

## **Prescribed burning in southeastern Arizona grasslands**

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Grasslands occur across southeastern Arizona at elevations from 3300 to over 5000 feet. They occur on a variety of soil types within two different precipitation zones. The lower zone is characterized by lower precipitation (12-16 inches yearly), lower elevations and higher temperatures. Grasslands within this zone are classed as semi-desert are more prone to soil erosion and shrub invasion and less tolerant of fire, continuous grazing and drought.

The upper zone is characterized by a 16-20 inch precipitation regime, higher elevations and lower temperatures. These are classified as plains grasslands, and are more tolerant of fire, grazing drought and other disturbances. They tend to remain open (less shrub invasion) and have not suffered as much from soil erosion.

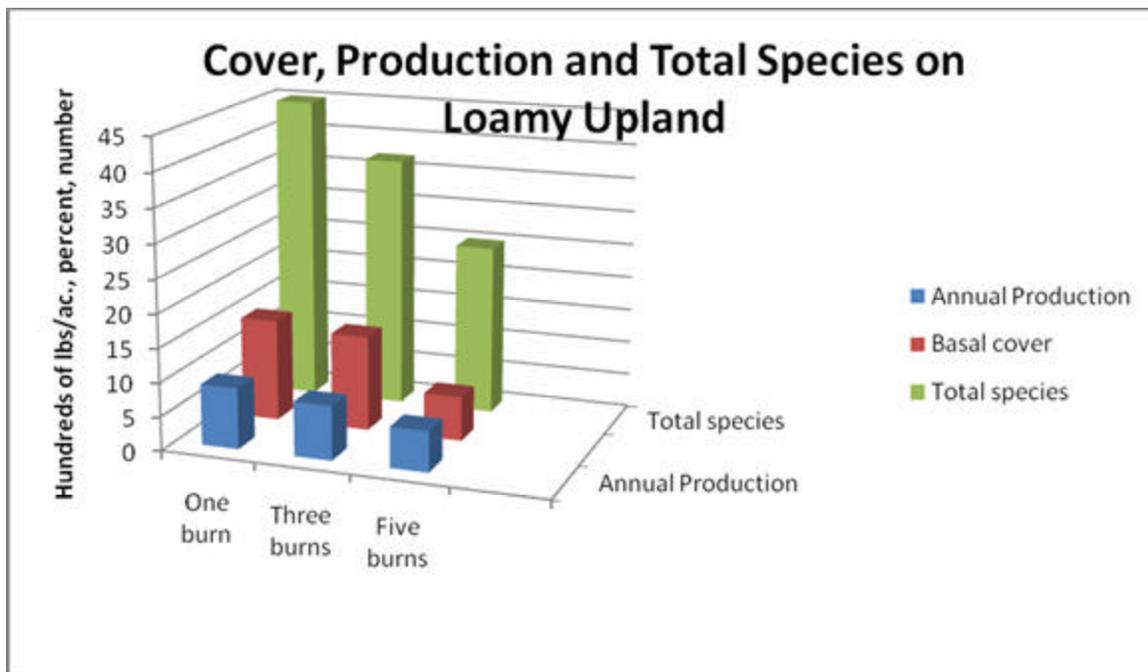
Grasslands in both zones experienced a natural fire regime prior to European settlement. Fires started by lightning or Native Americans burned the mountains and grasslands at various intervals. Many authors suggest a natural fire return interval of once every ten years as a good average for this region (Wright, Abbott, Robinett). As this is impossible to verify in grasslands it is implied as the regime necessary to keep the virgin grasslands shrub free (mesquite) and open like they were in the 1800s when the first Spanish ranchers arrived. Also we do know that fire frequency in the mountain woodlands was more frequent (6-8 year return interval) and that many of these fires would have carried down to the grasslands below (Wright and Bailey).

Natural fires started by lightning in June and July burned under hot and dry conditions just prior to the summer rainy season. Daytime temperatures were high and relative humidity low; good conditions for controlling woody plants and keeping grasslands open. Summer rains in late July would revive perennial grasses and forbs and allow fairly quick recovery from these naturally occurring fires.

Some studies show that periodic fire is important in these grasslands to maintain plant species diversity and productivity (Robinett, Webb). According to Webb,

et al. perennial grass and shrub (*Eriogonum wrightii*) biomass on Fort Huachuca was greater under a moderate fire regime (1-2 fires in fifteen years) than unburned or than a frequent fire regime (1 or more fires in five years). In addition there was a significant increase in total organic carbon (TOC) and phosphorous (PO<sub>4</sub>) in the moderate fire regime while nitrogen (NO<sub>3</sub>) was unchanged compared to unburned sites. All macronutrients were significantly lower in the frequent fire regime (TOC, PO<sub>4</sub> and NO<sub>3</sub>).

Grassland soils vary across southeastern Arizona. Soils with argillic (clayey) horizons are some of the most productive upland grassland sites. Some of these soils have thin surface (A) horizons of sandyloam over the clay. These soils can be negatively affected by frequent fires and are most difficult to manage. One study on Fort Huachuca found that a frequent fire regime (5 fires in 23 years) on Loamy Upland ecological site resulted in lower; basal cover, number of plant species and production of perennial grass (in lbs/ac air dry biomass) than areas that had burned only once or three times during the same period (Robinett).



Invasive species like Lehmann lovegrass has been shown to increase with fires and especially with increasing fire frequency (Robinett, Abbott). Other risks associated with fires in these grasslands include the possibility of increased soil erosion, increased runoff and reduced water quality.

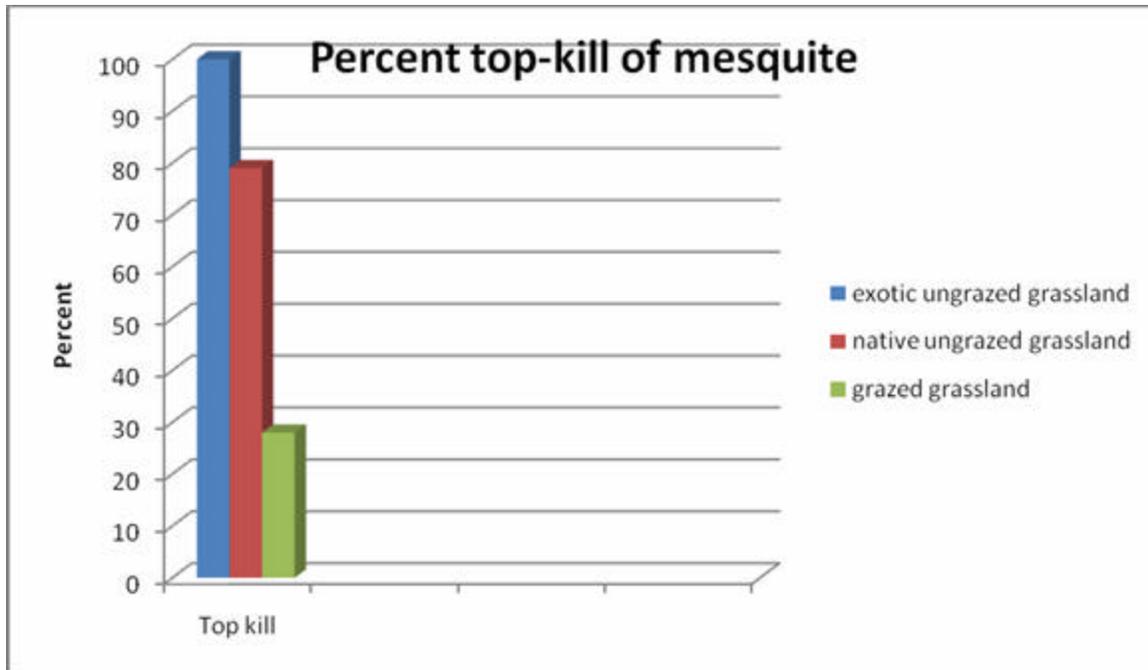
In studies on both the Empire Ranch and the Santa Rita Experimental Range (Emmerich and Cox) it was found that prescribed burning may increase the potential for surface runoff and erosion. The authors, using rainfall simulators, found that within one year there could be a significant increase in surface runoff and erosion after a single burn (one year there was not, the second year there was). After a second burn the following year there was always a significant increase in erosion and surface runoff as compared to the control.

In the same study Emmerich found that there was a significant loss of soil nutrients (nitrogen, potassium, phosphorous) one year after a fire as compared to control plots which were not burned. This loss however was insignificant when compared to the total amount of these nutrients available in the soil even after a second burn.

Prescribed burning has been done in these grasslands to control woody plant invasion. Single fires have not been effective in controlling established mesquite (Abbott, Robinett, Wright and Bailey). Single fires have been shown to be effective in controlling seedling and young mesquite plants with stem diameters less than one half inch (Wright and Bailey). Repeated fires with poor fuel loads are also ineffective in controlling established mesquite. Fire intensity is critical in controlling mesquite. Fuel loads of 1500 lbs/ac or less will do little other than top-kill established plants. Studies done in Texas showed that fires with fine fuel loads of 4400 lbs/ac killed 25% of established mesquite while areas with only 2200 lbs/ac killed 8% of mesquite trees (Wright and Bailey).

In a study on the Audubon Research Ranch, Bock and Kennedy et al, found that in an area burned twice (1987 and again in 2002) 18% of the established mesquite were killed. In the area burned only in 2002 the mortality was about 1%. This ungrazed grassland typically has between 2000 and 3000 lbs/ac (air dry) of fine fuels as a standing crop in late spring, early summer.

In the same study the authors found that mesquite top kill (from the 2002 fire) was different from grazed to the ungrazed area and between native grasses and Boers lovegrass.



**The risks associated with prescribed burns in upland grasslands can be minimized by following a good prescription.**

**Risks include;** burning in drought years with poor grassland recovery, increased soil erosion, increased surface water runoff, loss of basal cover and productivity of perennial grasses, increases in invasive weeds and exotic grasses, a decrease in water quality affecting plant and animal life in adjacent streams, springs or ponds and the possibility of escaped fire and liability for the damages.

**A good prescription for burning in southeastern Arizona grasslands is as follows;**

**Recommended frequency** – No more than once every ten years

**Burn window** – May and June

**Pre-burn conditions** – Should not be done following drought years (defined as yearly precipitation below 70% of average). Should not be done following very dry winters.

**Temperatures** – Variable but should not exceed 100 degree F daytime highs. Nighttime temps should recover to below 70 degrees F.

**Relative humidity** – Between 10 and 20%

**Wind speed** – Less than 10 mph

**Wind direction** – Should be done only under prevailing winds; should have a clear window (7 days) without any storm fronts moving across the area.

**Extent of burn** – Should be a manageable size. If the land is grazed the burn areas should, as much as possible, match the pasture boundaries so as not to concentrate grazing use on small burned areas.

**Recommended grazing season** – Two years minimum deferment unless the burn is followed by a wet summer (some winter grazing may be allowed).

**Objectives** – Need to be spelled out and planned for. If the objective is woody plant control then adequate fine fuel must be present and plans for future repeat burns should be developed.

**Monitoring** – Pre-burn and post-burn monitoring must be done to determine if the burn is meeting objectives.

#### **Impacts of prescribed fire on wildlife:**

There will be some direct mortality and indirect mortality due to loss of cover and loss of forage. Predators such as hawks and ravens will benefit immediately after the fire due to loss of cover for prey species. Patchy burns may reduce both direct and indirect mortalities by providing refugia. The rebound in forage will benefit grazers and browsers. Antelope often seek out recently burned grasslands to feed on the succulent new sprouts.

#### **References**

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