



Fire Effects Information System (FEIS)

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SPECIES: *Quercus turbinella*

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INTRODUCTORY

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AUTHORSHIP AND CITATION:

Tirmenstein, D. 1999. *Quercus turbinella*. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <https://www.fs.fed.us/database/feis/plants/tree/quetur/all.html/> [2018, September 27].

ABBREVIATION:

QUETUR

SYNONYMS:

Quercus turbinella var. *ajoensis* (C. H. Muller) Little [40]

Quercus turbinella ssp. *ajoensis* (C. H. Muller) Felger and Lowe [23]

NRCS PLANT CODE:

QUTU2
QUTUC2
QUTUT

COMMON NAMES:

Sonoran scrub oak
shrub live oak
turbinella oak

TAXONOMY:

The fully documented scientific name of Sonoran scrub oak is *Quercus turbinella* Greene (Fagaceae) [[32](#),[39](#),[40](#),[91](#),[101](#)]. It is a member of the white oak subgenus *Lepidobalanus* or *Quercus* [41,64,77,]. Varieties are as follows [[40](#),[91](#),[101](#)]:

Quercus turbinella var. *californica* (Tucker) L. Benson California Sonoran scrub oak
Quercus turbinella var. *turbinella* Sonoran scrub oak

Sonoran scrub oak hybridizes with Gambel oak (*Q. gambelii*): The hybrid is described as *Q.* × *pauciloba* Rydb. [[49](#)]. Sonoran scrub oak-Gambel oak hybrids are particularly evident in northern and southwestern Utah and in central Colorado [[13](#),[14](#),[21](#),[91](#),[92](#),[93](#)]. Alvord oak (*Q.* × *alvordiana* Eastw.) results from hybridization of Sonoran scrub oak and blue oak (*Q. douglasii*) [[49](#)]. Sonoran scrub oak also hybridizes with sand shinnery oak (*Q. havardii*), Nuttall's scrub oak (*Q. dumosa*), gray oak (*Q. grisea*), and valley oak (*Q. lobata*) [[14](#),[30](#),[49](#),[67](#),[92](#),[93](#),[99](#),[102](#)].

Welsh [[99](#)] divided Utah oaks into 3 complexes, one of which he identified as the Sonoran scrub oak (*Quercus turbinella*) complex. According to Welsh [[99](#)], there are "no apparent barriers to hybridization and intermediates are known between nearly all (species)" within the complex.

LIFE FORM:

Tree, shrub

FEDERAL LEGAL STATUS:

No special status

OTHER STATUS:

No entry

DISTRIBUTION AND OCCURRENCE

SPECIES: *Quercus turbinella*

- [GENERAL DISTRIBUTION](#)
- [ECOSYSTEMS](#)

- [STATES](#)
- [BLM PHYSIOGRAPHIC REGIONS](#)
- [KUCHLER PLANT ASSOCIATIONS](#)
- [SAF COVER TYPES](#)
- [SRM \(RANGELAND\) COVER TYPES](#)
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GENERAL DISTRIBUTION:

Sonoran scrub oak grows in the mountains of southwestern Colorado through southern Utah and Nevada to southern California and northern Mexico [49,91]. It extends eastward to the northwestern portion of the Trans-Pecos region of western Texas [49]. Shrub live oak is most abundant in the chaparral of central Arizona [8,14,63,68]. *Quercus turbinella* var. *turbinella* grows throughout most of the range of the species as a whole [49]. California Sonoran scrub oak grows from central San Benito County in California southeast in the inner South Coast Ranges to the mountain slopes near the southern and western borders of the Mojave Desert [90].

The northern distribution of Sonoran scrub oak is limited by spring freezes and summer moisture stress [57,78]. It is strongly influenced by the "Arizona monsoon gradient," which generates summer precipitation in the Southwest. Neilson and Wullstein [57] report that the frequency, intensity, and extent of late spring freezes, and intensity and extent of the "Arizona monsoon" appear to be the major factors controlling successful sexual reproduction in Sonoran scrub oak.

Sonoran scrub oak-Gambel oak hybrids have been reported hundreds of miles north of the present-day range of shrub live oak in parts of northern Utah and central Colorado [14,93]. Macrofossil evidence suggests that shrub live oak migrated northward in the warmer altithermal (or hypsithermal) period during which the Arizona monsoon shifted [14,57]. Later climatic shifts to cooler temperatures presumably eliminated Sonoran scrub oak from this northern area, but the more cold-hardy hybrids survived in some protected areas [14,30].

ECOSYSTEMS:

FRES21 Ponderosa pine
FRES28 Western hardwoods
FRES29 Sagebrush
FRES30 Desert shrub
FRES31 Shinnery
FRES34 Chaparral-mountain shrub
FRES35 Pinyon-juniper
FRES40 Desert grasslands

STATES:

AZ CA CO NV NM TX UT

MEXICO

BLM PHYSIOGRAPHIC REGIONS:

7 Lower Basin and Range
12 Colorado Plateau

KUCHLER PLANT ASSOCIATIONS:

K019 Arizona pine forest
K023 Juniper-pinyon woodland
K030 California oakwoods
K031 Oak-juniper woodlands
K032 Transition between K031 and K037
K033 Chaparral
K037 Mountain-mahogany-oak scrub
K057 Galleta-threeawn shrubsteppe
K071 Shinnery

SAF COVER TYPES:

67 Mohrs (shin) oak
237 Interior ponderosa pine
239 Pinyon-juniper
240 Arizona cypress
250 Blue oak-foothills pine

SRM (RANGELAND) COVER TYPES:

201 Blue oak woodland
202 Coast live oak woodland
203 Riparian woodland
206 Chamise chaparral
207 Scrub oak mixed chaparral
412 Juniper-pinyon woodland
413 Gambel oak
416 True mountain-mahogany
503 Arizona chaparral
504 Juniper-pinyon pine woodland
509 Transition between oak-juniper woodland and mahogany-oak association
730 Sand shinnery oak

HABITAT TYPES AND PLANT COMMUNITIES:

Sonoran scrub oak grows in semiarid, lower elevation chaparral, pinyon-juniper (*Pinus-Juniperus* spp.), shrub deserts, oak woodlands, ponderosa pine (*P. ponderosa*) and riparian communities of the Southwest [37,87,91,101]. It is a dominant shrub in Arizona chaparral and frequently comprises up to 50% of the shrub cover on these sites [42,63]. Published classifications listing Sonoran scrub oak as a dominant or indicator species in community types or plant associations are presented below.

Forest and woodland habitat types (plant associations) of Arizona south of the Mogollon Rim and southwestern New Mexico [2]

Vegetation and soils of the Pine and Mathews Canyon watersheds [5]

Arizona chaparral: plant associations and ecology [9]

Woodland classification: the pinyon-juniper formation [38]

Vegetation of the San Bernardino Mountains [51]

A series vegetation classification for Region 3 [53]

The natural vegetation of Arizona [59]

A vegetation classification system applied to southern California [66]

Plant associations (habitat types) of the forests and woodlands of Arizona and New Mexico [85]

Vegetation and flora of Fort Bowie National Historic Site, Arizona [98]

In Arizona chaparral, Sonoran scrub oak commonly occurs with pointleaf manzanita (*Arctostaphylos pungens*), Pringle manzanita (*A. pringlei*), grama (*Bouteloua* spp.), mountain-mahogany (*Cercocarpus* spp.), hollyleaf buckthorn (*Rhamnus crocea*), sugar sumac (*Rhus ovata*), desert ceanothus (*Ceanothus greggii*), Emory oak (*Quercus emoryi*), yellowleaf silktassel (*Garrya flavescens*), wait-a-minute bush (*Mimosa biuncifera*), yerba-santa (*Eriodictyon angustifolium*), broom snakeweed (*Gutierrezia sarothrae*), and bottlebrush squirreltail (*Elymus elymoides*) [16,24,25,42,74,70,79,87].

Common associates of Sonoran scrub oak in pinyon-juniper woodlands include oneseed juniper (*J. monosperma*), Utah juniper (*J. osteosperma*), singleleaf pinyon (*P. monophylla*), Colorado pinyon (*P. edulis*), grama, and skunkbush sumac (*R. trilobata*) [19,33].

MANAGEMENT CONSIDERATIONS

SPECIES: *Quercus turbinella*

- [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:

No entry

IMPORTANCE TO LIVESTOCK AND WILDLIFE:

Sonoran scrub oak generally provides relatively little browse for most species of wildlife and livestock. In many areas it is used heavily only when other more palatable species are lacking [70]; however, Sonoran scrub oak is sometimes an important food source for deer and livestock [8]. In southern and central Arizona, it is considered to be a valuable browse plant because of its abundance and evergreen leaves [94]. Sonoran scrub oak can be a valuable emergency winter food when snow is deep or when preferred foods are scarce [8]. Sonoran scrub oak also provides an excellent source of emergency browse during droughts when other plants become desiccated and unpalatable [94].

Sonoran scrub oak can survive heavy browsing and may remain as "almost the only forage" on deteriorated ranges in Arizona [35].

The foliage of Sonoran scrub oak is utilized to at least some degree by a number of big game species. New, succulent growth is the most palatable and is readily consumed [8,65]. New growth is described as "fair" forage for deer in Arizona. In some areas, deer may consume considerable amounts of foliage [65,94]. Use of Sonoran scrub oak by mule deer in the southern Rocky Mountains is described as "moderate" in winter and "light" in summer [46]. Use of Sonoran scrub oak by desert mule deer is described as "low to high" in winter, "low" in spring, "moderate to high" during summer, and "low" in the fall [44]. Desert bighorn sheep feed on Sonoran scrub oak in Arizona [82].

Cattle, domestic sheep [94], and domestic goats use Sonoran scrub oak at least moderately [7]. In some Arizona locations, shrub live oak may become too dense for livestock and big game use [70].

Acorns of Sonoran scrub oak and related species constitute an important source of mast for many small birds and mammals in the Southwest. Acorns are utilized by the collared peccary, wild turkey, numerous rodents such as Abert's squirrel, geese, grouse, quail, scrub jays, and many other birds [8,63,97]. Scrub jays and many rodents collect and cache acorns of Sonoran scrub oak, thereby aiding in seed dispersal [63]. Mule deer, white-tailed deer, and cattle also consume acorns during the fall [8,50,63,96].

In the Southwest, scrub live oak cambium is eaten by sapsuckers, porcupines eat the bark, and beavers consume the twigs [97].

PALATABILITY:

Palatability of Sonoran scrub oak to most species of wildlife and livestock is relatively low in most seasons [8,86]. It is generally used only lightly by deer in Arizona [65] and most other big game species throughout its range. New sprouts are most palatable and are browsed readily [8,65,86]. Domestic goats, however, frequently use it year-round [8,43]. In an Arizona chaparral study, Sonoran scrub oak was the most preferred species of domestic goats during the first weeks after goats were released onto the range [43]. Sonoran scrub oak is fairly palatable to cattle and domestic sheep in some areas [94].

The palatability of Sonoran scrub oak for livestock and wildlife species for Sonoran scrub oak in Utah is as follows [20]:

Cattle	Poor
Domestic sheep	Poor
Horses	Poor
Pronghorn	Fair
Elk	Poor
Mule deer	Fair
Small mammals	Good
Small nongame birds	Poor
Upland game birds	Good
Waterfowl	Poor

NUTRITIONAL VALUE:

Sonoran scrub oak is rated fair in energy and protein value [20]. Nutrient content (%) of Sonoran scrub oak is as follows [82]:

Date	Dry matter	Protein	Lignin	Cellulose	Ether	Ash
Jan-Feb	47.35	15.45	6.38	9.00	20.16	8.22
Mar-April	45.51	13.57	6.59	10.03	15.28	6.59
May-June	58.10	12.19	8.38	13.37	15.38	7.70
July-Aug	60.04	12.16	6.90	12.07	15.33	8.12
Sept-Oct	57.99	11.08	6.10	12.02	17.78	8.06
Nov-Dec	50.76	12.62	7.31	11.51	19.46	7.38

Crude fiber is lowest in May and highest during the winter months [76]. Crude protein levels of Sonoran scrub oaks in California varied seasonally as follows [4]:

Oven-dry weight (%)	
January	7.7
February	7.3
March	7.5
April	6.9

Nutritional value (%) for *Quercus* spp. forage is as follows [55]:

	Acorns	Acorn meats	Oak leaves
Dry matter	100.0	100.0	100.0
Organic matter	97.5	98.0	----
Ash	2.5	5.6	2.0
Crude fiber	13.9	2.0	27.4
Ether extract	5.4	8.9	2.5
N-free extract	73.5	80.7	54.3
Protein (N ? 6.25)	4.8	6.4	10.2
Cattle*	0.5	1.9	5.8
Horses*	1.7	3.1	6.2
Domestic goats*	1.7	3.1	6.1
Domestic sheep*	1.7	3.1	5.7

*digestible protein

COVER VALUE:

Sonoran scrub oak provides effective cover for a wide range of birds and mammals. Chaparral dominated by Sonoran scrub oak provides habitat for the peccary, California brown bat, ringtail, whitetail deer, Cooper's hawk, screech owl, many songbirds, canyon tree frog, leopard frog, and Mexican garter snake [77]. In central Arizona, mountain lion kills are sometimes hidden in Sonoran scrub oak thickets [60]. Sonoran scrub oak provides cover during 1 or more seasons for wildlife in Utah as follows [20]:

Pronghorn	Fair
Elk	Poor
Mule deer	Good
Small mammals	Good
Small nongame birds	Good
Upland game birds	Good
Waterfowl	Poor

VALUE FOR REHABILITATION OF DISTURBED SITES:

Sonoran scrub oak is rated as having "high potential" for erosion control and for long-term revegetation projects, but it is of little value in short-term revegetation [20].

Under laboratory conditions Sonoran scrub oak can be propagated from softwood cuttings of stems with fully expanded leaves [30]. Average successful rootings of up to 75% have been attained under optimal conditions [15]. Best results were obtained when cuttings were trimmed to 2 to 3 inches (5-8 cm) and put in a rooting medium of 1:1 perlite to peat moss. Details on propagation by cuttings are available [15,30].

OTHER USES AND VALUES:

Native Americans of the Southwest used Sonoran scrub oak acorns for food [94]; for example, the Pima used them as a "snack food" [73].

OTHER MANAGEMENT CONSIDERATIONS:

Exotic grass production increases in response to removal of Sonoran scrub oak. On Arizona sites where Sonoran scrub oak was killed by herbicides and weeping lovegrass (*Eragrostis curvula*) seeded, the basal cover of weeping lovegrass was found to be inversely proportional to oak cover. Where less than 50% of the Sonoran scrub oak cover was removed, the basal cover of weeping lovegrass remained constant for 3 years, but where more than 50% of the basal cover was removed, weeping lovegrass continued to increase during the 2nd and 3rd years [68].

Sonoran scrub oak may be difficult to control with herbicides [69]. Repeated applications are often necessary [87]. Best results have been reported if herbicides are applied when subsoil at 24 inches (60 cm) depth is moist or wet and when leaves are not senescent or falling [37]. Specific details on the effects of herbicides on Sonoran scrub oak are available [8,11,31,36,37,87].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: *Quercus turbinella*

- [GENERAL BOTANICAL CHARACTERISTICS](#)
- [RAUNKIAER LIFE FORM](#)
- [REGENERATION PROCESSES](#)
- [SITE CHARACTERISTICS](#)
- [SUCCESSIONAL STATUS](#)
- [SEASONAL DEVELOPMENT](#)

GENERAL BOTANICAL CHARACTERISTICS:

Sonoran scrub oak is a clump-forming or clonal evergreen shrub or less commonly a small tree [81,84,94,101]. It typically grows from 3 to 8 feet (0.9-2 m) in height with stem diameters to 8 inches (20 cm) [8,99,101]; however, it can reach 15 feet (5 m) or more [8]. The somewhat leathery leaves are 0.5 to 1.6 inches (1.3-4 cm) in length, 0.3 to 0.9 inch (0.7-2.4 cm) in width [94,101]. Leaves persist through the winter [93]. Fruits of Sonoran scrub oak are slender, annual acorns 0.5 to 1 inch (1.3-2.5 cm) in length, with turbinate cups [94].

Belowground structure: Root depths of over 25 feet (8 m) have been reported in parts of Arizona [81]. Roots and rhizomes may spread 16 feet (4.9 m) or more horizontally [16]. Sonoran scrub oak forms colonies by sprouting from rhizomes [8,100]. Thousands of individual stems may form from a single

or only a few individuals [8]. Davis and Pase [16] report "what appears to be a relatively open stand of Sonoran scrub oak aboveground, may actually be a relatively closed system" of overlapping roots and rhizomes. The top foot of soil typically contains a dense network of small surface laterals that aid in the absorption of surface soil moisture. In central Arizona, the greatest accumulation of belowground biomass occurred in the top 2 feet (0.6 m) of soil, with biomass decreasing with depth as follows [16]:

Soil depth (m)	Weight (g)
0 - 0.3	7053
0.3 - 0.6	7883
0.6 - 0.9	5068
0.9 - 1.2	3403
1.2 - 1.5	2602
1.5 - 1.8	1575

In an Arizona study, only 1 of 7 Sonoran scrub oak stems died within a 47-year period [69].

RAUNKIAER LIFE FORM:

Phanerophyte

REGENERATION PROCESSES:

Sonoran scrub oak reproduces through both sexual and vegetative means.

Sexual reproduction: Sonoran scrub oak produces small acorns which usually germinate and establish from late July through mid-September [8,93]. Germination often occurs shortly after acorn maturation and coincides with the summer rainy season [63]. Under laboratory conditions germination capacity may reach 95% [61].

Acorn production is largely dependent on the amount of precipitation received during the previous winter [63]. Dry summers may inhibit or retard acorn production [79,80]. In "good" years Sonoran scrub oak produces an abundance of acorns [79]. Total acorn failure, although rare, can occur [63,79]. Total crop failures may occur when October-March precipitation is less than 15 inches (38 cm) [63]. Generally, good crops are produced at 3- to 5-year intervals [61].

The vast majority of Sonoran scrub oak seedling mortality is apparently attributable to drought. In an Arizona study, seedling mortality during the first spring drought period following germination was 53%. Mortality rates appeared to decline by 3 years after germination [63].

Sonoran scrub oak acorns do not require a ripening period and frequently germinate while in storage. Shrub live oak acorns are characterized by a short period of viability, and seedbanking is unlikely. Pase [63] reports "there is probably a negligible carryover of seeds from 1 year to the next." Very few viable seeds remain 1 year after burial, due in large part to predation by insects, birds, and mammals [63].

Acorns are dispersed by numerous birds and mammals which eat and/or cache the acorns. Sonoran scrub oak seeds tend to be somewhat heavy, weighing an average of 0.046 to 0.053 ounce (1.3-1.5 g) per seed [30], and are consequently not transported long distances by most seed-dispersing animals. Scrub jays are particularly important dispersal agents. These birds generally "plant" single acorns at

depths of 1.5 to 2 inches (4-5 cm), a few feet to a hundred feet from the parent plant. Rodents more often cache multiple seeds, which can germinate and produce groups of 10 to 20 or more seedlings at a single location. Seedling distribution indicates that, at least in many of the central Arizona sites studied, scrub jays play a much more significant role as dispersers than do rodents [63].

Seedlings are rarely encountered in the field [8,79,63]. Successful establishment is thought to require 15 inches (38 cm) or more of precipitation from October through March, followed by 10 inches (25 cm) or more from July to September [8,63]. These conditions are met in only 1 year out of 10 at many Arizona sites [63]. In laboratory experiments seedling roots grew to a depth of 1 foot (30 cm) prior to leaf development [16]. Plants only 12.9 inches (7.4 cm) in height had roots that extended to 21 inches (53 cm) in depth [8].

Vegetative reproduction: Sonoran scrub oak tends to increase more through rhizome sprouting than by seedling establishment [63,79]. Sonoran scrub oak sprouts vigorously after fire, application of herbicides, or mechanical treatment [8,16,65,79,100,105].

SITE CHARACTERISTICS:

Sonoran scrub oak is particularly common on many low winter ranges in southern Utah and Nevada and in chaparral-desert grassland ecotones in Arizona [8,94]. Sonoran scrub oak often grows in scattered patches in swales and canyons [94].

Soil: Sonoran scrub oak grows well on dry hillsides and mesas and tolerates a wide range of soil types [94]. Growth is best on sandy to clay loams [20]. Soils are often slightly acidic [16]. This oak is not restricted to deep soils and can grow on shallow, broken and fractured substrates [16,79]. Soils are typically coarse-textured and poorly developed in Sonoran scrub oak chaparral [24].

In eastern Yavapai County in central Arizona, soils developed from quartz diorite provide more favorable moisture regimes than do heavy clay soils developed from volcanics. In north-central Arizona, shrub live oak growing on less favorable, drier, sedimentary and volcanic substrates may be more susceptible to drought damage. Where root penetration is restricted, plants are more susceptible to damage from drought or fire [79].

Climate: Sonoran scrub oak is drought tolerant and typically occupies drier and warmer sites than Gambel oak [57,58]. In the northern part of its range, Sonoran scrub oak often grows on warm, dry, southern exposures [21]. Arizona chaparral is characterized by a biseasonal precipitation pattern with summer and winter precipitation and spring and fall droughts [16]. Annual precipitation averages 16 to 25 inches (410-640 mm) [24].

Elevation: Ranges of Sonoran scrub oak are as follows [20,32,56,80,101]:

4,000 to 8,000 ft (1,220-1,525 m) in AZ
3,934 to 10,492 ft (1,200-2,000 m) in CA
2,689 to 5,607 ft (820-1,710 m) in UT

SUCCESSIONAL STATUS:

Sonoran scrub oak may have climax or seral status. This long-lived oak is considered to be an indicator of climax in parts of Arizona and New Mexico [8,53]. During the 2nd and 3rd years after

fire in Sonoran scrub oak-dominated chaparral in Arizona, forbs and grasses dominate. Shrubs, including Sonoran scrub oak, assume prominence the 5th through 7th year after disturbance, although it may take more than 11 years for shrubs to reach preburn levels [8]. A typical successional pathway in pinyon-juniper is as follows [33]:

bare soil
 annuals
 perennial grasses and forbs
 shrubs (including Sonoran scrub oak)
 shrubs and open trees
 climax pinyon-juniper

Pond [68] reports that weeping lovegrass dies out as the density of Sonoran scrub oak increases.

SEASONAL DEVELOPMENT:

Sonoran scrub oak flowers from April through June. In Ventura County, California, Sonoran scrub oak usually flowers in April [89]. In Utah, flowering begins by April and ends by May [20].

Sonoran scrub oak acorns mature by the summer or early fall. Acorns were present on Sonoran scrub oak from late August to early September at 1 Arizona site [79]. Acorns often germinate during the summer rainy period, with germination and emergence occurring from late July to mid-September [63].

FIRE ECOLOGY

SPECIES: *Quercus turbinella*

- [FIRE ECOLOGY OR ADAPTATIONS](#)
- [POSTFIRE REGENERATION STRATEGY](#)

FIRE ECOLOGY OR ADAPTATIONS:

Sonoran scrub oak is well adapted to survive fire. This oak typically sprouts vigorously from the root crown and rhizomes in response to fire or other types of disturbance [16,63,79,100,104,105]. Postfire establishment by seed also occurs. In central Arizona, seedlings generally emerge in summer after the onset of summer rain [65].

FIRE REGIMES:

In Arizona chaparral dominated by Sonoran scrub oak, fire return intervals have been estimated at 74 to 100 years. At least 20 years may be required before these sites can reburn [8]. Childers and Piirto [10] note that fire is a natural part of the ecosystem in southern California communities in which Sonoran scrub oak occurs.

Minnich and Chou [52] report the following average fire rotations in communities in which Sonoran scrub oak occurs:

southern California mixed chaparral - 59 years
 northern Mexico mixed chaparral - 59 years
 desert chaparral/pinyon-juniper woodland - 219 years

Find further fire regime information for the plant communities in which this species may occur by entering the species name in the [FEIS home page](#) under "Find Fire Regimes".

POSTFIRE REGENERATION STRATEGY:

Tree with adventitious bud/root crown/soboliferous species root sucker
 Initial off-site colonizer (off-site, initial community)

FIRE EFFECTS

SPECIES: Quercus turbinella

- [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:

Sonoran scrub oak is top-killed by fire [[15,18](#)]. The degree of damage and subsequent mortality rate of shrub live oak following fire depends largely on fire intensity and severity, site characteristics that influence fuel levels, and climatic factors [[87](#)]. On most sites, Sonoran scrub oak is difficult to kill by burning [[70](#)].

DISCUSSION AND QUALIFICATION OF FIRE EFFECT:

Sonoran scrub oak is more susceptible to fire-induced damage on drier, unfavorable sedimentary or volcanic substrates than on more favorable sites and can occasionally be eliminated from these marginal sites by fire. Evidence suggests that Sonoran scrub oak is especially difficult to kill on soils with relatively favorable moisture relationships [[79,80](#)].

Fires of high severity generally result in increased mortality. Seedling survival tends to be higher following "light" fires [[8,79,80](#)]. Survival of 1-year old Sonoran scrub oak seedlings was as follows after fires in central Arizona chaparral [[64](#)]:

intense burn*	light burn**
48%	91%

*leaves and twigs mostly consumed

**shrubs dead, but leaves and twigs mostly intact;

"largely a cool or ground fire"

A June wildfire in Arizona top-killed all Sonoran scrub oak present on the site [[18](#)]. In many areas annual burning may be necessary to eliminate or significantly reduce Sonoran scrub oak. On some

Arizona chaparral sites at least 5 consecutive annual burns were necessary to reduce stem numbers to below pretreatment levels [70].

PLANT RESPONSE TO FIRE:

Sonoran scrub oak typically sprouts from the root crown and rhizomes following fire [8,16,79,80,100,104,105]. In Arizona chaparral communities, Sonoran scrub oak may be favored by repeated burning [75].

Although sprouting is apparently the most common form of regeneration after fire, seedling establishment may also be important. A "moderate population" of shrub live oak seedlings was observed on Arizona chaparral burned 1 and 2 years earlier. Survival after 3 years was 26% with most mortality attributable to drought [63]. Postfire seedling emergence and survival after fall burning in Arizona chaparral site were as follows [65]:

Seedling emergence -

# years after burn	1	2	3	4	5
seedlings/acre	62	12	16	0	9 = 99 (total)

Seedlings surviving at the end of the growing season -

# years after fire	1	2	3	4	5
seedlings/acre	57	50	36	36	9

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE:

Recovery times after fire for Sonoran scrub oak range from 4 to 8 years or more [87]. Cable [7] observed that Sonoran scrub oak had regained preburn density within 5 years after fire in Arizona. After an early fall prescribed burn in a Sonoran scrub oak-true mountain-mahogany (*Cercocarpus montanus*) community in central Arizona, shrub live oak exceeded pretreatment cover within 5 years. Crown canopy over (%) of Sonoran scrub oak was as follows [65]:

	Postfire year					
Prefire	0	1	2	3	4	5
22.7	1.3	9.0	14.1	14.7	17.8	25.6

At a 2nd site in Arizona oak chaparral, Sonoran scrub oak began revegetating the area within 4 to 6 years after burning, herbicide treatment, and reseeded with Lehmann (*Eragrostis lehmanniana*) or weeping lovegrass. However, more than 8 years were required for complete recovery of shrub live oak at this site [87].

Cover values (%) of Sonoran scrub oak 1 to 8 years after fire in 2 Arizona studies were as follows:

1st study - based on line intercepts following June 1956 burn [8] -

1956	1957	1958	1960	1961
81.0	80.4	69.4	70.5	68.0

2nd study - crown cover by sites and treatments (all measured in 1963) [87] -

Treatment year	Unburned- native	Burned- reseeded*	Burned- reseeded*- herbicide
1955 site	21.8	16.8	---
1956 site	29.6	25.5	3.8
1958 site	27.2	19.8	2.1
1959 site	18.4	13.8	---
average	24.2	19.0	3.0

*seeded to Lehmann lovegrass and weeping lovegrass or a combination

In central Arizona chaparral communities, Sonoran scrub oak response depended in part on frequency of burning [70]. After the first 4 of 5 annual burns, stem counts were still higher than pretreatment numbers and only after the 5th burn did stem numbers drop below preburn levels. Burning at 2-year intervals failed to reduce sprouting in Sonoran scrub oak. After 3 treatments at 2-year intervals, live stems still numbered 4.37 times the original number [71]. Results of this study follow [70]:

	Stem counts before burning in indicated year -						
Yrs. between burns	1953 (pretmt)	1954	1955	1956	1957	1958	1959
1	121	710	330	371	161	38	17
2	152	---	1231	1161	1142	---	662
3	276	---	---	---	---	---	1469
4	170	---	---	---	790	---	773
5	94	---	---	---	---	436	1107

FIRE MANAGEMENT CONSIDERATIONS:

Davis and Dieterich [17] report "people experienced with fire characteristics in Arizona oak chaparral have always maintained that chaparral either burns fiercely or does not burn at all." A critical rate of spread threshold has been estimated at 20 feet per minute. For fire to spread, conditions must be suitable for generating spread at or above that rate. Minimum sustained spread of 1/4 mile per hour (22 ft/min) has been reported in prescribed burns [17]. Details are available on rate of spread in Sonoran scrub oak-dominated chaparral [17].

Flammability of Sonoran scrub oak is increased by preheating which may cause chemical changes. Detailed information is available [88].

Prescribed fire: Prescribed fires have resulted in temporary reduction of Sonoran scrub oak [65]. At some sites fuels are sparse, and broadcast burning may be nearly impossible [70]. Several years may be needed for Sonoran scrub oak chaparral to produce enough fuel to carry a fire. Ten to 20 years may be required for Sonoran scrub to reburn at some sites [6,8]. Herbicides may be applied prior to prescribed burning to increase flammability and kill the tops of Sonoran scrub oak without removing litter [65]. In an Arizona study, late summer application of 'Dinoxol' (a mixture of 2 lbs/gallon (acid equivalent) of the butoxyethanol esters of 2,4-D and 2,4,5-T herbicides) killed 80% of the leaves and twigs. Moisture content of herbicide-killed leaves was 8 to 15% (oven-dry) compared with 85 to 97% for untreated leaves [65]. Sonoran scrub oak leaves contain approximately 6.2% volatiles [27]. Regressions have been developed for foliar moisture of Sonoran scrub oak [48].

Grass production: The production of introduced perennial grasses may increase following fire in Sonoran scrub oak communities. Productivity may be increased for 5 to 7 years following fire. In an Arizona study, comparative production values by treatment were as follows [87]:

Perennial grass production

	Unburned- native	Burned- reseeded	Burned- reseeded- herbicide
1956 site	3 lb/acre	----	280 lb/acre
1958 site	31 lb/acre	179 lb/acre	803 lb/acre

The grasses increased in the preceding study were seeded exotics. Native grasses were scarce prior to burning and thus, treatment did not produce increases in native grasses. Grazing may have little impact on postburn cover of Sonoran scrub oak. Pond and Cable [71] reported the following results after a 1951 fire in Arizona chaparral:

Sonoran scrub oak cover (%)

	grazed	ungrazed
1952	20.40	18.46
1956	33.93	30.27
1958	36.37	31.04

Browse: Sonoran scrub oak is fairly palatable to browsers while in the early sprout stage. The value of Sonoran scrub oak to wildlife is thus enhanced by burning [65].

Soils: Fire acts as a mineralizing agent quickly volatilizing the litter and standing fuels of Sonoran scrub oak. These compounds then condense within the soil and on the soil surface. Immediately after a prescribed fire amounts of exchangeable ammonium and extractable phosphorus in the soil increased under shrub live oak [62].

FIRE CASE STUDY

SPECIES: Quercus turbinella

- [FIRE CASE STUDY CITATION](#)
- [REFERENCE](#)
- [SEASON/SEVERITY CLASSIFICATION](#)
- [STUDY LOCATION](#)
- [PREFIRE VEGETATIVE COMMUNITY](#)
- [PLANT SPECIES PHENOLOGICAL STATE](#)
- [SITE DESCRIPTION](#)
- [FIRE DESCRIPTION](#)
- [FIRE EFFECTS ON PLANT SPECIES](#)
- [FIRE MANAGEMENT IMPLICATIONS](#)

FIRE CASE STUDY CITATION:

Tirmenstein, D., compiler. 1999. Effects of prescribed fire on the Battleflat Watershed, central Arizona, on Sonoran scrub oak. In: Quercus turbinella. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: <https://www.fs.fed.us/database/feis/> [2018, September 27].

REFERENCE:

Wienhold, Brian J.; Klemmedson, James O. 1992. Effect of prescribed fire on nitrogen and phosphorus in Arizona chaparral soil-plant systems. *Arid Soil Research and Rehabilitation*. 6: 285-296. [103].

SEASON/SEVERITY CLASSIFICATION:

fall/severe

STUDY LOCATION:

The study was located in the Battleflat Watershed in the Bradshaw Mountains of central Arizona.

PREFIRE VEGETATIVE COMMUNITY:

The study site was covered by dense shrubby vegetation. Crown cover averaged 75 to 80%. Dominant shrubs included pointleaf manzanita (*Arctostaphylos pungens*), Sonoran scrub oak (*Quercus turbinella*,) and mountain-mahogany (*Cercocarpus betuloides*). Subdominant species included Emory oak (*Q. emoryi*), alligator juniper (*Juniperus deppeana*), Apache plume (*Fallugia paradoxa*), and yerba-santa (*Eriodictyon angustifolium*). The shrub stand was approximately 85 to 90 years old.

PLANT SPECIES PHENOLOGICAL STATE:

Not reported

SITE DESCRIPTION:

Topography was rough and dissected. Slopes ranged from 8 to 80°. Mean daily temperature was 15 °C.

FIRE DESCRIPTION:

The burn occurred over a 2-day period: October 30th and 31st, 1985. The burn was described as "intense" with a rate of spread of 12 m min⁻¹ and flame heights exceeding 4 meters. The fire was ignited with a helitorch. The burn was described as "patchy." Specific conditions during the burn were as follows:

relative humidity: 10-30%
air temperature: 16-29°C
wind speed: 2-8 m s⁻¹
fuel moisture of Sonoran scrub oak:
 new growth - 72%
 old growth - 61%

FIRE EFFECTS ON PLANT SPECIES:

The prescribed fire consumed 65% of aboveground dry matter on Sonoran scrub oak plants. Effect of fire on aboveground dry biomass of Sonoran scrub oak was as follows:

Loss

	preburn (kg m ⁻²)	postburn (kg m ⁻²)	amount (kg m ⁻²)	relative (%)
shoots	1.2	--	--	--
litter	3.3	--	--	--
total	4.5	1.6	2.9	64.6

FIRE MANAGEMENT IMPLICATIONS:

Prescribed fire increased inorganic nitrogen in the 0- to 2-cm soil layer under Sonoran scrub oak plants, mainly through increases in ammonium concentration. Inorganic nitrogen in the 2- to 10-cm soil layer did not change significantly. After fire, available phosphorus increased, especially in the top 2 cm of soil.

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