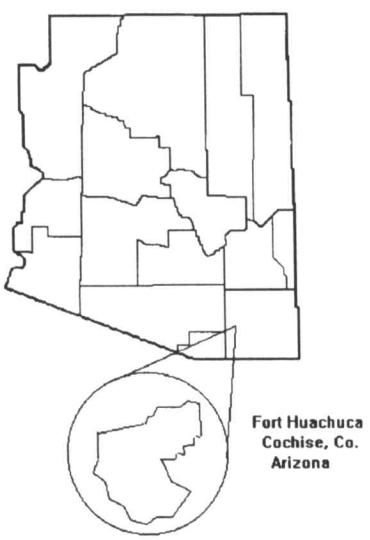
Fire Effects On Southeastern Arizona Plains Grasslands

Dan Robinett

Wildfires played an important role in shaping desert and plains grasslands in southeastern Arizona (Pase 1977). Lightening in early summer storms or Indians using fire to hunt, clean up favored campsites or accidental starts from their campfires, were common prior to the turn of the century (Bahre 1985 and Leopold 1924).

Natural fire frequencies for grasslands in southeastern Arizona have been estimated at between 10 and 20 years (Wright 1980). A variety of cultural and environmental impacts since Anglo settlement have greatly reduced the frequency and spread of wildfires (Bahre 1991). Over the last one hundred years very little of Arizona's grasslands have burned.

One of the few areas where fires have burned frequently is Fort Huachuca in Cochise Country. Fort Huachuca is a US Army installation established in 1877 as an outpost in the southwest to quell Apache raiding. In 1916 it played an important part in General Pershing's punitive expedition into Mexico after Pancho Villa (Wallmo 1951). Since then the 72,000 acre military reservation has grown to become the headquarters of the US Army Communications Command. It continues to accommodate troop training from regular and National Guard units in Arizona and from around the country. Several firing ranges and their associated impact areas occur on the 40,000 acre main post. These ranges are for live fire from troops and tanks. Wildfires caused by tracers are common each year.



This study was done in 1992 to help determine how frequently fires can burn the major range sites without long term negative impacts to the soils or plant communities. This study gives some insight into the adaptation of the major species to fire.

The grasslands around these training ranges are some of the finest in Arizona. Ecological condition is good to excellent in most areas. Although they have a long history of grazing in the past, most areas have not been grazed except by wildlife since the mid 1960's when the last of a small buffalo herd was removed from the post (Wallmo 1951).

Elevations range from 4,800 to 5,400 feet in this area. Average annual precipitation is 16 inches (NOAA 1992). Precipitation pattern produce two growing seasons. Cool season moisture tends to be frontal storms with moisture supplies from the Pacific and summer rainfall comes as convective storms of high intensity and short duration from moisture supplies originating in the Gulf of Mexico.

Fire history data has been kept on Post since 1977. The extent at each burn was delineated on a training range map along with the time, dates and a brief explanation of how it started and how it burned. Using this data and a recent soil and range survey of the Post, sampling areas were selected (USDA 1992).

A combination of three different fire frequencies on the four major range sites in the area were evaluated. The three burn frequencies are; one burn since 1977, two or three times since 1977, and five or six burns since 1977. All fires were in the hot season of May through July. The one burn areas had from 6 to 8 years since the burn; the two and three burn areas had from 4 to 6 years since their last fire; and the last burn on the five and six areas was in 1990 or 1991.

The four range sites sampled included; Loamy upland, Sandy loam upland, Loamy Hills, and Granitic hills (USDA 1988).

The loamy upland range site is characterized by deep soils classified as ustollic haplargids and haplustalfs (USDA 1992). They have thin (1 to 3 inches), coarse textured surfaces over clayey subsoil's. Slopes are 1 to 5%. The native potential plant community is an open grassland dominated by warm season mid-grasses.

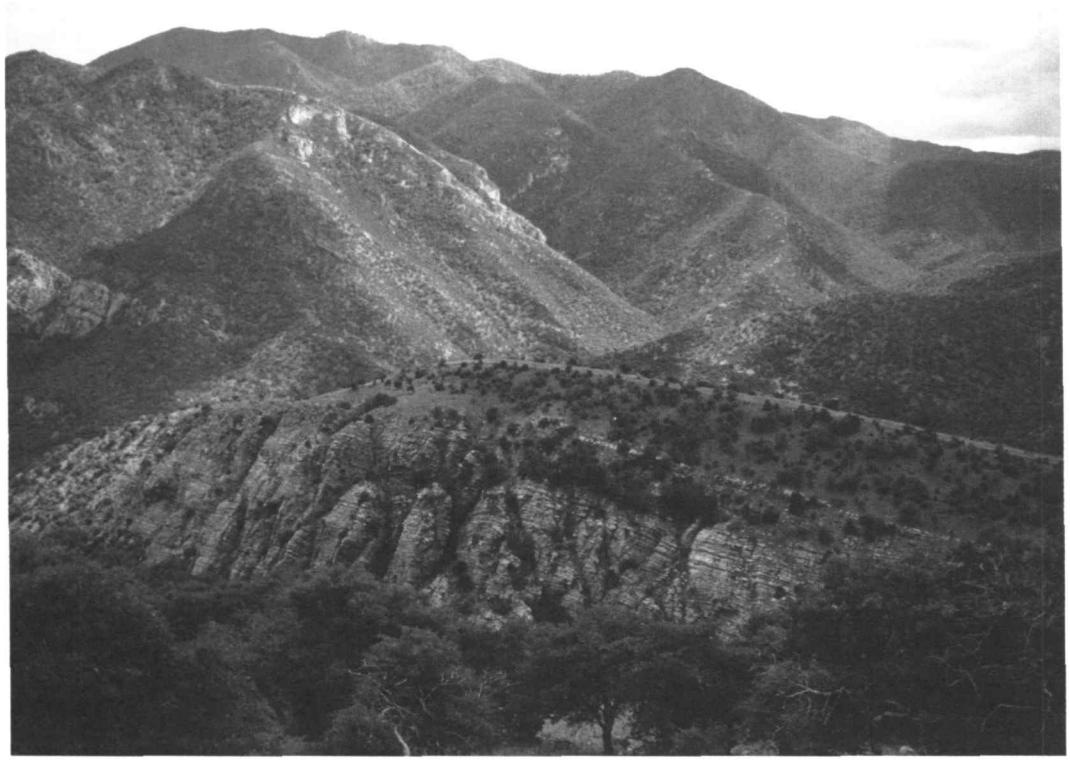
The sandyloam upland range site is characterized by similar soils but with a thicker (4 to 10 inches), coarse textured surface. Slopes are 1 to 3% and the potential native plant community is similar to Loamy upland except production is higher.

The loamy hills range site has deep soils classified as ustollic paleargids or haplargids and argiustolls and paleustalfs (USDA 1992). They have thick (8 to 16 inches), very cobbly and gravelly, dark colored, sandylaom surfaces over dense clay subsoil's. Slopes are from 10 to 35%. The potential native plant community is a grassland with a moderate percentage of low shrubs and succulents.

The granitic hills range site has shallow soils classified as

Editor's Note:

The author is Area Range Conservationist, USDA-SCS, Tucson, Arizona.



Huachuca Mountains, Ft. Huachuca-Cochise Co., Arizona.

lithic haplustolls and lithic argiustolls (USDA 1992). They have very cobbly and gravelly surfaces, are dark colored loams and sandyloams over slightly weathered granite bedrock. Slopes are from 20 to 50%. The native potential plant community is savannah with a 10 to 25% canopy of Mexican live oaks and an understory of warm season midgrasses, perennial forbs and low shrubs.

One sampling area was selected for each of the range site-burn frequency combinations. Site selection was heavily biased to represent what appeared to be average conditions for the area being studied. This was not a research effort. It was an investigation designed to produce some information about fire effects in a short period of time with a reasonable amount of effort.

Transects used different techniques to measure different attributes of the plant community. Basal, rock and gravel cover were measured as line intercept along three 100 foot steel tapes. Canopy cover was measured as shaded line intercept along the steel tapes at mid day. Frequency data was collected using a 40 square centimeter quadrat in a 100 plot transect. Plant species composition data was determined using the same quadrat size and transect and the Dry Weight Rank method (Ruyle 1988). Plant production data also used the same transect and quadrat size and the Comparative Yield method (Ruyle 1988).

Loamy Upland

This site appears to be the most affected by repeated fires. This site naturally produces a lot of runoff in the summer rainy season. The thin, coarse textured surface cannot capture all of the larger rainfall events. If the surface is not protected by grass and/or gravel cover, accelerated erosion can begin. Basal cover, annual herbage production and number of plant species all declined as fire frequency increased. (Figure 1).

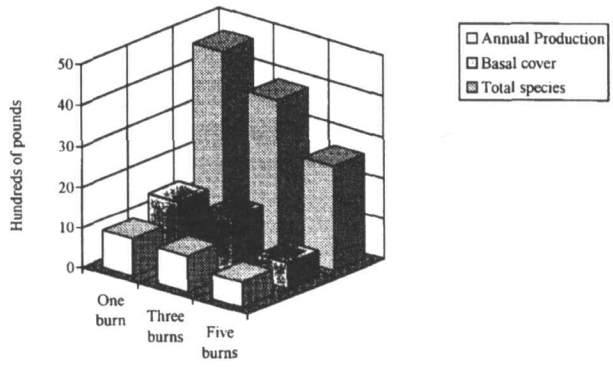


Fig. 1. *Cover, production and total species on Loamy Upland range site*

Basal cover on the one burn and three burn sites was about 15% and no erosion was evident. The site that had burned five times in the last 15 years had only 6.5% basal

Loamy Upland Range Site-five burn area with soil erosion.

cover and visible signs of accelerated erosion. As this site looses its surface horizon to water erosion it becomes less effective in capturing and storing intense summer rainfall. With enough soil loss, the potential productivity declines and the site can no longer support its natural plant community.

Another observation on this site was that even with 5 fires in the last 15 years there was little or no mortality of mature velvet mesquite trees. It appears that, at these elevations (4,800 ft.) and with 16 inches of annual precipitation, established mesquite trees can survive a very frequent summer fire regime.

Due to the delicate nature of this site, a recommended fire free interval would be a minimum of 6 or 7 years. This would allow adequate recovery of the grass cover and minimize soil erosion. An ideal interval would be 10 to 15 years.

Sandyloam Upland

This site, with thick coarse textured surfaces, produces very little runoff in the summer rainy season. Even with repeated fires this site showed no signs of accelerated erosion. Basal cover was nearly the same for all three burn frequencies. This site is the one most favored by Lehmann lovegrass in southeastern Arizona. Lehmann lovegrass is a warm season, perennial bunchgrass, introduced into this area from southern Africa in the 1930's. Since then it has steadily spread across southeastern Arizona developing into nearly monotypic stands on this range site.

Grazing, fire and drought have been implicated in the invasion of native grasslands by this species (Ogden 1988). The opportunistic nature of this species to respond to openings in native plant communities caused by fire (Cable 1965, 1971) and drought (Robinett 1992) has been documented in this region. Frequency of Lehmann lovegrass went from 9% on the one burn site to 96% on the five burn site. This was at the expense of sideoats and black gramas and plains lovegrass (Figure 2). Although annual production and cover remained nearly the same among the three

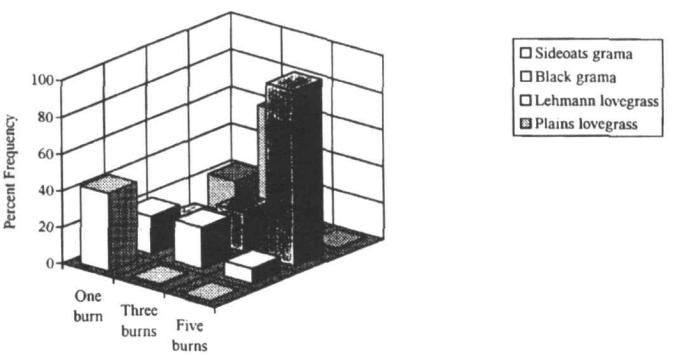


Fig. 2 - *Frequency of grass species on Sandyloam Upland range site*

burn frequencies, total number of plant species declined from 47 on the one burn area to 29 on the five burn area dominated by Lehmann lovegrass.

The ability of mature velvet mesquite trees to withstand frequent fires was noted again on this site. Another observation was that there was considerable decadence of native grass species; sideoats grama, cane bluestem and plains lovegrass in the one burn area (fire in 1984). Correspondingly there was a much higher percentage of annual forbs like goldeneye and aster in the plant community on the one burn area. This was not noticed in the three burn area (last fire in 1988). Regular disturbance, fire or grazing may be needed on this site if the objective is to keep mid grass stands healthy and vigorous. A recommended fire free interval on native stands would be a minimum of 4 to 5 years. An ideal interval would be about 10 years. The presence of Lehmann lovegrass on or near areas of this site poses a dilemma in fire management. With very frequent fire regime the plant community can become a monotype of Lehmann lovegrass. Soil protection will be more than adequate and for some uses like intensive military training this plant community may even be desirable.

Loamy Hills

Loamy Upland Range Site five burn area showing velvet mesquite.

This site has thick coarse textured surfaces, well protected by covers of stones, cobbles and gravels. Even on steep slopes, sites with frequent fires showed no sign of erosion. Basal cover, total number of species and production were the same for all three burn frequencies. Differences in species composition are within the range of variability for major grass groups in the potential plant community on this site (Table 1). Midgrasses like sideoats grama, Arizona cottontop, tanglehead, cane bluestem and green sprangletop are included in a group at 20 to 30 percent on the published range site description (USDA 1988). Range condition scores on the three areas ranged from 70 to 72.

Table 1. Species composition on Loamy Hills range site.

	One burn	Three burns	Five burns
Plain lovegrass	22	24	40
Lehmann lovegrass	0	1	2
Tanglehead	32	6	3
Sideoats grama	6	13	8
Slender grama	1	3	10
Cane beardgrass	6	8	2
Green sprangletop	8	5	4
Fall witchgrass	1	4	10
Threeawns	4	10	3
Arizona cottontop	0	13	1
False mesquite	11	11	16
Palmer agave	4	2	4
Ann. production	2375	2151	2360
Basal cover	15	15.5	16
Cobble cover	14	16	18
Total species	34	37	32

Surface rock fragments on this site not only protect the soil from accelerated erosion but also appear to protect the bases of perennial mid grasses from damage by hot season fires.

This site is a primary habitat for Palmer agave in southeastern Arizona. The blossoms of this agave are a major food source for a nectar-feeding bat which is listed as a endangered species. The lesser long-nosed bat uses saguaro and organpipe flowers in May and June and agave flowers in July and August during its migration from tropical Mexico to Arizona each year. Seedling agave plants are easily killed by hot season fires while older plants appear fire tolerant. One visible difference in the five burn plot on this site is that there are no carcasses of dead agave plants left on the area. Palmer agave lives 15 to 25 years, flowers and dies. The large heavy seeds fall from the panicle straight down and a high proportion of seedling establishment occurs around the base of the dead adult carcass. Frequent fires consume the dry dead plants and intense heating kills any seedlings growing nearby.

Although this site and its herbaceous plant community appear to be very resilient to repeated fires, the recommended fire free interval where Palmer agave is present would be at least 10 years. This interval would allow seedling agave to establish around the dead adults and

achieve enough size to survive burning. It would also allow enough time for the carcass of the parent to decompose reducing the fuel loads around young plants.

Again it was noted that there was considerable decadence among midgrasses like tanglehead, plains lovegrasses and sideoats grama on the one burn area (burn in 1984). This was not noted in the other burn areas. If plant community objectives are to maintain vigorous stands of native grasses on this site, regular disturbance by fire or grazing should be applied. If plant community objectives are to allow for a higher percentage of annual forbs like goldeneye and cudweed on the site, it should be protected from disturbance for longer periods of time.

Grantic Hills

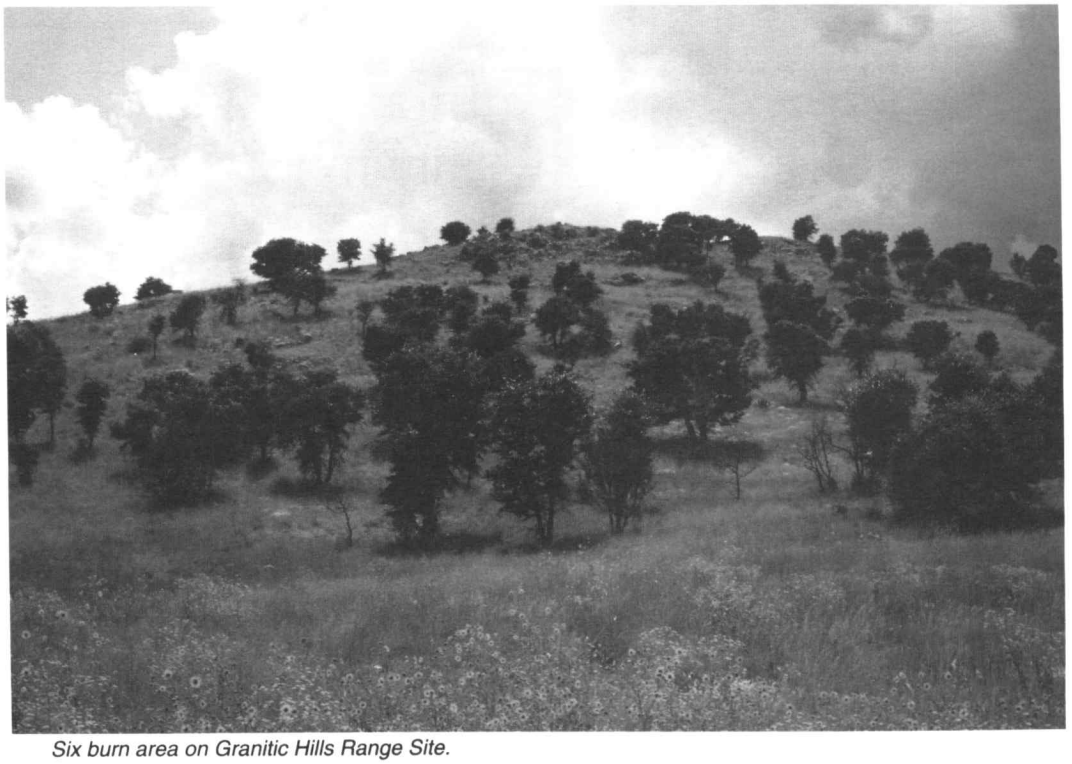
This site has shallow, coarse textured soils well protected by covers of stones, cobbles and gravels. Even on very steep slopes the only area showing signs of accelerated erosion was the 6 burn hillside. The area with three burns in the last 15 years showed no signs of erosion and illustrates the effectiveness of rock fragments and grass cover in protecting the soil and the remarkable adaptations of dominant grasses like Texas bluestem, plains lovegrass, bullgrass and sideoats grama to frequent fires.

Basal cover, annual production and total number of species were not different between the three areas of this site (Table 2). One visible difference was in the crown canopy of oak species found on the site. The 6 burn area had about half the tree canopy of the 1 burn area. These species of evergreen oak are very fire tolerant and vigorous sprouters but a few dead individuals were present on the 6 burn area and the repeated burning appears to prune the tree canopy and reduce it's lateral extent. As expected shade tolerant understory species like sedges and stolon daisy were much more common in the 1 burn area with double the canopy of the 6 burn area.

Table 2. Species composition on Granitic Hills range site.

	One burn	Three burns	Six burns
Texas bluestem	22	21	19
Plains lovegrass	5	11	16
Beggartick threeawn	24	13	6
Sideoats grama	3	25	4
Bullgrass	0	3	15
Squirreltail	5	0	2
Sedge	16	4	8
Oak species	4	3	2
Wedgeleaf haplopappus	3	0	0
Wild bean	4	1	2
Herbaceous sage	1	8	8
Stoloniferous daisy	6	2	0
Ann. production	938	1214	1098
Three canopy cover	23	13	10
Basal cover	8	12.5	9.5
Rock/cobble cover	16	15	16
Total species	57	51	47

The study plots on this site were all on northern aspects. Observations on southern exposures in this same area indicate that Lehmann lovegrass is invading the native plant communities where fires are frequent. Vehicles driving firebreak roads in this area are the probable mechanism for seed dispersal up the slopes.



Six burn area on Granitic Hills Range Site.

The recommended fire free interval for this site would be a minimum of 5 years. A longer interval of 8 to 10 years would allow for higher canopy covers of oak trees on the site. Protecting areas of this site from fire for very long periods of time can lead to thickening of the tree cover to the point where herbaceous understories are greatly reduced. This appears to have happened in the last hundred years in the mountain ranges nearby where grazing reduces fine fuels and protection from fire occurrs (Humphrey 1987). A comparison of photographs from the 1880's taken on Fort Huachuca in areas which have not burned in the last 30 or 40 years, show a thickening of the tree cover in present day scenes. When areas like this do eventually burn, erosion can be serious because there is insufficient grass cover to hold soils in place. Actions to stop the dispersal of seed Lehmann lovegrass onto these slopes will prevent it from invading areas of this site where fires occur.

The general information resulting from should be of interest to landusers and managers in nearby areas. Allowing fires to burn these plant communities at what is thought to be natural intervals of 10 to 20 years does not appear to diminish resource values or productivity. It may actually be beneficial on many sites to keep ungrazed grasslands vigorous and healthy.

Bibliography

Bahre, C.J. 1985. Wildfire in southeastern Arizona between 1859 and 1890, Desert Plants 7(4):190-194.

Bahre,C.J. 1991. A legacy of change, historic human impact on vegetation in the Arizona borderlands. University of Arizona Press, Tucson, Arizona.

Cable, D.R. 1965. Damage to mesquite, Lehmann lovegrass and black grama by a hot June fire. J. of Range Mange. 18:326-329.

Cable, D.R. 1971. Lehmann Lovegrass on the Santa Rita Experimental Range, 1937-1968. J. of Range Manage. 24:17-21.

Humphrey, Robert R. 1987. 90 years and 535 miles-vegetative changes along the Mexican border. University of New Mexico Press, Albuquerque, New Mexico.

Leopold, Aldo. 1924. Grass, brush and timber fire in southern Arizona. J. of Forestry 22 (6): 1-10.

National Oceanic and Atmospheric Administration, 1992. Weather record for station no. 3120 Fort Huachuaca, Arizona 1901-1992. National Climatic Data Center, Asheville, North Carolina.

Ogden, P.R., G.R. Ruyle and R.W. Rice. 1988. Defoliation patterns of cattle grazing Lehmann lovegrass. App. Agric. Res. 3(4): 177-181.

Pase, Charles P. 1977. The use of fire on Arizona rangelands. Arizona Interagency Range Publication No.4.

Robinett, Dan. 1992. Lehmann lovegrass and drought in southern Arizona. Rangelands, 14(2):100-103.

Ruyle, G.R. 1988. Some methods for monitoring rangelands and other natural area vegeration. University of Arizona, Extension report no. 9043, Tucson, Arizona.

USDA-Soil Conservation Service. 1988. Arizona technical range site descriptions MLRA 41-3.

USDA-Soil Conservation Service 1992. Soil survey of Fort Huachuca, Cochise Co. Arizona, unpublished.

Wallmo, Charles O. 1951. Fort Huachuca wildlife area investigations. Arizona Game and Fish Commission, Wildlife Restoration Division.

Wright, Henry A. 1980. The role and use of fire in the semidesert grass - shrub type. USDA Forest Service Gen. Tech. Report INT - 85.