

WILDFIRE RISK REDUCTION IN ARIZONA'S INTERIOR CHAPARRAL

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Introduction

Arizona's interior chaparral vegetation type covers approximately 3.5 million acres extending in a discontinuous band running southeast from Kingman, through Prescott and Payson, continuing into southeast Arizona below the Mogollon Rim (Figure 1.). In Arizona's Central Highlands it accounts for about 13% of the vegetative cover (compared to 5% for ponderosa pine). Interior chaparral is found between 3,200 and 5,700 foot elevations. Though variable, the topography where it occurs is mostly on mountainous sites, typically in steep, rough terrain in areas of moderately deep, coarse textured and poorly developed soils. Compared to California chaparral, where extensive residential and metropolitan areas extend right up to the shrub-covered hillsides, residential development in Arizona's interior chaparral is slowly increasing but remains limited.

The word *chaparral* is derived from the Spanish word *chaparro*, which means small evergreen oak, which itself comes from the Basque word *txapar*, with the same meaning. The most common species in interior chaparral is shrub live oak (*Quercus turbinella*), which often occurs in almost pure stands. Other chaparral shrubs include: mountain mahogany (*Cercocarpus* spp.), skunkbush (*Rhus trilobata*), sugar sumac (*R. ovata*), silktassels (*Garrya* spp.), desert ceanothus (*Ceanothus greggii*), hollyleaf buckthorn (*Rhamnus crocea*), cliffrose (*Purshia mexicana*), desert olive (*Forestiera neomexicana*), Arizona white oak (*Q. arizonica*), Emory oak (*Q. emoryi*), and manzanita (*Arctostaphylos* spp.).

Media accounts of chaparral wildfires in California can lead to misleading conclusions about chaparral types in other states. Arizona's interior chaparral differs significantly from that of California in terms of prevailing climate, growth patterns, average heights of shrubs, species present and the composition of understory grasses and forbs. The biggest difference between them is in the amount and distribution of precipitation. Annual precipitation in Arizona chaparral ranges from about 15 to 24 inches, with about 55% occurring during the winter and 45% during summer. Annual precipitation in California chaparral ranges from about

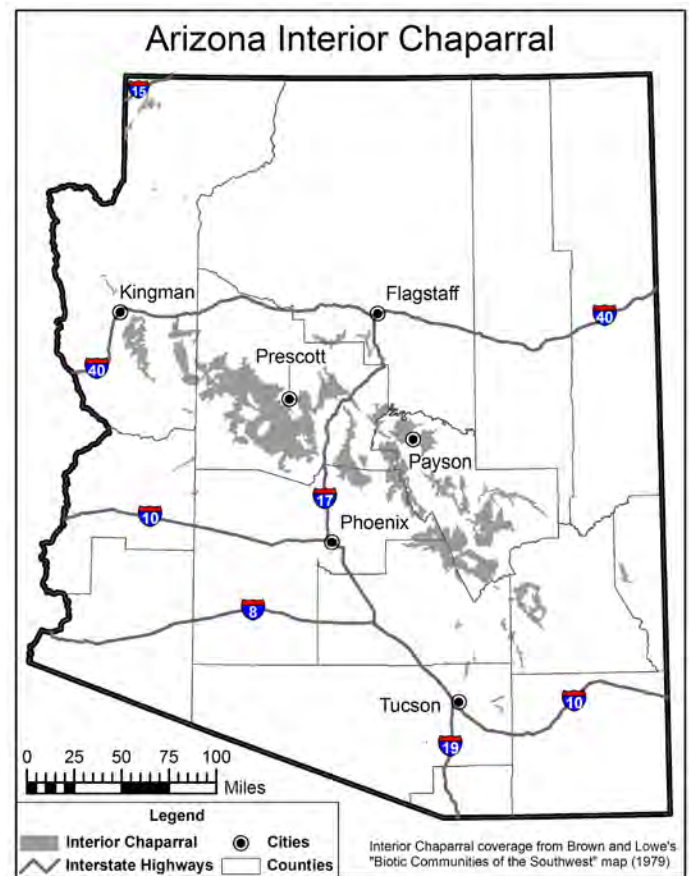


Figure 1. Map of Arizona showing general locations of interior chaparral.

26 to 36 inches, with most of it occurring during the cool winter months while the summers are hot and dry. Because of this, Arizona chaparral grows primarily in spring and summer, while California chaparral grows mainly in winter and spring.

Arizona chaparral is generally lower in height and less dense than California chaparral. Shrub canopy cover can

vary from 40% on drier sites to 80% on wetter sites (Brooks, Esque, and Duck 2003). In the more open parts of the canopy, grasses and forbs can be moderately abundant, though virtually absent under the dense canopy of mature stands (Pase and Brown 1994). In areas that have been moderately grazed, sideoats grama (*Bouteloua curtipendula*) and other perennial grasses are common, while in areas that have had poor grazing management, the non-native red brome (*Bromus rubens*) and other annual grasses are more common (Bolander 1982).

Though possessing different species compositions, Arizona and California chaparral share a number of common genera, including oak, manzanita, Ceanothus, sumac, silktassel and mountain mahogany. Typical plants in both chaparral types are generally moderately to deeply rooted, leathery-leaved, evergreen shrubs. Most sprout readily from root crowns and recover quickly after burning. Those that don't often produce prolific seed crops that can remain viable in the soil for decades, awaiting the next fire to germinate.

Chaparral Fire History and Behavior

Arizona's interior chaparral is a fire-adapted ecosystem. Because the extensive root systems are able to pull moisture and nutrients from a large area, chaparral stands can regenerate quickly, with shrub densities regaining those of adjacent unburned areas within 5-7 years following fire (Carmichael et al. 1978). Prior to European settlement, fire return intervals in Arizona's interior chaparral probably ranged from 30-100 years, depending on the site. In areas like the Prescott Basin, for example, with its mixture of oak species the average was 30-40 years (Sneed and Floyd-Hanna 2002). In sites dominated by shrub live oak, they were likely 74-100 years (Brooks, Esque, and Duck 2003). The pre-settlement fire regime was characterized by severe surface fires combined with crown fires that replaced mature stands which maintained a mosaic of different age classes.

"Conventional wisdom in the fire suppression community is that chaparral either does not burn, or when it does burn, it burns hot." (Brooks and Floyd-Hanna 2003). As the density of Arizona chaparral shrubs has increased due to fire suppression (Heubner, Vankat and Renwick 1999), the grasses and forbs that most readily carry fire gradually disappear beneath the canopy, thus making frequent wildfires less likely. When such stands do burn, however, the closed canopy coupled with the presence of volatile oils and waxes and accumulated deadwood results in fast-moving high intensity fires.

In Arizona, fire conditions are most severe in spring and early summer before summer rains and to a lesser degree in fall after the end of the monsoon season (DeBano 1989). The reverse is true during the monsoon season, however, when chaparral plants are actively growing and highest in live fuel moisture.

Creating Survivable Space

Because of its more flammable nature and its potential for extreme fire behavior, interior chaparral must be carefully

managed around homes within the wildland urban interface both to mitigate structural losses from wildfire and to protect adjacent wildlands from fires originating on residential or commercial property. Creating wildfire survivable space (also referred to as wildfire defensible space) in chaparral involves finding the right balance between reducing fuels and maintaining a diverse plant community that protects the soil from erosion and provides suitable habitat for desired wildlife species. Because of their potential for greater heat output and flame lengths, taller growing, more flammable plants in the landscape need to be selectively thinned or replaced by lower growing, less flammable plants. Native grasses and wildflowers, cacti and other succulents such as agaves and yuccas, and the sub-shrub shrubby buckwheat (*Eriogonum wrightii*) are excellent choices for wildfire survivable space in chaparral. This mimics the more open and visually interesting post-fire stage of succession in chaparral when herbaceous plants are more common. Interspersing various ground covers, both nonwoody and woody, among properly thinned, taller plants also helps to reduce wildfire risk while protecting the soil from erosion. Herbaceous plants, such as grasses and wildflowers, should have dead vegetation removed during their dormant season thus reducing fine fuels. Keep in mind that fire behavior is influenced by many factors including fuel volume (total biomass and size of stems), continuity, resin/oil content, and moisture content. These factors can be managed through pruning, irrigation, and/or individual plant removal. Table 1 lists some native plants suitable for use in wildfire survivable space within the interior chaparral vegetation type.

In choosing which plants to keep or install, a key factor is the plant's fire-resistive qualities. Non-resinous, deeply rooted plants, with thick, heavy leaves, are generally considered more fire-resistive. The amount of resin a plant contains affects how readily and intensely it burns. Manzanita has a high resin content and is usually considered highly flammable. The sub-shrub, broom snakeweed (*Gutierrezia sarothrae*), also has high resin content and should not be left where it could serve as a ladder fuel. Contrary to popular belief, not all chaparral plants are equally flammable. When fuel samples of mountain mahogany (*Cercocarpus montanus*), were burned in a combustion chamber they were shown to have a lower flammability than most other chaparral species tested, with flame heights of less than 2 inches. Plants of the Arizona interior chaparral tend to contain lower amounts of oils and waxes (<4.5%) compared to those of the California chaparral and are thus less flammable (Bennet, Kunzmann, Graham 1999).

Since water for irrigation is an increasingly scarce resource in the arid Southwest, the amount of water a landscape plant requires to keep it healthy is an important consideration. Often, it is a combination of characteristics that makes a plant more fire-resistive. Thus a plant that is both non-resinous and drought-tolerant is a much better choice than one with either of these characteristics alone. Another consideration is the total number of plants in the landscape.

Table 1. Selected plants suitable for use in wildfire survivable space within Arizona’s interior chaparral with growth form, approximate height and descriptive comments.

Scientific Name	Common Name	Growth Form	Height	Comments
<i>Agave parryi</i>	Parry's agave	succulent	2'	century plant, bluish rosettes
<i>Aristida spp</i>	three awns	grass	1.5'	cool season, perennial bunch
<i>Bouteloua gracilis</i>	blue grama	grass	1.5'	warm season, sod forming
<i>Bouteloua curtipendula</i>	sideoats grama	grass	2'	warm season, bunchgrass
<i>Ceanothus greggii</i>	desert ceanothus	shrub	3-5'	fragrant white flowers
<i>Cercocarpus ssp.</i>	mountain mahogany	shrub	8'	evergreen, featherlike seeds
<i>Echinocactus ssp.</i>	hedgehog cactus	cactus	1'	low succulent, colorful flowers
<i>Eriogonum wrightii</i>	shrubby buckwheat	subshrub	1.5'	wildlife food, white flowers
<i>Forestiera neomexicana</i>	desert olive	shrub	10-20'	deciduous, black fruits
<i>Garrya wrightii</i>	Wright silktassel	shrub	8'	gray-green foliage, purple fruits
<i>Glandularia wrightii</i>	Wright verbena	forb	1'	perennial wildflower
<i>Gutierrezia sarothrae</i>	broom snakeweed	subshrub	1.5'	yellow flowers, birds eat seeds
<i>Opuntia spp.</i>	prickly pear cactus	cactus	1-6'	flowers & fruits, erosion control
<i>Penstemon spp.</i>	penstemons	forb	2-3'	perennial flower, hummingbirds
<i>Purshia mexicana</i>	cliffrose	shrub	6'	fragrant flowers, erosion control
<i>Quercus arizonica</i>	Arizona white oak	tree	60'	summer deciduous, wildlife food
<i>Quercus emoryi</i>	Emory oak	tree	50'	summer deciduous, wildlife food
<i>Quercus turbinella</i>	shrub live oak	shrub	10'	summer deciduous, wildlife food
<i>Rhamnus crocea</i>	hollyleaf buckthorn	shrub	15'	red fruits, requires little pruning
<i>Rhus ovata</i>	sugar sumac	shrub	15'	evergreen, cream flowers
<i>Rhus trilobata</i>	Skunkbush sumac	shrub	6'	deciduous, red fruits
<i>Yucca baccata</i>	banana yucca	succulent	3-4'	white flowers, fleshy fruits

By simply reducing the number of plants through removal and thinning, remaining plants will have proportionally more access to natural precipitation and water applied through irrigation.

In addition, the re-sprouting ability of many chaparral shrubs is a fire adaptation that allows these plants to recover more quickly from wildfire and saves the homeowner time and money in replanting. This characteristic can be used to advantage in the creation of survivable space. Many of Arizona's interior chaparral species respond favorably to gradual rejuvenation pruning: the removal of the most mature stems at ground level on a yearly basis. Dead wood should also be removed during the pruning process. Here, new productive stems will replace older, decadent wood. This method allows the plant to remain attractive while also reducing hazardous fuels. Mountain mahogany, shrub live oak, silktassel, and skunkbush are some Arizona interior chaparral species that respond favorably to gradual rejuvenation pruning. *Topping* (i.e. cutting a stem in a random location to decrease its height) is not a desirable pruning practice and should be avoided.

Manzanita often retains large amounts of fine dead wood and does not usually respond positively to gradual rejuvenation pruning. Large specimens of manzanita can be pruned up slightly off the ground with some finer branches removed and isolated from any adjoining plants to create survivable space. All dead wood should be regularly removed. Heavily pruned manzanita can be susceptible to dieback from sun exposure and such work is best done in stages. Leaving larger groupings of manzanita in place can reduce the negative effects of excessive exposure to sun and wind.

Survivable Space Zoning

The area around the home should be viewed in terms of three survivable space zones. In chaparral, these zones will generally be wider than those in other ecosystems. Zone 1 is a setback area within 30 feet of the house (measured from the footprint of the structure or any attached structures such as a deck) and often requires intensive fuel reduction. Zone 1 can require year-round maintenance and may require more frequent irrigation depending on plants species present. Native interior chaparral plants should be largely, if not completely, removed from zone 1. Resprouting chaparral species can be permanently removed from zone 1 by digging out root crowns. On well-established plants, this can be more easily accomplished using a cut stump application of an appropriate herbicide (Schalau 2006). Because of their flammability, resinous trees and shrubs such as pines, junipers, cypresses and eucalyptus should not be present in this zone.

Zone 2 is a 30-100 foot greenbelt zone of moderate fuel reduction, with seasonal maintenance and occasional irrigation as needed. The size of Zone 2 is determined by the slope of the home site – the steeper the slope, the faster and more readily a fire will move uphill and thus the

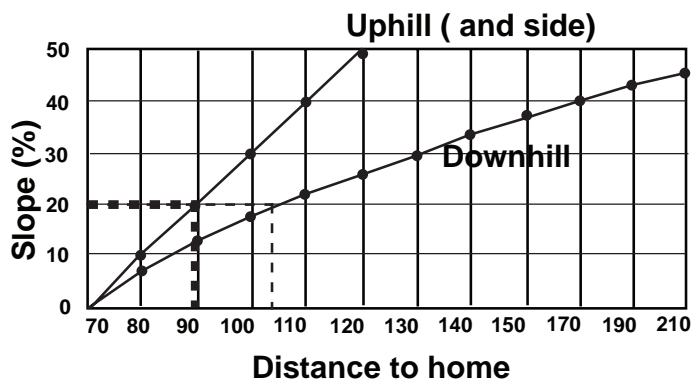


Figure 2. This chart indicates the minimum dimensions for survivable space from the home to the outer edge of Zone 2. For example, if your home is situated on a 20 percent slope, the minimum dimensions would be 90 feet uphill and to the sides of the home and 104 feet downhill from the home.

greater distance this zone must be extended (see Figure 2 for determining percent slope in Zone 2). The aim is to reduce fire intensity and fuel volume by removing dead plants, pruning fine dead branches, thinning out native shrubs and controlling weeds. The primary goal is to break up the continuity of fuels and minimize the spread of fire by thinning out overly dense shrubs and creating islands of vegetation that can be more easily maintained. A general rule of thumb is to maintain a distance of separation between chaparral islands equal to the average diameter of the island. For example, an island of chaparral 8 feet across should have 8 feet of clearance around it. Islands of chaparral plants in zone 2 should be no larger than 10-12 feet across. Heights of chaparral shrubs should be maintained between 4-6 feet using properly placed thinning cuts and/or gradual rejuvenation techniques described above. Local rules may vary and the ultimate authority for chaparral island spacing in Zone 2 is your local fire department.

In Zone 2, grasses and other fine fuels that can carry fire into the crowns of shrubs need to be managed through periodic mowing. Annual grasses and weeds should also be managed with the goal of replacement with perennial grasses. It is important, however, not to remove too much of the native vegetation. Doing so can expose the soil surface not only to increased erosion but to the sun and wind, raising soil temperatures and placing additional stress on remaining plants. Such problems can be avoided by performing the work in stages. Another way to protect the soil surface is to chip all cut vegetation on site and to use the chips as mulch, spreading around to a depth of 2-3 inches (check with local fire codes) avoiding the area around the trunks of trees and shrubs. Such a mulch layer can also help to conserve soil moisture while suppressing the invasion of non-native weeds. Because of the large amount of air space between chip particles, however, they could eventually help to spread fire to flammable structures or plants and thus should not be used in Zone 1 (Rogstad et al. 2007). Figures 3 and 4 show before and after survivable space treatments in interior chaparral near Peeples Valley, AZ.



Figure 3. Arizona interior chaparral before survivable space treatment.



Figure 4. Arizona interior chaparral after survivable space treatment showing small groupings of plants and chipped material used as mulch.

Zone 3 is a 100-200 foot managed wildland or thinning area, with periodic maintenance to further reduce fuel volume and continuity as well as to improve the health of the stand by removing insect-damaged, diseased or low-vigor plants. Chipping on site is also recommended here.

Summary

Interior chaparral is a major component of Arizona's wildlands, both as pure stands and where it mixes with ponderosa pine and pinyon-juniper vegetation types. Arizona interior chaparral is often misunderstood and maligned as "worthless shrub land" or just plain "brush." Creating survivable space in Arizona's interior chaparral will significantly reduce wildfire risk while also enhancing the beauty of a home and conserve water in the landscape. By applying the concepts discussed above, homeowners can create effective and visually appealing survivable space in Arizona's interior chaparral.

Literature Cited

- Bennett, Peter S., M.R. Kunzmann, and L.A. Graham. 1999. Descriptions of Arizona Vegetation Represented on the Gap Vegetation Map. Biological Resources Division, U.S. Geological Survey.
- Bolander, Donald H. 1982. Chaparral in Arizona. *Gen. Tech. Rep. PSW-58*. Berkeley: Pacific Southwest Forest and Range Experiment Station, Forest Service, USDA.
- Brooks, Matthew L., T.C. Esque, and T. Duck. 2003. Fuels and Fire Regimes in Creosotebush, Blackbrush, and Interior Chaparral Shrublands. Report for the Southern Utah Demonstration Fuels Project, United States Department of Agriculture, Forest Service, Rocky Mountain Research Station.
- Carmichael, R.S., O.D. Knipe, C.P. Pase and W.W. Brady. 1978. Arizona Chaparral: Plant Associations and Ecology. Res. Pap. RM-202. Rocky Mt. Forest and Range Experiment Station, Forest Service, USDA, Fort Collins, CO
- Debano, Leonard F. 1989. Effects of Fire on Chaparral Soils in Arizona and California and Postfire Management Implications. *USDA Forest Service Tech. Rep. PSW-109*.
- Halsey, Richard W. 2005. Fire, Chaparral, and Survival in Southern California. San Diego: Sunbelt Publications.
- Huebner, Cynthia D., J. L. Vankat, and W. H. Renwick. 1999. Change in the vegetation mosaic of central Arizona USA between 1940 and 1989. *Plant Ecology*. 144: Pp. 83-91.
- International Wildland-Urban Interface Code. 2006. International Code Council. p. 39. "Characteristics of Fire-Resistive Vegetation."
- Keeley, Jon E. and Frank W. Davis. 2000. Chaparral. Pp. 203-253, in *North American Terrestrial Vegetation*, Second Edition, by Michael G. Barbour and William Dwight Billings. (eds.). Cambridge (U.K.): Cambridge University Press.
- Pase, C. and D. Brown. 1994. Interior Chaparral. In: Brown, D., ed. *Biotic Communities. Southwestern United States and Northwestern Mexico*. Salt Lake City: University of Utah Press. Pp. 95-99.
- Radke, Klaus W.H. 2004. A Homeowner's Guide to Fire and Watershed Management at The Chaparral/Urban Interface. San Diego: Water Department, San Diego Fire Recovery Network and the Conservation Action Committee.
- Reid, Fiona. 2000. *A Trail Through Scrub Oak. A Natural History of the Interior Chaparral*. Prescott: Prescott College Master's Thesis.
- Rogstad, Alix, T. DeGomez, C. Hayes, J. Schalaus, and J. Kelly. 2007. Comparing the Ignitability of Mulch Materials for a Firewise Landscape. University of Arizona, College of Agriculture and Life Sciences Bulletin, az 1440. Tucson, Arizona. (<http://cals.arizona.edu/pubs/natresources/az1440.pdf>).

Schalau, J. 2006. Cut Stump Application of Herbicides to Manage Woody Vegetation. . University of Arizona, College of Agriculture and Life Sciences Bulletin, az 1401. Tucson, Arizona. (<http://cals.arizona.edu/pubs/garden/az1401.pdf>).

Sneed, Paul, Lisa Floyd-Hanna, and David Hanna. 2002. Final Report. Prescott Basin Fire History Project for: Prescott National Forest. Prescott: Prescott College.

Yavapai Communities Wildfire Protection Plan. November 2004. A Collaborative Communities Effort Directed and Monitored by Interagency Fire and Emergency Group of the Prescott Area Wildland/Urban Interface Commission.

Map Acknowledgement and Disclaimer

The Arizona Interior Chaparral map was created by Jeffrey Whitham of Yavapai County GIS on 5/11/2010. Yavapai County GIS may be contacted at 928-771-3169. Yavapai County assumes no responsibility for any errors, omissions, and/or inaccuracies in this map. The digital representation of the map's Interior Chaparral coverage from Brown and Lowe's paper map was developed by The Nature Conservancy in Arizona in 2004.



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