

Species Juniperus osteosperma.txt

Species: Juniperus osteosperma

From: Fire Effects Species Information Online database (2/23/2011)

SPECIES: Juniperus osteospermaIntroductory

Distribution and occurrence

Management Considerations

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INTRODUCTORY

SPECIES: Juniperus osteosperma

AUTHORSHIP AND CITATION

ABBREVIATION

SYNONYMS

NRCS PLANT CODE

COMMON NAMES

TAXONOMY

LIFE FORM

FEDERAL LEGAL STATUS

OTHER STATUS

AUTHORSHIP AND CITATION:

Zlatnik, Elena. 1999. Juniperus osteosperma. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2011, February 23].

ABBREVIATION:

JUNOST

SYNONYMS:

Juniperus utahensis (Engelm.) Lemmon [63]

Sabina osteosperma (Torr.) Antoine[127]

NRCS PLANT CODE:

JUOS

COMMON NAMES:

Utah juniper

TAXONOMY:

The accepted scientific name for Utah juniper is Juniperus osteosperma (Torr.) Little (Cupressaceae) [66,67,75].

In northwestern Nevada, Utah juniper hybridizes with western juniper (*J. occidentalis*). In Arizona, Utah juniper hybridizes with oneseed juniper (*J. monosperma*), Rocky Mountain juniper (*J. scopulorum*), and alligator juniper (*J. deppeana*) [62].

LIFE FORM:

Tree

FEDERAL LEGAL STATUS:

No special status

OTHER STATUS:

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No entry

DISTRIBUTION AND OCCURRENCE  
SPECIES: Juniperus osteosperma

GENERAL DISTRIBUTION

ECOSYSTEMS

STATES

BLM PHYSIOGRAPHIC REGIONS

KUCHLER PLANT ASSOCIATIONS

SAF COVER TYPES

SRM (RANGELAND) COVER TYPES

HABITAT TYPES AND PLANT COMMUNITIES

GENERAL DISTRIBUTION:

Utah juniper is the most common tree in the Great Basin and is widely distributed throughout the arid west [67,80]. The tree occurs occasionally in southern Idaho, southern Montana, and western Wyoming, and is common in Colorado, Utah, Nevada, New Mexico, Arizona, and southeastern California. Utah juniper is the most common juniper species in Arizona [4].

ECOSYSTEMS:

FRES21 Ponderosa pine  
FRES28 Western hardwoods  
FRES29 Sagebrush  
FRES30 Desert shrub  
FRES34 Chaparral-mountain shrub  
FRES35 Pinyon-juniper  
FRES36 Mountain grasslands  
FRES40 Desert grasslands

STATES:

AZ CA CO ID MT NV NM OR UT WY

BLM PHYSIOGRAPHIC REGIONS:

3 Southern Pacific Border  
4 Sierra Mountains  
5 Columbia Plateau  
6 Upper Basin and Range  
7 Lower Basin and Range  
9 Middle Rocky Mountains  
10 Wyoming Basin  
11 Southern Rocky Mountains  
12 Colorado Plateau  
13 Rocky Mountain Piedmont

KUCHLER PLANT ASSOCIATIONS:

K019 Arizona pine forest  
K023 Juniper-pinyon woodland  
K031 Oak-juniper woodlands  
K032 Transition between K031 and K037  
K037 Mountain-mahogany-oak scrub  
K038 Great Basin sagebrush

SAF COVER TYPES:

220 Rocky Mountain juniper

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237 Interior ponderosa pine  
239 Pinyon-juniper  
240 Arizona cypress  
241 western live oak

SRM (RANGELAND) COVER TYPES:

210 Bitterbrush  
211 Creosote bush scrub  
212 Blackbush  
412 Juniper-pinyon woodland  
413 Gambel oak  
415 Curlleaf mountain-mahogany  
416 True mountain-mahogany  
417 Littleleaf mountain-mahogany  
503 Arizona chaparral  
504 Juniper-pinyon pine woodlands

HABITAT TYPES AND PLANT COMMUNITIES:

Utah juniper is a climax species in a number of pinyon-juniper (*Pinus-Juniperus* spp.), sagebrush (*Artemisia* spp.)-grassland, and shrub-steppe habitat types. At the Idaho National Engineering Laboratory Site, Utah juniper dominates with big sagebrush (*A. tridentata*), antelope bitterbrush (*Purshia tridentata*), and threetip sagebrush (*A. arbuscula*), on areas with bluebunch wheatgrass (*Pseudoroegneria spicata*), needle-and-thread grass (*Hesperostipa comata*), Thurber's needlegrass (*Achnatherum thurberiana*), and Sandberg bluegrass (*P. secunda*) [3].

In Utah pinyon-juniper sites, Utah juniper dominates with singleleaf pinyon (*Pinus monophylla*), Saskatoon serviceberry (*Amelanchier alnifolia*), threetip sagebrush, black sagebrush (*Artemisia nova*), big sagebrush, desert ceanothus (*Ceanothus greggii*), curlleaf mountain-mahogany (*Cercocarpus ledifolius*), true mountain-mahogany (*C. montanus*), green rabbitbrush (*Chrysothamnus viscidiflorus*), Stansbury cliffrose (*Purshia mexicana* var. *stansburiana*), antelope bitterbrush, desert snowberry (*Symphoricarpos longiflorus*), blue grama (*Bouteloua gracilis*), cheatgrass (*Bromus tectorum*), bottlebrush squirreltail (*Elymus elymoides*), sheep fescue (*Festuca ovina*), galleta (*Hilaria jamesii*), prairie junegrass (*Koeleria macrantha*), Indian ricegrass (*Achnatherum hymenoides*), western wheatgrass (*Pascopyrum smithii*), Sandberg bluegrass, bluebunch wheatgrass, and needle-and-thread grass [24].

In pinyon-juniper woodlands in southern California, Utah juniper dominates with singleleaf pinyon, Parry pinyon (*Pinus quadrifolia*), and California juniper (*Juniperus californica*). Common associates include Joshua tree (*Yucca brevifolia*), oaks (*Quercus* spp.), manzanita (*Arctostaphylos* spp.), ceanothus (*Ceanothus* spp.), mountain-mahogany (*Cercocarpus* spp.), rabbitbrush (*Chrysothamnus* spp.), ephedra (*Ephedra* spp.), buckwheat (*Eriogonum* spp.), silktassel (*Garrya* spp.), snakeweed (*Gutierrezia* spp.), goldenweed (*Isocoma* spp.), bitterbrush (*Purshia* spp.), horsebrush (*Tetradymia* spp.), blackbrush (*Coleogyne ramosissima*), Stansbury cliffrose, Apache plume (*Fallugia paradoxa*), California fremont (*Fremontodendron californicum*), desert peach (*Prunus fasciculata*), skunkbush sumac (*Rhus trilobata*), and needlegrass (*Achnatherum* spp.) [118].

Habitat typings in which Utah juniper appears as a community dominant include:

Classification of the forest vegetation of Colorado by habitat type and community type [1]

Forest and woodland habitat types (plant associations) of Arizona south of the Mogollon Rim and southwestern New Mexico [11]

Vegetation and soils of the Coils Creek Watershed [15]

Vegetation and soils of the Cow Creek Watershed [16]

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Vegetation and soils of the Crane Springs Watershed [17]  
Vegetation and soils of the Rock Springs Watershed [18]  
Vegetation and soils of the Duckwater Watershed [20]  
Vegetation and soils of the Mill Creek Watershed [21]  
Vegetation and soils of the Churchill Canyon Watershed [22]  
Vegetation and soils of the Pine and Mathews Canyon watersheds [23]  
Vegetation of the Big Horn Mountains, Wyoming, in relation to substrate and climate [38]  
Grassland, shrubland, and forestland habitat types of the White River-Arapaho National Forest [65]  
A preliminary riparian habitat type classification system for the Bureau of Land Management Districts in southern and eastern Idaho [61]  
Forest and woodland habitat types (plant associations) of northern New Mexico and northern Arizona [81]  
Flora of the Orange Cliffs of Utah [110]

MANAGEMENT CONSIDERATIONS

SPECIES: Juniperus osteosperma

WOOD PRODUCTS VALUE  
IMPORTANCE TO LIVESTOCK AND WILDLIFE  
PALATABILITY  
NUTRITIONAL VALUE  
COVER VALUE  
VALUE FOR REHABILITATION OF DISTURBED SITES  
OTHER USES AND VALUES  
OTHER MANAGEMENT CONSIDERATIONS

WOOD PRODUCTS VALUE:

Utah juniper has long been used for construction, fence posts, firewood, pencils, Christmas trees, and other purposes [4,14,67,80]. Utah juniper wood is highly decay resistant [83].

IMPORTANCE TO LIVESTOCK AND WILDLIFE:

Utah juniper is used by many birds and animals, both wildlife and livestock, for cover and food.

PALATABILITY:

Juniper "berries" or berry-cones are eaten by jackrabbits and coyotes [80]. Many bird species depend on juniper berry-cones for fall and winter food [9]. The foliage is grazed by mule deer when other foliage is scarce and during periods of deep snow [67,39,43,55]. Although deer mice and other small mammals are common in Utah juniper stands, in deer mice feeding trials in Nevada, Utah juniper seeds were the least preferred food choice of 28 seeds [47].

Large mammal use of Utah juniper is outlined in the following table [31,55,60,74,92,91,87,109,113]:

Species NVUTAZNMCO

mule deer medium, in winter medium to high, in winter low low high, in winter  
elk --- low medium, in winter low  
domestic sheep --- none to low ---  
cattle --- none ---  
pronghorn --- low to medium ---

NUTRITIONAL VALUE:

Utah juniper is only moderately nutritious forage. The tree has low concentrations of manganese, iron, potassium, and phosphorus compared to other forage. Utah juniper does have high calcium, but with a calcium to phosphorous ratio of 28 to 1, animals probably would not do well on it [25]. Winter crude

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protein levels are from 6.4 to 7.9%. Eight percent protein is considered a maintenance value for mule deer [39]. In a Utah feeding trial, Smith [112] concluded that Utah juniper's low protein content makes it very poor feed, especially for young animals. In vitro dry matter digestibility for Utah juniper, measured in the fall, was 44.1% in a Utah study. Fifty percent is considered to be a maintenance level for mule deer [28].

Nutrient content of Utah juniper is as follows [90]:

NutrientContent	
Ash (%)	4.5
Crude fiber (%)	22.0
Ether extract (%)	16.3
N-free extract (%)	50.8
Protein (%)	6.4
Calcium (%)	1.59
Magnesium (%)	0.25
Phosphorus (%)	0.17
Thiamine (mg/kg)	2.4

Utah juniper needles contain volatile oils--monoterpene hydrocarbons, oxygenated monoterpenes, and sesquiterpenes--that, in high concentration, can be damaging to the microorganisms in a deer's rumen and prevent proper digestion of food [39,104]. In a study comparing Utah juniper oil with that of alligator juniper and Rocky Mountain juniper, Utah juniper was most inhibitory of rumen microbial activity. Deer are able to detect the volatile oil content of food and will preferentially browse foods with lower content [39].

COVER VALUE:

Utah juniper is an important cover and shelter species for several large animals, including mule deer throughout its range, elk for winter cover in Wyoming, Utah, and New Mexico, desert bighorn sheep throughout the Southwest, bison in Utah, wild horses throughout the West, mountain lion and lynx in Utah, Wyoming and Arizona, and pronghorn in Utah and Nevada [32,43,55,82,84,87,109].

Several small animals are also commonly found in pinyon-juniper woodlands, including the porcupine, desert cottontail, deer mouse, Great Basin pocket mouse, chisel-toothed kangaroo rat, desert woodrat, and others [55,121]. A study of small mammal populations on unchained, and on 8-year-old, and 15-year-old chained pinyon-juniper woodlands in Colorado found greater species diversity on the unchained site, although lower total numbers of animals [94].

Many reptiles also rely on the pinyon-juniper ecosystem for habitat [55].

Seventy-three different bird species breed in pinyon-juniper habitat woodlands, although of those, only 5 are obligates (screech owl, gray flycatcher, scrub jay, plain titmouse, and gray vireo) and 13 semi-obligates [9]. Ferruginous hawks nest in Utah juniper trees [68].

A study of chained juniper woodlands in Colorado concluded that breeding bird densities were more than double on unchained than on 8-year-old and 15-year-old chained areas. There were no breeding species in common between the 2 types of sites, since the woodland supported tree-dependent species, and the chained sites supported ground- and shrub-nesters. Species diversity was also greater on the unchained sites [94].

VALUE FOR REHABILITATION OF DISTURBED SITES:

Utah juniper is generally considered too slow growing to be useful as a site rehabilitation species [126].

OTHER USES AND VALUES:

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No entry

OTHER MANAGEMENT CONSIDERATIONS:

Currently one of the most important economic values of pinyon-juniper woodlands is for livestock grazing [98].

In northwest Colorado, chaining Utah juniper stands to increase livestock production resulted in a significant reduction of bird species diversity ( $p < 0.05$ ) and an increase in the number of small mammals [105].

Utah juniper is occasionally heavily infested by juniper mistletoe (*Phoradendron juniperum* ssp. *juniperum*) and dense mistletoe (*P. bolleanum* ssp. *densum*) [123].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: *Juniperus osteosperma*

GENERAL BOTANICAL CHARACTERISTICS

RAUNKIAER LIFE FORM

REGENERATION PROCESSES

SITE CHARACTERISTICS

SUCCESSIONAL STATUS

SEASONAL DEVELOPMENT

GENERAL BOTANICAL CHARACTERISTICS:

Utah juniper is a short tree that may live as long as 650 years [83]. Utah junipers grow less than 26.4 feet (8 m) and are often as short as 9.9 to 14.85 feet (3-4.5 m), with a trunk 4 to 7.5 inches (10-30 cm) thick [67,66,75,100]. Sometimes the tree has multiple stems [4].

Under severe site conditions, Utah juniper trees persist in very stunted forms. A 6-inch tree with a 24-inch (60 cm) taproot may be over 50 years old [80]. Utah junipers grow very slowly, usually only about 0.05 inch (0.127 cm) in diameter per year [58,88].

Utah junipers have a taproot that extends deep into the soil (as far as 15 feet (4.5 m)) and lateral roots that may extend as far as 100 feet (30.3 m) from the tree, several inches below the soil surface. Most root biomass is within the first 3 feet (0.9 m) of soil, with fine roots concentrated in the uppermost 18 inches (46 cm) [111] or just below the soil surface [119]. Utah juniper responds to low nutrient levels in the soil by developing extensive networks of fine roots at the base of the tree and at the end of lateral roots. These roots are in part responsible for the competitiveness of juniper versus understory species [72,78]. Junipers compete more efficiently for soil moisture than do herbaceous understory plants; therefore, over time, junipers are more likely to maintain a stable population, while understory plants decrease [8,50,114].

A Utah study concluded that Utah junipers do not use soil moisture from summer precipitation and do not have active roots in shallow soils layers during the summer [40].

Utah juniper is colonized by vesicular-arbuscular mycorrhizae [77].

RAUNKIAER LIFE FORM:

Phanerophyte

REGENERATION PROCESSES:

Utah juniper is monoecious and sometimes dioecious [4,67,54,80,123]. It reproduces by seeds in cones and produces abundant seeds in most years [4] or every couple of years [9,62]. Cones have 1 or 2 seeds [66]. The seeds have dormant embryos and impermeable seedcoats, so they need a period of

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"after-ripening" and usually germinate the second season following maturity [120].

Utah junipers begin to produce seed only when they are about 30 years old [24,58]. Utah juniper seeds are long-lived. In one study, 17% of Utah juniper seeds germinated after 45 years [4,j71]. In general, about 8 to 49% of Utah juniper seeds germinate [58].

Animal transport of seeds is an important factor in the dissemination of juniper seeds [9,24,88], especially by jackrabbits [10,103]. Seeds that have passed through the digestive tract of animals germinate more quickly than those that have not [4].

SITE CHARACTERISTICS:

Utah juniper thrives on very dry sites [66,80,88]. Precipitation patterns in juniper communities vary, but Utah juniper is generally found in areas of 12 to 18 inches (305-457 mm) of precipitation, with extremes of below 10 inches (254 mm)/year [97] to highs of 20 inches (508 mm) [31,88,114]. Utah juniper usually occurs in areas with hot, dry summers and cold, wet winters [9,59,93], although Utah juniper is also commonly found in areas of summer monsoonal precipitation in New Mexico and Arizona [114].

Utah juniper commonly grows on alluvial fans and dry, rocky hillsides [10,67,97,107], with shallow, alkaline soils [27]. Utah juniper is considered a "sodium-sensitive" species [27,107]. In west-central Utah, Utah juniper is found on a range of soil textures, but most often on gravelly loams and gravelly clay loams with a pH range of 7.4 to 8.0 [10]. In the Big Horn Mountains of Wyoming, Utah juniper dominates on limestone soils, whereas ponderosa pine (*Pinus ponderosa*) in the same elevations dominates on soils derived from granites and sandstones [2].

Decaying organic material below juniper trees may result in a 0.4 to 0.8 inch (1-2 cm) thick water-repellent soil surface [101,102]. Fire apparently destroys this water repellency [101].

Utah juniper occurs at 3,000 to 8,000 feet (909-2424 m) elevation in the Great Basin [80]. In Arizona, Utah juniper occurs at 3,000 to 7,500 feet (909-2273 m) [75], more commonly above 5,000 feet (1515 m) [89]. In California, the plant is common from 4290 to 8580 feet (1300-2600 m) [66] and found as high as 10,000 feet (3030 m) in the Sierra Nevada [9]. In Utah, Utah juniper is found most often from 5,000 to 7,000 feet (1,500-2,100 m) [37]. The upper limits of the pinyon-juniper zone in Utah and northeastern Arizona are from 6,500 feet (1970 m) on north-facing slopes to 8,400 feet (2545 m) on south-facing slopes [6].

SUCCESSIONAL STATUS:

Utah juniper is not shade tolerant [88]. It is a climax species in harsh areas where stands are open and regeneration can occur without competition for light.

Across the west, junipers have expanded their historical range in the years since European settlement [4,19,24,29,30,73,116,124], especially into sagebrush-grass communities below areas of traditional pinyon-juniper [10,36,86]. Overgrazing, fire suppression, and climatic change have been identified as potential causes of juniper invasion [19,30,33,37,42,86,95,114]. In the absence of fire or other disturbances, trees eventually dominate the site and crowd out herbaceous and shrub species [4,10,19]. On the Fort Apache Indian Reservation in Arizona, herbaceous cover on a grazed area was twice as high after clearing junipers as on control plots [5].

Juniper litter has an allelopathic effect on some understory species, especially Idaho fescue (*Festuca idahoensis*), Sandberg bluegrass, and blue grama [24,44,50,70,120]. This effect is particularly evident on heavy, poorly drained clay soils [70]. Broadcasting grass seeds over litter appeared to lower the

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allelopathic effects [44].

Cheatgrass does not appear to suffer from allelopathic effects [44], and fourwing saltbush (*Atriplex canescens*) growth increases under juniper canopies [72].

SEASONAL DEVELOPMENT:

Utah juniper seeds germinate in the spring [13].

seasonal development of Utah juniper in Arizona is as follows [64]:

Phenological stage	Date
Bark begins to slip	March 25
Pollen shedding; seed cones open	March 25
Approx. start of leader elongation	April 20
First conspicuous new pollen cones	August 19
Bark begins to stick	September 15
Leader elongation ceases	October 19

FIRE ECOLOGY

SPECIES: *Juniperus osteosperma*

FIRE ECOLOGY OR ADAPTATIONS

POSTFIRE REGENERATION STRATEGY

FIRE ECOLOGY OR ADAPTATIONS:

Utah juniper is usually killed by fire, especially when trees are small. However, Utah juniper habitat types rarely have sufficient fine fuels to produce severe or continuous fires. Fuel loads probably rarely exceed 1 to 3 tons per acre [34]. Phenolic compounds produced by the trees reduce ground cover and therefore further decrease fuel loading around the tree. Sites that are most likely to burn are those with small, scattered trees with sufficient herbaceous understory, or those with large, decadent trees able to sustain a crown fire under windy conditions [24]. Juniper stands are seldom dense enough to carry a crown fire from one tree to the next, so even if one tree is struck by lightning, a fire that burns throughout the stand may not result [35]. One difficulty in estimating fire histories in juniper habitat types is that junipers don't usually form fire scars. If a fire is severe enough to form a fire scar, it probably will kill the cambium [53].

Ten to 30 years is an estimated mean fire interval for Utah juniper in Arizona, and from 11 to 23 years in southwestern Idaho. Fires were probably more common on slightly more mesic sites than on xeric sites [24].

POSTFIRE REGENERATION STRATEGY:

Ground residual colonizer (on-site, initial community)

Initial off-site colonizer (off-site, initial community)

FIRE EFFECTS

SPECIES: *Juniperus osteosperma*

IMMEDIATE FIRE EFFECT ON PLANT

DISCUSSION AND QUALIFICATION OF FIRE EFFECT

PLANT RESPONSE TO FIRE

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE

FIRE MANAGEMENT CONSIDERATIONS

IMMEDIATE FIRE EFFECT ON PLANT:

Utah juniper is usually killed by fire [10,45], especially when shorter than 3

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to 4 feet (0.9-1.2 m) [35,125]. Larger trees, above 4 feet (1.2 m) tall, are capable of surviving surface fires [24,114]. Mortality occurs when 60% or more of the crown is scorched [69,114]. Surface fires will thin a juniper stand to large trees and trees growing on rocks and in other refugia [35].

Tausch and west [117] studied fire scars of Utah junipers in a stand in southwestern Utah. Thirty-eight percent of the Utah junipers sampled were older than an approximately 146 year-old fire, and 4 trees had fire scars from a second fire 317 years before sampling.

DISCUSSION AND QUALIFICATION OF FIRE EFFECT:

No entry

PLANT RESPONSE TO FIRE:

Barney and Frischknecht [10] evaluated 28 different burns in west-central Utah to assess vegetation changes following fire in pinyon-juniper communities. The effects of fire on Utah juniper over time were as follows: Approximate age

of burn (yrs) Crown cover (%) Basal area (ft<sup>2</sup>/acre)

3----

6----

11 trace

220.50.6

361.21.9

461.31.6

7116.021.5

8617.233.4

100+31.8142.6

Trees that established on burned sites immediately after the fire were adjacent to or underneath burned trees, suggesting they had grown from residual seed on the site. Utah junipers dominated these sites 46 to 71 years following the burn [10].

Rate of re-establishment of juniper depends on the age of the burned stand. More mature trees produce more seed, thereby increasing the rate at which a new stand is established [10,35]. Large rodent populations and unburned seeds or unburned patches within a burned stand will speed up re-establishment of Utah junipers [125].

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE:

No entry

FIRE MANAGEMENT CONSIDERATIONS:

Juniper habitats are often burned to increase herbaceous cover for grazing or wildlife. Junipers are often difficult to ignite, and burning has been most successful when the trees themselves were lit and managers did not depend on understory fire to carry into the crowns. Often the conditions necessary to get a fire to burn in a dense juniper stand--hot, dry, windy weather--are too dangerous to allow burning [26,114].

One technique for determining whether a prescribed fire in a juniper stand is likely to succeed, at temperatures below 75° Fahrenheit (24°C) and windspeeds above 5 miles/h, was published in 1979. Add together the maximum windspeed (miles/h), air temperature (°F), and percent vegetation cover. When the total of those three numbers exceeds 110, a burn is likely to succeed, with some retorching and some mosaic burning; when the number exceeds 130, conditions are too hazardous for burning. Ideal conditions for a carrying (self-sustaining) fire exist at a score of 126-130 [26].

Vegetative recovery following a fire in a mature juniper site may be slow, since the prefire herbaceous cover is often sparse [45,46,48]. During this intervening period, soil erosion may be a problem [29,57]. However, Roundy and others [101] studied erosion and infiltration rates following prescribed burns in Nevada and concluded that erosion rates would increase on interspaces, but that on coppice dunes (areas around vegetation with higher infiltration rates) erosion

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is not a problem.

Prediction of postfire succession is affected by prefire vegetation and its fire survivability, soil seedbank, immigrating propagules, and postfire precipitation [46,48,49,51]. Succession following fire in a climax pinyon-juniper woodland often proceeds as follows: skeleton forest and bare soil; annual stage (2-3 years); annual-perennial forb stage (3-4 years); perennial forb-grass-half-shrub phase (4-6 years); shrub stage or perennial grass stage; eventual pinyon-juniper climax [4,10,41]. However, Everett and Ward [51] studied 6 burned sites to determine successional pathways, and they concluded that succession starts from multiple points along a hypothetical pathway, and that early postfire communities vary considerably.

In the years following a fire, burned pinyon-juniper and juniper sites are preferred by wildlife species such as pronghorn, elk, bighorn sheep, and mule deer, due to increased understory forage [106]. McCulloch [85] evaluated the effects of wildfire and prescribed burns on mule deer use of pinyon-juniper woodlands. During a mild winter, there was no significant difference between use of the burned and unburned plots, but during the following winter, a harsh one, mule deer use was significantly higher ( $p < 0.10$ ) on the burned than unburned sites.

Severe fires that result in soil temperatures above 122° Fahrenheit (50°C) reduce the vesicular-arbuscular mycorrhizae propagules in the soil and may restrict the ability of juniper to recolonize the site [77,76].

Utah junipers, like many other arid and semi-arid shrubs and trees, concentrate soil nutrients underneath their canopies by withdrawing them from a large area around the tree through extensive roots. Burning may result in a volatilization loss of nitrogen from a nutrient poor site. Natural nitrogen replenishment rates on these sites are low [119].

FIRE CASE STUDIES

SPECIES: Juniperus osteosperma

FIRE CASE STUDY CITATION  
SEASON/SEVERITY CLASSIFICATION  
STUDY LOCATION  
PREFIRE VEGETATIVE COMMUNITY  
TARGET SPECIES PHENOLOGICAL STATE  
SITE DESCRIPTION  
FIRE DESCRIPTION  
FIRE EFFECTS ON TARGET SPECIES  
FIRE MANAGEMENT IMPLICATIONS

CASE NAME:

Zlatnik, Elena. 1999. Burning for Utah juniper control on the Benmore Experimental Forest, Utah. In: Juniperus osteosperma. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <http://www.fs.fed.us/database/feis/> [2011, February 23].

REFERENCE:

Astroth, Kirk A.; Frischknecht, Neil C. 1984. Managing Intermountain rangelands--research on the Benmore Experimental Range, 1940-84. Gen. Tech. Rep. INT-175. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station. 44 p. [7].  
SEASON/SEVERITY CLASSIFICATION:

Name of burn Date Begin time (p.m.) Temperature % Relative humidity windspeed

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West Dutch9/17/703:0070°F270-6 miles/h

Middle Dutch8/24/714:3082°F230-5 miles/h

East Dutch8/22/722:0084°F14 (fine fuel moisture 6%)12-15 miles/h

STUDY LOCATION:

Benmore Experimental Forest, north-central Utah.

PREFIRE VEGETATIVE COMMUNITY:

This area supports a variety of grass species, including bluebunch wheatgrass (*Pseudoroegneria spicata*), Sandberg bluegrass (*Poa secunda*), thickspike wheatgrass (*Elymus lanceolatus*), western wheatgrass (*Pascopyrum smithii*), Indian ricegrass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), basin wildrye (*Leymus cinereus*), and cheatgrass (*Bromus tectorum*). Forbs include lupine (*Lupinus* spp.), Utah sweetvetch (*Hedysarum boreale* ssp. *utahensis*), longleaf phlox (*Phlox longifolia*), low fleabane (*Erigeron pumilis*), desert globemallow (*Sphaeralcea ambigua*), groundsel (*Senecio* spp.), hawksbeard (*Crepis* spp.), and locoweed (*Astragalus* spp.). Woody species included big sagebrush (*Artemisia tridentata*), rubber rabbitbrush (*Chrysothamnus nauseosus*), Utah juniper (*Juniperus osteosperma*), and some Colorado pinyon (*Pinus edulis*).

TARGET SPECIES PHENOLOGICAL STATE:

No entry

SITE DESCRIPTION:

Elevation is approximately 5,800 feet (1,768 m) and annual precipitation is around 13 inches (330 mm). Summers are usually dry, hot, and windy, with a frost-free season from May 30 to September 25. Soils are fairly high in clay and low in organic matter. Topography is generally level.

FIRE DESCRIPTION:

The 1970 and 1971 fires were incomplete due to light winds and insufficient fuels. The 1972 burn was much more successful, with much higher windspeeds.

FIRE EFFECTS ON TARGET SPECIES:

In 1970, 32% of Utah junipers under 8 feet (2.4 m) were killed, while only 19% of trees over 8 feet burned.

In the complete burn of 1972, all Utah junipers on permanent plots were killed.

FIRE MANAGEMENT IMPLICATIONS:

One burn didn't carry very well because of the lack of grass as fine fuels. This may be a common problem if junipers have dominated a site and reduced herbaceous ground cover.

Following this experience, the authors established the following guidelines for burning to control junipers: less than 20% humidity, 80 to 95 °Fahrenheit (27-35 °C) and windspeed 10 to 15 miles/h (16.1-24 km/h).

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