

Chaparral in Arizona¹

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The State of Arizona, like California, has a large area of Mediterranean-type ecosystems, or chaparral as it is commonly called. There are, however, some important differences between the two States. The primary differences are in climate, size or average height of the brush plants, and the composition of the understory grasses and forbs. One other very important difference is in the relationship of population centers to the type.

The previous paper by Mr. Tyrrel has presented a brief discussion on the California chaparral. My paper will attempt to present comparable information for Arizona.

DESCRIPTION OF ARIZONA CHAPARRAL

The chaparral type in Arizona is found in a discontinuous band across the central part of the State which extends from northwest to southeast. Depending on the criteria used to classify the type, there are from 1.2 million to 2.4 million hectares in the type; 1.2 million hectares is considered close when the transitions into the Pinyon and Juniper woodland and the desert shrub are excluded.

The chaparral type is found under the following ownership:

Federal Government	Percent
Forest Service, USDA	52
Bureau of Land Management, USDI	15
Other Federal	2
State of Arizona	15
Private	12
Indian	<u>4</u>
TOTAL =	100

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Abstract: Arizona has about 1.2 million hectares of a low-growing brushland known as chaparral. Most of the brush plants are prolific crown or root sprouters and resist fire or heavy use by grazing. Over 100 years of man's activities have not greatly modified the type with the exception of the impact of grazing on the herbaceous component. Initial research was aimed at grazing and erosion problems and current research is stressing the feasibility of increasing water yields. Mechanical equipment, fire, herbicides, and seeding are employed to modify the type in order to increase water yield, forage and recreation opportunities.

The shrub plants in the Arizona chaparral have much in common with those found in California. They are moderately-deep to deep-rooted evergreen shrubs. Most species are prolific crown or root sprouters. A few non-sprouters produce abundant seed which germinates following heat scarification. Except on the best sites, Arizona's chaparral tends to be of somewhat lower growth form and the stand more open than its California counterpart. Primary shrub species in Arizona include

Shrub live oak (Quercus turbinella)
Manzanita (Arctostaphylos spp.)
Desert ceanothus (Ceanothus greggi)
Mountain mahogany (Cercocarpus spp.)
Silktassel (Garrya spp.)

Where shrub canopy is open, grasses and forbs are often moderately dense. On areas which have not been subjected to heavy, destructive grazing, perennial grasses such as sideoats grama (Bouteloua curtipendula) are common. On areas which have been heavily grazed, annual grasses such as red brome (Bromus rubens) are common. The presence of perennial grasses and the more open canopy is an important difference from the California type.

The topography where the Arizona chaparral occurs is highly variable. Most of the type is found on mountainous areas, much of it on extremely rough, steep terrain, and a relatively small amount on flat sites. It occurs between 900 and 1,800 meters elevation on all aspects.

Typical soils are moderately deep, coarse textured, and poorly developed. Most of the soil depth is in the C horizon. Soil texture varies from cobbly and gravelly loamy sand to gravelly loam. Parent materials include deeply weathered and fractured granite, schist, diabase and sandstone. Granites are found on more than half the total chaparral area, while diabase and sandstone comprise less than 10 percent.

The Arizona chaparral zone receives between 400 and 600 mm. of precipitation a year. About 55 percent comes as rain and snow between November and April, and 35 percent during the July to

September season, primarily as thunderstorms. The summer rainy season, which California does not have, is the primary reason for the perennial grasses that occur in the Arizona chaparral.

Mean monthly temperatures vary from less than 5°C in January to more than 27°C in July. Relative humidity is low with evaporation occurring at rates up to 2,100 mm. per year.

Wind generally is out of the southwest. The most windy period is May and June when average daily wind speeds are between 16 and 19 kilometers per hour. This coincides with the driest and warmest time of year. June is considered the most critical month for disastrous wildfires.

HISTORY

Arizona was inhabited for thousands of years by the native Indians before the Europeans arrived. The Indians made little impact on the chaparral type through their hunting, gathering of native plant fruits, nuts, and other material or through the simple agricultural practices they employed. Early-day explorers and trappers also made little impact.

A few years after the 1849 California gold rush had peaked, prospectors began to move eastward from California and elsewhere to the Arizona territory. In the early 1860's there were a few mining camps established within or near the Arizona chaparral. Army troops, prospectors, traders, trappers and others related stories of the fine grasses and ideal climate. Early in the 1870's a few cattlemen began to bring small herds of stock into the area. By 1890 there were a number of cattle and a few bands of sheep grazing on and near the chaparral country. Livestock numbers then increased rapidly and are believed to have reached a peak by 1900.

The first towns in or near the chaparral, such as Globe and Prescott, were settled by miners. A crude road and trail transportation system evolved to support these towns and mines. The wildlife was used by these early settlers to supplement their food supply. Fire in the chaparral occurred from time to time as it always had. Although man-caused fires increased, lightning-caused fires still accounted for most of the fires.

Early-day reports indicate that the chaparral was more open than it is today. The heavy, year-long grazing depleted the perennial grasses. Introduced annual grasses and forbs, typical of the Mediterranean area, largely replaced the native perennials that once grew in openings and the understory plants. The brush also has gotten thicker, influenced by fire suppression.

PRESENT USES

Today mining and cattle ranching continue to be important activities in the chaparral. The use

of wildlife has shifted from subsistence hunting to recreational hunting. Deer and quail are the most sought game species. Road and trail access, with few exceptions, is still rather primitive. The towns have grown, but are still small by Southern California standards. Growth is attributed to a number of factors such as retirement, tourism, light industry and local government. Most recently, population is increasing rapidly.

There is one very important difference between the California and Arizona chaparral area as it relates to the pattern of settlement or the urban-wildland interface. Where California has extensive home building within the chaparral, there are few homes built within the type in Arizona. Where California has large metropolitan areas developed on the flats immediately below the steep brush covered hillsides, Arizona does not. Most of the land below Arizona's chaparral is undeveloped desert or semi-desert. The wildfires that denude the brushy hillsides set the stage for flooding. California has a higher and more concentrated rainfall than Arizona. This fact combined with the location of the developed areas in California, accounts for the major differences in damage from fire and subsequent flooding in California compared to Arizona.

RESEARCH

Early research by the USDA Forest Service was aimed primarily at grazing and erosion problems. Starting in the 1950's the research was expanded to study the feasibility of increasing water yields through modification of the chaparral. Research sites were established on the Tonto and Prescott National Forests. The sites represented conditions with different soils, climate and plant density and composition.

Most of the more recent research has been related to improving water yield. This research shows that the mean annual water yield from Arizona chaparral varies from less than 3 mm. per year on drier sites to 60 mm. on the wetter areas. Dry years produce little water, while wet years, particularly wet winters, may yield 20 percent of precipitation or more. A typical chaparral site with an average of 550 mm. of precipitation will yield 30 mm.

Water yields can be substantially increased by removing the deep-rooted shrubs and replacing them with shallow-rooted grasses and forbs that use less water. For example, that typical chaparral site with 550 mm. of annual precipitation will yield an on-site increase of 95 mm. following brush removal.

The effectiveness, costs, and effects on the environment which result from the different brush treatment methods have been a part of the research. Mechanical, chemical, fire and biological (grazing with goats) methods of

removing brush have all been studied. The sprouting nature of the chaparral brush plants, and the steep, rocky nature of most of the type has made the use of herbicides a key element of past and current type conversion projects. Research to find an effective, safe herbicide continues to be an important part of the scientists task in developing a prescription for chaparral management.

RECENT PAST AND CURRENT MANAGEMENT

Land managers and owners started putting research findings to practical use on a small scale as the information became available. Serious efforts to convert chaparral sites to grass started in the 1960's. Relatively rock-free sites on gentle terrain were selected for root-plowing on the Prescott National Forest. The root-plow is a blade which is pulled by a tractor and cuts the brush roots off about 300 mm. underground. Grass seed is broadcast onto the newly disturbed area during the plowing operation. On the Prescott this operation increased grazing capacity for cattle by one-fourth of an animal unit month per acre.

The Tonto National Forest attempted to improve forage supplies and water yields through the use of prescribed fire and the use of herbicides. This method was successful when the use of herbicides was continued until the brush was removed. The phenoxy group (2,4-D; 2,4,5,-T; and silvex) were initially used but use was reduced after these herbicides became controversial. Soil active herbicides such as Fenuron and Picloram were also used to a limited extent.

Prescribed fire has been used to rejuvenate the brushland sites and temporarily improve the forage supply for both wildlife and livestock. This treatment results in improved range productivity for up to 10 years. The Prescott National Forest has used a roller-chopping implement to accomplish the same purpose. Grass and forb seed are also broadcast into the disturbed site. This treatment does not result in a type conversion but does introduce a more desirable forage which is available for a few years until the brush once again dominates the site.

Based on past research and land management practices, it is clear that the Arizona chaparral can produce more water, forage, and recreation than is currently produced. This increased production can be obtained by altering the chaparral site by various means. In 1978 a site was selected on the Prescott National Forest for a pilot application project. The current state-of-the-art would be applied to demonstrate how the chaparral type could be economically treated to improve production.

Structures and instruments have been installed at the Battle Flat demonstration area during the past two years to measure water and sediment yields and get water quality and climatic information. Special studies to obtain information on the geology, soils, vegetation, and wildlife have also been conducted. A proposed treatment plan is now being developed. In about 3 or 4 years, after the baseline pretreatment information is obtained, about 560 hectares of the 920-hectare watershed will be treated to convert the site from brush to grass and forbs. A brush-grass mosaic will be created. At this time it appears that a combination of fire, soil active herbicides, and broadcast seeding will be used to accomplish the type conversion in the most economical way. An adjacent 640-hectare watershed has also been instrumented to be used as a control for the treated watershed.

When the Battle Flat project has been completed, we will have a much better basis to predict what additional benefits can be obtained from the Arizona chaparral. It should be kept in mind that only a small portion of the 1.2 million hectares of chaparral can be treated. Some of the type is in wilderness and legally cannot be converted. Archeological sites are found on other areas and must be avoided. Some of the lower elevation, low rainfall sites have such a low potential for increased production that it is not economical to treat them. Other sites are so steep that mass soil movement would result if the brush cover were removed. The remaining, suitable area should be only partly converted to grass in order to maintain wildlife habitat and minimize the visual impacts. It has been estimated that only between 15 and 20 percent of the chaparral type on National Forest System lands in Arizona would actually ever be converted to grassland. The Bureau of Land Management, State and private lands are generally at lower elevation, less mountainous and drier than the National Forest segment. A somewhat higher percent may be suitable for conversion; however, herbage and water yields per acre would be less from most of these lands.

CONCLUSION

There are about 1.2 million hectares of chaparral in Arizona. The type has not been greatly modified by man's activities to date, with the exception of the impact of grazing on the herbaceous component. Planned site modifications have been very limited, and have been mostly confined to the better sites and to research-related activities.

Management direction on the National Forests has been to gain more information on the techniques and effects of treatment, and to apply this known information on a small scale. The fact that the chaparral type has the potential

to produce more water, forage and recreation, primarily as hunting, is well known. The biggest restraints against site modification have been economics and the need for an effective, safe herbicide. I believe that we now have or will soon have an effective herbicide. High costs are still a problem.

Future management direction could abruptly change should new, more economical ways be found to harvest and process this woody material into such things as fuel or processed livestock forage for off-site use. Until such time as these new uses are found, I see a continuation of the past trend, i.e., slowly find new and better ways to convert or modify the site and implement these techniques as they become economical.