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**An Analysis of the Flora of the Canadian River Canyon
Mills Canyon Section**

by

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(Note: This article was originally written in 1981. Since 1981 there have been a number of taxonomic revisions which have resulted in name changes and combinations of species. This article, although not previously published, has been cited in other studies. In order to maintain the integrity of the data as originally collected, there has been no attempt to update the taxonomic revisions which have occurred since the original data collection in 1981.)

Within the grasslands of northeastern New Mexico, the Canadian River has carved out an enormous canyon known as the Canadian River Canyon, exposing a variety of sandstone strata and supporting extensive stands of both riparian and woodland vegetation. A portion of the Canadian River Canyon occurs within the Kiowa National Grassland (Panhandle National Grasslands). The Canadian River Canyon-(Mills Canyon Section) area is located in Harding and Mora counties, northeastern New Mexico, about 30 miles east-northeast of Wagon Mound. In 1981, a detailed floristic survey of the Mills Canyon section of the Canadian River Canyon was undertaken. This report is a summary of the findings of the 1981 study which covered approximately 50 sections of rangeland, canyonland, and floodplain west of State Highway 39.

The study area was restricted to those portions of the Kiowa National Grassland along the Canadian River that were contained within a rectangular area approximately 6 miles wide and extending from the vicinity of Roy, New Mexico, northward for approximately 14 miles.

Geology of the Study Area

The Canadian River Canyon study area encompasses large expanses of flat upland habitat as well as numerous steep rocky slopes and canyon bottoms. There are also a number of precipitous side canyons, many of which are several hundred feet deep. This variation in habitats makes the Canadian River Canyon study area ideally situated to provide an interesting mixture of prairie and montane species.

Most of the Mills Canyon section of the Canadian River Canyon consists of what, at first glance, appears to be relatively homogenous sandstone overlaid by a thin band of limestone. However, between the village of Mills and the bottom of the Canadian River to the west, there is a drop of nearly 1000 feet in elevation. Throughout this 1000-foot drop, there are numerous geologic strata representing the Cretaceous, Jurassic, and Triassic ages. The following are the more prominent formations arranged stratigraphically from the top of the canyon to the bottom.

The first strata encountered at the top of the canyon is Greenhorn limestone, which occurs on knolls, hills, and breaks on top of the canyon. Beneath the Greenhorn limestone lies Graneros shale, a dark gray shale interbedded with thin layers of limestone. Both the Greenhorn limestone and Graneros shale underlie the grasslands which stretch outward from the lip of the canyon.

Beneath the Graneros shale lies Dakota sandstone. Within the Canadian River Canyon the Dakota sandstone can vary from lenticular to parallel-bedded gray shale, shaley sandstone, and sandstone layers. The basal unit of this member is composed of an uninterrupted band of massive sandstone. Dakota sandstone outcrops near the rim of the canyon.

The Morrison formation occurs beneath the Dakota sandstone. It consists of gray-green and reddish-brown sandy clays intermixed with local beds of white to brown sandstone, siltstones, and occasional limestones. These beds mark the transition from the Cretaceous to the Jurassic age. Outcrops of the Morrison

formation are often found in the middle slopes of the canyon. Beneath the Morrison formation occur the massive white to pink, fine-grained sandstones of the San Rafael group, layers that often occur near the bottom of the canyon. The light brown sandstones and reddish-brown to purple mudstones of the Dockum group also occur near the bottom of the canyon. The Dockum group represents the transition into rocks of the Triassic age and is composed of the oldest rocks exposed in the Mills section of the Canadian River Canyon.

History of the Study Area

Human use of the Canadian River Canyon extends far back into prehistory. Archaeological sites occur throughout the canyon. The Canadian River Canyon, however, is also of great historic significance. Wagons following the Santa Fe Trail often crossed the canyon in the areas of Mills. Perhaps the most significant cultural resource in the area is the remains of a large orchard and stone house located on the floodplain of the Canadian River near the Mills Forest Camp. The stone house was built in 1881 by Melvin Whitson Mills on land which his father, Daniel Mills, had homesteaded in 1870. The house served as headquarters for managing the large orchard which contained some 14,000 trees, including peaches, apples, pears, cherries, apricots, plums, mulberries, quinces, nectarines, grapes, walnuts, chestnuts, pecans, and almonds. The house was also a stagecoach stop for Mills' Concord Coach line, a line which originated in Kansas and ran from Clayton through the Canadian River Canyon to Fort Union. The old stagecoach road still exists and is the primary access to the Canadian River Canyon. In October of 1904, a large flood occurred in the Canadian River Drainage. This flood severely damaged the orchard. The orchard never fully recovered, and the last reported harvest occurred in 1912. Surprisingly, during the 1981 survey, a few scattered trees were encountered, still persisting along the canyon bottom. These included pear, apple, apricot, mulberry, walnut, pecan, plum, and osage orange.

Survey Strategy

The analysis of the Mills Canyon Section of the Canadian River Canyon involved two periods of collection and observation. The first week in July was selected as the prime time for the first field session after checking historical rainfall patterns for the grasslands. It was felt that if investigations had to be confined to a one-time effort, this time period would allow for the inclusion of some of the holdovers from the spring flora as well as some of the early fall-

flowering species. The first field period actually occurred between June 30 and July 4, 1981, and was staffed by a volunteer field crew composed mostly of experienced field botanists. These personnel represented the University of New Mexico, New Mexico State University, the U. S. Forest Service, the New Mexico State Heritage Program, and the Los Angeles County Museum of Natural History and included William Martin, Reggie Fletcher, Paul Knight, Richard Spellenberg, Robert Soreng, Darell Ward, Beth Schmidt, Ann Cully, Mollie Toll, Sandra Limerick, Tim Fischer, Robert Gustafson, Pamela Fletcher, Gwendolyn Fletcher, Christina Allen, Rex Wahl, and Elizabeth McClellan.

The second field period of this study occurred on September 17 and 18, 1981. At this time a floristic survey was completed by William Martin and Reggie Fletcher. The second survey period was necessary because of the drought conditions which prevailed in the area until midsummer of 1981. The flora was relatively sparse during the early part of the growing season in late June and July. During that time the greatest variety of species occurred in protected habitats, such as in canyons and along watercourses. Abundant mid- and late summer rains (more than 20 inches in less than two months) resulted in an explosive growth of vegetation late in the growing season. This development made necessary the second survey in September to make additional collections from selected parts of the study area.

In all, more than 1000 collections of vascular plants from numerous habitats were made during the summer and fall surveys. These collections represented 493 taxa arranged in 73 families of ferns, fern allies, gymnosperms, and angiosperms. The severe drought in 1981 affected the number of taxa present and their flowering times. During a more mesic year, the number and diversity of vascular species within the study area would undoubtedly increase.

Our initial survey plan was to implement a series of transects through the canyon to gather species and distribution data. After the second field day of the first field session, it was agreed that it would be more efficient to concentrate on a general survey of the area that would be as complete as possible and to reduce emphasis on transect data and other numerical values for use in comparative studies.

The results of this survey include an annotated checklist of plant taxa and a vegetation map of the area. General descriptions of various small side canyons

and other areas collected are provided to further familiarize the reader with the study area. The following are descriptions of each of the canyons.

Field Notes on the Canadian River Canyon Study Area

During this study, field notes on the ecology of the Canadian River Canyon and its tributaries were compiled and distribution data were gathered on all vascular plant species encountered. Due to the drought, these data are probably incomplete. In spite of intensive field searches, the drought undoubtedly detracted from the completeness of our distribution data. The following are the field notes and observations of habitats within the various canyons and collection locations within the study area.

Vercere Canyon

Vercere Canyon is a small tributary (Sections 21 and 22, T21N, R24E). The canyon is oriented from east to west and empties into the Canadian River about 1/4 mile below Mills Forest Camp. The mouth of the canyon lies at approximately 5200 feet. Physiographically, Vercere Canyon is composed of steep hillsides of reddish sandstone, with sandstone scarps of various sizes lining the rim of the canyon. This canyon was sampled from its mouth to a point near its head at approximately 5900 feet.

The mouth of Vercere Canyon was dominated by *Pinus edulis* and *Juniperus monosperma* in an approximate 1:1 ratio. The piñon trees in the canyon produced a moderate fall crop of nuts despite the severe drought. *Ipomoea leptophylla*, which was common in the sandy areas along the river, occurred infrequently above the floodplain near the mouth of the canyon. More common taxa in the canyon included *Bouteloua gracilis*, *B. curtipendula*, *Hilaria jamesii*, *Andropogon scoparius*, *A. saccharoides*, *Gutierrezia sarothrae*, *Rhus trilobata*, *Quercus undulata*, *Quercus grisea*, and *Opuntia imbricata*. In addition, *Artemisia filifolia* was occasionally present, as were *Eurotia lanata* and *Artemisia frigida*, which were both uncommon.

The floor of the lower Vercere canyon contained *Tamarisk pentandra*, *Salix exigua*, *Fallugia paradoxa*, and *Melilotus albus*. *Rhus radicans* and *Parthenocissus inserta*, common in the narrow rugged tributaries of the Canadian River drainage, were rare near the mouth of Vercere Canyon. These species, however, became increasingly common as one proceeded farther into

the canyon.

The exposed south-facing slope of Vercere Canyon had few *Pinus edulis* compared with the dominant *Juniperus monosperma*. An abundance of *Dalea formosa*, *Echinocereus triglochidiatus*, *Fallugia paradoxa*, *Rhus trilobata*, and *Cercocarpus montanus* was found on these slopes. The north-facing slope was dominated by stands of *Quercus undulata*. Some 600 yards up the canyon, beyond the mouth, there were stands of *Juniperus scopulorum* and *Pinus ponderosa*. Beyond that point, the canyon floor steepened to an approximate 10° slope with an average of 30° slopes for the canyon walls. *Quercus undulata* grew on both the north and south canyon walls. *Juniperus scopulorum* also increased in abundance in the upper portions of the canyon.

Populus acuminata occurred along the canyon bottom, with *Amorpha canescens* and *Verbascum thapsus* at the border of Sections 21 and 22. Ponderosa pine was also found but was uncommon. This portion of the canyon floor was strewn with large boulders, some of them several feet in diameter. Oaks dominated the south-facing slope, but *Bouteloua eriopoda* and *Prosopis glandulosa* were also encountered.

In general, the woodland area on the east side of the Canadian River Canyon was more or less confined to the vicinity of the canyon rim. In contrast, the west side of the canyon was dominated by a wide border more typical of a piñon-juniper community type. The rim on the west side was, however, slightly higher than the rim of the east side. The rim above Vercere Canyon was bordered by an often bare sandstone cap, with scattered scrubby ponderosa pine growing out of the shallow soils on top of the sandstone. These trees owed their existence to moisture accumulating in the cracks in this sandstone. As one proceeded in all directions away from the rim, the soil depth increased and the ponderosa pine diminished in importance, eventually sharing dominance with piñon-juniper vegetation. The more common grasses at these locations included *Bouteloua gracilis*, which dominated along with *Buchloe dactyloides*, *Muhlenbergia torreyi*, and *Hilaria jamesii*, the later varying in amounts according to intensity of pasturage.

Biscante Canyon

Biscante Canyon is located in Sections 21 and 22, T22N, R24E, and is oriented from northeast to southwest. The head of this canyon diverges into a multitude

of tiny fingerlike canyons that disappear into the dry plains. The surrounding plains were represented by open grasslands characterized by scattered *Yucca glauca* and *J. monosperma*. The grassland was interspersed with stands of *Gutierrezia*.

A shallow depression occurred at the head of the canyon, marked by concentrations of *Pinus edulis*. The soil was compact and sandy, derived from a white, fractured, erodible sandstone. The most common species were *Chenopodium album*, *Melampodium leucanthum*, *Hymenoxys acaulis*, *Gaura coccinea*, *Portulaca oleracea*, *Solanum rostratum*, *Pinus edulis*, and *Gutierrezia sarothrae*. Continuing down into the canyon, the walls steepened to form a narrow, gently sloping gorge which cut through the sandstone at a 4-6° dip. At this point, bedrock lined the canyon bottom, with permanent pools of water and marshes nestled in sandstone basins in the bedrock. These basins appeared to have been formed by storm waters that carved into the floor of the canyon. The abundance of water within these pools suggested that they were spring fed. One large pool of approximately 20 feet by 40 feet was at least 10 feet deep and populated by sunfish. The shallower portions of the pools supported extensive populations of *Sagittaria cuneata*. The pools were often rimmed by dense stands of *Juncus*, *Carex*, and *Oxalis*. Ferns were very common on the sandstone ledges above the pools. The dominant vegetation of the surrounding upland habitats included *Rhus trilobata*, *Quercus undulata*, *Opuntia imbricata*, *Juniperus monosperma*, and *Brickellia californica*.

Within the middle portions of the canyon, alluvium began to cover the sandstone bedrock on the canyon floor. The water, which was so prevalent in the upper canyon, disappeared beneath the sandy soils which covered the canyon bottom. Willows and canyon grape (*Vitis arizonica*) were abundant. The adjacent hillsides were dominated by stands of *Rhus trilobata*, *Pinus ponderosa*, *Pinus edulis*, *Juniperus monosperma*, *J. scopulorum*, *Vitis arizonica*, and occasionally *Cucurbita foetidissima*. Dense stands of cacti abounded (especially *Echinocereus triglochidiatus*) on the drier slopes of the canyon. Forest elements became more prevalent on the lower canyon slopes. Huge ponderosa pines and spreading piñon pines formed a canopy. At a point about 3/4 mile down the canyon, abundant stands of *Tradescantia*, *Melilotus*, *Amorpha*, *Tragopogon*, and *Verbascum* grew in the deeper soils along the bottom. At that point, the forests which were common on the upper canyon slopes retreated to the canyon bottom. Sandstone parapets dominated the upper slopes as the canyon widened and became drier. The canyon bottom still

barriers existing between the white oak and black oak sub genera.

Approximately 1.5 miles down the canyon a decided change was noticed in the relative humidity level of the canyon. As the canyon broadened, the ponderosa pine phased out and species of juniper began to appear. At this point, the study team travelled diagonally to the north and cut across the south-facing slope of the canyon. The only plant of interest encountered in this side trip was a small truncate *Mammillaria* with the apex only slightly above ground level. The team's initial reaction was that this was probably a species called *M. gummifera* or perhaps a variety of *M. heyderi*. Without flowers and/or fruit, definite identification was not possible. The team then angled back to the northeast and skirted the top of the canyon. Vegetation of significance included grassland dominated by a carpet of snakeweed and dotted with patches of *Yucca*.

Mestenito Canyon

Mestenito Canyon (Sections 2, 11, 35, T21N, R24E) is roughly T-shaped, with the top of the 'T' longer than the stem and running from north to south. The stem of the 'T' is not only shorter but also drier and runs from east to west. Mestenito Canyon is visually impressive, with the upper area composed of red sandstone and the lower slopes composed of sculptured white sandstone. The top of the canyon was dominated by *Juniperus monosperma*, *Rhus trilobata*, *Quercus undulata*, and *Cercocarpus montanus*.

The study team began the exploration Mestenito Canyon by walking from west to east from the mouth of the main canyon toward its head. A torrent of water rushing down the canyon was soon encountered. The lower canyon was very mesic and supported large stands of *Pinus ponderosa*. Here, the slopes were strewn with boulders covered with numerous lichens. Many of these boulders provided suitable habitat for an extensive population of *Cheilanthes villosa*. The secondary dominants at this location were *Quercus gambelli*, *Ptelea trifoliata*, *Pinus edulis*, *Juniperus scopulorum*, and *Rhus trilobata*. Adjacent to the stream were significant stands of *Urtica*, *Vicia*, and *Helianthus*.

The upper slopes of this canyon were more xeric and were dominated by *Quercus*, *Cercocarpus*, *Echinocereus viridiflorus*, *E. triglochidiatus* var. *melanocanthus*, *Opuntia imbricata*, and *Coryphantha vivipara*. Further up the canyon, numerous boulders and ledges were encountered. Plant life there included *Hilaria jamesii*, *Bouteloua curtipendula*, *Brickellia californica*,

Cheilanthes villosa, *Woodsia* spp., and *Solidago wrightii*. The mid-slopes at that point were characterized by ponderosa and piñon pines, *Ribes* spp., *Rhus toxicodendron*, *Bromus*, *Andropogon*, *Quercus*, and *Parthenocissus insertus*. The north-facing slope below the rim featured stands of grapes, including the genera *Andropogon*, *Sporobolus*, *Hilaria*, and *Aristida*.

The upper reaches of the canyon were definitely drier than the lower canyon. These xeric conditions may be attributed to the fact that the upper canyon was relatively shallow, no longer providing the sheltered effect typically afforded by a deep narrow canyon. The north-facing slope was vegetated by *Pinus ponderosa*, *Rhus trilobata*, *Pinus edulis*, scattered *Penstemon barbatus*, and species of *Quercus*. The streamside habitat was occupied by *Vitis arizonica*, *Brickellia californica*, *Melilotus alba*, *Rumex* spp., *Verbascum thapsus*, *Bouteloua curtipendula*, *Equisetum*, *Cyperus*, *Juncus*, and an occasional *Tamarix*. The south-facing slope of the canyon was dominated by *Pinus edulis*, *Opuntia imbricata*, *Yucca baccata*, and species of *Quercus*.

At this point, the team left the east-west dogleg of Mestenito Canyon and proceeded northwest to intersect with the head of the main canyon which runs approximately north to south. The interceding area between the two canyons was heavily grazed open grassland. At this juncture, a wild burro was encountered moving off into the canyon. The surveyors also noted numerous plants of *Mammillaria* at the margins of the grassland. The head of the north-south drainage of Mestenito Canyon was densely populated by *Prunus virginiana*, *Pinus edulis*, *Rhus trilobata*, *Cercocarpus montanus*, *Bouteloua gracilis*, *Hilaria jamesii*, *Brickellia californica*, *Portulaca oleracea*, and *Chenopodium album*. Scattered stands of *Opuntia phaeacantha*, *O. Polyacantha*, *Guierrezia sarothrae*, *Buchloe dactyloides*, and *Artemisia frigida* also occurred in the area.

Proceeding southward into the canyon proper, the team began to encounter mesic areas dominated by *Verbascum thapsus*, *Bouteloua curtipendula*, *Rhus toxicodendron*, *Melilotus alba*, *Scirpus* spp., *Juncus* spp., *Phragmites communis*, *Woodsia* spp., *Vitis arizonica*, *Sagittaria cuneata*, *Taraxacum officinale*, and *Equisetum*.

Approximately 1/3 mile farther down the canyon, a large spring emerged from the east-facing canyon wall. Although the spring surfaced from a sandstone substrate, the water was highly calcareous, suggesting that the water may have