CONTRIBUTIONS TO THE FLORA OF CIMARRON COUNTY AND THE BLACK MESA AREA

Amy K. Buthod
Oklahoma Biological Survey
University of Oklahoma
Norman, OK 73019
amybuthod@ou.edu

Bruce W. Hoagland
Oklahoma Biological Survey
Department of Geography and Environmental Sustainablity
University of Oklahoma
Norman, OK 73019

Keywords: flora, Cimarron County, Black Mesa, vascular plants, rare plants

ABSTRACT

This paper reports the results of recent collection activities in Cimarron County, including the Black Mesa area, in the state of Oklahoma. A total of 331 taxa in 60 families were collected. Two-hundred and six genera, 279 species and 52 infraspecific taxa were identified. The largest families were the Poaceae with 72 taxa and the Asteraceae with 63. Thirty-six exotic taxa were collected (10.9 % of the flora), including two species new to Oklahoma: *Scorzonera laciniata* and *Ranunculus testiculatus*. Forty-six taxa tracked by the Oklahoma Natural Heritage Inventory were found.

INTRODUCTION

Cimarron County has long been recognized as a botanically significant region in Oklahoma. A total of 95 vascular plants tracked by the Oklahoma Natural Heritage Inventory (ONHI) occur in the county (Oklahoma Natural Heritage Inventory 2013). Included among these is *Asclepias uncialis* Greene, which, prior to 1996, was listed as a likely candidate for federal listing as threatened or endangered by the U.S. Fish and Wildlife Service (United States Department of the Interior 1993). Before this survey, nineteen of the tracked taxa had an ONHI ranking of SH, meaning that reports of occurrences are older than twenty years (Oklahoma Natural Heritage Inventory 2013; NatureServe 2015). The number of taxa in Cimarron County that are rare at the state level is due in part to the presence of Black Mesa, an extension of the Mesa de Maya, which extends for 72 km from east of Raton, New Mexico, though Colorado and into northwestern Cimarron County. The eastern-most extension of the Rocky Mountain foothill vegetation is present in the area; Rogers (1953) found it to be "an excellent example of the intergradation of the flora of the great plains with that of the Rocky Mountain foothills". Our intent for this work was to relocate the rare taxa, update their ONHI ranks, and, hopefully, expand our knowledge of the area's current flora.

The earliest botanical collections from the Black Mesa region were made in 1820 by Edwin James, botanist for Major Stephen Long's expedition to the Rocky Mountains. Eighty-four years later, Per Axel Rydberg, author of *Flora of Colorado* (1906) and *Flora of the Rocky Mountains and Adjacent Plains* (1917), botanized in the area. The first thorough botanical inventory of the Mesa de Maya was completed by Rogers (1953). From 1947 and 1949, he collected along the mesa in Colorado, New Mexico and Oklahoma, as well as from some of the secondary mesas in the area (Rogers 1953). According

https://doi.org/10.22488/okstate.17.100114

to a list published in 1953, Rogers collected 267 taxa from 51 families in Oklahoma, but in a later work (1954) he notes that "approximately five-hundred were found, or could be found". U. T. Waterfall collected at Black Mesa and in Cimarron County within the same time period, adding approximately 30 taxa to the state's flora (Waterfall 1949, 1950a, b). James K. McPherson completed an inventory with the sole focus of Black Mesa in the early 1990s, reporting 236 taxa from 58 families (2003a, b). His collecting activities were confined to the areas of the mesa on the property belonging to the state of Oklahoma (Township 6N, Range 1E, Sections 28–33 and Township 5N, Range 1E, Section 6). Patricia Folley (2003) supplemented the McPherson list with collections made from 1994 through 2003. Folley collected over a wider area than McPherson, surveying the state park around Lake Etling, the roadsides leading to the park and mesa, and some private lands, including Tesequite Canyon (Folley 2003). She found an additional 49 taxa from 25 families. Other botanists have contributed to the knowledge of the Black Mesa/Cimarron County flora over the years, including Delzie Demaree, who worked in the area in the 1930s, George Goodman (from the late 1930s through the early 1970s), John and Connie Taylor (1960s and 1970s), and Larry Magrath in the 1980s (Oklahoma Vascular Plants Database 2015).

STUDY SITE

Cimarron County falls within the High Plains and the Cimarron River Valley geomorphic provinces (Curtis et al. 2008). The High Plains province consists of flat uplands over Tertiary-era Dakota sandstones and is found throughout most of the county (Rogers 1953). The Cimarron River Valley is found in the northeastern part of the county and is distinguished by dissected valleys of Mesozoic-era shale and sandstone. The Black Mesa, the flat, eroded remnant of a Tertiary-era lava flow, is located in this area (Curtis et al. 2008). The highest point in Oklahoma, at 1515 m, is on the mesa. Rolling, low hills and canyons surround the mesa.

Four soil associations occur within Cimarron County. Travessilla-Kim soils are only found in the northeastern corner of the county. They consist of "loam, calcareous, and humus-poor soils on steep slopes" (Carter and Gregory 2008). Dalhart-Vona soils are found primarily in the southern half of the county; these are "very deep loamy soils on gentle slopes" (Carter and Gregory 2008). Sherm-Ulysses type soils dominate the eastern half of the county. These soils are "very deep, silty and clayey, humus-rich soils on gentle slopes" (Carter and Gregory 2008). Conlen-Pastura-Plack soils are the least common soil type in the county; they consist of "loamy and calcareous soils on moderately steep slopes" (Carter and Gregory 2008). Potential vegetation types in Cimarron County include shortgrass high plains, sandsage grassland, piñon pine/juniper mesa, and bottomland forest (Duck and Fletcher 1943; Hoagland 2008).

Cimarron County has a dry climate, falling within Trewartha's steppe or semi-arid type (1968). Average annual precipitation ranges from 38–50 cm, with most falling from May through August. Thunderstorms occur in the spring and summer. Average temperature is 13–14°C. The average high (in July) is 34°C, and the average low (in January) is -7°C. South-southwesterly winds are dominant and relative humidity ranges from 29–84%. Over 70% of days are sunny (Oklahoma Climatological Survey 2015).

METHODS

Plants were collected at 100 sites throughout Cimarron County (Fig. 1; Table 1). Collection sites were chosen based on location information from the Oklahoma Natural Heritage Inventory Database and

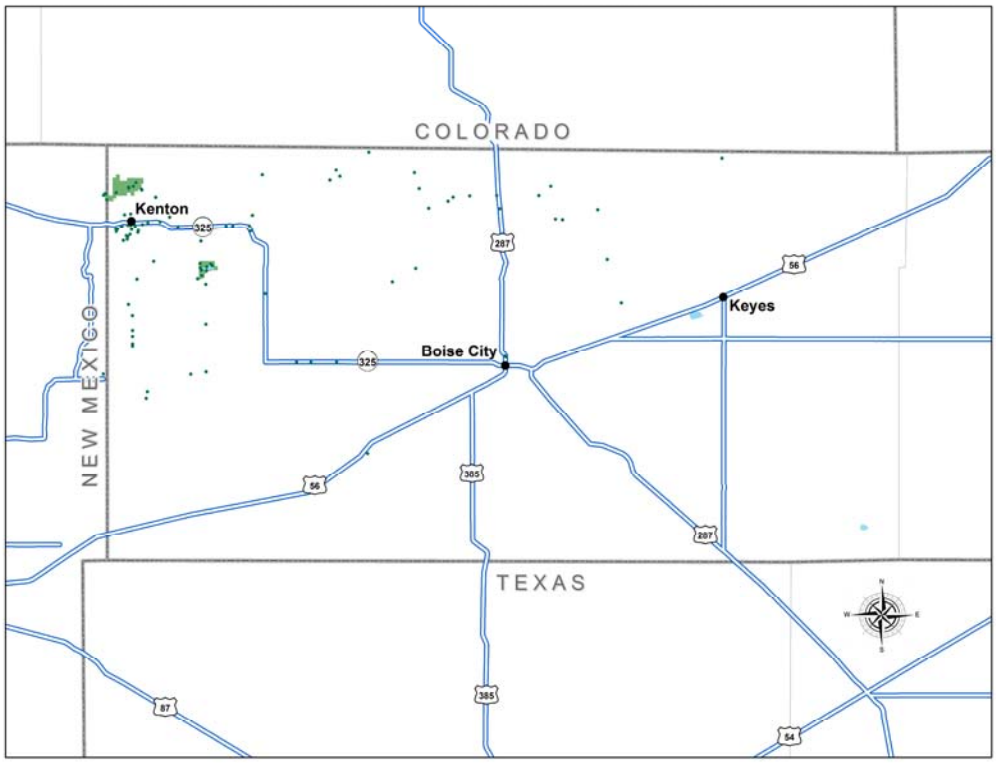

Figure 1 Cimarron County, Oklahoma. Dots indicate collection sites. Shaded areas indicate Black Mesa Nature Preserve lands. Map by Todd Fagin, Oklahoma Biological Survey.

the Oklahoma Vascular Plants Database. Additional collections were also made opportunistically. Coordinates of each site were collected using a Garmin GPSmap 76Cx unit. Sites were located between latitudes N36.98989 and N36.62313 and longitudes W102.67913 and W102.68063. Elevations ranged from 1118 m to 1513 m. Field work began in March of 2013, with subsequent monthly trips until September. An additional trip was made in May of 2014. One example of each taxon encountered was collected and processed according to standard herbarium protocols. Specimens were deposited at the Robert Bebb Herbarium (OKL) at the University of Oklahoma. Manuals used to identify plants included Great Plains Flora Association (1986), Tyrl et al. (2010) and Allred and Ivey (2012); the collections of the Robert Bebb Herbarium were also used to verify identifications. Taxonomy follows the Integrated Taxonomic Information System (2015). Duration and nativity to Oklahoma were determined using the PLANTS Database (USDA-NRSC 2015); if the information from PLANTS was ambiguous, Taylor and Taylor (1991) was consulted. Vegetation classifications were assigned based on Hoagland (2000).

RESULTS AND DISCUSSION

Three-hundred and thirty-one taxa in 60 families were collected in this study (Appendix A). Two-hundred and six genera, 279 species, and 52 infraspecific taxa were identified. Two-hundred thirty-one taxa were perennials; there were 96 annuals and four biennials. Thirty-six taxa were non-native to Oklahoma, including two species new to the state (*Scorzonera laciniata* in the Asteraceae and *Ranunculus testiculatus* in the

Ranunculaceae); non-native taxa accounted for 10.9% of the total flora. The Poaceae had the greatest number of exotic taxa with 11; the Brassicaceae had five. The largest families were the Poaceae with 72 taxa and the Asteraceae with 63. Forty-six taxa tracked by the Oklahoma Natural Heritage inventory were found (Table 2). *Asclepias uncialis*, the former candidate for federal listing, was not located.

Vegetation classes encountered in this study included the *Artemisia filifolia/Sporobolus cryptandrus-Schizachyrium scoparium* shrubland association. It is found on sandy soils and stabilized dunes in the northwestern and central portions of the study site. Associated taxa included *Andropogon gerardii* ssp. *hallii*, *Abronia fragrans,* and *Eriogonum annuum* (Duck and Fletcher 1943; Hoagland 2000).

Two intergrading variations of shortgrass prairie were noted. The *Bouteloua curtipendula-B. gracilis-B. dactyloides* herbaceous association is found on rocky slopes and well-drained soils in the southern part of the study area (Duck and Fletcher 1943; Hoagland 2000). Plants found here included *Muhlenbergia torreyi*, *Ratibida columnifera,* and *Sphaeraclea coccinea*. The *Bouteloua gracilis-Hilaria jamesii* herbaceous association is found in northwestern Cimarron County on slopes and uplands (Hoagland 2000). Plants found in this type included *Cylindropuntia imbricata*, *Melampodium leucanthum*, and *Zinnia grandiflora*.

The *Bouteloua gracilis-Hilaria jamesii* herbaceous association intergrades with the fourth vegetation type, the *Juniperus monosperma* woodland alliance. This alliance includes *the Juniperus monosperma/Bouteloua curtipendula* woodland association and the *Juniperus monosperma-Pinus edulis/Bouteloua curtipendula* woodland association and is found in northwestern Cimarron County. Plants from this type included *Bouteloua gracilis*, *Cercocarpus montanus,* and *Prunus virginiana* (Hoagland 2000).

Herbaceous wetland vegetation was found at only a few sites, including those with seeps, lakes, and intermittently flowing streams and rivers. Plants found in this vegetation type included *Polypogon monspeliensis*, *Populus deltoides*, *Salix exigua*, and *Tamarix chinensis*. Vegetation of disturbed areas includes taxa found around lawns, stock tanks, campgrounds, parking lots, and gravel pits. Plants in this vegetation type included *Conyza canadensis*, *Descurainia sophia*, *Kochia scoparia*, and *Malva neglecta*.

Table 1 Collection sites in Cimarron County

Latitude	Longitude	Township, Range, and Section
36.623130	-102.68063	Sec. 24-T2N-R3E
36.690420	-102.95001	Sec. 33-T3N-R1E
36.698390	-102.9484	Sec. 28-T3N-R1E
36.719380	-102.89576	Sec. 13-T3N-R1E
36.719660	-103.00208	Sec. 18-T3N-R1E
36.722180	-102.877	Sec. 18-T3N-R2E

36.733790	-102.7183	Sec. 15-T3N-R3E
36.733800	-102.76698	Sec. 17-T3N-R3E
36.733920	-102.74949	Sec. 16-T3N-R3E
36.739900	-102.51231	Sec. 10-T3N-R5E
36.741100	-102.51344	Sec. 10-T3N-R5E
36.753940	-102.96656	Sec. 4-T3N-R1E
36.756350	-102.96655	Sec. 4-T3N-R1E
36.765380	-102.96653	Sec. 32-T4N-R1E
36.772640	-102.96652	Sec. 32-T4N-R1E
36.780300	-102.87736	Sec. 30-T4N-R2E
36.790710	-102.96668	Sec. 29-T4N-R1E
36.804340	-102.97145	Sec. 20-T4N-R1E
36.806220	-102.37202	Sec. 13-T4N-R6E
36.817480	-102.80509	Sec. 13-T4N-R2E
36.829480	-102.87738	Sec. 7-T4N-R2E
36.832480	-102.65052	Sec. 8-T4N-R4E
36.835430	-102.96116	Sec. 9-T4N-R1E
36.836080	-102.88737	Sec. 6-T4N-R2E
36.840080	-102.88219	Sec. 6-T4N-R2E
36.845780	-102.87656	Sec. 5-T4N-R2E
36.846420	-102.88263	Sec. 6-T4N-R2E
36.848380	-102.62216	Sec. 3-T4N-R4E
36.849240	-102.88435	Sec. 6-T4N-R2E
36.850360	-102.87642	Sec. 31-T5N-R2E
36.850360	-102.87642	Sec. 31-T5N-R2E

36.851790	-102.86967	Sec. 32-T5N-R2E
36.853670	-102.87138	Sec. 32-T5N-R2E
36.854090	-102.88454	Sec. 31-T5N-R2E
36.856980	-102.94078	Sec. 34-T5N-R1E
36.859200	-102.38917	Sec. 34-T5N-R6E
36.881280	-102.88344	Sec. 19-T5N-R2E
36.882050	-102.97772	Sec. 20-T5N-R1E
36.883330	-102.97295	Sec. 20-T5N-R1E
36.886460	-102.97238	Sec. 20-T5N-R1E
36.887550	-102.97424	Sec. 20-T5N-R1E
36.889260	-102.96963	Sec. 20-T5N-R1E
36.891690	-102.96015	Sec. 21-T5N-R1E
36.892660	-102.98643	Sec. 19-T5N-R1E
36.893120	-102.82283	Sec. 22-T5N-R2E
36.893790	-102.95947	Sec. 16-T5N-R1E
36.895370	-102.9677	Sec. 17-T5N-R1E
36.895760	-102.98476	Sec. 18-T5N-R1E
36.895960	-102.98691	Sec. 18-T5N-R1E
36.897520	-102.91134	Sec. 13-T5N-R1E
36.897950	-102.96324	Sec. 16-T5N-R1E
36.898540	-102.98034	Sec. 17-T5N-R1E
36.899190	-102.97931	Sec. 17-T5N-R1E
36.899370	-102.8527	Sec. 16-T5N-R2E
36.899560	-102.84465	Sec. 16-T5N-R2E
36.899830	-102.82454	Sec. 15-T5N-R2E

36.900190	-102.96891	Sec. 17-T5N-R1E
36.900640	-102.97209	Sec. 17-T5N-R1E
36.901170	-102.96404	Sec. 16-T5N-R1E
36.901410	-102.95449	Sec. 16-T5N-R1E
36.903700	-102.94789	Sec. 16-T5N-R1E
36.904800	-102.93303	Sec. 15-T5N-R1E
36.907530	-102.44369	Sec. 7-T5N-R6E
36.908160	-102.45214	Sec. 7-T5N-R6E
36.910440	-102.92143	Sec. 11-T5N-R1E
36.912730	-102.82081	Sec. 11-T5N-R2E
36.913450	-102.97624	Sec. 8-T5N-R1E
36.914270	-102.96875	Sec. 8-T5N-R1E
36.919640	-102.4009	Sec. 10-T5N-R6E
36.920710	-102.51988	Sec. 9-T5N-R5E
36.921370	-102.60638	Sec. 10-T5N-R4E
36.921370	-102.60638	Sec. 10-T5N-R4E
36.929980	-102.58279	Sec. 1-T5N-R4E
36.931820	-102.99784	Sec. 6-T5N-R1E
36.934710	-102.9383	Sec. 3-T5N-R1E
36.934710	-102.93839	Sec. 3-T5N-R1E
36.934850	-102.57666	Sec. 1-T5N-R4E
36.936330	-102.55646	Sec. 21-T6N-R5E
36.936870	-102.52358	Sec. 33-T6N-R5E
36.936880	-102.47233	Sec. 36-T6N-R5E
36.937150	-103.0018	Sec. 6-T5N-R1E

36.938120	-103.00098	Sec. 31-T6N-R1E
36.938800	-103.00023	Sec. 31-T6N-R1E
36.939080	-102.99954	Sec. 31-T6N-R1E
36.940380	-102.98649	Sec. 31-T6N-R1E
36.943380	-102.95534	Sec. 33-T6N-R1E
36.944330	-102.95544	Sec. 33-T6N-R1E
36.945420	-102.618	Sec. 34-T6N-R4E
36.945760	-102.97118	Sec.32-T6N-R1E
36.947060	-102.97128	Sec. 32-T6N-R1E
36.947930	-102.96566	Sec. 33-T6N-R1E
36.948080	-102.45784	Sec. 31-T6N-R6E
36.952680	-102.96242	Sec. 28-T6N-R1E
36.955610	-102.72656	Sec. 27-T6N-R3E
36.960120	-102.71428	Sec. 27-T6N-R3E
36.962150	-102.80867	Sec. 26-T6N-R2E
36.964600	-102.62363	Sec. 28-T6N-R4E
36.967830	-102.71885	Sec. 22-T6N-R3E
36.982940	-102.24962	Sec. 13-T6N-R7E
36.989890	-102.67913	Sec. 13-T6N-R3E

Table 2 Taxa located during this study that are tracked by the Oklahoma Natural Heritage Inventory (Oklahoma Natural Heritage Inventory 2013; NatureServe Explorer 2015). Status ranks are on a 1–5 scale, with a 1 indicating the taxa is critically imperiled. G ranks are at the global level and S ranks are at the subnational or state level. Infraspecific taxa are assigned a T rank. A taxon with NR indicates that it has not been ranked at the global level (NatureServe 2015). Highlighted taxa were re-ranked as a result of this survey.

Family	Taxon	Ranking
Amaranthaceae	*Krascheninnikovia lanata* (Pursh) A. Meeuse & A. Smit	S1G5
Apocynaceae	*Asclepias macrotis* Torr.	S1G4
Asteraceae	*Ambrosia confertiflora* DC.	S1G5
Asteraceae	*Artemisia carruthii* Alph. Wood ex Carruth.	S2G4?
Asteraceae	*Brickellia brachyphylla* (A. Gray) A. Gray	S1G5
Asteraceae	*Brickellia californica* (Torr. & A. Gray) A. Gray	S1G5
Asteraceae	*Brickellia eupatorioides* (L.) Shinners var.	S1G5T5
Asteraceae	*Ericameria nauseosa* (Pall. ex Pursh) G.L. Nesom &	S1G5T5
Asteraceae	*Picradeniopsis woodhousei* (A. Gray) Rydb.	S2G4G5
Asteraceae	*Solidago velutina* DC. ssp. *sparsiflora* (A. Gray) Semple	S1G5?TNR
Boraginaceae	*Cryptantha cinerea* (Greene) Cronquist var.	S2G5T5?
Boraginaceae	*Cryptantha thyrsiflora* (Greene) Payson	S2G4
Cactaceae	*Cylindropuntia imbricata* (Haw.) F.M. Knuth	S2G5
Cactaceae	*Echinocereus reichenbachii* (Terscheck ex Walp.) J.N.	S3G5
Cactaceae	*Echinocereus viridiflorus* Engelm.	S1G5
Cactaceae	*Escobaria vivipara* (Nutt.) Buxb.	S1G5
Cactaceae	*Opuntia polyacantha* Haw. var. *polyacantha*	S2G5T5
Convolvulaceae	*Cuscuta umbellata* Kunth	S1G5
Crossomataceae	*Glossopetalon spinescens* A. Gray var.	S1G5TNR
Cupressaceae	*Juniperus monosperma* (Engelm.) Sarg.	S2G4G5
Fabaceae	*Dalea formosa* Torr.	S2G5

Fabaceae	*Dalea jamesii* (Torr.) Torr. & A. Gray	S1G5
Fabaceae	*Desmanthus cooleyi* (Eaton) Trel.	S2G5
Fabaceae	*Hoffmannseggia drepanocarpa* A. Gray	S2G5
Fabaceae	*Lupinus plattensis* S. Watson	S1G4
Grossulariaceae	*Ribes cereum* Douglas	S1G5
Malvaceae	*Sphaeralcea angustifolia* (Cav.) G. Don	S2G5
Nyctaginaceae	*Abronia fragrans* Nutt. ex Hook.	S2G5
Papaveraceae	*Argemone squarrosa* Greene	S1G4
Pinaceae	*Pinus edulis* Engelm.	S1G5
Plantaginaceae	*Penstemon fendleri* Torr. & A. Gray	S1G5T4?
Poaceae	*Aristida arizonica* Vasey	S1G4
Poaceae	*Bouteloua barbata* Lag.	S1G5
Poaceae	*Bouteloua eriopoda* (Torr.) Torr.	S1G5
Poaceae	*Hesperostipa neomexicana* (Thurb.) Barkworth	S1G4G5
Poaceae	*Hilaria jamesii* (Torr.) Benth.	S1G5
Poaceae	*Muhlenbergia phleoides* (Kunth) Columbus	S1G5
Poaceae	*Muhlenbergia porteri* Scribn. ex Beal	S1G5
Poaceae	*Muhlenbergia torreyi* (Kunth) Hitchc. ex Bush	S1G4
Poaceae	*Piptatherum micranthum* (Trin. & Rupr.) Barkworth	S1G5
Polygonaceae	*Eriogonum jamesii* Benth.	S1G5
Polygonaceae	*Eriogonum lachnogynum* Torr. ex Benth.	S1G4?
Polygonaceae	*Eriogonum tenellum* Torr.	S1G5
Rosaceae	*Cercocarpus montanus* Raf.	S1G5
Rosaceae	*Rubus deliciosus* Torr.	S1G4?
Selaginellaceae	*Selaginella underwoodii* Hieron.	S1G5?

DISCUSSION

One-hundred sixty taxa from 46 families reported in the Rogers, McPherson, and Folley studies were not found (Appendix B), and only 46 of the 95 taxa tracked by the Oklahoma Natural Heritage Inventory were located. One explanation for this difference is land access. For instance, we were not able to collect in Tesequite Canyon, which is known to have populations of tracked taxa (Oklahoma Natural Heritage Inventory 2015), as was done in the Folley study. We were uncomfortable botanizing along some of the public roads, as well. Another explanation could be that vegetation changes have occurred in the area. Vegetation analysis by Graham et al. (unpubl. data) indicates a decrease in the amount of grassland/herbaceous vegetation and an increase in forest/shrubland since 1992. This is most probably due to the increased amount of cholla (*Cylindropuntia imbricata*) in the area.

The most likely explanation for our results, however, is drought. Cimarron County is considered to be the epicenter of the exceptional drought experienced by the High Plains regions of northern Texas, southwestern Kansas, northeastern New Mexico, southeastern Colorado, and the northwestern Oklahoma panhandle (Lindsey 2008; South Central Climate Science Center 2013). Throughout the survey period, western Cimarron County experienced exceptional, extreme, or extreme/severe drought (National Oceanic and Atmospheric Administration et al. 2015). Rogers (1953) stated that the "severe drouth of the 1930s had a disturbing effect on the vegetation", but noted a "great recovery" in the following decade. Although the National Weather Service predicts that the drought status for the area will likely be removed, another "great recovery" is unlikely (U. S. Geological Survey 2014). The area could be as much as 5°C hotter by the end of the century, and decreases in precipitation, runoff, and amounts of soil water storage are also likely (U. S. Geological Survey 2014).

ACKNOWLEDGEMENTS

This work was supported by a grant from the Department of Interior, U. S. Fish and Wildlife Service. The authors wish to thank Todd Fagin (Oklahoma Biological Survey/Department of Geography and Environmental Sustainability, University of Oklahoma) for assistance with map preparation.

LITERATURE CITED

Allred, K.W. and R.D. Ivey. 2012. *Flora Neomexicana III: An Illustrated Identification Manual*. Self-published.

Carter, B.J. and M.S. Gregory. 2008. Soil map of Oklahoma. In: *Earth Sciences and Mineral Resources of Oklahoma*. Johnson, K.S. and K.V. Luza (eds.). Norman (OK): Oklahoma Geological Survey.

Curtis, N.M., W.E. Ham, and K.S. Johnson. 2008. Geomorphic provinces of Oklahoma. In: *Earth Sciences and Mineral Resources of Oklahoma*. Johnson, K.S. and K.V. Luza (eds.) Norman (OK): Oklahoma Geological Survey.

Duck, L.G. and J.B. Fletcher. 1943. *A Survey of the Game and Fur-Bearing Animals of Oklahoma*. Oklahoma City (OK): Oklahoma Department of Wildlife Conservation.

Folley, P.A. 2003. Additions to Black Mesa flora study. *Oklahoma Native Plant Record* 3:19–22.

Great Plains Flora Association. 1986. *Flora of the Great Plains*. Lawrence (KS): University of Kansas Press.

Hess, W.J. 2002. *Nolina*. pp. 415–422. In: *Flora of North America North of Mexico*. Vol. 26. Flora of North American Editorial Committee (eds.). New York and Oxford.

Hoagland, B.W. 2000. The vegetation of Oklahoma: A classification for landscape mapping and conservation planning. *The Southwestern Naturalist* 45:385–420.

Hoagland, B.W. 2008. Vegetation of Oklahoma. In: *Earth Sciences and Mineral Resources of Oklahoma*. Johnson, K.S. and K.V. Luza (eds.). Norman (OK): Oklahoma Geological Survey.

Integrated Taxonomic Information System. 2015. http://www.itis.gov (12 February 2015).

Lindsey, R. 2008. Devastating drought settles on the High Plains. http://earthobservatory.nasa.gov (17 March 2015).

McPherson, J.K. 2003a. Black Mesa flora study. *Oklahoma Native Plant Record* 3:4–7.

McPherson, J.K. 2003b. Black Mesa flora study: Year two supplement. *Oklahoma Native Plant Record* 3:8–18.

National Drought Mitigation Center. 2015. http://droughtmonitor.unl.edu (17 March 2015).

National Oceanic and Atmospheric Administration, U.S. Department of Agriculture, and National Drought Mitigation Center. 2015. U.S. Drought Monitor. http://droughtmonitor.unl.edu/Home.aspx (9 March 2015).

NatureServe. 2015. NatureServe Explorer. http://www.natureserve.org/explorer (12 February 2015).

NOAA Center for Weather and Climate Prediction. 2015. http://www.cpc.noaa.gov (23 March 2015).

Oklahoma Climatological Survey. 2015. The Climate of Cimarron County. http://www.ocs.ou.edu (11 March 2015).

Oklahoma Natural Heritage Inventory. 2013. Plant Tracking List. http://www.oknaturalheritage.ou.edu (15 January 2013).

Oklahoma Natural Heritage Inventory. 2015. Heritage Database. http://www.oknaturalheritage.ou.edu (17 March 2015).

Oklahoma Vascular Plants Database. 2015. http://www.oklahomaplantdatabase.org (4 November 2015).

Rogers, C.M. 1953. The vegetation of the Mesa de Maya Region of Colorado, New Mexico and Oklahoma. *Lloydia* 16:257–290.

Rogers, C.M. 1954. Some botanical studies in the Black Mesa region of Oklahoma. *Rhodora* 56: 205–212.

South Central Climate Science Center. 2013. Drought history for the Oklahoma panhandle. http://www.southcentralclimate.org (17 March 2015).

Taylor, R.J. and C.E.S. Taylor. 1991. *An Annotated List of the Ferns, Fern Allies, Gymnosperms and Flowering Plants of Oklahoma*. Self-published.

Trewartha, G.T. 1968. *An Introduction to Climate*. New York: McGraw-Hill.

Tyrl, R.J., S.C. Barber, P. Buck, W.J. Elisens, J.R. Estes, P. Folley, L.K. Magrath, C.L. Murray, A.K. Ryburn, B.A. Smith, C.E.S. Taylor, R.A. Thompson, J.B. Walker, and L.E. Watson. 2010. *Keys and Descriptions for the Vascular Plants of Oklahoma*. Noble (OK): Flora Oklahoma Incorporated.

United States Department of the Interior, Fish and Wildlife Service. 1993. Federal Register, Part IV 58(188):51160.

United States Geological Survey. 2014. Summary of Cimarron County. http://regclim.coas.oregonstate.edu/NEXDCP30_app/data/counties_20140331/summaries/40025/40025.pdf (23 March 2015).

USDA, NRCS. 2015. The PLANTS Database. http://plants.usda.gov/plants (9 March 2015).

Waterfall, U.T. 1949. Some results of a summer's botanizing in Oklahoma. *Rhodora* 51:18–28.

Waterfall, U.T. 1950a. Some additions to the Oklahoma flora. *Rhodora* 52:19–24, 35–41.

Waterfall, U.T. 1950b. Some results of a third summer's botanizing in Oklahoma. *Rhodora* 52:165–175.

APPENDIX A

List of Plant Taxa in Cimarron County and Black Mesa, Oklahoma

Taxa list with duration, vegetation type, and nativity. A=annual, B=biennial, P=perennial; AFSA=*Artemisia filifolia* shrubland association, BCBGBD=*Bouteloua curtipendula-Bouteloua gracilis-Bouteloua dactyloides* herbaceous association, BGHJ=*Bouteloua gracilis-Hilaria jamesii* herbaceous association, DAOF=Disturbed area/old field vegetation, HWV=herbaceous wetland vegetation, JMWA=*Juniperus monosperma* woodland alliance. An asterisk (*) indicates a taxon that is non-native to the United States. A dagger (†) indicates a tracked taxon. Taxonomy follows the Integrated Taxonomic Information System (2015). Duration and nativity to Oklahoma were determined using the PLANTS Database (USDA-NRSC 2015); if the information from PLANTS was ambiguous, Taylor and Taylor (1991) was consulted. Vegetation classifications were based on Hoagland (2000).

Alismataceae
Alisma subcordatum Raf., P, HWV

Amaranthaceae
Amaranthus palmeri S. Watson, A, AFSA
Amaranthus tuberculatus (Moq.) J.D. Sauer, A, AFSA
Atriplex canescens (Pursh) Nutt., P, BGHJ
**Chenopodium album* L., A, BGHJ
Chenopodium berlandieri Moq., A, DAOF
Chenopodium incanum (S. Watson) A. Heller, A, BGHJ
Chenopodium leptophyllum (Moq.) Nutt. ex S. Watson, A , DAOF
Chenopodium pratericola Rydb., A, BGHJ
Chenopodium simplex (Torr.) Raf., A, BCBGBD
Chenopodium standleyanum Aellen, A, JMWA
Froelichia floridana (Nutt.) Moq., A, JMWA
**Kochia scoparia* ssp. *scoparia* (L.) Schrad., A, DAOF
†*Krascheninnikovia lanata* (Pursh) A. Meeuse & A. Smit, P, JMWA
Monolepis nuttalliana (Schult.) Green, A, DAOF
**Salsola tragus* L., A, BCBGBD
Tidestromia lanuginosa (Nutt.) Standl., A, AFSA

Amaryllidaceae
Allium drummondii Regel, P, BGHJ

Anacardiaceae
Rhus aromatica Aiton var. *pilosissima* (Engl.) Shinners, P, BGHJ
Toxicodendron rydbergii (Small ex Rydb.) Greene, P, JMWA

Apiaceae
Cymopterus montanus Nutt. ex Torr. & A. Gray, P, JMWA

Apocynaceae
Apocynum androsaemifolium L., P, JMWA
Asclepias asperula (Decne.) Woodson ssp. *capricornu* (Woodson) Woodson, P, JMWA
Asclepias engelmanniana Woodson, P, AFSA
Asclepias latifolia (Torr.) Raf., P, AFSA
†*Asclepias macrotis* Torr., P, JMWA
Asclepias subverticillata (A. Gray) Vail, P, AFSA
Asclepias viridiflora Raf., P, BCBGBD

Asparagaceae
**Asparagus officinalis* L., P, BCBGBD
Yucca glauca Nutt., P, AFSA

Asteraceae
†*Ambrosia confertiflora* DC., P, AFSA
Ambrosia grayi (A. Nelson) Shinners, P, DAOF
Ambrosia psilostachya DC., P, DAOF
Ambrosia trifida L., A, BGHJ
Amphiachyris dracunculoides (DC.) Nutt., A, AFSA
†*Artemisia carruthii* Alph. Wood ex Carruth., P, BCBGBD
Artemisia filifolia Torr., P, AFSA
Artemisia ludoviciana Nutt., P, BGHJ
Baccharis salicina Torr. & A. Gray, P, HWV
Berlandiera lyrata Benth., P, AFSA
†*Brickellia brachyphylla* (A. Gray) A. Gray, P, BGHJ
†*Brickellia californica* (Torr. & A. Gray) A. Gray, P, BGHJ
†*Brickellia eupatorioides* (L.) Shinners var. *chlorolepis* (Woot. & Standl.) B.L. Turner, P, BGHJ
Cirsium ochrocentrum A. Gray ssp. *ochrocentrum*, P, BGHJ
Cirsium undulatum (Nutt.) Spreng., P, BGHJ
Conyza canadensis (L.) Cronquist, A, DAOF
Diaperia prolifera (Nutt. ex DC.) Nutt., A, BGHJ
Dyssodia papposa (Vent.) Hitchc., A, JMWA
Engelmannia peristenia (Raf.) Goodman & C.A. Lawson, P, BGHJ
†*Ericameria nauseosa* (Pall. ex Pursh) G.L. Nesom & Baird var. *graveolens* (Nutt.) Reveal & Schuyler, P, JMWA
Erigeron bellidiastrum Nutt., AFSA, A
Erigeron flagellaris A. Gray, B, AFSA
Gaillardia pinnatifida Torr., P, BGHJ
Gaillardia pulchella Foug., A, BGHJ
Grindelia squarrosa (Pursh) Dunal, P, BGHJ
Gutierrezia sarothrae (Pursh) Britton & Rusby, P, BGHJ
Helianthus annuus L., A, BGHJ
Helianthus ciliaris DC., P, BCBGBD
Helianthus petiolaris Nutt., A, DAOF
Heterotheca stenophylla (Gray) Shinners var. *angustifolia* (Rydb.) Semple, P, JMWA
Heterotheca subaxillaris (Lam.) Britton & Rusby spp. *latifolia* (Buckley) Semple, A, BGHJ

Heterotheca villosa (Pursh) Shinners var. *villosa*, P, JMWA
Hymenopappus flavescens A. Gray, B, AFSA
Hymenopappus tenuifolius Pursh, B, BGHJ
**Lactuca serriola* L., A, DAOF
Liatris punctata Hook. var. *punctata*, P, AFSA
Lygodesmia juncea (Pursh) D. Don ex Hook., P, JMWA
Machaeranthera tanacetifolia (Kunth) Nees, A, JMWA
Melampodium leucanthum Torr. & A. Gray, P, BGHJ
Packera plattensis (Nutt.) W.A. Weber & A. Löve, P, BGHJ
Palafoxia sphacelata (Nutt. ex Torr.) Cory, A, BCBGBD
†*Picradeniopsis woodhousei* (A. Gray) Rydb., P, BGHJ
Pseudognaphalium canescens (DC.) W.A. Weber ssp. *canescens*, B, BGHJ
Ratibida columnifera (Nutt.) Woot. & Standl., P, BCBGBD
Ratibida tagetes (James) Barnhart, P, DAOF
**Scorzonera laciniata* L., P, DAOF
Senecio flaccidus Less. var. *flaccidus*, P, BGHJ
Senecio riddellii Torr. & A. Gray, P, JMWA
Solidago gigantea Aiton, P, DAOF
†*Solidago velutina* DC. ssp. *sparsiflora* (A. Gray) Semple, P, BGHJ
Symphyotrichum subulatum (Michx.) G.L. Nesom, A, HWV
**Taraxacum officinale* F.H. Wigg., P, DAOF
Tetraneuris acaulis (Pursh) Greene var. *acaulis*, P, JMWA
Tetraneuris scaposa (DC.) Greene var. *scaposa*, P, BGHJ
Thelesperma ambiguum A. Gray, P, AFSA
Thelesperma filifolium (Hook.) A. Gray, P, BGHJ
Thelesperma megapotamicum (Spreng.) Kuntze, P, BGHJ
Townsendia exscapa (Richardson) Porter, P, BGHJ
**Tragopogon dubius* Scop., A, JMWA
Vernonia marginata (Torr.) Raf., P, JMWA
Xanthisma spinulosum (Pursh) D.R. Morgan & R.L. Hartm. var. *spinulosum*, P, BGHJ
Xanthium strumarium L., A, HWV
Zinnia grandiflora Nutt., P, BGHJ

Boraginaceae

†*Cryptantha cinerea* (Greene) Cronquist var. *jamesii* (Torr.) Cronquist, P, AFSA,
Cryptantha minima Rydb., A, AFSA
Cryptantha thyrsiflora (Greene) Payson, P, BGHJ
Lappula occidentalis (S. Watson) Greene var. *cupulata* (A. Gray) Higgins, A, DAOF
Lappula occidentalis (S. Watson) Greene var. *occidentalis*, A, DAOF
Lithospermum incisum Lehm., P, BGHJ
Onosmodium bejariense DC. ex A. DC. var. *occidentale* (Mack.) B.L. Turner, P, JMWA

Brassicaceae

**Camelina microcarpa* DC., A, BCBGBD
Descurainia pinnata (Walter) Britton ssp. *brachycarpa* (Richardson) Detling, A, JMWA
**Descurainia sophia* (L.) Webb ex Prantl, A, DAOF
Erysimum asperum (Nutt.) DC., P, BGHJ

Erysimum capitatum (Douglas ex Hook.) Greene, P, BGHJ
**Erysimum repandum* L., A, BGHJ
**Lepidium densiflorum* Schrad., A, DAOF
Physaria ovalifolia (Rydb.) O'Kane & Al-Shehbaz ssp. *ovalifolia*, P, JMWA
Rorippa sinuata (Nutt.) Hitchc., P, HWV
**Sisymbrium altissimum* L., A, BGHJ

Cactaceae
†*Cylindropuntia imbricata* (Haw.) F.M. Knuth, P, BGHJ
†*Echinocereus reichenbachii* (Terscheck ex Walp.) J.N. Haage, P, AFSA
†*Echinocereus viridiflorus* Engelm., P, JMWA
†*Escobaria vivipara* (Nutt.) Buxb., P, JMWA
Opuntia humifusa (Raf.) Raf. var. *humifusa*, P, BGHJ
Opuntia macrorhiza Engelm., P, JMWA
Opuntia phaeacantha Engelm., P, BGHJ,
†*Opuntia polyacantha* Haw.var. *polyacantha*, P, JMWA

Cannabaceae
Celtis reticulata Torr., P, BGHJ

Caryophyllaceae
Paronychia jamesii Torr. & A. Gray, P, BGHJ
Paronychia sessiliflora Nutt., P, BGHJ

Cleomaceae
Polanisia dodecandra (L.) DC., A, BGHJ

Commelinaceae
Commelina erecta L., P, JMWA
Tradescantia occidentalis (Britton) Smyth var. *occidentalis*, P, BGHJ

Convolvulaceae
**Convolvulus arvensis* L., BGHJ, P
Convolvulus equitans Benth., BGHJ, P
†*Cuscuta umbellata* Kunth, A, DAOF
Evolvulus nuttallianus Schult., P, BGHJ
Ipomoea leptophylla Torr., P, BGHJ

Crossomataceae
†*Glossopetalon spinescens* A. Gray var. *planitierum* (Ensign) Yatsk., P, JMWA,

Cucurbitaceae
Cucurbita foetidissima Kunth, P, BGHJ
Cyclanthera dissecta (Torr. & A. Gray) Arn., A, JMWA

Cupressaceae
†*Juniperus monosperma* (Engelm.) Sarg., P, JMWA

Cyperaceae
Carex gravida L.H. Bailey, P, HWV
Carex muehlenbergii Schkuhr ex Willd., P, HWV
Schoenoplectus acutus (Muhl. ex Bigelow) Á. Löve & D. Löve var. *acutus*, P, HWV
Schoenoplectus pungens (Vahl) Palla var. *pungens*, P, HWV

Euphorbiaceae
Croton texensis (Klotzsch) Müll. Arg., A, BGHJ
Ditaxis mercurialina (Nutt.) J.M. Coult., P, JMWA
Euphorbia dentata Michx., A, AFSA
Euphorbia exstipulata Engelm., A, BGHJ
Euphorbia fendleri Torr. & A. Gray, P, JMWA
Euphorbia glyptosperma Engelm., A, AFSA
Euphorbia lata Engelm., P, BGHJ
Euphorbia marginata Pursh, A, BCBGBD
Euphorbia missurica Raf., A, BCBGBD
Euphorbia serpyllifolia Pers. var. *serpyllifolia*, A, BCBGBD
Tragia ramosa Torr., P, JMWA

Fabaceae
Amorpha canescens Pursh, P, JMWA
Astragalus missouriensis Nutt., P, BGHJ
Astragalus mollissimus Torr., P, BGHJ
Dalea aurea Nutt. ex Fraser, P, BGHJ
Dalea candida Michx. ex. Willd var. *oligophylla* (Torr.) Shinners, P, JMWA
Dalea enneandra Nutt. ex Fraser, P, AFSA
†*Dalea formosa* Torr., P, JMWA
†*Dalea jamesii* (Torr.) Torr. & A. Gray, P, BGHJ
Dalea lanata Spreng., P, BGHJ
Dalea tenuifolia (A. Gray) Shinners, P, BGHJ
Dalea villosa (Nutt.) Spreng., P, DAOF
†*Desmanthus cooleyi* (Eaton) Trel., P, BGHJ
Glycyrrhiza lepidota Pursh, P, BGHJ
†*Hoffmannseggia drepanocarpa* A. Gray, P, BGHJ
Hoffmannseggia glauca (Ortega) Eifert, P, BCBGBD
†*Lupinus plattensis* S. Watson, P, AFSA
**Medicago sativa* L., P, BGHJ
**Melilotus officinalis* (L.) Lam., A, DAOF
Mimosa borealis A. Gray, P, BGHJ
Oxytropis lambertii Pursh, P, AFSA
Pediomelum cuspidatum (Pursh) Rydb., P, BGHJ
Prosopis glandulosa Torr. var. *glandulosa*, P, BGHJ
Psoralidium tenuiflorum (Pursh) Rydb., P, BGHJ
Robinia pseudoacacia L., P, DAOF
Sophora nuttalliana B.L. Turner, P, BGHJ

Fagaceae
Quercus mohriana Buckley ex Rydb., P, JMWA

Geraniaceae
**Erodium cicutarium* (L.) L'Hér. ex Aiton, A, DAOF

Grossulariaceae
Ribes aureum Pursh var. *villosum* DC., P, BCBGBD
†*Ribes cereum* Douglas, P, JMWA

Juncaceae
Juncus interior Wiegand, P, HWV
Juncus torreyi Coville, P, HWV

Krameriaceae
Krameria lanceolata Torr., P, BGHJ

Lamiaceae
Hedeoma drummondii Benth., P, BGHJ
**Marrubium vulgare* L., P, BGHJ
Monarda pectinata Nutt., A, AFSA
Salvia reflexa Hornem., A, JMWA
Teucrium laciniatum Torr., P, JMWA

Linaceae
Linum pratense (Norton) Small, A, BGHJ
Linum rigidum Pursh var. *rigidum*, A, BCBGBD

Loasaceae
Mentzelia multiflora (Nutt.) A. Gray, A, AFSA
Mentzelia nuda (Pursh) Torr. & A. Gray, P, AFSA
Mentzelia oligosperma Nutt. ex Sims, P, BGHJ

Malvaceae
Callirhoe involucrata (Torr. & A. Gray) A. Gray, P, BCBGBD
**Malva neglecta* Wallr., A, DAOF
†*Sphaeralcea angustifolia* (Cav.) G. Don, P, AFSA
Sphaeralcea coccinea (Nutt.) Rydb., P, BCBGBD

Martyniaceae
Proboscidea louisianica (Mill.) Thell., ssp. *louisianica*, A, AFSA

Moraceae
**Morus alba* L., P, JMWA

Nyctaginaceae
†*Abronia fragrans* Nutt. ex Hook., P, AFSA

Mirabilis albida (Walter) Heimerl, P, JMWA
Mirabilis linearis (Pursh) Heimerl var. *subhispida* (Heimerl) Spellenb., P, JMWA
Mirabilis nyctaginea (Michx.) MacMill., P, JMWA

Oleaceae
Forestiera pubescens Nutt., P, BGHJ

Onagraceae
Oenothera cespitosa Nutt., P, JMWA
Oenothera cinerea (Wooton & Standl.) W.L. Wagner & Hoch ssp. *cinerea*, P, BCBGBD
Oenothera curtiflora W.L. Wagner & Hoch, A, DAOF
Oenothera hartwegii Benth. ssp. *pubescens* (A. Gray) W.L. Wagner & Hoch, P, BGHJ
Oenothera serrulata Nutt., P, BCBGBD
Oenothera suffrutescens (Ser.) W.L. Wagner & Hoch, P, BGHJ
Oenothera triloba Nutt., P, BGHJ

Orobanchaceae
Orobanche ludoviciana Nutt. ssp. *multiflora* (Nutt.) T.S. Collins ex H.L. White & W.C. Holmes, A, BGHJ

Papaveraceae
†*Argemone squarrosa* Greene, P, BGHJ
Corydalis aurea Willd. ssp. *occidentalis* (Engelm. ex A. Gray) G.B. Ownbey, A, BCBGBD

Pinaceae
†*Pinus edulis* Engelm., P, JMWA

Plantaginaceae
Penstemon albidus Nutt., P, BGHJ
Penstemon ambiguus Torr., P, BGHJ
†*Penstemon fendleri* Torr. & A. Gray, P, AFSA
Plantago patagonica Jacq., A, BGHJ
Veronica anagallis-aquatica L., P, HWV

Poaceae
**Aegilops cylindrica* Host, A, DAOF
Andropogon gerardii Vitman ssp. *hallii* (Hack.) Wipff, P, AFSA
Andropogon gerardii Vitman ssp. *gerardii*, P, BCBGBD
Aristida adscensionis L., A, BGHJ
†*Aristida arizonica* Vasey, P, BGHJ
Aristida havardii Vasey, P, BCBGBD
Aristida oligantha Michx., A, AFSA
Aristida purpurascens Poir., P, BCBGBD
Aristida purpurea Nutt. var. *purpurea*, P, BGHJ
Bothriochloa barbinodis (Lag.) Herter, P, BGHJ
**Bothriochloa ischaemum* (L.) Keng, P, AFSA
Bothriochloa laguroides (DC.) Herter, P, BGHJ
†*Bouteloua barbata* Lag., A, JMWA

Bouteloua curtipendula (Michx.) Torr., P, AFSA
Bouteloua dactyloides (Nutt.) Columbus, P, BGHJ
†*Bouteloua eriopoda* (Torr.) Torr., P, BGHJ
Bouteloua gracilis (Kunth) Lag. ex Griffiths, P, BCBGBD
Bouteloua hirsuta Lag. , P, BGHJ
**Bromus arvensis* L., A, DAOF
**Bromus catharticus* Vahl, A, DAOF
**Bromus racemosus* L., A, BGHJ
**Bromus tectorum* L., A, DAOF
Calamovilfa gigantea (Nutt.) Scribn. & Merr., P, BCBGBD
Cenchrus spinifex Cav., P, BGHJ
Chloris verticillata Nutt., P, AFSA
Chloris virgata Sw., A, BGHJ
**Cynodon dactylon* (L.) Pers., P, DAOF
Distichlis spicata (L.) Greene var. *stricta* (Torr.) Thorne, P, BGHJ
Echinochloa muricata (P. Beauv.) Fernald, A, DAOF
Elymus canadensis L., P, BGHJ
Elymus elymoides (Raf.) Swezey, P, JMWA
Elymus virginicus L., P, AFSA
**Eragrostis cilianensis* (Bellardi) Vignolo ex Janch., A, AFSA
Erioneuron pilosum (Buckley) Nash, P, JMWA
†*Hesperostipa neomexicana* (Thurb.) Barkworth, P, BGHJ
†*Hilaria jamesii* (Torr.) Benth., P, BGHJ
Hopia obtusa (Kunth) Zuloaga & Morrone, P, AFSA
Hordeum jubatum L., P, DAOF
Hordeum pusillum Nutt., A, DAOF
Leptochloa fusca (L.) Kunth spp. *fasicularis* N.W. Snow, A, HWV
Muhlenbergia asperifolia (Nees & Meyen ex Trin.) Parodi, P, AFSA
Muhlenbergia paniculata (Nutt.) Columbus, P, DAOF
†*Muhlenbergia phleoides* (Kunth) Columbus, P, BGHJ
†*Muhlenbergia porteri* Scribn. ex Beal, P, JMWA
†*Muhlenbergia torreyi* (Kunth) Hitchc. ex Bush, P, BCBGBD
Munroa squarrosa (Nutt.) Torr., A, BGHJ
Panicum capillare L., A, DAOF
Panicum hallii Vasey, P, BGHJ
Panicum virgatum L., P, JMWA
Pascopyrum smithii (Rydb.) Barkworth & D.R. Dewey, P, AFSA
Paspalum setaceum Michx. var. *stramineum* (Nash) D.J. Banks, P, DAOF
†*Piptatherum micranthum* (Trin. & Rupr.) Barkworth, P, JMWA
Poa fendleriana (Steud.) Vasey, P, JMWA
**Polypogon monspeliensis* (L.) Desf., A, HWV
Schizachyrium scoparium (Michx.) Nash, P, AFSA
Setaria macrostachya Kunth, P, DAOF
**Setaria viridis* (L.) P. Beauv., A, DAOF
Sorghastrum nutans (L.) Nash, P, BGHJ
**Sorghum halepense* (L.) Pers., P, BGHJ
Sporobolus airoides (Torr.) Torr. , P, BGHJ

Sporobolus cryptandrus (Torr.) A. Gray, P, AFSA
Sporobolus pyramidatus (Lam.) Hitchc., P, AFSA

Polemoniaceae
Ipomopsis laxiflora (J.M. Coult.) V.E. Grant, A, JMWA

Polygalaceae
Polygala alba Nutt., P, BGHJ

Polygonaceae
Eriogonum annuum Nutt., A, AFSA
†*Eriogonum jamesii* Benth., P, BCBGBD
†*Eriogonum lachnogynum* Torr. ex Benth., P, BGHJ
†*Eriogonum tenellum* Torr., P, JMWA
Persicaria amphibia (L.) Delarbre, P, HWV
Persicaria lapathifolia (L.) Gray, A, HWV
**Polygonum aviculare* L., A, DAOF
Rumex altissimus Alph. Wood, P, HWV
**Rumex crispus* L., P, HWV
Rumex venosus Pursh, P, DAOF

Portulacaceae
Phemeranthus parviflorus (Nutt.) Kiger, P, AFSA
Portulaca oleracea L., A, JWMA
Portulaca pilosa L., A, DAOF

Potamogetonaceae
Zannichellia palustris L., P, HWV

Pteridaceae
Cheilanthes eatonii Baker, P, JMWA
Notholaena standleyi, P, JMWA

Ranunculaceae
Delphinium carolinianum Walter ssp. *virescens* (Nutt.) R.E. Brooks, P, JMWA
Ranunculus abortivus L., P, HWV
Ranunculus sceleratus L., A, HWV
**Ranunculus testiculatus* Crantz, A, DAOF

Rosaceae
†*Cercocarpus montanus* Raf., P, JMWA
Prunus virginiana L. var. *demissa* (Nutt.) Torr., P, JMWA
†*Rubus deliciosus* Torr., P, JMWA

Rutaceae
Ptelea trifoliata L., P, JMWA

Salicaceae
Populus deltoides W. Bartram ex Marshall, P, HWV
Salix amygdaloides Andersson, P, HWV
Salix exigua Nutt., P, HWV
Salix nigra Marshall, P, HWV

Santalaceae
Comandra umbellata (L.) Nutt. ssp. *pallida* (A. DC.) Piehl, P, JMWA

Sapindaceae
Sapindus saponaria L. var. *drummondii* (Hook. & Arn.) L.D. Benson, P, DAOF

Selaginellaceae
†*Selaginella underwoodii* Hieron., P, JMWA

Solanaceae
Chamaesaracha coniodes (Moric. ex Dunal) Britton, P, JMWA
Datura quercifolia Kunth, A, DAOF
Physalis hederifolia A. Gray var. *fendleri* (A. Gray) Cronquist, P, JMWA
Physalis longifolia Nutt. var. *longifolia*, P, AFSA
Quincula lobata (Torr.) Raf., P, JMWA
Solanum elaeagnifolium Cav., P, DAOF
Solanum ptychanthum Dunal, A, BCBGBD
Solanum rostratum Dunal, A, AFSA
Solanum triflorum Nutt., A, DAOF

Tamaricaceae
**Tamarix chinensis* Lour., P, HWV

Verbenaceae
Glandularia bipinnatifida (Nutt.) Nutt. var. *ciliata* (Benth.) B.L. Turner, A, BGHJ
Glandularia canadensis (L.) Nutt., P, JMWA
Glandularia pumila (Rydb.) Umber, A, BGHJ
Phyla cuneifolia (Torr.) Greene, P, HWV
Verbena bracteata Cav. ex Lag. & Rodr., A, AFSA

Violaceae
Hybanthus verticillatus (Ortega) Baill., P, BGHJ

Vitaceae
Vitis vulpina L., P, JMWA

Zygophyllaceae
Kallstroemia parviflora Norton, A, AFSA
**Tribulus terrestris* L., A, AFSA

APPENDIX B

List of Plant Taxa in Cimarron County and Black Mesa, Oklahoma Not Found by Buthod and Hoagland

Taxa from the published lists of Rogers (1953), McPherson (2003a, b), and Folley (2003) that were not found by Buthod and Hoagland. R=Rogers collection, M=Mcpherson collection, F=Folley collection. Taxonomy has been updated and follows the Integrated Taxonomic Information System (2015).

Amaranthaceae
Amaranthus retroflexus L., M
Chenopodium albescens Small, R
Cycloloma atriplicifolium (Spreng.) J.M. Coult., R
Froelichia gracilis (Hook.) Moq., R
Guilleminea densa (Humb. & Bonpl. ex Schult.) Moq. var. *densa*, R
Salsola kali L. ssp. *tenuifolia* Moq., M
Suckleya suckleyana (Torr.) Rydb., M

Amaryllidaceae
Allium canadense L. var. *fraseri* Ownbey, M

Anacardiaceae
Rhus aromatica Aiton var. *simplicifolia* (Greene) Cronquist, R
Toxicodendron radicans (L.) Kuntze, M

Apiaceae
Cymopterus glomeratus (Nutt.) DC., M

Apocynaceae
Asclepias arenaria Torr. , M
Asclepias involucrata Engelm. ex Torr. , R
Asclepias pumila (A. Gray) Vail, R, M
Asclepias uncialis Greene, M
Funastrum crispum (Benth.) Schltr., R, M

Araceae
Lemna minor L., M

Asparagaceae
Nolina texana S. Watson, F (collections are actually *Nolina greenei* S. Watson ex Trel.; Hess 2002))
Yucca harrimaniae Trel., F

Aspleniaceae
Asplenium septentrionale (L.) Hoffm., M

Asteraceae
Antennaria parvifolia Nutt., R

Artemisia dracunculus L., R, M
Baccharis wrightii A. Gray, R
Bidens cernua L., F
Brickellia eupatorioides (L.) Shinners var. *corymbulosa* (Torr. & A. Gray) Shinners, R
Chaetopappa ericoides (Torr.) G.L. Nesom, R, M
Ericameria nauseosa (Pall. ex Pursh) G.L. Nesom & Baird var. *nauseosa*, R, M
Erigeron nudiflorus Buckley, R
Erigeron tracyi Greene, M
Nothocalais cuspidata (Pursh) Greene, M
Oonopsis foliosa (A. Gray) Greene var. *foliosa*, R
Packera tridenticulata (Rydb.) W.A. Weber & A. Löve, R, M
Pericome caudata A. Gray, R, M, F
Picradeniopsis oppositifolia (Nutt.) Rydb. ex Britton, R
Psilostrophe villosa Rydb., F
Solidago mollis Bartlett , M
Solidago petiolaris Aiton, M
Stephanomeria pauciflora (Torr.) A. Nelson, R, M
Symphyotrichum ericoides (L.) G.L. Nesom, R, M
Symphyotrichum fendleri (A. Gray) G.L. Nesom, M
Symphyotrichum oblongifolium (Nutt.) G.L. Nesom, M
Verbesina encelioides (Cav.) Benth. & Hook. f. ex A. Gray, M
Vernonia fasciculata Michx., F
Xanthisma spinulosum (Pursh) D.R. Morgon & R.L. Hartm. var. *glaberrimum* (Rydberg) D.R. Morgan & R.L. Hartm., R

Boraginaceae
Cryptantha cinerea (Greene) Cronquist var. *cinerea*, R
Cryptantha crassisepala (Torr. & A. Gray) Greene, R
Euploca convolvulacea Nutt., F
Lithospermum multiflorum Torr. ex A. Gray, F

Brassicaceae
Boechera fendleri (S. Watson) W.A. Weber, M

Cactaceae
Opuntia fragilis (Nutt.) Haw., F

Campanulaceae
Lobelia cardinalis L., F

Cleomaceae
Peritoma serrulata (Pursh) DC., R, F
Polanisia jamesii (Torr. & A. Gray) Iltis, F

Cupressaceae
Juniperus scopulorum Sarg., M

Cyperaceae
Carex brevior (Dewey) Mack. , F
Cyperus croceus Vahl, F
Cyperus schweinitzii Torr., R, M
Schoenoplectus tabernaemontani (C.C. Gmel.) Palla, M
Scirpus atrovirens Willd., F
Scirpus pallidus (Britton) Fernald, R

Cystopteridaceae
Cystopteris fragilis (L.) Bernh., F

Equisetaceae
Equisetum laevigatum A. Br., R

Euphorbiaceae
Ditaxis humilis (Engelm. & A. Gray) Pax, R, M
Euphorbia geyeri Engelm., R
Euphorbia spathulata Lam., R

Fabaceae
Astragalus ceramicus E. Sheld., F
Astragalus crassicarpus Nutt., R
Astragalus crassicarpus Nutt. var. *paysonii* (E.H. Kelso) Barneby, M
Astragalus gracilis Nutt., R
Astragalus hallii A. Gray, R
Astragalus lotiflorus Hook. , R, M
Astragalus puniceus Osterh., M
Colutea arborescens L., F
Dalea candida Michx. ex Willd var. *candida*, R
Dalea compacta Spreng. var. *compacta*, R
Dalea nana Torr. ex A. Gray, R
Dalea purpurea Vent. var. *purpurea*, R
Hedysarum boreale Nutt., R
Melilotus albus Medik., R
Pediomelum argophyllum (Pursh) J.W. Grimes, M
Pediomelum hypogaeum (Nutt.) Rydb. var. *hypogaeum*, R
Pomaria jamesii (Torr. & A. Gray) Walp., R, M
Vicia americana Muhl. ex Willd. , M
Vicia ludoviciana Nutt. ex Torr. & A. Gray var. *leavenworthii* (Nutt. ex Torr. & A. Gray) Broich, R

Fagaceae
Quercus gambelii Nutt., R
Quercus grisea Liebm., R
Quercus X *undulata* Torr., R

Lamiaceae
Salvia azurea Michx. ex Lam. var. *grandiflora* Benth., M

Linaceae
Linum lewisii Pursh , R, M

Loasaceae
Mentzelia decapetala (Pursh ex Sims) Urb. & Gilg, R, M

Lythraceae
Lythrum alatum Pursh, R

Nyctaginaceae
Mirabilis glabra (S. Watson) Standl., R, M
Mirabilis linearis (Pursh) Heimerl var. *linearis*, R

Onagraceae
Oenothera albicaulis Pursh, R
Oenothera engelmannii (Small) Munz, R, F
Oenothera lavandulifolia Torr. & A. Gray, M
Oenothera pallida Lindl. ssp. *latifolia* (Rydb.) Munz, F

Orobanchaceae
Castilleja sessiliflora Pursh, R, M

Papaveraceae
Argemone polyanthemos (Fedde) G.B. Ownbey, R

Plantaginaceae
Penstemon angustifolius Nutt. ex Pursh var. *caudatus* (A. Heller) Rydb., R

Poaceae
Achnatherum hymenoides (Roem. & Schult.) Barkworth, R, M
Achnatherum scribneri (Vasey) Barkworth, R, M
Andropogon virginicus L., F
Aristida barbata E. Fourn., R
Aristida divaricata Humb. & Bonpl. Ex Willd., R
Aristida purpurea Nutt. var. *fendleriana* (Steud.) Vasey, R
Aristida purpurea Nutt. var. *longiseta* (Steud.) Vasey, R
Aristida purpurea Nutt. var. *wrightii* (Nash) Allred, R, M
Bothriochloa saccharoides (Sw.) Rydb., M
Bouteloua hirsuta Lag. var. *hirsuta*, M
Bromus japonicus Thunb. ex Murray, R
Bromus lanatipes (Shear) Rydb., R, M
Cenchrus incertus M.A. Curtis, R
Cenchrus longispinus (Hack.) Fernald, M
Dichanthelium oligosanthes (Schult.) Gould, R
Digitaria californica (Benth.) Henrard, R
Digitaria cognata (Schult.) Pilg., R
Echinochloa crus-galli (L.) P. Beauv., M

Enneapogon desvauxii P. Beauv., R
Eragrostis curtipedicellata Buckley, R
Eragrostis intermedia Hitchc., R
Eragrostis secundiflora J. Presl, R
Eragrostis sessilispica Buckley, R
Eragrostis trichodes (Nutt.) Alph. Wood, M
Hesperostipa comata (Trin. & Rupr.) Barkworth, R, M
Leptochloa dubia (Kunth) Nees, R
Muhlenbergia arenicola Buckley, R
Muhlenbergia racemosa (Michx.) Britton, Sterns & Poggenb., R, F
Phalaris caroliniana Walter, R
Phragmites australis (Cav.) Trin. ex Steud., R
Poa nemoralis L., R
Poa pratensis L., R
Setaria leucopila (Scribn. & Merr.) K. Schum., M
Sphenopholis obtusata (Michx.) Scribn., R
Tridens muticus (Torr.) Nash var. *elongatus* (Buckley) Shinners, R
Triplasis purpurea (Walter) Chapm., R
Vulpia octoflora (Walter) Rydb., R, M

Polemoniaceae
Giliastrum rigidulum (Benth.) Rydb., F

Polygonaceae
Polygonum ramosissimum Michx. , M

Pteridaceae
Astrolepis sinuata (Lag. ex Sw.) D.M. Benham & Windham ssp. *sinuata*, R
Cheilanthes feei T. Moore, R, M
Cheilanthes lanosa (Michx.) D.C. Eaton, M
Pellaea atropurpurea (L.) Link, R, M

Ranunculaceae
Clematis hirsutissima Pursh var. *scottii* (Porter) R.O. Erickson, M
Ranunculus cymbalaria Pursh, R

Rhamnaceae
Ceanothus herbaceus Raf., R

Rosaceae
Fallugia paradoxa (D. Don) Endl. ex Torr., R
Physocarpus monogynus (Torr.) J.M. Coult., R, M
Prunus americana Marshall , M
Rosa woodsii Lindl., F

Rubiaceae
Galium texense A. Gray, M

Salicaceae
Salix interior Rowlee, M

Selaginellaceae
Selaginella densa Rydb., R

Solanaceae
Solanum nigrum L., R

Tamaricaceae
Tamarix gallica L., R, M

Urticaceae
Parietaria pensylvanica Muhl. ex Willd., M

Verbenaceae
Verbena plicata Greene, R

Vitaceae
Parthenocissus quinquefolia (L.) Planch., M
Vitis acerifolia Raf., R, F,

Woodsiaceae
Woodsia oregana D.C. Eaton, R, M