# TYPICAL VEGETATION PATTERNS OF CENTRAL NEW MEXICO

WILLIAM A. DICK-PEDDIE
Department of Biology, New Mexico State University, Las Cruces, NM 88001

**Abstract**—Variations in vegetation patterns are chiefly the result of available moisture. Available moisture tends to be positively correlated with altitude because temperatures vary inversely with altitude and less moisture is lost by evaporation at lower temperatures. Also, precipitation tends to increase at higher elevations. A majority of vegetation types of New Mexico can be found in the T or C region. Except for riparian vegetation, the major types tend to fall along an elevational gradient from Forest (highest), down through Woodland and Grassland to Scrubland (lowest). Several types of riparian vegetation are associated with intermittent and perennial water courses.

This paper describes the trees, shrubs, common cacti, and grasses that inhabit these vegetation-type areas in the T or C region. Some comparison is made between the vegetation now present and what was present during the Spanish territorial time.

## INTRODUCTION

Vegetation patterns vary because different combinations of plant species dominate different habitats. Different habitats result from combinations of different climates, landforms, and parent materials. Gross variations in vegetation patterns are recognized by everyone. The most obvious variations are those caused by differences in the life-forms (tree, shrub, and herb) of the dominant species occupying an area. The vegetation of New Mexico can be generalized as follows:

TUNDRA VEGETATION
- Alpine Tundra

FOREST VEGETATION
- Subalpine Coniferous Forest
- Montane Coniferous Forest

WOODLAND AND SAVANNA VEGETATION
- Coniferous Woodland
- Juniper Savanna (ecotone)

GRASSLAND VEGETATION
- Subalpine–Montane Grassland
- Great Basin Grassland
- Plains–Mesa Grassland
- Desert Grassland (ecotone)

SCRUBLAND VEGETATION
- Chihuahuan Desert Scrub
- Great Basin Desert Scrub
- Plains Scrub (Shinnery)
- Montane Scrub
- Closed Basin Scrub

RIPARIAN VEGETATION
- Alpine riparian
- Montane riparian
- Floodplain–Plains riparian
- Arroyo riparian
- Alkali Sink–Playa–Swale riparian

Except for riparian vegetation, the major vegetation types found in New Mexico tend to fall along an elevational gradient from Tundra, highest, through Forest, then down through Woodland, Grassland and finally Scrubland, the lowest. With the exception of Tundra, these types occur in response to the amount of available moisture (moisture available to and maintained within the plant during the growing season) rather than in response to temperature. Available moisture tends to be positively correlated with altitude because temperatures vary inversely with altitude and with lower temperatures less moisture is lost by evaporation from plants and soil. Also both annual and seasonal precipitation tend to increase with an increase in elevation.

A majority of the vegetation types of New Mexico can be found within a rectangle formed by Socorro in the northeast corner, San Andres Mountains in the southeast corner, Datil in the northwest corner, and San Lorenzo in the southwest corner (Fig. 1). This paper deals with the vegetation found in the Fig. 1 rectangle. Because riparian vegetation is restricted to drainage systems, it often forms such a narrow zone that mapping is not feasible. No riparian vegetation is depicted in Fig. 1. However, riparian vegetation is found in the area encompassed by the rectangle and it will be discussed in this paper.

## VEGETATION

The area (rectangle) includes small mountain units. These are the San Mateos, Magdalenas, Fra Cristobals, and Caballos. A portion of the lower eastern slope of the Black Range is also included in the area covered. Higher elevations support Subalpine and Montane Coniferous Forest. There is a considerable amount of woodland below the montane-forest areas. The Fra Cristobals and Caballos are not of sufficient size or height to support forest, but small amounts of woodland can be found on these mountains. The Magdalena Mountains have considerable amounts of dry rocky outcrops on their eastern sides. Montane scrub covers these areas. The mountains are surrounded by gradually sloping erosion fans or piedmonts, often referred to in the Southwest as "bajadas." These bajadas are usually underlain at their bases by older, relatively flat, erosion plains (mesas). At their lower levels, these bajadas and mesas support Juniper Savanna and Desert Grassland vegetation (Fig. 1).

Vegetation associated with water courses is referred to as riparian. The mountains in the area 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 either into the Rio Grande or into closed basins. Closed basins may contain ephemeral ponds (playas).

### Riparian vegetation

#### Floodplain riparian

In addition to building dams, man has greatly modified Floodplain riparian habitat in New Mexico. The disturbance has been from livestock grazing, burning, bulldozing, cutting, and plowing. The combination of upstream dams and grazing by domestic livestock appears to have accelerated the establishment of dense stands of the introduced shrub, salt cedar (*Tamarix* spp.), on much of the riparian habitat in the southern part of the state. Prior to dams and extensive settlement, the southern Rio Grande floodplain supported gallery forests of cottonwood (*Populus fremontii*). These trees were in great demand for fuel and vegas for houses.

The water table in the Rio Grande floodplain is at or relatively near the surface during most of the growing season. If the water table does not fluctuate too rapidly, the roots of most plants will grow in or on the capillary fringe of this ground water. Plants growing under these conditions are called "phreatophytes." Most Floodplain riparian veg-

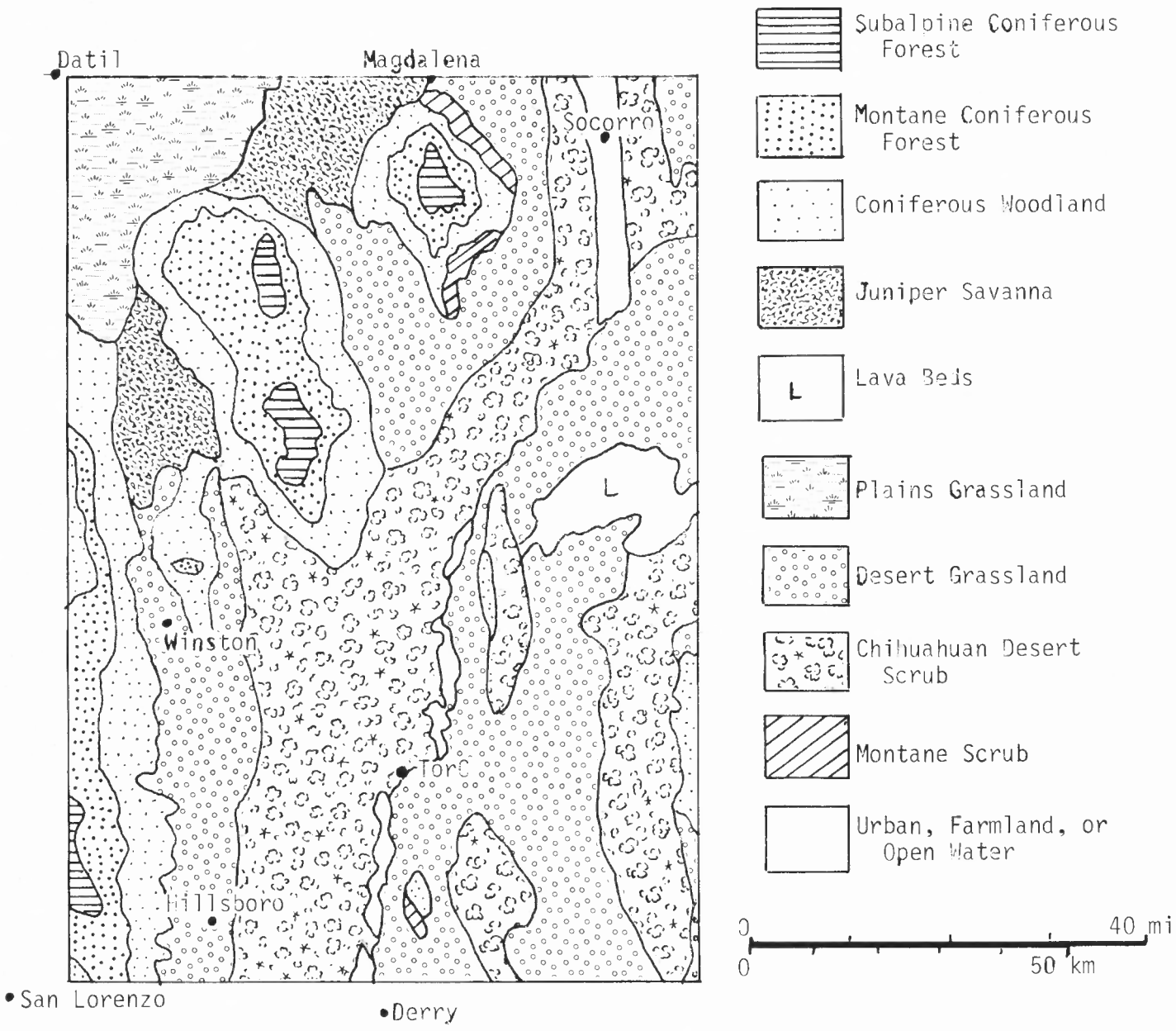


FIGURE 1—Vegetation patterns in a portion of south-central New Mexico.

etation in New Mexico is growing under phreatophytic conditions. Dense stands of trees and/or shrubs are commonly found on the river floodplain. Such stands are often called "bosques" in New Mexico (Dick-Peddie 1975). Some may contain nothing but salt cedar in the center, with bank willows (*Salix exigua*) on the river side and with mesquite (*Prosopus glandulosa*) and/or four-wing saltbush (*Atriplex canescens*) on the mesa side. Open areas will often be covered with saltgrass (*Distichlis stricta*). Some bosques are composed of stands of cottonwood trees with an occasional tree willow (*Salix gooddingii*). These stands will also have bank willows at the river's edge and desert shrubs at the mesa edge. In addition to salt grass, openings in these cottonwood stands may have seep willow (*Baccharis glutinosa*), wolfberry (*Lycium torreyi*), and/or arrow weed (*Pluchea sericea*). If these cottonwood stands are left undisturbed long enough for the trees to mature and form a closed canopy, the stand may be referred to as a grove or gallery forest rather than a bosque. Cottonwood gallery forests dominated the Rio Grande floodplain prior to dams and extensive settlement (Campbell & Dick-Peddie 1964). It can be assumed that floodplain vegetation other than gallery forests indicates past habitat disturbance by man.

**Arroyo riparian**

Riparian plants normally grow in the "wash" itself or on slightly elevated sites such as the channel margins and alluvial islands out in the wash. Common species found in the wash are two medium-sized shrubs, apache plume (*Fallugia paradoxa*) and brickelbush (*Brickellia laciniata*), and a tree-like shrub, desert willow (*Chilopsis linearis*). Found less commonly, but often forming dense stands, are two medium-sized shrubs, burroweed (*Hymenoclea monogyra*) and rabbitbrush (*Chrysothamnus* spp.). On the slightly elevated sites, the dominants are a medium shrub, four-wing saltbrush mentioned earlier, two large shrubs, mesquite and little-leaf sumac (*Rhus microphylla*), and a tree-like shrub called whitethorn (*Acacia constricta* or *neovernicosa*).

The arroyo vegetation associated with the higher drainages closer to the mountains differs considerably from that just described. These reaches have water in them more often and for longer periods of time. The

channel cutting due to the grade is so much greater that steep-walled canyons are often formed, which markedly affects the microhabitat through reduced evapo-transpiration potentials. In these situations the channel has usually narrowed and has cut to bedrock, so there are few plants in the wash (bed) of the arroyo. Riparian trees now begin to line the channel. Beginning lower and working up grade, we are likely to find soapberry (*Sapindus saponaria*), hackberry (*Celtis reticulata*), little-leaf mulberry (*Morus microphylla*), grey or Arizona oak (*Quercus grisea* or *arizonica*), velvet ash (*Fraxinus velutina*), and Arizona walnut (*Juglans major*). If the mountain range is high enough, as in the San Mateos and the Magdalenas, the drainage may become a perennial stream and trees such as chokecherry (*Prunus virginiana*), alder (*Alnus oblongifolia*), and boxelder (*Acer negundo*) will be found growing along the banks (Freeman & Dick-Peddie 1970).

### Swale riparian

Where arroyos cross grassland mesas on very gentle grades, there may be little arroyo-channel formation and considerable water spreading. Small catchment areas called "swales" are often found. The swales are covered with tobosa grass (*Hilaria mutica*) and soaptree yucca (*Yucca elata*) often grows on their sandy margins. Today the vegetation of swales differs little from that reported in the territorial survey records. If the catchment is large enough for water to stand for extended periods of time, the low center may be free of grass. These larger catchments, called "playas," may support annuals periodically in the center areas, and the surrounding margins are likely to have vine mesquite (*Panicum obtusum*), burrograss (*Scleropogon brevifolius*), and alkali sacaton (*Sporobolus airoides*). Tobosa grass may be found near playas in areas where water does not stand too long.

## Forest vegetation

### Subalpine and Montane Coniferous Forest

The higher areas of the San Mateo and Magdalena Mountains support Subalpine Coniferous Forest vegetation dominated by Engelmann spruce (*Picea engelmannii*). At lower elevations or on warmer microsites the Montane Coniferous Forest can be found. This type is dominated by Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and occasionally southwestern white pine (*Pinus strobiformis*). Blue spruce (*Picea pungens*) may be found in riparian or pseudoriparian situations such as the foot of a talus slope. The lower (warmer) portions of the Montane type are dominated by stands of ponderosa pine (*Pinus ponderosa*). There may be an occasional alligator juniper (*Juniperus deppeana*) in the lower parts of the ponderosa zone. Large old alligator junipers are sometimes found in areas currently covered by Woodland vegetation. In most instances the sites where the old junipers are found are sites where ponderosa stands have been removed and the sites may be changing back to forest. Openings in the forest are usually due to some sort of past disturbance such as logging or fire. At higher elevations these openings are covered by aspen (*Populus tremuloides*) with gambel oak (*Quercus gambelii*) and New Mexican locust (*Robinia neomexicana*) dominating lower disturbed sites. With time, conifers germinate under the aspens or oaks and the site gradually returns to its predisturbance condition.

Various combinations of shrub species are found in the understories of the Subalpine and Montane forests. Starting high in these mountains and moving down, the shrub layer is dominated by box-leaf (*Pachistima myrsinites*), creeping mahonia (*Berberis repens*), cliffbush (*Jamesia americana*), snowberry (*Symphoricarpos oreophilus*), rock-spiraea (*Holociscus dumosus*), gooseberry (*Ribes* spp.), and elderberry (*Sambucus neomexicana*). Cliffbush and elderberry usually occupy riparian-like sites in the understory.

## Woodland–Savanna vegetation

### Coniferous Woodland

Below the coniferous forest the Coniferous Woodland vegetation forms bands generally following contour lines (Fig. 1). At the lower edge of the Montane Forest where ponderosa pine becomes less dense, the vegetation begins to be dominated by Coniferous Woodland species. These are the Colorado pinyon (*Pinus edulis*) and one-seed juniper (*Juniperus monosperma*). This pinyon–juniper vegetation is one of the most extensive types in the state and throughout the Southwest. In other parts of the state, the one-seed juniper may share with or give way to Rocky Mountain juniper (*Juniperus scopulorum*) or Utah juniper (*Juniperus osteosperma*). Small stands of oaks are occasionally found in the woodland. The oaks may be gambel, grey, Arizona, or wavy-leaf (*Quercus undulata*).

The Coniferous Woodland is more open that the Montane Forest. After a ponderosa stand has been disturbed (burned or logged), the Woodland species take over the site until shade and moisture conditions are created which will permit the germination and seedling survival of ponderosa pines. Consequently, an apparent Woodland area may actually be a successional stage which will be replaced by a ponderosa forest. The presence of ponderosa seedlings will verify that the site is in a successional stage.

Shrubs and grasses are major components of the Pinyon–Juniper Woodland, but they tend to form a mosaic with the trees rather than to be in an understory. Common shrubs from higher (cooler) elevations to lower (warmer) are fendlerbush (*Fendlera rupicola*), mock orange (*Philadelphus* spp.), scrub live-oak (*Quercus turbinella*), Wright's silktassle (*Garrya wrightii*), desert buckbrush (*Ceanothus greggii*), and algerita (*Berberis haematocarpa*). The dominant grasses are the gramas: side-oats (*Bouteloua curtipendula*), blue (*B. gracilis*), black (*B. eriopoda*), and hairy (*B. hirsuta*). Mountain muhly (*Muhlenbergia montana*) may occur in the higher portions where woodland intergrades with ponderosa forest.

### Juniper Savanna

This type of vegetation rarely forms discrete boundaries with the Woodland type on its higher, more moist edge or with the Grassland type at the lower (drier) edge. The Juniper Savanna can be considered a transition zone (ecotone) between Woodland and Grassland. A typical savanna will have scattered junipers in a grass matrix. This type is usually restricted to lower bajadas. If observed carefully, it will be apparent that the density of the junipers tends to be positively correlated with elevation: higher density–higher elevation. When savanna can be viewed from a distance, it can be seen in addition to the density trend that the junipers follow the erosion (drainage) patterns of the bajadas. There is a considerable amount of Juniper Savanna in the state (Donart et al. 1978) and it has been and is expanding (Sallach 1986). Virtually all of this expansion is on range lands and juniper increase–livestock grazing are positively correlated. Dominant grasses of the Juniper Savanna are the same as those found in the Pinyon–Juniper Woodland and the Mesa Grassland.

## Grassland vegetation

### Mesa Grassland

Mesa Grassland is found in the northwestern corner of the area (Fig. 1). This type of grassland is extensive in New Mexico and the patch which has a portion in the area under discussion is actually a western "outlier" or disjunct from the area of its primary occurrence in the state. Mesa and Plains Grasslands are similar. The Plains Grassland is a western continuation of the Short Grass Prairie and is generally limited to the eastern portion of the state. The Mesa Grassland type has a slightly lower moisture requirement than the Plains Grassland and the higher moisture requiring grasses of the plains are absent from the Mesa Grassland. In addition, black grama, which is a low-moisture-tolerant grass, is a member of the Mesa but not the Plains Grassland. The dominants of the Mesa Grassland are the blue, black, and hairy gramas, sand dropseed (*Sporobolus cryptandra*), ring muhly (*Muhlenbergia torreyi*), galleta (*Hilaria jamesii*), various threeawn species (*Aristida* spp.), and needle grasses (*Stipa* spp.). Various combinations of these species dominate at any one site. The amount of this vegetation type is diminishing in New Mexico and sites previously supporting Mesa Grassland are now occupied by Juniper Savanna, Desert Grassland, or Chihuahuan Desert Scrub.

### Desert Grassland

This type is composed of desert shrubs in a mosaic with grasses. Few of the dominant plants are peculiar to this type. The principal shrubs are also the dominants of the Chihuahuan Desert Scrub type. The major grasses are also the dominants of the Mesa Grassland type. Lowe (1967) had this to say about the Desert Grassland type:

> 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.
>
> This is a broad and highly varied transition region between the plains grassland (short-grass plains) and the Southwestern Desert scrub 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.

Lowe's comments indicate that we can consider the Desert Grassland as an ecotone (transition zone) between the Mesa Grassland and the Chihuahuan Desert Scrub. As in the case of Juniper Savanna, it is difficult for the observer to know if a given ecotonal zone has existed for the past few thousand years or if it is of recent origin. The study of territorial survey records from New Mexico has revealed that most of the Juniper Savanna and some of the Desert Grassland are less than 120 years old (Buffington & Herbel 1965, Gross & Dick-Peddie 1979). Actually, the total amount of Desert Grassland in New Mexico has not changed much because a great deal of the Desert Grassland area of 100 years ago is now Chihuahuan Desert Scrub. Areas on the upper, more moist portions have been added to the Desert Grassland, while portions of the lower, drier Desert Grassland have been lost to Chihuahuan Desert Scrub.

The Desert Grassland type is a mosaic of shrubs and grasses. The patterns are based upon available moisture. Consequently, drier sites such as gravelly or rocky surfaces and south-facing slopes will be covered with desert shrubs such as creosotebush (*Larrea tridentata*), various species of cholla and prickly-pear cacti (*Opuntia* spp.), four-wing saltbush, snakeweed (*Gutierrezia* spp.), banana yucca (*Yucca baccata*), sotol (*Dasyleron wheeleri*), and whitethorn. The grasses are those of the Mesa Grassland.

## Scrubland vegetation

### Montane Scrub

Mountains in New Mexico often have rocky outcrops with little or no soil formation. These sites are covered with rather dense stands of shrub species. Often three or four species are co-dominants on a site. Some of the Montane Scrub type occurs on the Magdalenas and the Caballos (Fig. 1). Dominant shrubs are scrub live-oak (*Quercus turbinella*), mountain mahogany (*Cercocarpus montanus*), squawbush (*Rhus trilobata*), and buckbrush.

### Chihuahuan Desert Scrub

The Chihuahuan Desert Scrub and the Desert Grassland are the most extensive types found in the area (Fig. 1). A typical Chihuahuan Desert Scrub site has a rocky surface, sometimes referred to as "gravel pavement." The dominant plants are shrubs with occasional clumps of fluffgrass (*Erionuron pulchellum*). The dominant shrub is creosotebush. Sometimes ratany (*Krameria parvifolia*), whitethorn (*Acacia constricta* or *neovernicosa*), or tarbush (*Flourensia cernua*) will be co-dominants. Whitethorn normally occupies minor gullies or drainage troughs. Variations in drainage, rock outcrops, alkalinity, and so forth will support local stands of conspicuous xeric shrubs. Among these are ocotilla (*Fouquieria splendens*), banana yucca, sotol, allthorn (*Koeberlinia spinosa*), and wait-a-minute bush (*Mimosa biuncifera*).

Most of the drainage patterns in the area have east–west orientations with the arroyos eventually reaching the Rio Grande floodplain. The sides of these east-flowing arroyos are either north- or south-facing slopes. The effect of exposure upon vegetation is easily apparent because the cooler northern exposures have considerable quantities of grass and only a few creosotebush plants, while the south-facing slopes are covered with dense stands of creosotebush and little else.

## SUMMARY

Topographic and geological diversity result in varied patterns of habitats having different levels of moisture availability. As a consequence, a majority of the vegetation types found in New Mexico can also be found in the small area discussed in this paper.

Highly specialized species are found along major (floodplain) and minor (arroyo) drainage systems. This vegetation is referred to as riparian vegetation. Up out of the drainages on open sites, the lower (drier) mesas support Chihuahuan Desert Scrub. Slightly more elevated mesas support a mixture of desert shrubs and grasses (Desert Grassland). Higher up on the bajadas, the vegetation will be Grassland, Juniper Savanna, or Pinyon–Juniper Woodland. If the mountain mass is large enough, as in the case of San Mateos and Magdalenas, Montane and Subalpine Coniferous Forest vegetation can be found. Even the untrained eye can detect past and present vegetation changes (dynamics). Recent changes can usually be determined by consulting old records such as territorial survey records. The information found in these records allows the reconstruction of past vegetation patterns. These patterns can then be compared with those of today. Current change (succession) can be recognized by looking at young plants on a site. If there are few or no seedlings of the species which are currently dominating the site, but instead the seedlings are of other species, it can be assumed that the site is undergoing vegetation change (Gross & Dick-Peddie 1979, York & Dick-Peddie 1969).

Much of the vegetation of the area has undergone recent change or is currently changing. These changes are major, such as Woodland becoming Forest or Grassland replaced by Scrubland. Such gross and recent changes are not the result of changing climate. Climatic change, if any, during the past two hundred years is controversial. In any case, if there has been a climatic change, it has been so subtle that major changes in vegetation must be the result of some other factor, such as man.

## REFERENCES

Axelrod D.I. 1950. Evolution of desert vegetation in western North America. *In* Studies in late Tertiary paleobotany.—Carnegie Institute Publication 590: 1–323.

Buffington L.C. & Herbel C.H. 1965. Vegetation changes on a semi-desert grassland range.—Ecological Monographs, 35: 139–164.

Campbell C.J. & Dick-Peddie W.A. 1964. Comparison of phreatophyte communities on the Rio Grande in New Mexico.—Ecology, 45: 492–502.

Dick-Peddie W.A. 1975. Vegetation of southern New Mexico.—New Mexico Geological Society, Guidebook 26: 81–84.

Donart G.B., Sylvester D.D. & Hickey W.C. 1978. A map of the potential natural vegetation of New Mexico.—New Mexico Interagency Range Committee Report #11, Portland, Oregon, U.S. Department of Agriculture, Soil Conservation Service.

Freeman C.E. & Dick-Peddie W.A. 1970. Woody riparian vegetation in the Black and Sacramento Mountain ranges, southern New Mexico.—Southwestern Naturalist, 15(1): 145–164.

Gross F.A. & Dick-Peddie W.A. 1979. A map of primeval vegetation in New Mexico.—Southwestern Naturalist, 24(1): 115–122.

Lowe C.H. 1967. The vertebrates of Arizona.—University of Arizona Press, Tucson, 270 pp.

Sallach B.K. 1986. Vegetation changes in New Mexico documented by repeat photography (M.S. thesis): New Mexico State University, Las Cruces, 45 pp.

Shreve F. 1942a. The vegetation of Arizona. *In* Kearney T.H. & Pebbles R.H. (eds.), Flowering plants and ferns of Arizona.—U.S. Department of Agriculture, Miscellaneous Publication 423: 10–23.

Shreve F. 1942b. The desert vegetation of North America.—Botanical Review, 8: 195–246.

Shreve F. 1942c. Grassland and related vegetation in northern Mexico.—Madrono, 6: 190–198.

York J.C. & Dick-Peddie W.A. 1969. Vegetation changes in southern New Mexico during the past hundred years. *In* Arid lands in perspective.—University of Arizona Press, Tucson, pp. 155–166.