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VEGETATION OF SOUTHERN NEW MEXICO

by

WILLIAM A. DICK-PEDDIE
 Department of Biology
 New Mexico State University
 Las Cruces, New Mexico 88003

The present vegetation patterns of southern New Mexico can best be understood after obtaining some ecological and historical perspectives.

PERSPECTIVE

In pre-settlement times the vast North American grassland (prairies) extended from the eastern deciduous forests of Indiana, northwest to the boreal forests of Canada, westward to the Rocky Mountain slopes, and south to the deserts of northern Mexico and southwestern United States. The grasslands varied from tall-grass prairie in the east to short-grass plains in the west. The North American deserts were bounded on the east by the grasslands, by the mountains on the north and northwest, and by a complex of mountains and the ocean on the south and southwest (Oosting, 1956).

Southern New Mexico appears to fall either in the southwestern portion of the grasslands or in the northeastern portion of the desert. Consequently, over the years the vegetation of southern New Mexico has been considered to be a grassland by some (Weaver and Clements, 1938; Whitfield and Beutner, 1938; Whitfield and Anderson, 1938; Gardner, 1951) and a desert by others (Shreve, 1917, 1939, 1942a, 1942b, 1942c; Livingston and Shreve, 1921; Shantz and Zon, 1924; Muller, 1939, 1940). A compromise term, Desert Grassland, has also been in common use (Shreve, 1942c). Lowe (1967) has made a pertinent comment about the latter situation as follows:

"The mythical Desert-Grassland is listed as a formation merely to follow convention. It is a transitional region (ecotone) with a transitional climate between grassland and desert (Shreve, 1942a,b,c); it is, incidentally, misunderstood by many American ecologists and often misinterpreted."

Whatever classification is ultimately found to be suitable it can be assumed that there has been a mosaic pattern of grassland and desertscrub in southern New Mexico for a long period of time (Shreve, 1939, 1942c; Gardner, 1951; Ditmer, 1951; Lowe, 1955). Lowe (1967) stated this situation as follows:

"This is a broad and highly varied transition region between the plains grassland (short-grass plains) and the Southwestern Desertscrub of more recent evolution (Axelrod, 1950). The climate is intermediate between desert and grassland, and a slight change in the precipitation-evaporation ratio (for example, by a slight but significant rise in environmental temperature) can effect a pronounced change in the vegetation at a given locality."

From this quotation, which indicates the delicate balance between grassland and desertscrub conditions, it is apparent that the replacement of grassland by desertscrub could be accomplished with very little modification of the environment. Evidently such a modification did occur.

There has been a spectacular and relatively recent (80-90

years) shift in the dominant life-form over many thousands of acres from grass, black grama (*Bouteloua eriopoda*) and blue grama (*B. gracilis*), to desert shrub, creosote bush (*Larrea divaricata*) and mesquite (*Prosopis glandulosa*). The extent and degree of the present shrub domination have led many to speculate that possibly there never were extensive grasslands in southern New Mexico. However, the Territorial Survey Records verify that grasses dominated the mesas of southern New Mexico as recently as the 1880's (York and Dick-Peddie, 1969). The period of this dramatic shift is too recent to be attributed to climatic change. The topography of the area and the growth habit of grama grass render it unlikely that fire played a major role in maintaining pre-settlement grasslands in southern New Mexico. The major environmental modification of sufficient magnitude which could have triggered this change in this period of time is the initiation of extensive ranching in the area.

There no longer appears to be a grassland-desert scrub mosaic in southern New Mexico. Instead we have Chihuahuan Desert with occasional pockets of grama grass. In most cases it is unlikely that extensive grass will return even if grazing is terminated because the soil profiles which evolved with and supported the post-Pleistocene grasslands have been modified. Also there appears to have been a slight climatic shift over the past few hundred years in a xeric direction (Lowe, 1967). Even though this climatic change has not been extreme or recent enough to have caused the vegetation changes, it may well prevent a succession back to grassland even on sites with undisturbed soil profiles.

MAJOR HABITATS AND THEIR VEGETATION

An appropriate way to obtain a cursory understanding of the vegetation of southern New Mexico is through its relationship to the major topographic features found in this part of the state.

Most of the mountain ranges in this area are surrounded by gradually sloping erosion fans or piedmonts, often referred to in the southwest as "bajadas." These bajadas are often underlain at their bases by older relatively flat erosion plains ("mesas").

The mountain ranges are of modest mass and height and as a consequence, virtually all drainages are intermittent. These intermittent stream systems are referred to as "arroyos." Arroyo systems dissect the bajadas and mesas to varying degrees and then feed into major floodplain systems such as the Rio Grande; or into relatively permanent shallow lakes or ponds ("cienegas"); or into ephemeral ponds ("playas" or "swales").

Vegetation associated with water courses is often referred to as "riparian" vegetation. This vegetation can be further divided into that associated with arroyos and that associated with major floodplains.

Riparian Vegetation

Floodplains

The Rio Grande floodplain vegetation in southern New Mexico today might be expected to be slightly different from that which existed prior to the construction of dams up river. It is difficult to demonstrate that this is so, because there has been virtually continuous disturbance of this vegetation since the building of these dams. The disturbance has been from grazing, burning, bulldozing, cutting, plowing, and so forth. Studies conducted by Campbell and Dick-Peddle (1964) gave an indication that if left alone, the vegetation below the dams would eventually display a composition and structure similar to that found above the dams. Prior to the dams and prior to extensive settlement, the southern Rio Grande floodplain evidently supported gallery forests of cottonwood (*Populus fremontii*). The vigas used in the houses of communities along the river were mostly cottonwood.

The water table in the Rio Grande floodplain is at or relatively near the surface during most of the growing season. Providing the water table does not fluctuate too rapidly, the roots of most species of plants will grow fast enough to stay in or on the capillary fringe of this water. The species found in these habitats can usually tolerate relatively poor aeration and relatively high salinity. Plants growing under these conditions are sometimes referred to as "phreatophytes." An introduced phreatophyte, salt cedar (*Tamarix* spp.), has increased spectacularly on these sites during the last 100 years.

Occasionally the water table stays at the surface and marsh vegetation results. The phreatophytic vegetation which grows on sites slightly drier than that found in marshes and on river banks, but more mesic than on sites at the edges of the floodplain, may be composed of several dominant species and is often referred to as "bosque" vegetation. Today these bosques are varied in their composition and structure. Some may contain thick stands of nothing but salt cedar in their centers with shrub willows (*Salix* spp.) on the river side and mesquite (*Prosopis glandulosa*) and four-winged-saltbush (*Atriplex canescens*) on the mesa side, usually near arroyo entrances. Occasional openings will have saltgrass (*Distichlis stricta*). Other bosques may be slightly more open and have screwbean (*Prosopis pubescens*) and saltgrass thickets in the center surrounded by a salt cedar zone. Still other bosques will consist primarily of a stand of cottonwood trees with an occasional tree willow (*Salix amygdaloides*) in the center surrounded by zones of the other types described. In all examples described you may find shrub species in openings within or at the edges. These will usually be seep willow (*Baccharis glutinosa*), wolfberry (*Lycium torreyi*), squawbush (*Rhus trilobata*), or arrow weed (*Pluchea sericea*).

Campbell and Dick-Peddle (1964) suggest that the differences in bosques is primarily a reflection of the time since disturbance and the type of disturbance. They indicate that if left undisturbed, most sites would open up and form the cottonwood grove type of bosque. Consequently, today bosques can be found exhibiting all intermediate conditions and combinations of the three examples described.

Arroyos

Arroyo vegetation will be covered in two parts. The first part will cover vegetation associated with lower elevation reaches which drain the mesas and empty into a major flood-

plain. The second part will describe vegetation associated with reaches further "upstream," which have steeper grades and have usually formed small canyons.

The riparian species characteristically occupy one of the two positions in an arroyo. They are either in the "wash" itself or on higher sites such as the channel margins and alluvial islands out in the wash. Common species found in washes include two medium sized shrubs, apache plume (*Fallugia paradoxa*) and brickelbush (*Brickellia laciniata*) and one large tree-like shrub, desert willow (*Chilopsis linearis*). Less common, but which often form dense stands, are two medium sized shrubs, burweed (*Hymenoclea monogyra*) and rabbitbrush (*Crysothamnus* spp.). The seepwillow mentioned earlier is also occasionally present. On the slightly elevated sites, the dominants are a medium shrub, four-winged-saltbush, mentioned earlier, two large shrubs, mesquite and little leaf sumac (*Rhus microphylla*), and a tree-like shrub, whitethorn (*Acacia constricta*). With the exception of four-winged-saltbush and mesquite, these plants are rarely encountered in non-riparian situations.

The vegetation associated with the arroyo reaches nearer the bajadas and mountains differ considerably from that just described. These reaches have water in them more often and for longer periods of time. Also, the channel-cutting due to the grade is so much greater than that further down that often steep-walled canyons are formed, which in turn markedly modify the microhabitat through reduced evapo-transpiration potentials. In this situation the channel has usually narrowed and has cut to bedrock so that there are few plants in the wash.

Riparian trees begin to replace the shrubs which dominate further down. Beginning with those trees which are the most xeric (hence, coming in the farthest down stream) and moving up stream we encounter soapberry (*Sapindus saponaria*), hackberry (*Celtis reticulata*), little-leaf mulberry (*Morus microphylla*), grey oak (*Quercus grisea* or *arizonica*), and ash (*Fraxinus veutina*). If the mountain range is of sufficient size, the arroyo may tend to become a more permanent stream. Also this condition is usually accompanied by an increase in elevation. When these conditions prevail, walnut (*Juglans major*), chokecherry (*Prunus virginiana*), alder (*Alnus oblongifolia*), and boxelder (*Acer negundo*) may be representatives of the riparian vegetation. As indicated earlier, most species which normally grow out on open sites can become facultative riparians, and when they do, they will be found growing at considerably lower elevations than when growing on their normal open sites.

Open Vegetation

The vegetation described here is that which covers the mesas, swales, bajadas, and mountain slopes. The pre-settlement mosaic was that of grassland vegetation on the majority of sites, while Chihuahuan Desert vegetation occupied the very dry sites such as rocky surfaces, steep south facing slopes, and so forth.

Grazing and the subsequent erosion have so increased the proportion of desert-scrub (dry) sites to grassland sites that today we have a reversal of the mosaic. The majority of sites now support Chihuahuan Desert vegetation while grassland vegetation occupies only the more mesic sites such as deep soils, north facing slopes, or otherwise protected situations. One notable exception to this change are the tobosa grass

(*Hilaria mutica*) swales. These swale sites appear to be little changed from pre-settlement times (York and Dick-Peddie, 1969).

Desert vegetation

A typical Chihuahuan Desert site in New Mexico has a rocky surface, sometimes referred to as "gravel pavement." The dominant plants are shrubs with occasional stands of hardy grasses such as fluff grass (*Tridens pulchellus*). The dominant shrub is creosotebush (*Larrea divaricata*). Sometimes another shrub will co-dominate over fairly extensive areas. In such instances the other shrub is likely to be one of the following: tarbush (*Flourensia cernua*), range ratany (*Krameria parvifolia*), or whitethorn (*Acacia constricta*). Whitethorn normally occupies minor gullies or drainage troughs. Within this limited dominant pattern, variations in drainage, rock outcrops, alkalinity, and so forth will support local stands of conspicuous xeric shrubs. Among these are ocotillo (*Fouquieria splendens*), banana yucca (*Yucca baccata*), allthorn (*Koeberlinia spinosa*), sotol (*Dasyllirion wheeled*), and wait-a-minute bush (*Mimosa biuncifera*).

When compared with the species diversity of the Sonoran Desert in Arizona, the Chihuahuan Desert in New Mexico exhibits a depauperate flora.

Mesquite (*Prosopis glandulosa*) covers extensive areas on the mesas of southern New Mexico. The mesquite-dominated sites invariably have finer textured and deeper soils than do the creosote-dominated sites. Generally, it can be assumed that mesquite sites are less deteriorated from past grassland conditions than are creosote sites. York and Dick-Peddie (1969) found an area in Dorm Ana County, New Mexico, where a piedmont which supported a mesquite stand in the 1870's, now supports a creosotebush stand. This shift is undoubtedly due to the loss by erosion of the finer textured soil.

Grassland vegetation

Three species of grama grass dominated the gently rolling mesas of southern New Mexico 100 years ago (York and Dick-Peddie, 1969). The most xeric of these grasses is black grama (*Bouteloua eripoda*); requiring more moisture is blue grama (*Bouteloua gracilis*). Side oats grama (*Bouteloua curtipendula*) requires the most moisture of the three. Their presence on a site has an indicator value with respect to available moisture. Another common grass was bushmuhly (*Muhlenbergia ported*).

Scattered stands of conspicuous shrubs interrupted the uniformity of the grasslands. Such patches reflected major site variations. Some of these shrubs were mesquite, four-winged-saltbush, creosotebush, mormon tea (*Ephedra trifurca*), sacahuista (*Nolina microcarpa*), prickly pear (*Opuntia* spp.), and cholla (*Opuntia* spp.). The site variations were usually due to such things as rock outcrops and shallow or deep soils. Some of these plants are now considered indicators of the deterioration of grassland sites.

Tobosa grass (*Hilaria mutica*) occupied valley bottomlands and swales. Vine-mesquite (*Panicum obtusum*) grew on sites which were ephemeral ponds (playas).

Soap-tree (*Yucca elata*) was common in the grassland. It was found on fine sandy sites. These sights were common around the edges of swales and playas.

Savannah and forest vegetation

The grasslands formed a mosaic with the coniferous forests at higher elevations where the mesas and bajadas meet the mountains. This mosaic is sometimes referred to as "savannah." The xeric trees of the coniferous forest which formed these savannahs were one-seeded juniper (*Juniperus monosperma*), alligator-bark juniper (*Juniperus deppeana*), and pinyon pine (*Pinus edulis*).

With increasing elevation the grassland gives way to forest. Following pinyon pine, the ponderosa pine (*Pinus ponderosa*) begins to dominate. With increasing elevation ponderosa is followed by douglas fir (*Pseudotsuga menziesii*), limber pine (*Pinus strobiformis*) and/or balsam fir (*Abies concolor*), and at the highest elevations in southern New Mexico blue spruce (*Picea pungens*) may be found. In openings, a number of trees and shrubs can express local domination. Beginning at the lower elevations and moving up, we can expect to find these shrubs: silktassel (*Garrya wrightii*), rock-spiraea (*Holodiscus dumosus*), mountain mahogany (*Cercocarpus* spp.) and two trees, New Mexican locust (*Robinia neomexicana*) and gambel oak (*Quercus gambelii*). The shrub versus forest patterns usually reflect past disturbances. The greater amount of shrub vegetation, the more recent the disturbance.

SUMMARY EXPLANATION

This discussion of southern New Mexico grassland vegetation describes pre-settlement conditions. Today the xeric shrubs have occupied all but the most moist or protected sites and the coniferous pioneers have moved down to meet the shrubs. This results in highly varied species arrangements which presents little recognizable pattern to the untrained eye.

Many annual herbaceous plants constitute the flora of southern New Mexico. These species exhibit virtually infinite adaptations to the exacting demands of southern New Mexico's climate. The typical year to year variation in seasonal moisture and temperature patterns makes prediction of annual appearance hazardous. Also annuals rarely dominate extensive areas. Consequently, herbaceous annuals have not been used in this description of southern New Mexico's vegetation.

Table 1 is designed to summarize the relationships of the plants which dominate the vegetation of southern New Mexico.

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Table 1. Dominant and indicator plants of the vegetation of southern New Mexico.

RIPARIAN VEGETATION		OPEN VEGETATION
1. Floodplain (bosque) vegetation		1. Chihuahuan desert
<i>trees</i>		<i>shrubs</i>
cottonwood (<i>Populus fremontii</i>)		creosotebush (<i>Larrea divaricata</i>)
peach-leaf willow (<i>Salix amygdaloides</i>)		tarbush (<i>Flourenzia cernua</i>)
<i>shrub-trees</i>		range ratany (<i>Krameria parvifolia</i>)
screwbean (<i>Prosopis pubescens</i>)		whitethorn (<i>Acacia constricta</i>)
salt cedar (<i>Tamarix</i> spp.)		mesquite (<i>Prosopis glandulosa</i>)
<i>shrubs</i>		#banana yucca (<i>Yucca baccata</i>)
*four-winged saltbush (<i>Atriplex canescens</i>)		#ocotilla (<i>Fouquieria splendens</i>)
seep-willow (<i>Baccharis glutinosa</i>)		#crucifixion thorn (<i>Koeberlinia spinoa</i>)
bank willow (<i>Salix</i> spp.)		#wait-a-minutebush (<i>Mimosa biuncifera</i>)
*squawbush (<i>Rhus trilobata</i>)		#sotol (<i>Dasylerion wheeleri</i>)
arrow weed (<i>Pluchea sericea</i>)		#cholla cactus (<i>Opuntia</i> spp.)
**mesquite (<i>Prosopis glandulosa</i>)		#prickly-pear cactus (<i>Opuntia</i> spp.)
<i>grass</i>		<i>grass</i>
salt grass (<i>Distichlis stricta</i>)		fluff grass (<i>Tridens pulchellus</i>)
2. Arroyo vegetation		2. Grassland
lower (mesa)		<i>grasses</i>
<i>shrub-trees</i>		black grama (<i>Bouteloua eriopoda</i>)
desert willow (<i>Chilopsis linearis</i>)		blue grama (<i>Bouteloua gracilis</i>)
*whitethorn (<i>Acacia constricta</i>)		side oates grama (<i>Bouteloua curtipendula</i>)
<i>shrubs</i>		bushmuhly (<i>Muhlenbergia porteri</i>)
little-leaf sumac (<i>Rhus microphylla</i>)		tobosa grass (<i>Hilaria mutica</i>)
**mesquite (<i>Prosopis glandulosa</i>)		vine-mesquite (<i>Panicum obtusum</i>)
brickelbush (<i>Brickellia</i> spp.)		<i>shrubs</i>
*four-winged saltbush (<i>Atriplex canescens</i>)		soap-tree (<i>Yucca elata</i>)
burroweed (<i>Hymenoclea mongyra</i>)		#mormon tea (<i>Ephedra trifurca</i>)
rabbitbrush (<i>Crysothamnus nauseosus</i>)		#sacahuista (<i>Nolina microcarpa</i>)
upper (canyon)		#cholla cactus (<i>Opuntia</i> spp.)
<i>trees</i>		#prickly-pear cactus (<i>Opuntia</i> spp.)
soapberry (<i>Sapindus saponaria</i>)		3. Savannah and forest
hackberry (<i>Celtis reticulata</i>)		<i>trees</i>
little-leaf mulberry (<i>Morus microphylla</i>)	Lower elevation	one-seeded juniper (<i>Juniperus monosperma</i>)
*grey oak (<i>Quercus grisea</i>)	riparian	aligatorbark juniper (<i>Juniperus deppeana</i>)
*Arizona white oak (<i>Quercus arizonia</i>)		pinyon pine (<i>Pinus edulis</i>)
ash (<i>Fraxinus veutina</i>)	to	ponderosa pine (<i>Pinus ponderosa</i>)
*chokecherry (<i>Prunus virginiana</i>)		douglas fir (<i>Pseudotsuga menziesii</i>)
alder (<i>Alnus oblongifolia</i>)	Higher elevation	limber pine (<i>Pinus strobiformis</i>)
walnut (<i>Juglans major</i>)	riparian	balsam fir (<i>Abies concolor</i>)
box elder (<i>Acer negundo</i>)		blue spruce (<i>Picea pungens</i>)
		<i>shrub-trees</i>
		New Mexican locust (<i>Robinia neomexicana</i>)
		gambel oak (<i>Quercus gambeli</i>)
		<i>shrubs</i>
		silktassle (<i>Garrya wrightii</i>)
		mountain mahogany (<i>Cercocarpus</i> spp.)
		rock-spiraea (<i>Holodiscus dumosus</i>)

*These plants can occasionally be found in situations other than riparian. In such instances they are usually in an erosion gully, rock crevice, or other water catchment situation.

**When mesquite is established on other than riparian sites or cienega and playas borders it can be an indication of establishment via digestive tracts of domestic animals.

#These plants may be locally prominent and in some instances can form dense stands. Their presence reflects local soil variations, rock outcrops, or in grasslands a more xeric condition than surrounding sites.