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NEW MEXICO VEGETATION PAST PRESENT AND FUTURE

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Pines

Pinus aristata	Bristlecone Pine
Pinus edulis	Colorado Pinyon
Pinus discolor	Border Pinyon
**Pinus monophylla*	One-leafed Pinyon
**Pinus quadrifolia*	Four-leafed Pinyon

Junipers

Juniperus ashei	Mexican Juniper
**Juniperus californica*	California Juniper
Juniperus deppeana	Alligator Juniper
Juniperus erythrocarpa	Redberry Juniper
**Juniperus flaccida*	Drooping Juniper
Juniperus monosperma	One-seed Juniper
Juniperus osteosperma	Utah Juniper
Juniperus pinchotii	Redberry Juniper
Juniperus scopulorum	Rocky Mountain Juniper

Usually only one species of pinyon is found in a Coniferous Woodland stand, although occasionally two or even three species of juniper may be found in a stand.

CONIFEROUS AND MIXED WOODLAND

Except for Bristlecone Pine woodland, Coniferous Woodland in New Mexico is pinyon-juniper and mixed woodland (Table 6.1). There are small amounts of Bristlecone Pine woodland on high, dry ridges and talus slopes (DeVelice et al., 1986). These sites are similar to the rocky outcrop (escarpment) sites of lower elevations, where pinyon-juniper woodland can sometimes be found. In New Mexico, the only series in the Bristlecone Pine type is *Pinus aristata/Ribes montigenum/S**. This is considered a habitat type by the Forest Service.

PINYON-JUNIPER WOODLAND

On the lower, drier boundary of Pinyon-Juniper Woodland vegetation, individual trees are often widely spaced. When their spacing is such that they are merely scattered in grass, the vegetation is referred to as savanna rather than woodland. Vegetation is usually called savanna if there are fewer than 320 individual trees per hectare (130/acre). Savanna is a transitional zone between woodland and grassland. The boundary between woodland and grassland may, however, be abrupt and without a savanna. On the upper, more moist boundary of Pinyon-Juniper Woodland vegetation, woodland trees may be closely spaced, resulting in almost a closed canopy. Kennedy (1983) found an average tree density of 420/h (170/a) in the *Pinus edulis–Juniperus monosperma/S/Stipa columbiana* communities of the Jicarilla and Sacramento mountains in south-central New Mexico. The Forest Service in New Mexico indicates that in closed *Pinus edulis–Juniperus/Artemisia tridentata*/MG-F communities of north-central and northwestern New Mexico, tree densities may be 690 plus or minus 120 individuals per hectare (Moir and Carleton, 1987).

It is not uncommon to find seral Pinyon-Juniper Woodland vegetation as a result of past disturbance of coniferous forest. In New Mexico, the disturbed forest has usually been ponderosa pine forest. The presence of young ponderosa pines in pinyon-juniper woodland could signify the successional nature of the stand. In the mountains around the Plains of San Agustin, Potter (1957) found pinyon-juniper woodland dominated by Colorado Pinyon (*P. edulis*) and Alligator Juniper (*J. deppeana*). These stands were located at elevations of from 7,000 to 9,000 ft. (2,100–2,700 m). The small numbers of young Ponderosa Pine that Potter found in these stands could indicate ecotonal vegetation between coniferous woodland and montane coniferous forest or, more likely, imply a woodland sere on disturbed ponderosa pine sites (Pl. 13).

Dittmer (1951) summarized the major features of the coniferous woodland in New Mexico as follows:

Few mountain areas of the southwest are so dry and so hot that they will not have a pinon-juniper association. The one-seeded junipers occupy the lower areas of this belt while the pinon pines grow better in the upper margins. Above this belt and extending down into it slightly in the northern areas is *Juniperus scopulorum*, while in the southern area the alligator-bark juniper is more prominent. This association ordinarily would make good grazing land, because the blue grama grass occupies most of the soil between trees. However, as is so common throughout the southwest, overgrazing has hit this belt as hard as the grasslands themselves.

Moir and Carleton (1987) propose the following three elevational subzones for the woodland life zone of Region 3 (Arizona and New Mexico, the lowest of these is our savanna zone).

1. The aridic (warm, dry) juniper savannas
   Tree cover: 5–30%
   Height of tallest trees: <5 m
2. Typical or model open woodlands
   Tree cover: 30–50%
   Height of tallest trees: 4–8 m
3. Mesic (cool, wet) closed woodlands
   Tree cover: 50–80%
   Height of tallest trees: 7–13 m

In portions of its range, the vegetation below Pinyon-Juniper Woodland may be Montane Scrub or Desert Grassland, instead of Plains-Mesa Grassland vegetation. In south-central and southwestern Colorado and north-central and northwestern New Mexico, Montane Scrub vegetation, dominated by Big Sagebrush (*Artemisia tridentata*), has often replaced the grasslands that once bordered the woodlands on their lower side. On steep slopes, Pinyon-Juniper Woodland may comprise a narrow band between the forest above and the grassland or scrubland below.

Pinyon-Juniper Woodland is not restricted to mountain slopes. It was and still can be found on mesas, if they are located at an elevation where moisture availability is sufficient. There are thousands of hectares of Pinyon-Juniper vegetation on mesas in the central and south-central part of the state (see vegetation map insert).

Pinyon-Juniper Woodland may be found on rocky outcrops surrounding an elevated mesa where the precipitation is only enough to support grassland. This juxtaposition of woodland and grassland vegetation results because such escarpments provide relatively high moisture conditions in cracks and fissures where run-off accumulates. Training material for Region 3 of the Forest Service states that, "A scarp is any slope between adjacent landforms of sharply contrasting elevations. It is formed by geologic erosion and slope retreat via the processes of hillslope and channel erosion." And, "Here we limit scarp woodlands to slopes steeper than 40% and with cobbly-bouldery soils having much discontinuity because of rock outcrop or bare rock exposure" (USDA Forest Service, 1986). Scarp Pinyon-Juniper Woodland vegetation is common along breaks associated with the rivers of northeastern and east-central New Mexico. Scarp woodland stands are often too small in area to be included on our maps.

Colorado Pinyon (*Pinus edulis*) is by far the most common pinyon of the Pinyon-Juniper Woodland vegetation of New Mexico. It is replaced by Border Pinyon (*P. discolor*) in the southwestern corner of the state. A one-needle variety, *P. edulis* var. *fallax* (Little, 1968) is found on the southeastern portion of the Colorado Plateau in west-central New Mexico. This variety is not to be confused with One-Leafed Pinyon (*P. monophylla*) of the eastern California and Great Basin Pinyon-Juniper Woodland vegetation. Woodin and Lindsey (1954) note that One-seed Juniper (*J. monosperma*) is not important in Colorado or Mexico. Rocky Mountain Juniper (*J. scopulorum*) replaces One-seed Juniper in Colorado, while Alligator Juniper (*J. deppeana*) replaces it in Mexico. Woodin and Lindsey also state that pinyon densities are higher than juniper densities in the upper portion of the pinyon-

juniper woodland zone. In the central portion of their range, the pinyons and junipers tend to exhibit equal densities. These observations are similar to those of Dittmer (1951) and the Forest Service (1986, 1987a and b). Generally, Pinyon Pines have higher available-moisture requirements than junipers. Consequently, Colorado Pinyon has higher densities than juniper in the higher, more moist portions of this vegetation zone and is found in minor amounts in the lower, drier portions. For example, Donart, Sylvester, and Hickey (1978b) have a pinyon-juniper series (CW1) and a juniper-pinyon series (CW2) that reflect a reversal in relative pinyon and juniper densities.

One-seed Juniper (*Juniperus monosperma*) is the most widespread juniper in New Mexico. It may share dominance with Rocky Mountain Juniper in the northern third of the state; with Utah Juniper (*J. osteosperma*) and Rocky Mountain Juniper in the northwestern corner; with Alligator Juniper (*J. deppeana*) in south-central and southwestern areas; and with Redberry Juniper (*J. pinchotii*) or Mexican Juniper (*J. ashei*) in the southeast. Redberry Juniper tends to be a shrub and in New Mexico is more commonly a member of montane scrub than of pinyon-juniper woodland vegetation. Junipers are often erroneously called cedars; so-called cedar posts are all from junipers.

There are differences in available-moisture requirements among juniper species, reflected in their different relative positions in the vegetation, documented by Kennedy (1983) in the Guadalupe, Sacramento, and White mountains; Naylor (1964) in the Sandia Mountains; Robinson (1969) in the Guadalupe Mountains; and Fletcher (1978) in the Datil Mountains. Alligator Juniper (*J. deppeana*) requires more moisture and appears to be more shade tolerant than other junipers. Alligator Juniper may also be a member of Ponderosa Pine communities in New Mexico. Large living Alligator Juniper relicts can be found today on logged sites of past pine forest in the Sacramento and White mountains of south-central New Mexico. Kennedy (1983) described a *Pinus ponderosa–Juniperus deppeana/S/Muhlenbergia dubia* habitat type from the Guadalupe and Sacramento mountains. This type is included in the forest vegetation classification in Table 5.1. Kennedy found that the average elevation of thirty-one plots dominated by Pinyon and One-seed Juniper in the Lincoln National Forest was 1,980 m (6,540 ft.), while the average elevation of thirteen plots dominated by Pinyon and Alligator Juniper was 2,100 m (6,950 ft.).

The most common pinyon-juniper type (Table 6.1) in south-central and possibly all of New Mexico is *Pinus edulis–Juniperus monosperma/S/Bouteloua gracilis*. Kennedy (1983) identified this type from the Guadalupe, Jicarilla, Capitan, and Sacramento mountains. Barnes (1986) identified this type in the mountains near Los Alamos. Barnes also found a type near Los Alamos with Mountain Muhly (*Muhlenbergia montanus*) as the dominant grass instead of Blue Grama. Another common and widespread type found in south-central New Mexico on lower drier sites is the *P. edulis–J. monosperma/Rhus trilobata/Muhlenbergia pauciflora* type. In these communities, juniper has a much higher density than pinyon. At higher elevations, the *P. edulis–J.deppeana/S/S* type is common from the Sacramento Mountains to the Datil Mountains of west-central New Mexico. In the Peloncillo Mountains, Alligator Juniper and One-seed Juniper share dominance with Border Pinyon (*P. discolor*), rather than with Colorado Pinyon (*P. edulis*). In these types, Mexican Pinyon is usually many times denser than junipers. The shrub layer in this type is dominated by Toumey Oak (*Q. toumeyi*) and ground cover is sparse (*S*). The pinyon-juniper associations having Rocky Mountain Juniper as dominant or codominant with One-seed Juniper and Colorado Pinyon are found in the north-central part of the state, while communities with Utah Juniper (*J. osteosperma*) as the dominant juniper occur in north-central and northwestern New

Mexico. These northern New Mexico pinyon-juniper communities usually have Big Sagebrush (*A. tridentata*) as the dominant shrub. In the south-central mountains there is a pinyon-juniper type with Mountain Mahogany (*Cercocarpus montanus*) dominating the shrub layer and Big Bluestem (*Andropogon gerardii*) the dominant grass (Kennedy, 1983).

Some pinyon-juniper community types have an understory shrub layer dominated by one shrub species. Others have a number of shrub species dominating the understory. About 40% of the pinyon-juniper communities in the classification for New Mexico have virtually no shrub layer as indicated by "S" for sparse. The shrub layers of some types may be dominated by Wavyleafed Oak (*Quecus undulata*), Gambel Oak (*Q. gambelii* [shrubby form]), or Toumey Oak (*Q. toumeyi*). Other shrubs that may be important in pinyon-juniper understory are Big Sagebrush, Mountain Mahogany, and Skunkbush (*Rhus trilobata*). Table 6.2 lists major plants comprising woodland and savanna vegetation in New Mexico. Many shrubs, forbs, and grasses typical of the vegetation types bordering pinyon-juniper woodland vegetation are also found in woodlands in New Mexico; the species listed in Table 6.2 are only those most commonly found in this type.

MIXED WOODLAND

In New Mexico there are areas where the dominant trees in woodland vegetation are not restricted to conifers but may include broadleaf tree species as codominants. In west and north-central New Mexico, Gambel Oak (*Q. gambelii*) may be a codominant in woodland (see Table 6.1). Donart, Sylvester, and Hickey (1978b) found this type of woodland in the San Francisco Mountains, southwest of Reserve; in the Burro Mountains, northwest of Lordsburg; in the Tularosa Mountains, west of the Plains of San Agustin; in the Nacimiento and Jemez mountains, west, south, and east of Jemez Springs; and in the mountains north, south, and east of Zuni, in northwestern New Mexico. Gambel Oak, the dominant oak of the Mixed Woodlands mentioned, is deciduous.

There are woodlands in New Mexico where the dominant nonconiferous trees are evergreen. The term "encinal" has been used for these woodland types (Brown, 1982), and we have used it in the classification of mixed woodland vegetation. One of these encinal mixed woodland types is found in the Guadalupe Mountains, in south-central New Mexico. The broadleaf, evergreen codominant tree is Texas Madrone (*Arbutus xalapensis*). The rest of the encinal communities in the state have oaks as the broadleaf, evergreen tree component. Evergreen oaks that may dominate these types are Arizona White Oak (*Q. arizonica*), Gray Oak (*Q. grisea*), and Emory Oak (*Q. emoryi*). Arizona White Oak–Gray Oak hybrids are common in southwestern New Mexico. *Q. grisea* in parentheses in the classification (Table 6.1) indicates that Gray Oak may be the dominant oak. Pointleaf Manzanita (*Arctostaphylos pungens*) and Wright Silktassel (*Garrya wrightii*) is frequently the dominant shrub in encinal woodland. The coniferous trees Border Pinyon and Alligator Juniper have relatively low densities in these communities. In New Mexico, these oak-dominated encinal mixed woodlands are restricted to the southwestern corner. Perez-Garcia (1978) reports large areas covered by oak woodland just south of New Mexico, in the Sierra Madre Occidental of northern Chihuahua, Mexico. These woodlands have the same dominant tree species as those of southwestern New Mexico.