# 11160
# Madrean Juniper Savanna

BpS Model/Description Version: Aug. 2020

| Modelers | | Reviewers | |
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**Vegetation Type**
Steppe/Savanna

**Map Zone**
26

**Model Splits or Lumps**
This Biophysical Setting (BpS) is lumped with: 2610250.

**Geographic Range**
Sierra Madre Occidentale and Sierra Madre Oriental in Mexico, Trans-Pecos Texas, southern Arizona (south of the Mogollan Rim), and southwestern New Mexico.

**Biophysical Site Description**
This BpS is typically found at elevations between 1,400-2,200m. Madrean juniper savannas occur at the lower altitudinal limits for foothill tree species, below the pinyon-juniper (PJ) woodlands but at or above semi-desert grassland where soil moisture limits cover of montane woody plants. At higher and therefore moister elevations, woodlands grade into Madrean encinal or, less frequently, montane pine-oak woodlands characterized by taller and denser vegetation than these woodlands. Savannas and woodlands are found on many and varied topographic positions, including low- to mid-elevation mountain slopes, hills, plateaus, basins, and flats.

**Vegetation Description**
The upper vegetation canopy is composed of open to moderately dense tree layer dominated by Mexican pinyon pine (*Pinus cembroides*), two-needle pinyon (*P. edulis*), alligator juniper (*Juniperus depeanna*), and/or one-seed juniper (*J. monosperma*). In the Trans-Pecos, Pinchot's juniper (*J. pinchotii*) and redberry juniper (*J. coahuilensis*) are present. Madrean oaks such as Emory oak (*Q. emoryi*), gray oak (*Q. grisea*), Mexican blue oak (*Q. oblongifolia*) (very little in the Trans-Pecos), or Mohr oak (*Q. mohriana*) may be present to co-dominant with pinyon and/or juniper trees. In southwest New Mexico, *Q. grisea* may be dominant. *Juniperus monosperma* is often present to dominant on the Gila National Forest. Understory layers are variable and may be dominated by shrubs such as manzanita (*Arctostaphylos pungens*, *A. pringlei*), Apache plume (*Fallugia paradoxa*), or barberry (*Berberis* spp.). Graminoids may form dense (savanna) to sparse canopy. Common species include sideoats grama (*Bouteloua curtipendula*), cane bluestem (*Bothriochloa barbinodis*), and muhly grasses (*Muhlenbergia emersleyi*, *M. torreyi*, *M. porteri*). Graminoids decrease in cover and biomass with increasing cover of woody plants.

**BpS Dominant and Indicator Species**

| Symbol | Scientific Name | Common Name |
|---|---|---|
| JUDE | *Juncus debilis* | Weak rush |
| PIED | *Pinus edulis* | Twoneedle pinyon |
| PICE | *Pinus cembroides* | Mexican pinyon |
| QUAR | *Quercus arizonica* | Arizona white oak |
| QUEM | *Quercus emoryi* | Emory oak |
| QUGR3 | *Quercus grisea* | Gray oak |
| QUOB | *Quercus oblongifolia* | Mexican blue oak |
| PILE | *Pinus leiophylla* | Chihuahuan pine |

Species names are from the NRCS PLANTS database. Check species codes at http://plants.usda.gov.

## Disturbance Description

Fire regime as described here is based on expert estimate of historical range of variation (Schussman and Smith 2006). Fires are ignited by lightning during summer monsoon season. Fire is fairly frequent in May and June, mostly mixed-severity. Fire in map zone (MZ) 26 is probably more frequent than modelers in MZ25 described it. Significant drought occurs about every 60yrs and, in combination with herbivory from invertebrates, causes disproportional mortality of large, old trees. In Big Bend National Park and the Davis Mountains, fire return interval (FRI) ranged from 11.2-36.5 years (Poulos 2009).

## Fire Frequency

| Severity | Avg FI | Percent of All Fires | Min FI | Max FI |
|---|---|---|---|---|
| Replacement | 25 | 41 | 20 | 1000 |
| Moderate (Mixed) | 27 | 37 | 20 | 1000 |
| Low (Surface) | 47 | 22 | 10 | 100 |
| All Fires | 10 | 100 | | |

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is the central tendency modeled. Percent of all fires is the percent of all fires modeled in that severity class. Minimum and Maximum FIs show the relative range of fire intervals as estimated by model contributors, if known.

## Scale Description

Pinyon-juniper woodland usually was distributed across the landscape in large patches between 100s-1,000s of acres in size. Matrix formations occur at higher elevations, i.e., in the Davis Mountains. In particularly dissected topography, this type may have occurred in smaller patches.

## Adjacency or Identification Concerns

This system is generally found at higher elevations and more mesic sites than semi-desert grassland. Typically, it is bordered at higher elevations by Madrean Pine-Oak Woodlands. Cover and density of juniper and pinyon trees at lower elevations in this type doubtless have increased as a result of fire suppression (possibly as mitigated by livestock grazing). This phenomenon is characteristic of BpS 1116 (juniper savanna), with which BpS 1025 (pinyon-juniper woodland) has been lumped for MZs 15 and 26. This system is bordered at low elevation by Madrean encinal and desert grasslands on the Gila National Forest and elsewhere in the Trans-Pecos.

**Issues or Problems**

Virtually no components of the fire regimes are known with any certainty. Fire scars are rare, and trees in this system cannot be aged with conventional dendrochronological techniques. Information about fire regimes is extrapolated from adjacent systems, and extreme caution is warranted when interpreting these models. Fire season can be inferred more reliably than fire frequency; the former likely is equally or more important than the latter. This system also includes pinyon-juniper woodlands and savannas with understories dominated by other shrubs or a grass layer and lacks evergreen oaks, which may have a different fire behavior. Adjacent pinyon-juniper systems in Big Bend National Park and the Davis Mountains have FRIs of 36.5 and 11.2yrs, respectively (Poulos 2009).

**Native Uncharacteristic Conditions**

**Comments**

In August 2019 Blankenship changed the alternative succession pathway from Mid 1 Closed to Late1 Open from .02 to .01 in order to get at least 1% of landscape into the Late 1 Closed Class. Decreasing the alternate succession probability to Late 1 Open increased the number of cells available to transition to Late 1 Closed through the main successional pathway. This change caused about a 10% increase in the amount of Mid 1 Closed and a corresponding decrease in Late 1 Open. Late 1 Closed increased from about .5% to 1%, and the amount in the Early state did not change. The fire frequency results were similar between the original and the modified versions of the model.

## *Succession Classes*

**Mapping Rules**

| Upper Layer Lifeform | Height (m) | Canopy Cover (%) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0-10 | 11-20 | 21-30 | 31-40 | 41 - 50 | 51-60 | 61-70 | 71-80 | 81-90 | 91-100 |
| Herb | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Herb | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Herb | >1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0-0.5 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 0.5-1.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | 1.0-3.0 | A | A | A | A | A | A | A | A | A | A |
| Shrub | >3.0 | A | A | A | A | A | A | A | A | A | A |
| Tree | 0-5 | B | B | B | B | B | B | B | B | B | B |
| Tree | 5-10 | D | D | D | D | D | C | C | C | C | C |
| Tree | 10-25 | D | D | D | D | D | C | C | C | C | C |
| Tree | 25-50 | D | D | D | D | D | C | C | C | C | C |
| Tree | >50 | D | D | D | D | D | C | C | C | C | C |

Succession class letters A-E are described in the Succession Class Description section. Some classes use a leafform distinction where a qualifier is added to the class letter: Brdl (broadleaf), Con (conifer), or Mix (mixed conifer and broadleaf). UN refers to uncharacteristic native or a combination of height and cover that would not be expected under the reference condition. NP refers to not possible or a combination of height and cover which is not physiologically possible for the species in the BpS.

**Description**

**Class A 26 Early Development 1 - All Structures**

*Indicator Species*

| Symbol | Scientific Name | Common Name | Canopy Position |
|---|---|---|---|
| BOCU | Bouteloua curtipendula | Sideoats grama | Upper |
| ACHNA | Achnatherum | Needlegrass | Upper |
| QUGR3 | Quercus grisea | Gray oak | Upper |
| QUEM | Quercus emoryi | Emory oak | Upper |

*Description*

Initial post-fire community dominated by perennial caespitose grasses. Evidence of past fires may be observed, including charcoal and resprouting woody plants.

*Maximum Tree Size Class*

None

**Class B 42 Mid Development 1 - Closed**

*Indicator Species*

| Symbol | Scientific Name | Common Name | Canopy Position |
|---|---|---|---|
| JUDE | Juncus debilis | Weak rush | Upper |
| PICE | Pinus cembroides | Mexican pinyon | Upper |
| QUGR3 | Quercus grisea | Gray oak | Upper |
| QUEM | Quercus emoryi | Emory oak | Upper |

*Description*

Community dominated by young to mature alligator juniper and evergreen oak trees of various ages.

*Maximum Tree Size Class*

Pole 5-9" DBH

**Class C 1 Late Development 1 - Closed**

*Indicator Species*

| Symbol | Scientific Name | Common Name | Canopy Position |
|---|---|---|---|
| JUDE | Juncus debilis | Weak rush | Upper |
| PICE | Pinus cembroides | Mexican pinyon | Upper |
| QUGR3 | Quercus grisea | Gray oak | Middle |
| QUEM | Quercus emoryi | Emory oak | Middle |

*Description*

Woodland phase: site dominated by relatively dense old alligator juniper, redberry juniper, and evergreen oak trees. The tallest trees would be ~ 35-40ft tall.

*Maximum Tree Size Class*
Medium 9-21" DBH

**Class D 31 Late Development 1 - Open**

*Indicator Species*

| Symbol | Scientific Name | Common Name | Canopy Position |
|---|---|---|---|
| JUCO11 | Juniperus coahuilensis | Redberry juniper | Upper |
| PICE | Pinus cembroides | Mexican pinyon | Upper |
| QUGR3 | Quercus grisea | Gray oak | Middle |
| QUEM | Quercus emoryi | Emory oak | Middle |

*Description*
Savanna phase with more frequent fire. *Juniperus coahuliensis* is dominant, and *J. pinchotii* is present. The tallest trees would be ~35-40ft tall.

*Maximum Tree Size Class*
None

## Model Parameters

### Deterministic Transitions

| From Class | Begins at (yr) | Succeeds to | After (years) |
|---|---|---|---|
| Early1:ALL | 0 | Mid1:CLS | 9 |
| Mid1:CLS | 10 | Late1:CLS | 84 |
| Late1:CLS | 85 | Late1:CLS | 999 |
| Late1:OPN | 85 | Late1:OPN | 999 |

### Probabilistic Transitions

| Disturbance Type | Disturbance occurs In | Moves vegetation to | Disturbance Probability | Return Interval (yrs) | Reset Age to New Class Start Age After Disturbance? | Years Since Last Disturbance |
|---|---|---|---|---|---|---|
| Replacement Fire | Early1:ALL | Early1:ALL | 0.1 | 10 | Yes | 0 |
| Alternative Succession | Mid1:CLS | Late1:OPN | 0.01 | 100 | Yes | 0 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.025 | 40 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:CLS | 0.05 | 20 | No | 0 |
| Wind or Weather or Stress | Late1:OPN | Late1:OPN | 0.015 | 67 | No | 0 |
| Replacement Fire | Late1:OPN | Early1:ALL | 0.0167 | 60 | Yes | 0 |
| Mixed Fire | Late1:OPN | Late1:OPN | 0.05 | 20 | No | 0 |
| Surface Fire | Late1:OPN | Late1:OPN | 0.0667 | 15 | No | 0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Wind or Weather or Stress | Late1:CLS | Late1:OPN | 0.015 | 67 | Yes | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.0167 | 60 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:OPN | 0.05 | 20 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.0667 | 15 | No | 0 |

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