10250

Madrean Pinyon-Juniper Woodland

BpS Model/Description Version: Aug. 2020 ,

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| --- | --- | --- | --- |
| **Modelers** |  | **Reviewers** |  |
| Guy R. McPherson | grm@ag.arizona.edu | Tim Christiansen | tchristiansen@tnc |
| Mike Babler | mbabler@tnc.org | Reese Lolley | [rlolley@fs.fed.us](mailto:rlolley@fs.fed.us) |
| None | None | Keith Schulz | Keith\_Schulz@natureserve.org |

**Reviewer:** Tim Christiansen

Vegetation Type

Forest and Woodland

Map Zones

14, 15, 24, 25, 26

Geographic Range

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

Biophysical Site Description

This Biophysical Setting (BpS) typically is found at elevations between 1,400m-2,200m. Madrean Juniper savannas occur at the lower altitudinal limits for foothill tree species, below the pinyon-juniper 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 *Pinus cembroides*, *Pinus discolor*, *Pinus edulis*, *Juniperus depeanna*, and/or *Juniperus monosperma*. Madrean oaks such as *Quercus arizonica*, *Q. emoryi*, *Q. grisea*, *Q. oblongifolia*, or *Q. mohriana* may be co-dominant with pinyon pines (*Pinus edulis*, *P. discolor*) and/or juniper trees. In southwestern New Mexico, *Q. grisia* may be dominant. *Pinus engelmannii* occurs infrequently, and *P. ponderosa* and *P. arizonica* are absent or sparse. *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*), cliffrose (*Cowania mexicana*), 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*), muhly grasses (*Muhlenbergia emerslyei*, *M. torreyi*, and *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 |
| PIDI3 | *Pinus discolor* | Border 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 |
| QUMO | *Quercus mohriana* | Mohr oak |

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

Disturbance Description

The fire regime of this ecological system is almost completely unknown. There are essentially no data about fire frequency, fire history, or fire behavior. The occasional paper that addresses fire includes considerably more speculation than data. It would seem that fire occurrence was determined primarily by fire occurrence in the surrounding matrix vegetation and was ignited by lightning during early summer. However, even this information is speculative and undocumented; based on contemporary ecological knowledge, models that assume specific fire regimes are little more than wild guesses. Such a model follows, in the sincere hope that it will be ignored or improved upon.

This system is likely predisposed to stand-replacement fires during the earliest stage of stand development. Replacement fires are assumed to have occurred every century or so and mixed severity fires slightly less frequently. Significant drought occurs about every 60yrs and, in combination with herbivory from invertebrates, causes disproportional mortality of large, old trees.

Fire Frequency

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Severity** | **Avg FI** | **Percent of All Fires** | **Min FI** | **Max FI** |
| Replacement | 135 | 34 | 20 | 1000 |
| Moderate (Mixed) | 208 | 22 | 20 | 1000 |
| Low (Surface) | 104 | 44 |  |  |
| All Fires | 46 | 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 patches between 100s-1000s of acres in size. In particularly dissected topography, this type may have occurred in smaller patches.

Adjacency or Identification Concerns

This system generally is 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 11160 (juniper savanna), with which BpS 1025 (pinyon-juniper woodland) has been lumped for map zone (MZ) 15. Bordered at low elevation by Madrean Encinal and Desert Grasslands on Gila NF.

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 ecological system was originally described assuming evergreen oak species are present to co-dominant in the understory or canopy in MZ15 (Schulz, personal communication). 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. Christiansen suggests that further data may justify merging with another pinyon-juniper BpS.

Native Uncharacteristic Conditions

Comments

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 | B | B | B | B | B | B | B | B | B | B |
| Tree | 10-25 | C | C | C | C | C | C | C | C | C | C |
| Tree | 25-50 | C | C | C | C | C | C | C | C | C | C |
| Tree | >50 | C | C | C | C | C | 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 5 Early Development 1 - All Structures

Indicator Species

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | | **Common Name** | | **Canopy Position** | |
| BOCU | Bouteloua curtipendula | | Sideoats grama | | Upper | |
| BOBA3 | Bothriochloa barbinodis | | Cane bluestem | | Upper | |
| MUCA2 | | Muhlenbergia capillaris | | hairawn muhly | | Upper |
| QUGR3 | | Quercus grisea emoryi | | Gray oak | | Mid-Upper |
| QUAR | | Quercus arizonica | | Arizona white oak | |  |
| QUEM | | Quercus emoryi | | Emory oak | |  |

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*  
No Data

Class B 57 Mid Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| JUDE | Juncus debilis | Weak rush | Upper |
| PIED | Pinus edulis | Twoneedle pinyon | Upper |
| QUAR | Quercus arizonica | Arizona white 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 38 Late Development 1 - Closed

Indicator Species

|  |  |  |  |
| --- | --- | --- | --- |
| **Symbol** | **Scientific Name** | **Common Name** | **Canopy Position** |
| JUDE | Juncus debilis | Weak rush | Upper |
| PIED | Pinus edulis | Twoneedle pinyon | Upper |
| QUAR | Quercus arizonica | Arizona white oak | Upper |
| QUEM | Quercus emoryi | Emory oak | Upper |

Description

Site dominated by relatively dense old alligator juniper and evergreen oak trees.

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

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 | 984 |

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 |
| Replacement Fire | Mid1:CLS | Early1:ALL | 0.003 | 333 | Yes | 0 |
| Mixed Fire | Mid1:CLS | Mid1:CLS | 0.005 | 200 | No | 0 |
| Replacement Fire | Late1:CLS | Early1:ALL | 0.003 | 333 | Yes | 0 |
| Mixed Fire | Late1:CLS | Late1:CLS | 0.005 | 200 | No | 0 |
| Wind or Weather or Stress | Late1:CLS | Mid1:CLS | 0.015 | 67 | Yes | 0 |
| Surface Fire | Late1:CLS | Late1:CLS | 0.025 | 40 | No | 0 |

References

Alexander, R.R. and F. Ronco, Jr. 1987. Classification of the forest vegetation on the National Forests of Arizona and New Mexico. Res. Note RM-469. Fort Collins, CO: USDA Forest Service, Rocky Mountain Forest and Range Experiment Station. 10 pp.

Anderson, H.E. 1982. Aids to Determining Fuel Models For Estimating Fire Behavior. Gen. Tech. Rep. INT-122. Ogden, UT: USDA Forest Service, Intermountain Forest and Range Experiment Station. 22 pp.

Arno, S.F. 2000. Fire in western forest ecosystems. Pages 97-120 in: J.K. Brown and J. Kapler-Smith, eds. Wildland fire in ecosystems: Effects of fire on flora. Gen. Tech. Rep. RMRS-GTR-42-vol. 2. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station.

Baker, W.L. and D.J. Shinneman. 2004. Fire and restoration of pińon-juniper woodlands in the western United States. A review. Forest Ecology and Management 189: 1-21.

DeBano, L.F., P.F. Ffolliott, A. Ortega-Rubio, G.J. Gottfried, R.H. Hamre and C.B. Edminster, technical coordinators. 1995. Biodiversity and Management of the Madrean Archipelago: The Sky Islands of the Southwestern United States and Northern Mexico. General Technical Report RM-264. Fort Collins, CO: USDA Forest Service Rocky Mountain Experiment Station.

Ffolliott, P.F. et al., technical coordinators. 1996. Effects of Fire on Madrean Province Ecosystems: A Symposium Proceedings. USDA Forest Service General Technical Report RM-GTR-289. 277 pp.

Gruell, G.E. 1999. Historical and modern roles of fire in pinyon-juniper. Pages 24-28 in: S.B. Monsen, R. Stevens, R.J. Tausch, R. Miller and S. Goodrich, compilers. Proceedings: ecology and management of pinyon-juniper communities within the Interior West. 15-18 Sept 1997, Provo, UT. Proceedings RMRS-P-9. Ogden, UT: USDA Forest Service, Rocky Mountain Research Station.

Hardy, C.C., K.M. Schmidt, J.P. Menakis and R.N. Samson. 2001. Spatial data for national fire planning and fuel management. Int. J. Wildland Fire. 10(3&4): 353-372.

Haworth, K. and G.R. McPherson. 1994. Effects of Quercus emoryi on herbaceous vegetation in a semi-arid savanna. Vegetatio 112: 153-159.

Kuchler, A.W. 1964. Potential Natural Vegetation of the Conterminous United States. American Geographic Society Special Publication No. 36. 116 pp.

McClaran, M.P. and G.R. McPherson. 1999. Oak savanna of the American Southwest. Pages 275-287 in: R.C. Anderson, J.S. Fralish, and J. Baskin, editors. Savannas, Barrens, and Rock Outcrop Plant Communities of North America. Cambridge University Press, Cambridge, England.

McPherson, G.R. and J.F. Weltzin. 1998. Response of understory to overstory removal in southwestern oak woodlands. Journal of Range Management 51:674-678.

McPherson, G.R. and J.F. Weltzin. 2000. The role and importance of disturbance and climate change in U.S./Mexico borderlands: a state-of-the-knowledge review. USDA Forest Service Rocky Mountain Research Station General Technical Report RMRS-GTR-50.

NatureServe. 2004. International Ecological Classification Standard: Terrestrial Ecological Classifications. Terrestrial ecological systems of the Great Basin US: DRAFT legend for Landfire project. NatureServe Central Databases. Arlington, VA. Data current as of 4 November 2004.

NatureServe. 2007. International Ecological Classification Standard: Terrestrial Ecological Classifications. NatureServe Central Databases. Arlington, VA. Data current as of 10 February 2007.

Romme, W.H., L. Floyd-Hanna and D. Hanna. 2003. Ancient pinyon-juniper forests of Mesa Verde and the West: a cautionary note for forest restoration programs. Pages 335-350 in: P.N. Omi and L.A. Joyce. tech. eds. Fire, fuel treatments, and ecological restoration: conference proceedings. 16-18 April 2002. Fort Collins, CO. Proceedings RMRS-P-29. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 475 pp.

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Soule’, P.T. and P.A. Knapp. 1999. Western juniper expansion on adjacent disturbed and near-relict sites. Journal of Range Management 52: 525-533.

Soule’, P.T. and P.A. Knapp. 2000. Juniperus occidentalis (western juniper) establishment history on two minimally disturbed research natural areas in central Oregon. Western North American Naturalist (60)1: 26-33.

Tausch, R.J. and N.E. West. 1987. Differential Establishment of Pinyon and Juniper Following Fire. The American Midland Naturalist 119(1): 174-184.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/ [Accessed: 11/15/04].

Webster, G.L. and C.J. Bahre (editors) 2001. Changing Plant Life of La Frontera: Observations on Vegetation in the United States/Mexico Borderlands. University of New Mexico Press, Albuquerque. 260 pp.

Wright, H.A., L.F. Neuenschwander and C.M. Britton. 1979. The role and use of fire in Sagebrush-Grass and Pinyon-Juniper Plant Communities. Gen. Tech. Rep. INT-GTR-58. Ogden, UT: USDA Forest Service, Intermountain Research Station. 48 pp.