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COMMON PLANTS AND PLANT ASSOCIATIONS OF THE MOGOLLON SLOPE

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Abstract—The landscape of the Mogollon Slope of west-central New Mexico and east-central Arizona supports a diverse flora of herbaceous wildflowers, shrubs, vines and trees. With an elevation range of 5500 to more than 10,000 ft above sea level, the following vegetational zones are represented: Desert and Plains-Mesa Grasslands (5000 to 6000 ft), Pinyon-Juniper Savanna and Woodlands (6000 to 7000 ft), Pine-Oak Forest (6500 to 8000 ft), and Fir-Aspen Forest (above 8000 ft). In addition, Chihuahuan Desert Scrub is well represented in the vicinity of Socorro, New Mexico. Riparian and wetland habitats support a variety of phreatophytes.

INTRODUCTION

The diverse landscapes of New Mexico harbor a varied flora that complements the many rock types that make this state a treasure of natural history. The present vegetation represents the response of plants to a variety of factors, including natural processes such as fires and natural grazing pressures, human disturbances such as overgrazing and the use of pesticides, and the introduction of opportunistic exotic species such as salt cedar and Russian thistle. The vegetation map of New Mexico (Dick-Peddie, 1993) lists 13 vegetation types, ranging from Alpine Tundra to Closed Basin Scrub vegetation. Most of the eastern part of the state is Plains-Mesa Grassland, the single most widespread vegetation type in the state. The western half of the state supports more numerous floral assemblages and greater diversity, consisting mostly of Desert Grassland but with large areas of Juniper Savanna, Coniferous and Mixed Woodland, Montane Coniferous Forest and Subalpine Coniferous Forest. The Mogollon Slope, lying at elevations ranging from 6000 to almost 10,000 ft, includes a broad slice of the vegetational diversity that typifies the western half of the state. U. S. Highway 60 between Socorro and Quemado traverses Chihuahuan Desert Scrub (in the vicinity of Socorro), Desert Grassland (between Socorro and Magdalena), Juniper Savanna (Magdalena to the edge of the Plains of San Agustín), Plains-Mesa Grassland (along the north margin of the Plains of San Agustín), and Coniferous and Mixed Woodland (west of Datil). Coniferous and Mixed Woodland and Montane Coniferous Forest are encountered in the vicinity of Alpine, Arizona.

Climatic extremes and the availability of water determine the types of plants that thrive at these elevations. The major factor for vegetation type at a particular latitude is elevation. However, plant associations may vary over a short distance depending on slope exposure or with distance from a stream or lake. This paper provides a short introduction to the common and abundant plant types in the vegetational zones traversed during the Mogollon Slope field conference.

METHODOLOGY

Field surveys along the scheduled route of the Field Conference were conducted in September and October 1993. Species in flower and/or fruit were identified and/or collected and pressed in the field. Most of the field identifications were verified by comparison with specimens in the West Texas A & M University Herbarium. These species (Table 1) will likely be conspicuous during the 1994 field trip. References consulted in identification included Correll and Johnston (1970), Elmore (1976), Ivey (1986), and Martin and Hutchins (1988). Additional field guides useful for this area include Patraw (1951), Dodge (1973), Spellenberg (1979), Amberger (1982), and Whitson (1991).

CHIHUAHUAN DESERT SCRUB

The Chihuahuan desert of northern Mexico extends from near San Luis Potosí northward to southern New Mexico and Arizona, and western Texas. This desert, because it occupies generally higher elevations than other southwestern deserts, is cooler and has greater rainfall than other warm deserts (MacMahon, 1988). It is characterized by the presence of creosotebush (*Larrea tridentata*) and/or tarbush (*Flourensia*

cernua). The Chihuahuan Desert Scrub is dominated by the shrubby woody perennial plants listed above plus one or more of the following: honeybean mesquite (*Prosopis glandulosa*), lechugilla (*Agave lechugilla*), and whitethorn acacia (*Acacia constricta*), as well as a variety of cacti and grasses.

DESERT AND PLAINS-MESA GRASSLANDS

Desert Grassland spans the transition zone between the shortgrass prairie of the High Plains and the Chihuahuan Desert of northern Mexico. These grasslands are undergoing shrub invasion as grasses are gradually replaced by desert shrubs such as creosotebush, tarbush and mesquite. Probable reasons for this change include disturbance by overgrazing of domestic livestock producing erosion of the thin topsoil, fire suppression and a gradual warming of the climate in the southwest (Sims, 1988). The expansion of mesquite onto desert grasslands has been rapid where drought has thinned stands of grass, allowing the opportunistic mesquite to invade (Herbel et al., 1972). Dick-Peddie (1993) suggested that if desert grassland shrub species are typical of the Chihuahuan Desert, the desert community is probably a recent one. If the dominant forbs of a Desert Grassland are also major species of Montane Scrub vegetation, the community may represent an ecotone between Montane Scrub and Plains-Mesa Grassland.

The list of common plants in the Desert Grasslands of southern New Mexico is large because of the transitional nature of this habitat. Plants diagnostic of this vegetation type include (Dick-Peddie, 1993) lechugilla (*Agave lechugilla*), feather peavine (*Dalea formosa*), sotol (*Dasyliroia wheeleri*), barrel cactus (*Ferocactus wislizenii*), snake-weed (*Gutierrezia sarothrae*), and tree cholla (*Opuntia imbricata*), as well as several species of grasses, including black grama (*Bouteloua eriopoda*), bush muhly (*Muhlenbergia porteri*) and burrograss (*Scleropogon brevifolius*).

Plains-Mesa Grassland is the most extensive vegetation type in New Mexico and includes the Plains of San Agustín (Fig. 1) in the west-central part of the state. This grassland type merges with Savanna or Juniper Woodlands (Fig. 2) at elevations of about 7000 feet, and with Desert Grassland at elevations below 6000 feet in southwestern New Mexico. Under optimum (climax) conditions, this vegetation type consists almost entirely of grasses, with less than 10% forbs and shrubs (Heerwagen, 1956). The dominant grass is blue grama (*Bouteloua gracilis*); other typical grasses include sideoats grama (*Bouteloua curtipendula*) and black grama (*Bouteloua eriopoda*). Typical forbs include red globemallow (*Sphaeralcea coccinea*), curly cup gumweed (*Grindelia squarrosa*) and zinnia (*Zinnia grandiflora*) (Fig. 3). In disturbed areas, rabbitbrush (*Chrysothamnus spp.*), woolly mullein (*Verbascum thapsus*) and snakeweed (*Gutierrezia sarothrae*) are common. Winter-fat (*Ceratoides lanata*) is a common shrub along the roadsides in this vegetation type, and apache plume (*Fallugia paradoxa*) is locally abundant (Fig. 4). In the vicinity of Quemado, grasslands have been invaded by rabbitbrush, a typical response to overgrazing. According to Dick-Peddie (1993, p.106), "It is not surprising that when stocking rates similar to those in Texas and Oklahoma were used on the relatively xeric and open grama grass (black grama), found on slopes with shallow soils, there was an extensive and rapid succession

TABLE 1. Plants identified in September and October 1993 along route of the 1994 New Mexico Geological Society Field Conference. Key to community types: 1 – Desert Scrub (less than 4800 ft elevation), 2 – Grassland (4800 to 6000 ft), 3 – Pinyon-Juniper Savanna and Woodland (6000 to 7000 ft), 4 – Pine-Oak Woodland (6500 to 8000 ft), 5 – Fir-Spruce-Aspen Forest (above 8000 ft, 6 – Riparian and Wetland communities.

Species	Common name	Community type	Species	Common name	Community type
<i>Alnus tenuifolia</i>	Thin-leaf alder	6	<i>Machaeranthera tanacetifolia</i>	Aster	1 2 3
<i>Argemone</i> sp.	Prickly poppy	2 3 4	<i>Machaeranthera tephrodes</i>	Gray aster	1 2 3
<i>Aristida</i> sp.	Three-awn	1	<i>Marubium vulgare</i>	Horehound	2 3 4
<i>Artemisia filifolia</i>	Sand Sage	1 2	<i>Mentzelia rusbyi</i>	Rusby stickleaf	1 2 3 4
<i>Artemisia frigida</i>	Fringed Sage	2 3	<i>Mirabilis multiflora</i>	Wild four o'clock	3 4
<i>Asclepias latifolia</i>	Broadleaf milkweed	1 2 3	<i>Mirabilis oxybaphoides</i>	Wild four o'clock	3 4 5
<i>Atriplex canescens</i>	Four-winged Saltbush	1 2 3	<i>Monarda punctata</i>	Spotted horsemint	2 3 4
<i>Berlandiera lyrata</i>	Green-eyes	1 2 3	<i>Muhlenbergia torreyi</i>	Ring muhly	1 2
<i>Botriochloa laguroides</i>	Silver bluestem	1 2 3	<i>Oenothera pallida</i>	Pale evening primrose	2 3 4
<i>Bouteloua gracilis</i>	Bluc grama	1 2 3	<i>Opuntia imbricata</i>	Cholla	1 2
<i>Bouteloua hirsuta</i>	Hairy grama	3	<i>Oryzopsis bloomeri</i>	Indian rice grass	
<i>Bouteloua curtipendula</i>	Sideoats Grama	1 2 3	<i>Parthenocissus vitacea</i>	Virginia creeper	4 5 6
<i>Brickellia californica</i>	Brickellbush	2 3	<i>Penstemon ambiguus</i>	Penstemon	
<i>Brickellia grandiflora</i>	Brickellia	1 2 3 4	<i>Physalis hederaceaefolia</i>	Groundcherry	1 2 3
<i>Castilleja integra</i>	Indian paintbrush	2 3 4	<i>Picea engelmannii</i>	Engelmann spruce	5
<i>Cercocarpus montanus</i>	Mountain mahogany	4	<i>Picea pungens</i>	Blue spruce	5
<i>Chrysothamnus nauseosus</i>	Rabbitbrush	1 2 3 4	<i>Pinus edulis</i>	Pinyon pine	3 4
<i>Cirsium drummondii</i>	Dwarf thistle	3 4 5	<i>Pinus monophylla</i>	Single-leaf pinon	3 4
<i>Cirsium</i> sp.	Yellow-spined thistle	1 2	<i>Pinus ponderosa</i>	Ponderosa pine	3 4 5
<i>Clematis ligusticifolia</i>	Goat's beard	2 3 4	<i>Populus angustifolia</i>	Narrowleaf cottonwood	5 6
<i>Cleome serrulata</i>	Rocky Mountain Bee plan	1 2 3 4	<i>Populus tremuloides</i>	Quaking aspen	5
<i>Convolvulus incanus</i>	Bindweed	1 2 3	<i>Proboscidea parviflora</i>	Devil's claw	2 3
<i>Cosmos bipinnatus</i>	Cosmos	2 3	<i>Prosopis glandulosa</i>	Honey Mesquite	1 2
<i>Cowania mexicana</i>	Mexican cliffrose	3 4	<i>Pseudotsuga menziesii</i>	Douglas fir	5
<i>Cucurbita foetidissima</i>	Buffalo gourd	2 3	<i>Psilostrophe tagetina</i>	Paper Daisy	2 3 4
<i>Datura quercifolia</i>	Oak-leaved thornapple	1 2 3	<i>Quercus arizonica</i>	Arizona oak	3 4
<i>Datura stramonium</i>	Jimsonweed	2 3	<i>Quercus gambellii</i>	Gambel's oak	3 4
<i>Dithyrea wislizenii</i>	Spectacle-pod	1 2 3	<i>Quercus grisea</i>	Gray oak	4
<i>Dyssodia papposa</i>	Fetid marigold	1 2 3 4	<i>Quercus turbinella</i>	Shrub live oak	1 2
<i>Engelmannia pinnatifid</i>	Engelmann daisy	2 3	<i>Rhamnus</i> sp.	Buckthorn	
<i>Ephedra</i> sp.	Mormon tea	1 2	<i>Rhus microphylla</i>	Little-leaf Sumac	1 2
<i>Eragrostis curvula</i>	Weeping lovegrass		<i>Rhus trilobata</i>	Skunkbush	1 2 3
<i>Erigeron</i> sp.	Fleabane	2 3 4	<i>Ribes wolfii</i>	Wolf currant	3 4
<i>Eriogonum jamesii</i>	Antelope sage	3 4	<i>Robinia neomexicana</i>	New Mexican locust	4
<i>Eriogonum</i> sp.	Whild buckwheat	2 3 4	<i>Rosa</i> sp.	Wild rose	3 4 5 6
<i>Eurotia lanata</i>	Winter fat	2 3	<i>Sambucus</i> sp.	Elderberry	5
<i>Fallugia paradoxa</i>	Apache plume	1 2 3	<i>Senecio douglasii</i>	Groundsel	1 2 3
<i>Forestiera neomexicana</i>	New Mexico forestiera	4	<i>Senecio multicapitatus</i>	Groundsel	2 3 4
<i>Gaura pauciflora</i>	Small-flowered gaura	1 2 3	<i>Sitanion hystrix</i>	Squirreltail	
<i>Geranium fremontii</i>	Fremont geranium	3 4 5	<i>Solanum heterodoxum</i>	Melonleaf nightshade	1 2 3
<i>Grindelia squarrosa</i>	Curlycup gumweed	2 3 4	<i>Solanum texanum</i>	Texas cotton	1 2 3
<i>Gutierrezia sarothrae</i>	Snakeweed	1 2 3 4	<i>Sphaeralcea grossulariaefo</i>	Globemallow	2 3
<i>Helianthus</i> sp.	Sunflower	1 2 3	<i>Sphaeralcea incana</i>	Globemallow	1 2 3 4
<i>Ipomoea cristulata</i>	Scarlet creeper	3	<i>Sporobolus contractus</i>	Spike dropseed	
<i>Ipomopsis aggregata</i>	Skyrocket or Scarlet gilia	2 3 4 5	<i>Sporobolus</i> sp.	Dropseed	
<i>Ipomopsis longiflora</i>	Throated trumpet	1 2 3	<i>Sporobolus texanus</i>	Texas dropseed	
<i>Ipomopsis multiflora</i>	Many-flowered ipomopsis	2 3	<i>Stephanomeria pauciflora</i>	Wire Lettuce	1 2 3
<i>Juniperus deppeana</i>	Alligator juniper	3 4	<i>Tamarix pentandra</i>	Salt Cedar	6
<i>Juniperus monosperma</i>	One-seed juniper	3	<i>Tragopogon</i> sp.	Salsify	1 2
<i>Juniperus osteosperma</i>	Utah juniper	3	<i>Tribulus terrestris</i>	Goathead	1 2 3
<i>Juniperus scopulorum</i>	Rocky Mountain juniper	3	<i>Verbascum thapsus</i>	Mullein or Miner's Candle	1 2 3 4
<i>Larrea tridentata</i>	Creosotebush	1	<i>Verbena ciliata</i>	Creeping vervain	1 2 3
<i>Lepidium montanum</i>	Narrow-leaved peppergrass	1 2 3	<i>Vitis arizonica</i>	Canyon grape	3 4 5 6
<i>Linum vernale</i>	Flax	2	<i>Yucca elata</i>	Soaptree yucca	2 3
<i>Machaeranthera bigelovii</i>	Purple aster	1 2 3	<i>Zinnia grandiflora</i>	Zinnia	1 2 3

of these grasslands toward Desert Grassland or desert scrublands." The controversy over the roles that various factors play in the development and maintenance of grassland are admirably summarized by Anderson (1982, p. 298), "It is my opinion that the apparent confusion regarding the roles of fire and climate in grassland maintenance and distribution can be explained by understanding that fire and climate do not have separate, unrelated effects on grasslands, and that the response of grasslands to fire can be quite different under different climatic regimes. Furthermore, other factors, including grazing animals, edaphic patterns, and landscape topography, need to be considered to under-

stand the mosaic pattern of forest, savannah, and grassland vegetation that can develop under a single climate."

JUNIPER SAVANNA

The Juniper Savanna plant association can be viewed as the result of the invasion of trees and shrubs onto grasslands (Anderson, 1982). In New Mexico, this ecotone between woodland and grassland is widespread and has been expanding during this century (Dick-Peddie, 1993). The Juniper Savanna in western New Mexico consists mostly of one-seed juniper (*Juniperus monosperma*) and Rocky Mountain



FIGURE 1. View southwest of the Plains of San Agustin and the VLA (Very Large Array) radiotelescope in the background. Low sand dunes in the foreground support a growth of sunflowers (*Helianthus sp.*), snakeweed and sparse grama grasses.

juniper (*Juniperus scopulorum*). In some areas pinyon pine is locally abundant. The dominant grasses are blue grama and sideoats grama. A large number of wildflowers, many still blooming in early fall, include the abundant zinnia and purple asters (*Machaeranthera sp.*).

CONIFEROUS AND MIXED WOODLAND

This vegetation type typically consists of a mixture of junipers, oaks and pinyon pine, forming a woodland carpeted with a layer of blue grama. It merges with pine forest (Fig. 5) at higher elevations and with juniper savanna and juniper woodland at lower elevations. In southwestern New Mexico the typical oak is either gambel oak (*Quercus gambelii*) or gray oak (*Quercus grisea*). Alligator juniper (*Juniperus deppeana*) may be locally abundant at elevations between 6000 and 8000 feet (Fig. 6). In the shade of the trees flowering plants can be found, including wild four-o'clock (*Mirabilis multiflora*) and zinnia (*Zinnia grandiflora*).

MONTANE AND SUBALPINE CONIFEROUS FOREST

In southwestern New Mexico the lowest elevation Montane Forest is dominated by ponderosa pine (*Pinus ponderosa*) and gambel oak, the so-called Pine-Oak Belt. At higher elevations aspen (*Populus tremu-*

loides) is locally abundant and readily recognized in the fall by the golden color of its leaves. At elevations above 8000 feet, in the vicinity of Alpine, Arizona, other conifers can be found, including Douglas fir (*Pseudotsuga menziesii*), blue spruce (*Picea pungens*), Engelmann spruce (*Picea engelmannii*) and limber pine (*Pinus flexilis*)—typical trees of the Fir-Aspen Belt (Table 1). Out of the carpet of pine and spruce needles wildflowers can be found, including the Fremont's geranium (*Geranium fremontii*).

RIPARIAN AND WETLAND HABITATS

Riparian and wetland habitats occur at all elevations, although because of reduced temperatures at the higher elevations, water there usually occurs throughout the growing season. At lower elevations of the Mogollon Slope, riparian habitats are characterized by narrowleaf cottonwood (*Populus angustifolia*), and a variety of shrubs and vines. Common shrubs and trees observed in the riparian zone include willows (*Salix spp.*), water birch (*Betula occidentalis*) and thinleaf alder (*Alnus tenuifolia*). Skunkbush (*Rhus trilobata*) and Arizona walnut



FIGURE 2. Pinyon-juniper savanna, 10 mi west of Magdalena.



FIGURE 3. The yellow-orange blooms of the native wild zinnia are an abundant component of the fall landscape in western New Mexico. The short (3 to 9 in. high) leafy stems support round clumps of yellowish-orange flowers 1-1.5 in. in diameter.



FIGURE 4. The feathery plumes of the apache plume, a shrub that grows to heights of 3 to 6 ft, are a striking and common sight along the roadsides of western New Mexico. The white rose-like blooms indicate that this plant is a member of the rose family.

(*Juglans major*) are common on the floodplains of major streams. Common vines include goatsbeard (*Clematis ligusticifolia*), Virginia creeper (*Parthenocissus vitaceae*), canyon grape (*Vitis arizonica*) and hops (*Humulus americanus*) (Fig. 7). The primitive horsetail (*Equisetum spp.*) is locally abundant in this habitat. In locations where standing water is present much of the year, cattails (*Typha latifolia*), smartweeds (*Polygonum spp.*) and sedges (*Scirpus spp.*) are common.



FIGURE 5. Ponderosa pine forest with an understory of Gambel's oak, 19 mi south of Springerville, Arizona.



FIGURE 6. The thick and deeply furrowed bark give the alligator juniper its name. However, only mature trees exhibit this alligator skin texture. It may grow to a height of 40 ft (Elmore, 1976) and is common in the vicinity of Reserve.



FIGURE 7. The hop vine (*Humulus americanus*) occurs in the Rocky Mountain region (Kearney and Peebles, 1951), at elevations of 5500 to 9500 ft. The pistillate flowers of the closely related European species are used in the brewing of beer to impart a bitter flavor. According to Kearney and Peebles (1951), the southwestern plant was utilized by Native Americans, the Apache name for this plant meaning, "to make bread with it".

SUMMARY

The grasslands of western New Mexico merge at lower elevations with desert scrubland species typical of the Chihuahuan Desert and at higher elevations with coniferous trees ranging from juniper and pinyon pine to firs and spruce. The mosaic of vegetational types is the result of complex and incompletely understood interactions between natural and human disturbances. It hosts a variety of plant species for us to appreciate and admire.

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