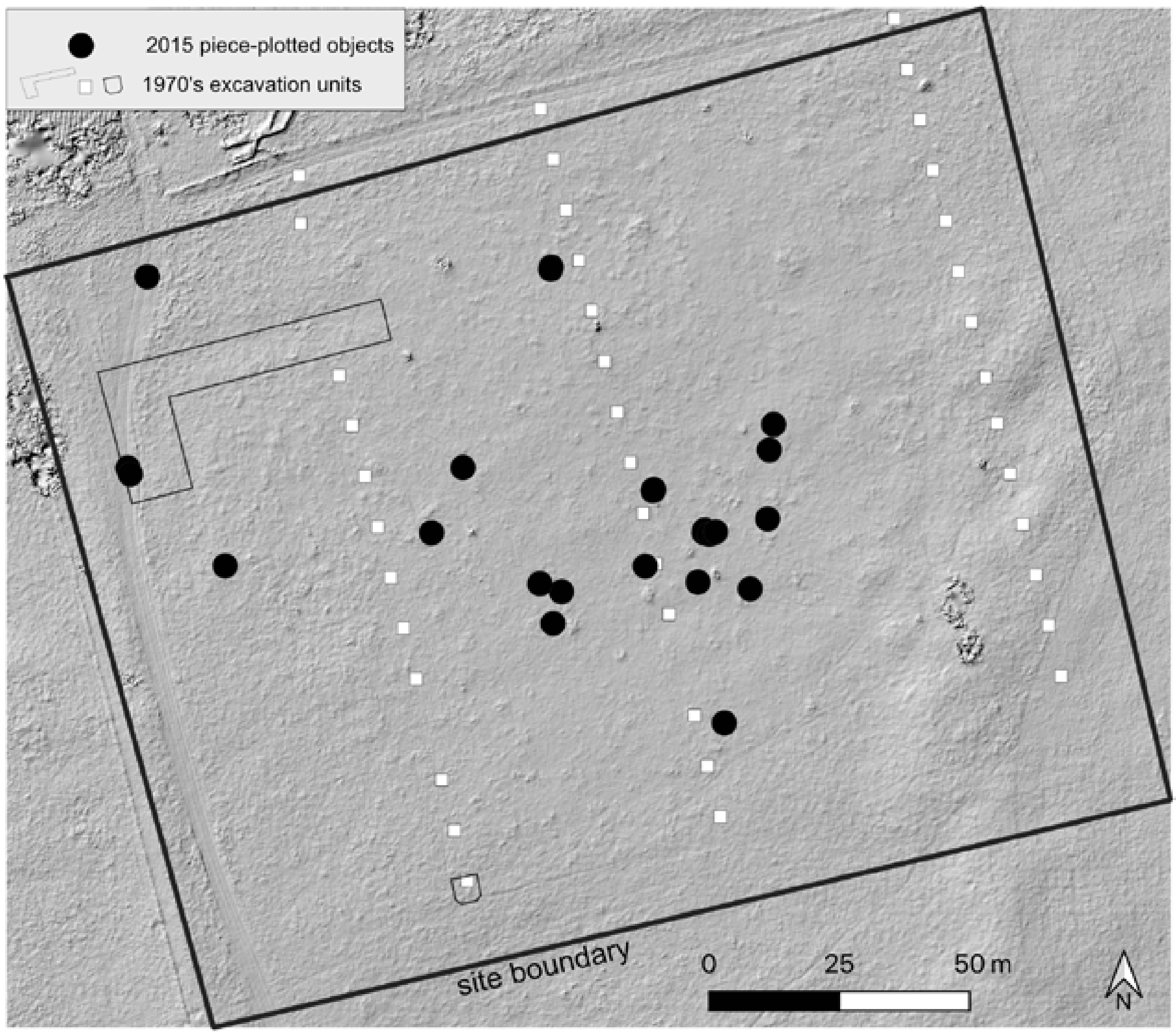

Figure 3. Location of piece-point-plotted lithic artifacts recovered during the 2015 pedestrian survey at Adair-Steadman (41FS2).

Table 2. Flakes recovered from the 2015 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Platform Type	Platform Dimensions (mm*)	Count
50093	chert	Edwards Formation	32.76, 29.28, 4.34	abraded	4.57, 1.25	1
50092	chert	Edwards Formation	12.26, 16.76, 2.09	abraded	7.42, 2.71	1
50082	chert	Edwards Formation	20.86, 23.53, 2.87	abraded	5.62, 2.22	1
50099	chert	Edwards Formation	21.53, 18.15, 2.18	abraded	5.42, 1.85	1
50104	chert	Edwards Formation	14.83, 14.4, 1.73	abraded	3.41, 1.68	1
50086	chert	Edwards Formation	12.52, 17.43, 6.18	abraded	16.97, 6.18	1
50102	chert	Edwards Formation	40.41, 31.11, 3.76	abraded	6.14, 2.29	1
50095	chert	Edwards Formation	9.21, 8.36, 0.99	flat	2.45, 0.61	1
50098	chert	Edwards Formation	27.34, 12.76, 2.48	flat	7.05, 1.3	1
50083	chert	Edwards Formation	25, 17.43, 2.88	flat	2.47, 1.20	1
50090	chert	Edwards Formation	22.02, 16.04, 8.07	flat	14.15, 8.07	1
50103	chert	Edwards Formation	18.13, 32.85, 3.15	flat	23.68, 2.5	1
50088	chert	Edwards Formation	16.57, 22.38, 2.31	crushed	n/a	1
50094	chert	Edwards Formation	10.47, 10.92, 2.41	abraded	8.04, 2.77	1
50091	chert	Edwards Formation	15.94, 10.47, 2.18	flat	3.38, 1.43	1
Total						**15**

*length, width, thickness

Table 3. Debris recovered from the 2015 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Count
50084	chert	Edwards Formation	17.59, 16.71, 2.04	1
50096	chert	Edwards Formation	18.32, 24.38, 3.5	1
50085	chert	Edwards Formation	11.44, 20.95, 3.71	1
50089	chert	Edwards Formation	9.7, 13.97, 2.13	1
50097	chert	Edwards Formation	12.22, 14.58, 1.94	1
50105	chert	Edwards Formation	11.5, 17.69, 1.73	1
50101	chert	Edwards Formation	13.65, 14.02, 1.15	1
Total				**7**

* length, width, thickness

Table 4. Unifaces recovered from the 2015 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-.)	Material	Source	Dimensions (mm*)	Platform Type	Platform Dimensions (mm*)	Count
50087	chert	Edwards Formation	17.64, 30.72, 4.21	flat	5.32, 1.99	1
50100	chert	Edwards Formation	24.4, 22.28, 5.62	n/a	n/a	1
Total						**2**

* length, width, thickness

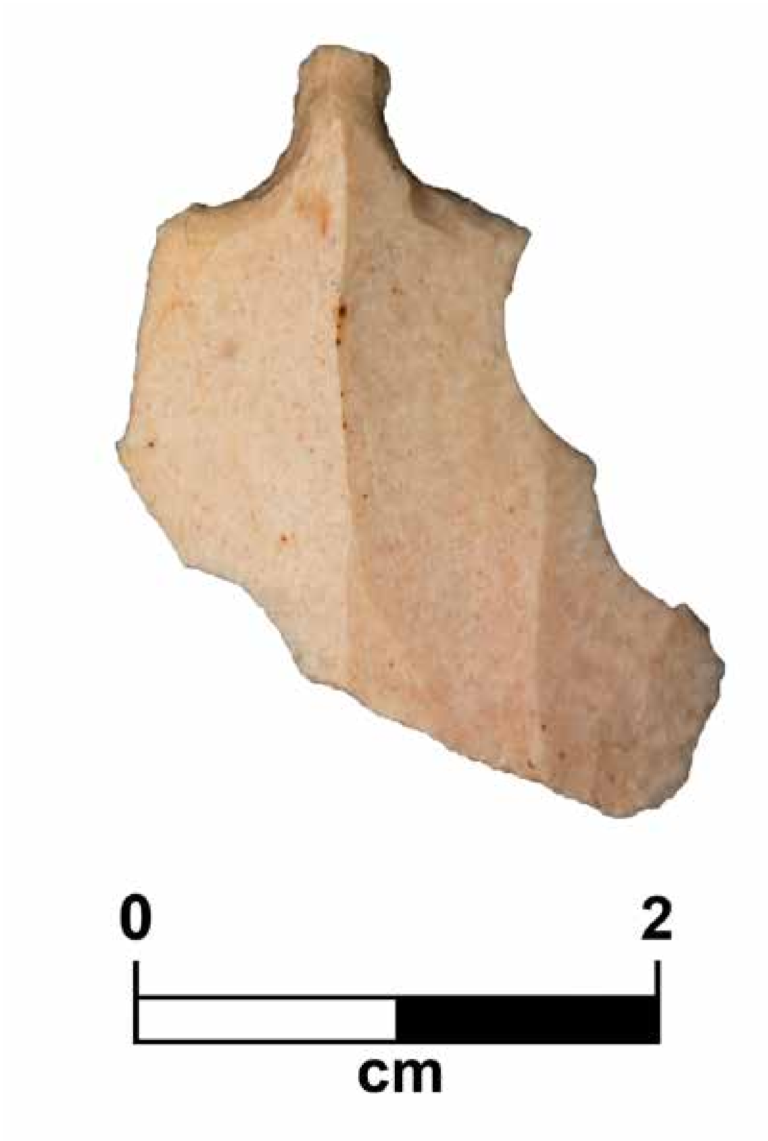

Figure 4. A uniface (TTU-A7-50087) found during the 2015 pedestrian survey at Adair-Steadman (41FS2).

Uniface TTU-A7-50100 (Figure 5, Table 4) was flaked on the dorsal surface along the right side, the flaking of which formed an edge angle of 69°. Polishing and rounding of the edge suggested the uniface was used as a scraping tool for processing hide or wood (e.g., Odell and Odell-Vereecken, 1980).

2016 Field Season

A crew of four people completed a 100% pedestrian survey during the 1-day 2016 season. One biface and eight pieces of lithic debitage were mapped and collected throughout the Adair-Steadman site area (Figure 6; Tables 5-7). All nine (100%) of the lithics collected were chert that was sourced to the Edwards Formation.

Figure 5. A uniface (TTU-A7-50100) found during the 2015 pedestrian survey at Adair-Steadman (41FS2).

The debitage consisted of two flakes and six pieces of debris. The flake platforms were classified as flat (n=1; 50%) and crushed (n=1; 50%). The presence of a flat platform indicated that this flake was detached from a blocky core (e.g., Andrefsky, 1998).

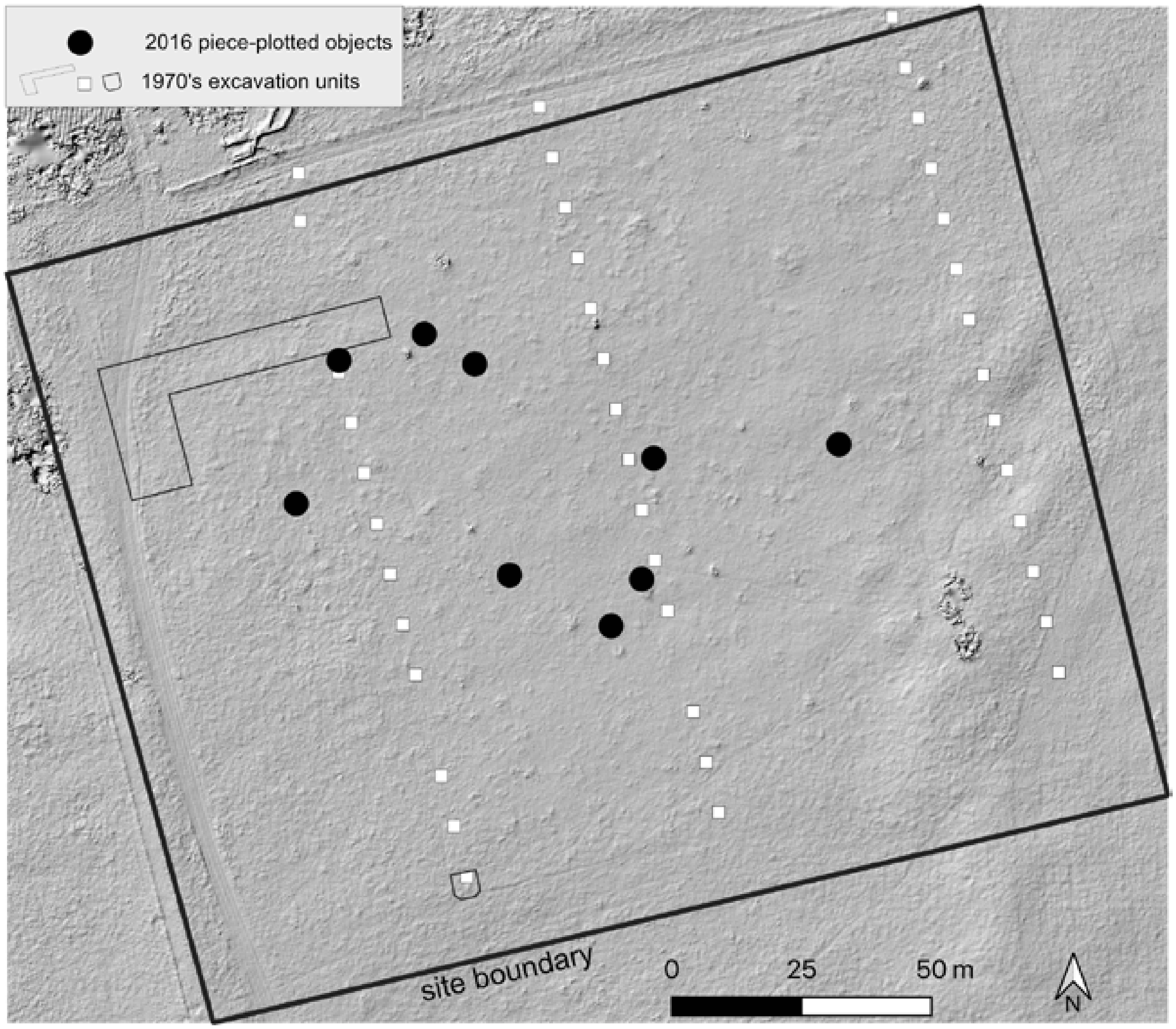

Figure 6. Location of piece-point-plotted lithic artifacts recovered during the 2016 pedestrian survey at Adair-Steadman (41FS2).

Table 5. Flakes recovered from the 2016 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Platform Type	Platform Dimensions (mm*)	Count
67796	chert	Edwards Formation	12.61, 10.53, 1.58	Flat	4.04, 1.59	1
67794	chert	Edwards Formation	14.94, 20.57, 6.74	Crushed	n/a	1
Total						**2**

* length, width, thickness

Table 6. Debris recovered from the 2016 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Count
67795	chert	Edwards Formation	13.94, 13.39, 2.82	1
67790	chert	Edwards Formation	27.69, 39.11, 6.58	1
67792	chert	Edwards Formation	8.93, 8.87, 0.84	1
67793	chert	Edwards Formation	6.33, 7.43, 1.13	1
67789	chert	Edwards Formation	14.59, 16.83, 1.78	1
67788	chert	Edwards Formation	27.64, 11.43, 5.34	1
Total				**6**

* length, width, thickness

Biface TTU-A7-67791 (Figure 7; Table 7) was a mid-section of a bifacial core or tool. It was completely flaked on both sides with no cortex remaining.

Figure 7. A biface (TTU-A7-67791) found during the 2016 pedestrian survey at Adair-Steadman (41FS2).

Table 7. Biface recovered from the 2016 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Count
67791	chert	Edwards Formation	43.62, 36.50, 11.23	1
Total				**1**

* length, width, thickness

2017 Field Season

A crew of three people completed a 100% pedestrian survey during the 1-day 2017 season. Seven lithic debitage were mapped and collected throughout the Adair-Steadman site area (Figure 8; Tables 8-9). All seven (100%) of the debitage were chert that was sourced to the Edwards Formation.

The debitage consisted of four flakes and three pieces of debris. The flake platforms were classified as flat (n=2; 50%), abraded (n=1; 25%), and crushed (n=1; 25%). The presence of both abraded and flat platforms indicated that these flakes were detached from both bifacial and blocky core types (e.g., Andrefsky, 1998).

Over a span of 45 minutes (from 12:15 pm to 12:45 pm), a UAV was flown over Adair-Steadman and a total of 135 overlapping aerial images were captured. These images then were imported into Agisoft Metashape photogrammetry software on an iMac computer at the Landmark's Quaternary Research Center. From these images, a dense point cloud was created consisting of 34,493,855 points (Figure 9). From the dense cloud data, a high resolution digital elevation model then was interpolated within Metashape with an output resolution of 6,099x8160 6.46cm/pix (Figure 10). The last step was the creation of an orthomosaic map that seamlessly tiled aerial images together into a new georeferenced image with a resolution of 11182x15268 3.23 cm/pix (Figure 11).

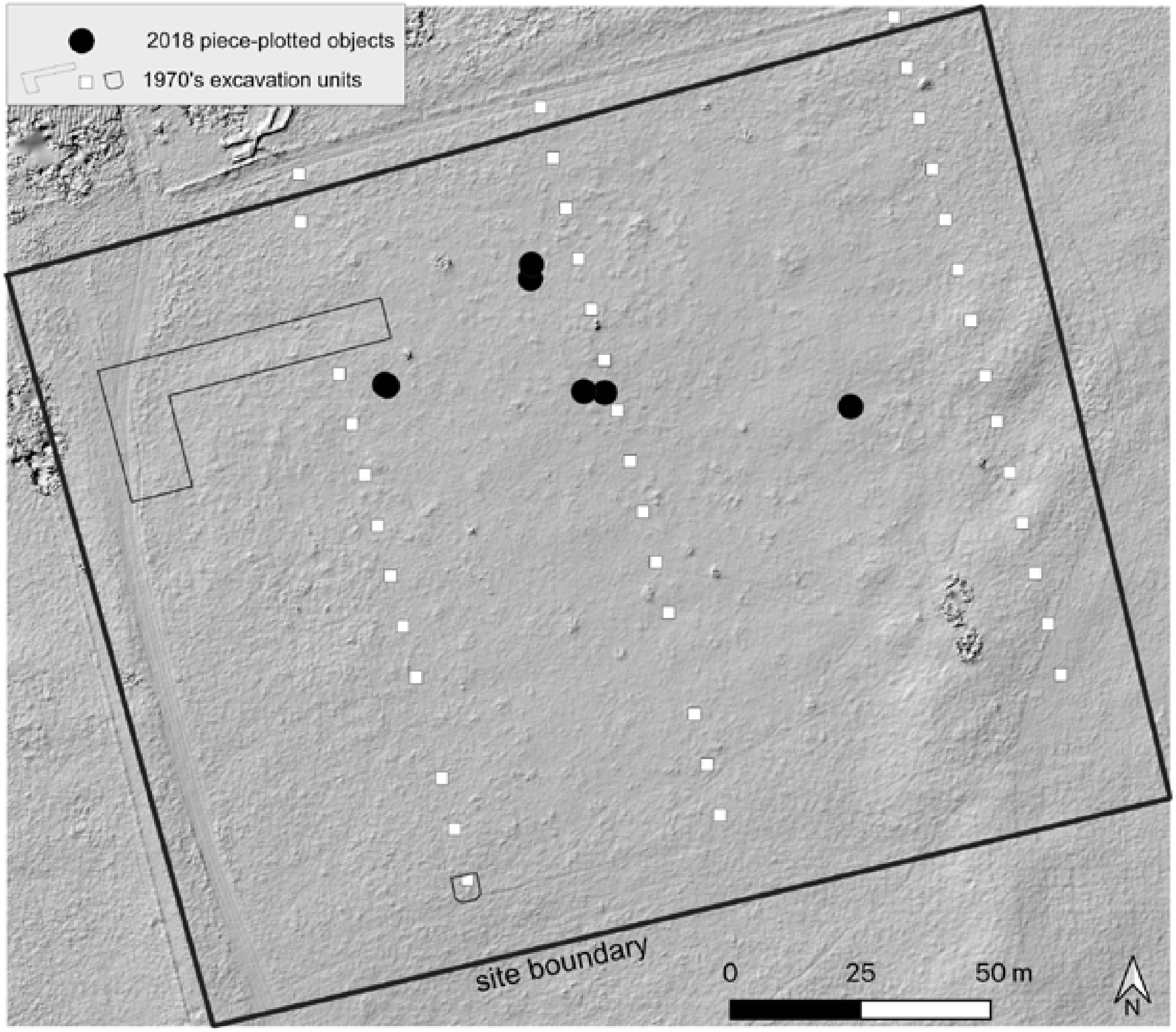

Figure 8. Location of piece-point-plotted lithic artifacts recovered during the 2017 pedestrian survey at Adair-Steadman (41FS2).

Table 8. Flakes recovered from the 2017 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-.)	Material	Source	Dimensions (mm*)	Platform Type	Platform Dimensions (mm*)	Count
68698	chert	Edwards Formation	19.87, 22.32, 9.19	flat	18.83, 10.32	1
68701	chert	Edwards Formation	13.58, 21.28, 3.41	abraded	13.18, 3.72	1
68697	chert	Edwards Formation	18.69, 17.66, 3.93	crushed	n/a	1
68702	chert	Edwards Formation	12.07, 14.77, 2.77	flat	10.63, 3.49	1
Total						**4**

* length, width, thickness

Table 9. Debris recovered from the 2017 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Count
68703	chert	Edwards Formation	42.48, 21.21, 21.54	1
68700	chert	Edwards Formation	8.51, 12.55, 4.97	1
68699	chert	Edwards Formation	23.41, 21.37, 6.46	1
Total				**3**

* length, width, thickness

Figure 9. A dense cloud model of the Adair-Steadman (41FS2) site.

2018 Field Season

A crew of four people completed a 100% pedestrian survey during the 1-day 2018 season. Six lithic debitage were mapped and collected throughout the Adair-Steadman site area (Figure 12; Tables 10-11). Five pieces of debitage (60%) were chert that was sourced to the Edwards Formation. One piece (20%) of debitage was chert that was sourced to the Ogallala Formation gravels. The debitage consisted of three flakes and three pieces of debris. The flake platforms were classified as abraded (n=2; 67%) and flat (n=1; 33%). The presence of both abraded and flat platforms indicated that these flaked were detached from both bifacial and blocky core types (e.g., Andrefsky, 1998).

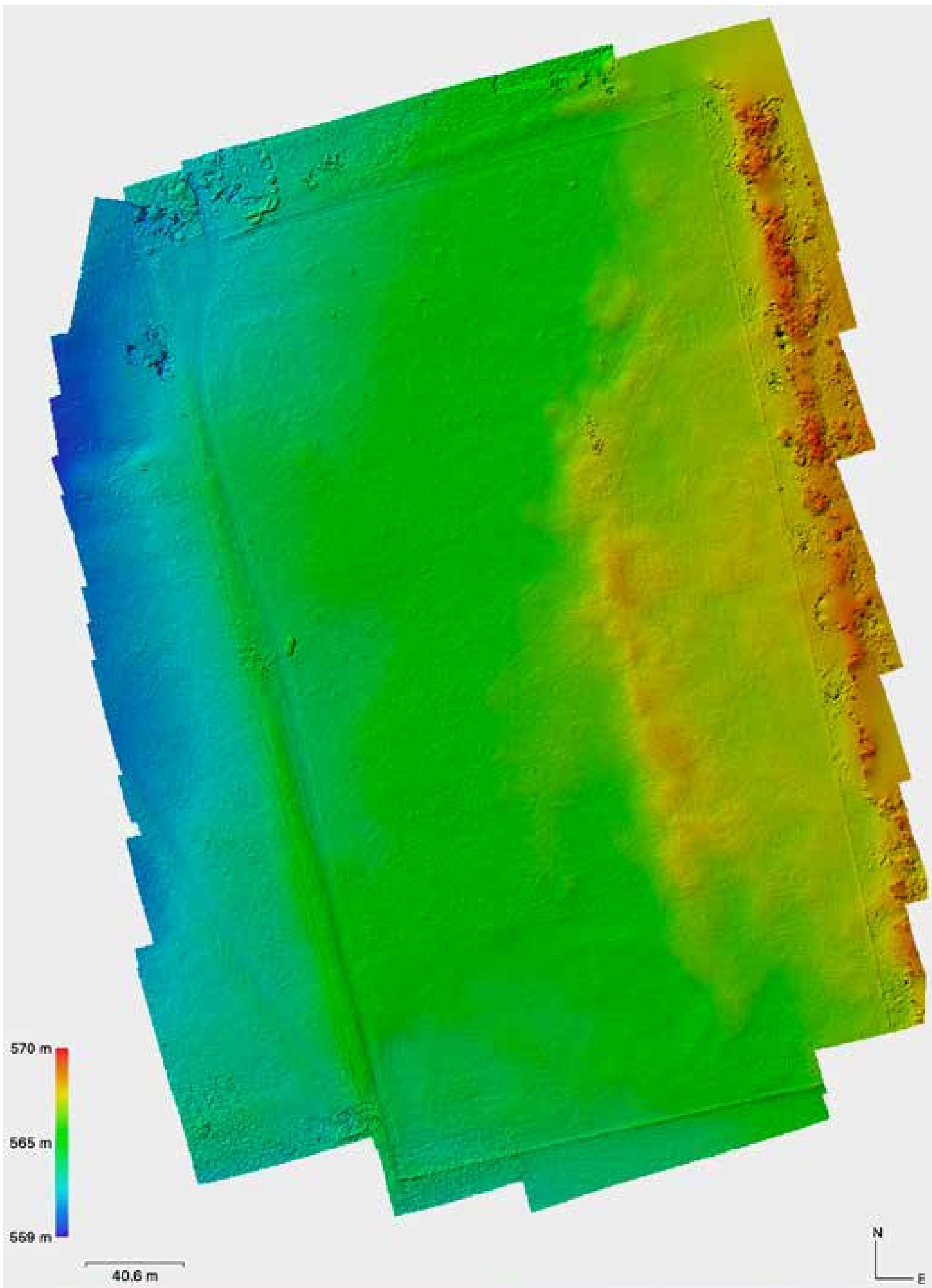

Figure 10. A digital elevation model of the Adair-Steadman (41FS2) site.

Figure 11. An orthomosiac model of the Adair-Steadman (41FS2) site.

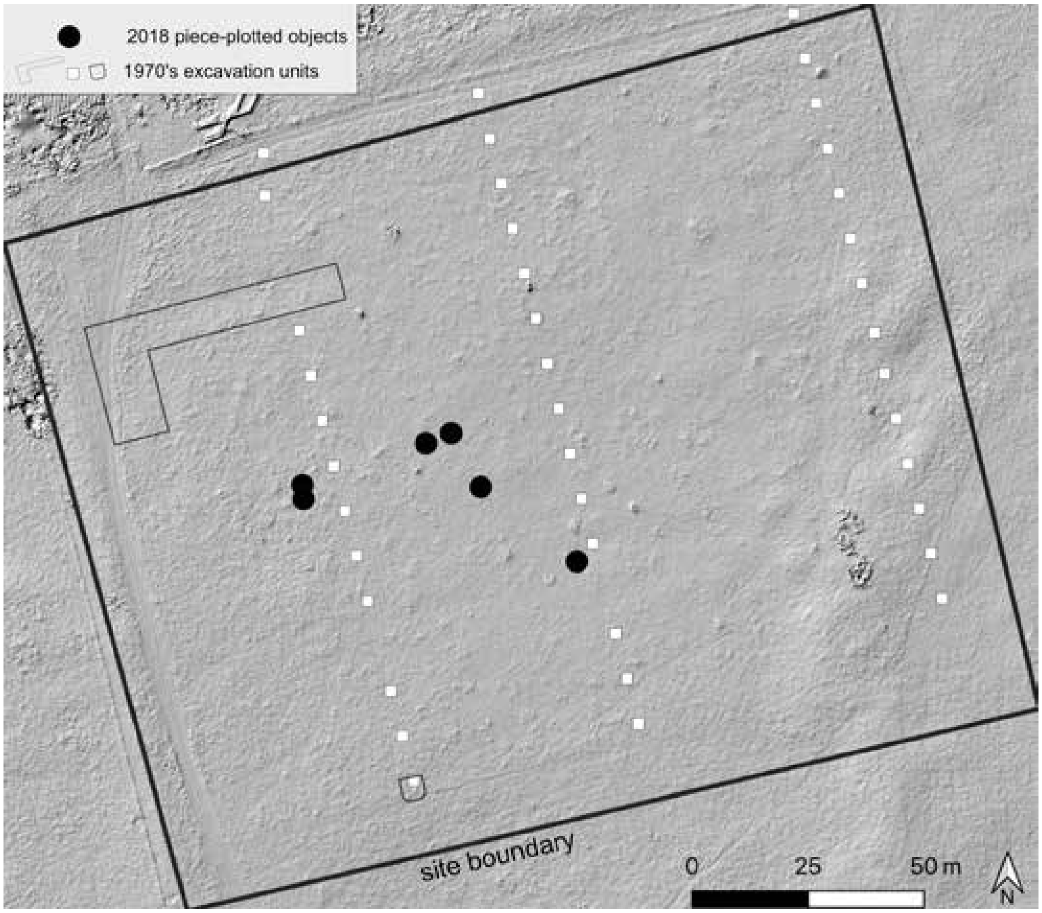

Figure 12. Location of piece-point-plotted lithic artifacts recovered during the 2018 pedestrian survey at Adair-Steadman (41FS2).

Table 10. Flakes recovered from the 2018 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Platform Type	Platform Dimensions (mm*)	Count
69452	chert	Edwards Formation	31.13, 22.47, 6.3	abraded	18.15, 5.94	1
69451	chert	Ogallala Formation	24.7, 18.07, 4.8	flat	8.45, 3.83	1
69453	chert	Edwards Formation	35.28, 24.01, 3.48	abraded	3.11, 1.29	1
Total						**4**

* length, width, thickness

Table 11. Debris recovered from the 2018 pedestrian survey at Adair-Steadman (41FS2).

Catalog Number (TTU-A7-)	Material	Source	Dimensions (mm*)	Count
69456	chert	Edwards Formation	29.94, 35.95, 10.4	1
69455	chert	Edwards Formation	8.63, 10.08, 3.07	1
69454	chert	Edwards Formation	8.63, 10.08, 1.07	1
Total				**3**

* length, width, thickness

2019 Field Season

A crew of two people completed a 100% pedestrian survey during the 1-day 2019 season. No objects were found during survey. A thunderstorm that had just finished precipitated a significant amount of rainfall onto to the site prior to the survey. The rain most likely impacted the ability to view lithic material on the surface.

Spatial Analysis

The spatial distribution of lithic artifacts (n=47) recovered from the 2015-2019 season pedestrian surveys was examined in relationship to objects (n=407) collected from previous survey work between 1999-2014 (MacEwen et al., 2006; Hurst and Johnson, 2012, 2016; Figure 13). A spatial cluster analysis was used to ascertain if any additional concentrations of lithic material might suggest the location of new activity areas.

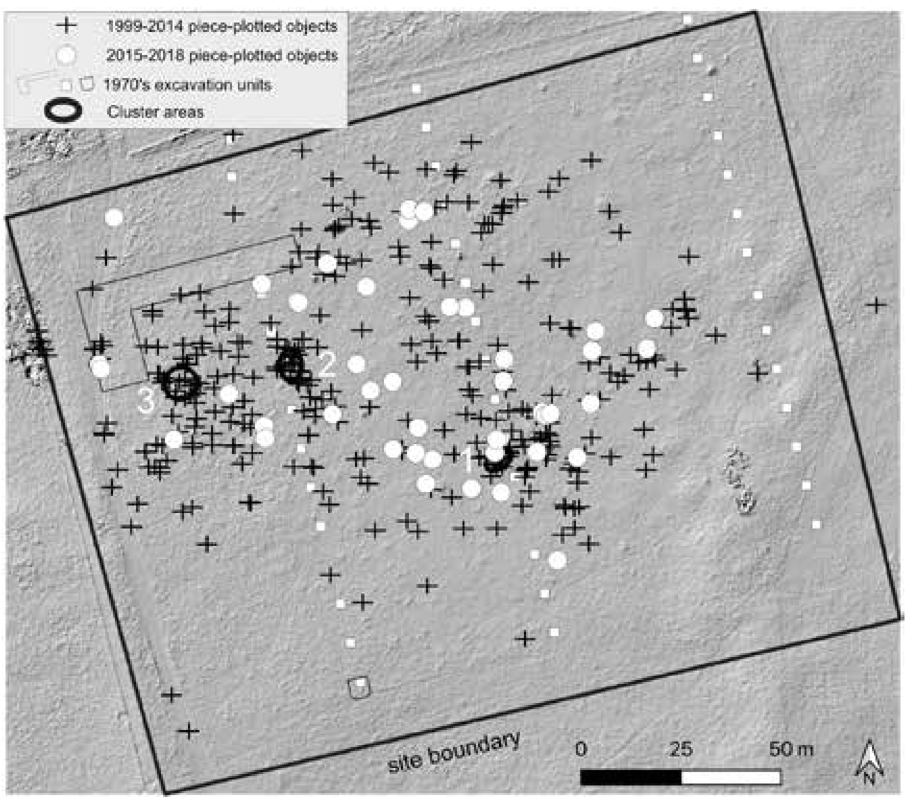

Figure 13. Lithic cluster analysis of objects found during the 1999-2014 and 2015-2019 pedestrian survey at Adair-Steadman (41FS2).

Overall, no change occurred in the locations of where objects were found during survey between 2015-2019 in comparison to the previous years (1999-2014). This result meant that through the years materials were wording out throughout the site. Results of the cluster analysis identified three lithic concentration areas that contained 10 or more objects within a 5m area (Figure 13). Concentration areas 1 and 2 were identified previously based on the spatial distribution of lithic material collected between 1999-2004 (Hurst and Johnson, 2016). These first two concentration areas were excavated between 2011-2013 (Hurst and Johnson, 2016). The third concentration area was new with the addition of the 2015-2019 lithic material. In future work, subsurface testing in this area will explore if any intact activity features exist at this location.

Optical Stimulated Luminescence (OSL) dating

Four sediment samples were collected and sent to the University of Washington's Luminescence Lab to be dated using the OSL method by Dr. James Feather in 2013 (Hurst and Johnson, 2016). Dating of these samples was completed in 2016.

Test excavation at Adair-Steadman from 2011-2013 in unit 36N11E uncovered a clay band that consisted of a layer of lamellae within sandy sediments. Clay bands were a pedogenic feature that is characteristic of soils formed in sand (Holliday, 2004:112).

The presence of the clay band in the Adair-Steadman dune indicated that the dune had remained stable at some point in time in order for the clay to accumulate as a layer. To test this hypothesis, OSL samples were collected above and below the clay band (Figures 14, 15). This unit was chosen for sampling because it was the most deeply excavated unit.

The OSL samples were collected by hammering light-tight PVC cylinders into the side of the test-unit profile (e.g., Feathers et al., 2006). A wooden block was used to buffer the impact of hammer blows at the end of the pipe. Both ends of the PVC cylinders were capped and tapped to ensure the sediment samples were not impacted by light.

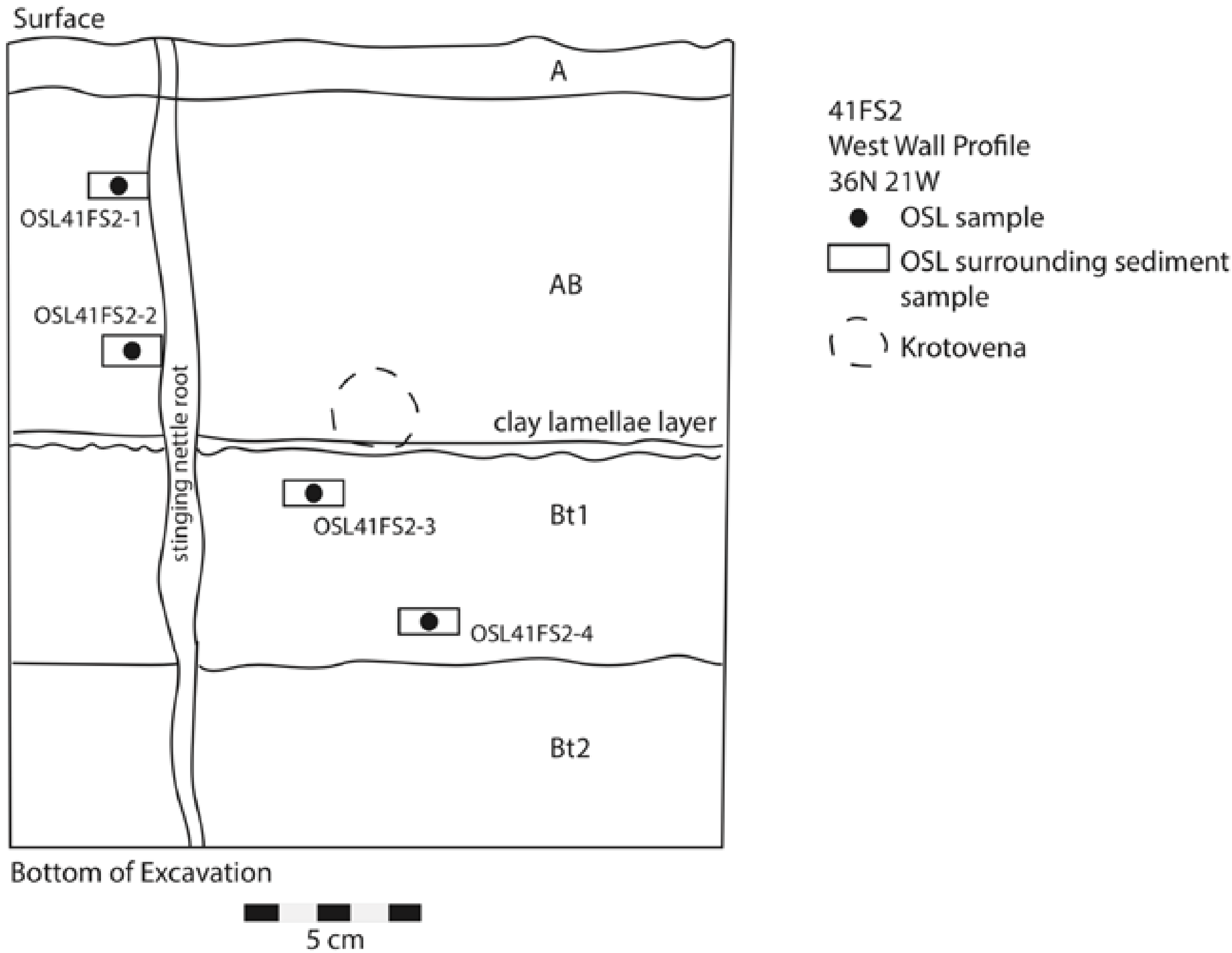

Figure 14. Profile drawing of OSL sampling areas — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

Optical stimulated luminescence was applied to 180-212µm quartz grains. The sensitivity of the quartz grains was not high resulting in equivalent dose values of UW 3016 (n = 54), UW 3017 (n = 63), UW 3018 (63), and UW 3019 (60). The average acceptance rate was 5.4%, and sample UW 3016 was lower at 3.7% due to its location closer to the surface. All of the samples were bi or tri modal either from mixing or partial bleaching (Figures 16, 17, 18, and 19).

The youngest grains represented by the first component was 20th-century in age for UW2016 and a 500 year age for UW3019. The first component of these samples were likely sand grains being transported downward from the surface.

In all of the samples, the second and third components were distinct, with no higher precision points between them. Very old grains were represented by the third and fourth components. These older grains within the sample were likely derived from upward admixture of grains from a lower stratum. A likely source for the third component of sample UW3016 is from upward movement of sand grains from the lower sand layers below the clay lamellae.

Figure 15. Dr. Vance Holiday removing OSL samples — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

The second component, therefore, likely represents the depositional age of the sediment layers at Adair-Steadman, and these are the accepted OSL ages. A clear distinction exists between ages from above and below the clay lamellae layer. The two upper samples are dated to the late Holocene with ages of 600±80 (UW 3016) and 2,320±870 (UW3017) years. In contrast, the two lower samples, below the clay lamellae layer, are dated to the middle Holocene with ages of 6,900±700 (UW3018) and 6,430±640 (UW3019; Figure 20,Table 12) years. The two lower sample dates, however, are out of chronological order, but the dates were statistically indistinguishable due to their high calculated errors.

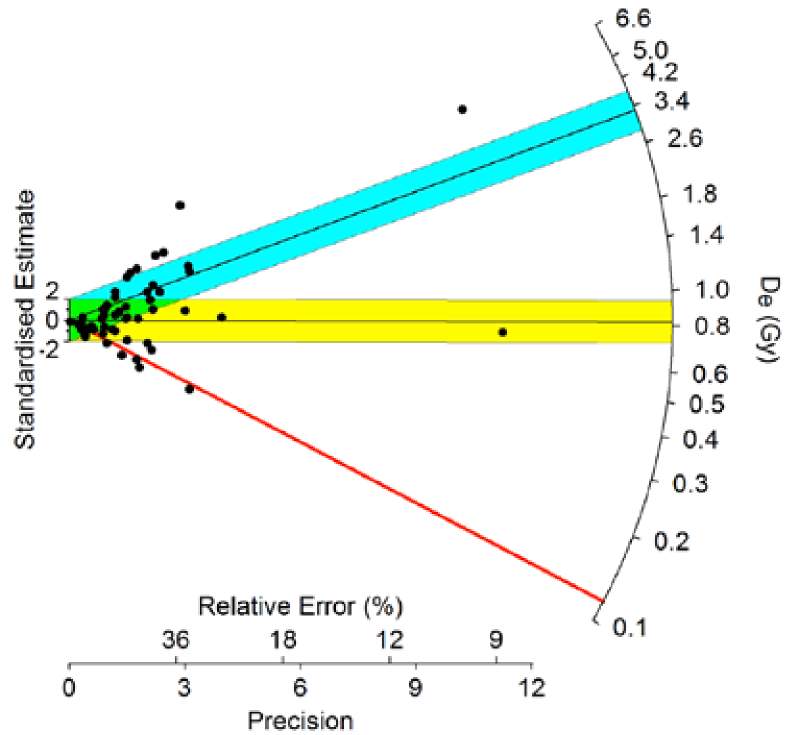

Figure 16. Radial graph of single-grain DE's of OSL sample UW3016 — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

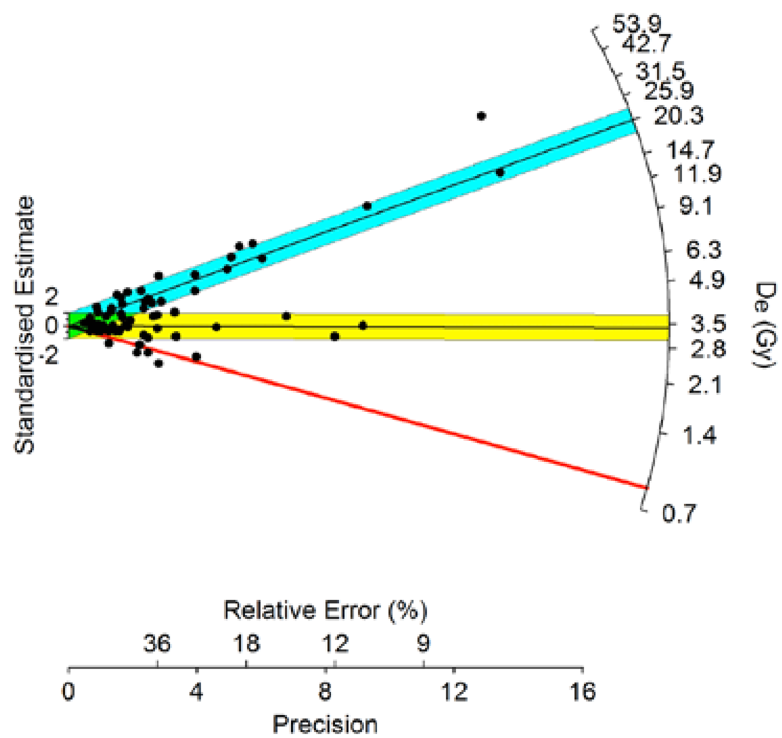

Figure 17. Radial graph of single-grain DE's of OSL sample UW3017 — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

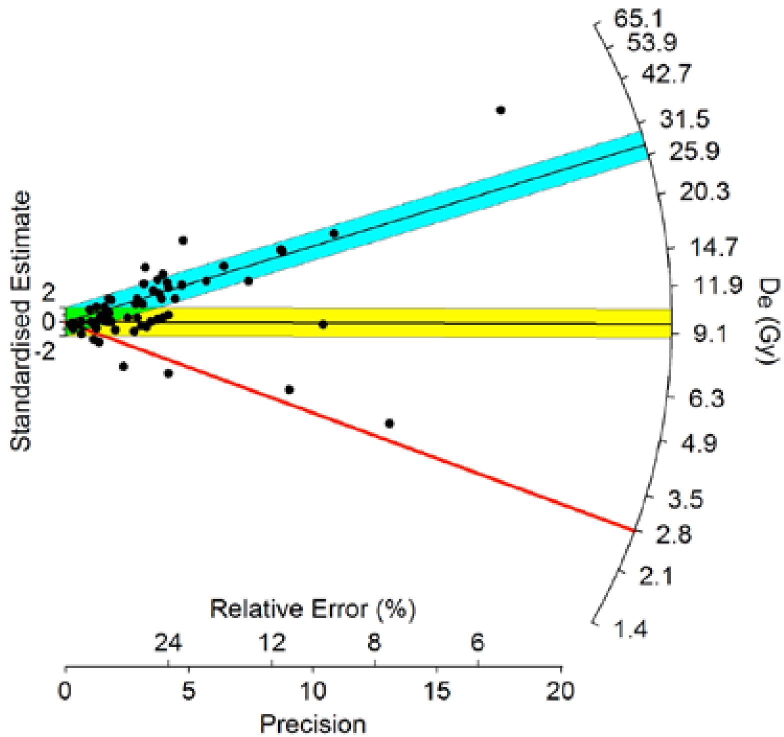

Figure 18. Radial graph of single-grain DE's of OSL sample UW3018 — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

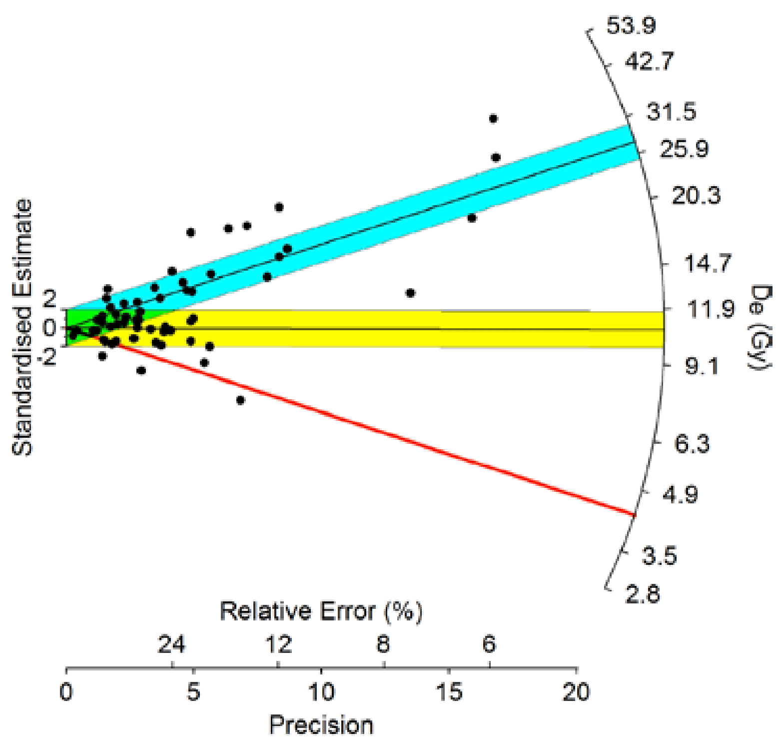

Figure 19. Radial graph of single-grain DE's of OSL sample UW3019 — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

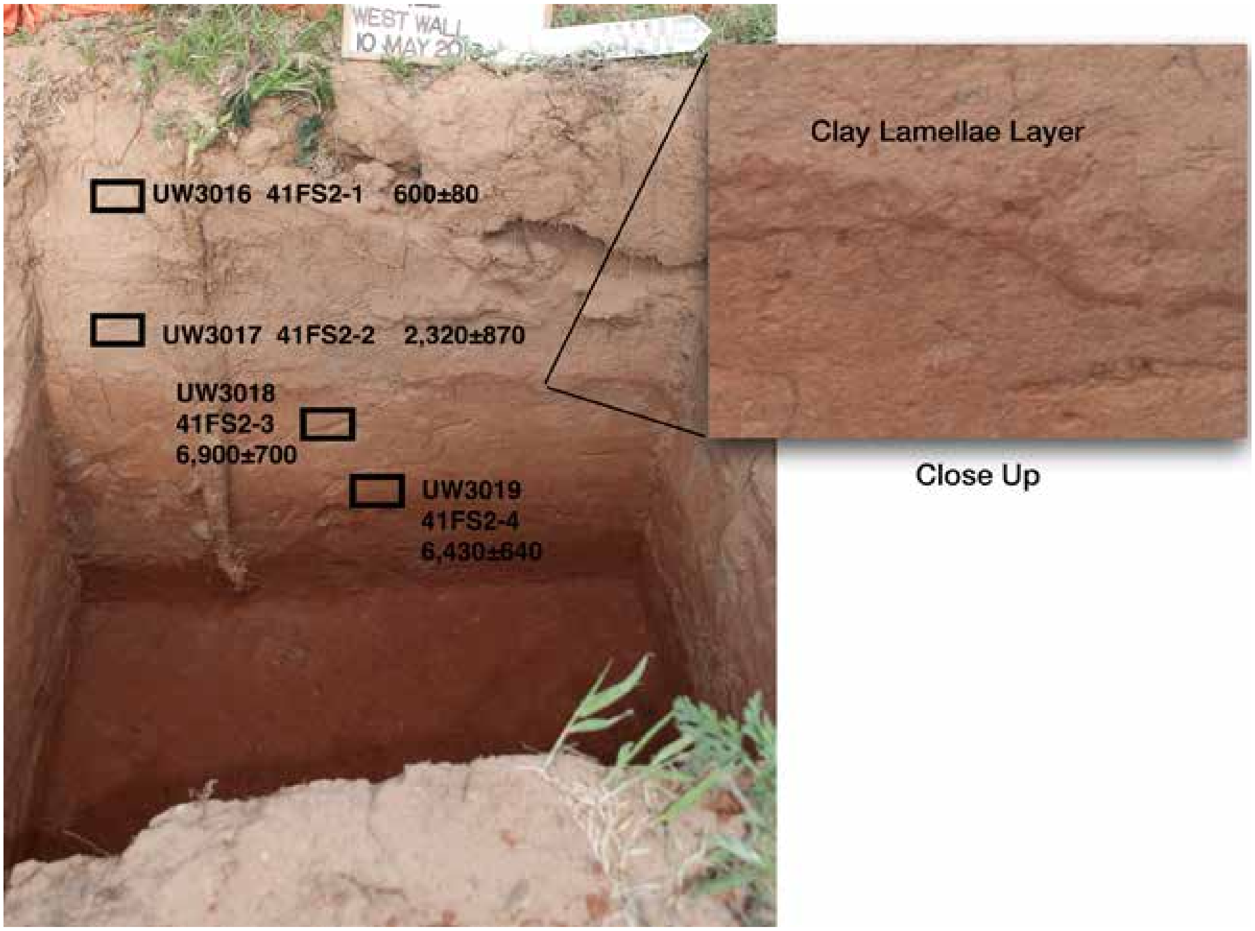

Figure 20. Location of OSL samples and ages — west wall excavation unit 36N 21W at Adair-Steadman (41FS2).

Table 12. Optical Stimulated Luminescence results from the Adair-Steadman (41FS2) site.

Sample Number	Depth (cm below surface)	OSL Age
UW 3016	51	600±80
UW 3017	87	2,320±870
UW 3018	172	6,900± 700
UW 3019	202	6,430 ± 640

OSL ages
Sample, Depth, component
Upper Sand Layer
UW 3016, .51 m, 600±80
UW 3017, .87 m, ± 2,320±870
Lower Sand Layer
UW3018 1.72 6,900± 700
UW3019 2.02 6,430 ± 640

The age of the UW3019 sample possibly may be underestimated. This sample was the only one with no high precision points within the accepted second component. A slightly older high precision point occurred, and if accepted, would adjust sample UW3019's age to 8,600 years. Accepting this older high precision point into the age calculation, however, would place too much weight into this one data point. Further work would be needed to clarify the age of the lower portion of the dune.

DISCUSSION

Field work and analysis from 2015-2019 at Adair-Steadman is providing new insights into this hunter-gatherer campsite. A total of 47 lithic artifacts have been recorded on the surface over the past five years. Continued erosion of the site exposes new artifacts on the surface each year, although that number is decreasing through time. The last five-year total recovery rate is lower than the number of lithic artifacts mapped from 2010-2014 (n=104; Hurst and Johnson, 2016a), 2005-2009 (n=151; Hurst and Johnson, 2012), and 1999-2004 (n=154; McEwen et al., 2006). Survey, nevertheless, has been successful in monitoring site erosion and the mapping and collecting of lithic artifacts on an annual basis.

The spatial distribution of artifacts mapped and collected over the past 21 years has defined three concentration areas. Two of these concentration areas were investigated through test excavation (Hurst and Johnson, 2016a). A new concentration area was identified with the addition of the 2015-2019 collected objects. This new concentration area would be slated for test excavation in the next five-year period.

The OSL results indicate that the sediments at Adair-Steadman were middle (~6,900 years) to late Holocene (~600 years) in age. Further work is needed to clarify the age of the lower sediment below the clay lamellae layer, however, due to the potential impact of bioturbation. The OSL sediment samples directly below and above the clay lamellae layer were dated to ~6,430 years and ~2,320 years. These results indicate that the clay band is a stratigraphic marker and could be used to distinguish sediments deposited during the late Holocene across the site (i.e., sediments above the clay band).

The OSL dates do not provide an age for the Folsom occupation at Adair-Steadman. The discovery of Folsom objects on the surface at Adair-Steadman (Hurst and Johnson 2016b) suggests that bioturbation has impacted greatly the vertical distribution of Folsom objects. This situation suggests it may be difficult to find an intact Folsom occupational surface at Adair-Steadman.

CONCLUDING REMARKS

The investigation of Adair-Steadman (41FS2) during the 2015-2019 field seasons consisted of annual survey and mapping with a UAV drone. Dating OSL sediment samples collected in 2013 was completed in 2016. Survey results indicated that artifacts continue to be exposed. The lower number of objects found in the last five years, however, suggests the rate of erosion has slowed.

The results of OSL dating indicate that the clay band in the Adair-Steadman dune can be used as a stratigraphic marker to distinguish upper late Holocene deposits from lower middle Holocene sediments. The sediments below the lamellae layer, however, are not Folsom-age. Bioturbation has impacted the vertical distribution of Folsom artifacts at the site and finding an intact Folsom occupational surface at Adair-Steadman may be difficult.

Appendix A

HERITAGE LANDSCAPE MANAGEMENT AT ADAIR-STEADMAN 2015-2019

Sterling Scott Trevey

Adair-Steadman is situated in the Rolling Plains of Texas, and like most of the region, suffers from a lack of natural fire frequency resulting in encroaching brush. Historically, fire plays an active role in shaping the landscape and reducing the density of brush species such as mesquite (Wright and Bailey, 1982). Honey mesquite (Prosopis glandulosa) has long been an invasive problem in the Southwest and a focus for management since the 1950s (Parker and Martin, 1952; Martin, 1975; Martin and Morton, 1993; Tiedemann and Klemmedson, 2004). Restoration and preservation efforts at Adair-Steadman focus on controlling the dense mesquite population.

Although mesquite is a native brush, it can become a serious problem for landowners when left unchecked from a management standpoint. Rangeland with a dense cover of mesquite competes with other native plants, reducing their numbers, and therefore, reducing the amount of available forage for domestic livestock and wildlife. It also competes for water, sunlight, and other nutrients beneficial to all species in a healthy rangeland ecosystem. From a cultural resource perspective, as the top growth of mesquite matures, so does its root system. As the root system matures, it impacts surface and subsurface cultural resources. Because of the archaeological sensitivity of the site, typical brush management methods cannot be used (e.g., roller-chopping, excavating, and the use of diesel in an herbicidal solution). Instead, methods used at the Lubbock Lake Landmark (Trevey and McEwen, 2012) that do not impact the archaeological resources are utilized at Adair-Steadman. The methods used at Adair Steadman are mechanical removal and herbicide applications.

In 2006, mesquite populated most of the Adair-Steadman site (Trevey and McEwen, 2012). The Landmark historical maintenance team initially cleared out the landscape using a combination of archaeologically safe herbicides and non-subsurface disturbing mechanical techniques (Trevey and McEwen, 2012). Since 2006, mesquite at Adair-Steadman has been maintained through monitoring signs for new growth and applying herbicides as warranted.

Herbicide was once again was applied to re-sprouted mesquite as well as Hackberry, Scattered Sand Shinnery, Persimmon, Plains Prickly Pear, and Queens Delight on May 3rd, 2018 (Figures 21, 22). It was noticed while investigating the resprouted mesquite that diesel may have been used by the landowner to treat mesquite. The herbicide used was Sendero Herbicide (2 quartz), non ionic surfactant (1 quart), and blue dye (1 pint) mixed with 50 gallons of water. A total of 27 gallons of herbicide was used.

Continued work will keep the mesquite population under control to prevent surface and subsurface disturbance to the site. Yearly inspections at this site will be in order for the vegetation to continue to flourish as a native rangeland plant community, free of brush and invasive weed species.

a


b


Figure 21. View from the east of Adair-Steadman vegetation: a) taken in April 2016 indicating some weedy growth within primarily a grassland setting (note the thick mesquite growth in the distance off of the site); b) taken in April 2017 indicating increase in weedy growth and sprouting of mesquite trees.

c

Figure 21 (Continued). View from the east of Adair-Steadman vegetation: c) taken in April 2018 indicating increased growth and number of young mesquite trees.

Figure 22. Applying herbicide on one of the mesquite trees at Adair-Steadman that had sprouted in 2016 to 2017.

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