Fire Session

Management of South Texas Shrublands with Prescribed Fire

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Introduction

The Rio Grande Plains (RGP) and Coastal Prairie (CP) of South Texas is the southernmost extension of the Great Plains Grasslands. Fire, along with other climatic variables, such as drought, presumably maintained mesquite (*Prosopis glandulosa* Torr.) savannas and interspersed grasslands of pre-European settlement South Texas. Frequency of fire appeared to be highly variable and ranged from 5 to 30 years (Wright and Bailey 1982). Following European settlement, the change from grassland to woodlands/shrublands was accelerated by introduction of livestock and fencing. Domestic animals served as ideal agents of seed dispersal for some species, notably mesquite. Removal of biomass by grazing also removed the fine fuel necessary to generate the intense, hot fires required to kill young woody plants. Where fuel was available to carry the fires, people worked to suppress them. Through time, woody plants gained a decided competitive edge over the grasses and forbs that had characterized the original grasslands, and the "brush country" was formed (Scifres and Hamilton 1993). Thus, suppression of fire, combined with heavy livestock grazing, led to the current thorn woodlands common throughout South Texas (Archer et al. 1988; Archer 1994).

Beginning in the mid-twentieth century, South Texas landowners began to convert thorn woodlands back to grasslands to enhance rangelands for livestock production. Treatments, such as root plowing and herbicides, were commonly used to achieve this goal. In recent years the size of individual landholdings has decreased and revenue from wildlife has increased (Wilkins and others 2000). Brush management to enhance habitat has evolved into "brush sculpting" where brush is manipulated to increase edge, juxtaposition, and biodiversity. Mechanical, chemical, and prescribed fire treatments are used in this effort.

Fire provides an economical means of controlling woody species and maintaining the life of mechanical and chemical brush management treatments. Burning during late winter and early spring has been recommended for achieving many goals on South Texas rangelands (Scifres and Hamilton 1993), however, information on summer burning has been collected (Drawe and Kattner 1978; Ruthven and Synatzske 2003) and summer burning is now somewhat more acceptable.

Although fire has been used as a management tool for over a hundred years, the effects of fire on South Texas rangeland have not been studied until relatively recent times. In a thorough review of the literature, the earliest study mentioned by Vogl (1974) was that of Box and others (1967). However, since 1967, much work has since been conducted in the region. Certainly, a landmark publication that documents the state of the art of the use of prescribed fire in the region is Scifres and Hamilton's (1993) book titled "Prescribed Burning for Brushland Management: The South Texas Example".

Methods and Materials

Information in this paper was collected mainly from three South Texas locations (fig. 1). The Chaparral Wildlife Management Area, in the western RGP, is characterized by

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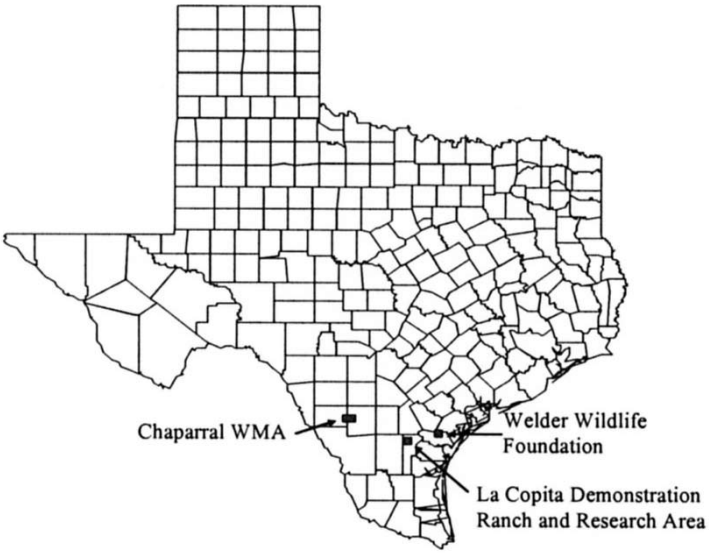

Figure 1. Location of study sites on the Rio Grande Plain and Coastal Prairie.

hot summers and mild winters. The growing season is 249 to 365 days, and precipitation patterns is bimodal with peaks occurring in late spring (May-June) and early fall (September-October). The 11-year (1989-2000) average precipitation amount is 54 cm. The second study area was on La Copita Demonstration Ranch and Research Area in the eastern RGP. Climate is subtropical with mild winters and hot summers. Mean annual temperature is 22.4 ˚C and the growing season is 289 days. Average annual rainfall is 68 cm, with maxima in May and September. The third area was the Rob and Bessie Welder Wildlife Foundation Refuge, located on the transitional zone between the CP and RGP. Average annual precipitation (1956-1985) is 906 mm.

Although generally considered historic grassland, South Texas today is a brush-grass complex; a grassland with brush of various densities covering almost all sites except the deep sands of the Nueces soils. Vegetation at all three locations is dominated by honey mesquite with various mixtures of broad-leaved evergreen and deciduous shrubs in its understory. Herbaceous vegetation between shrub clusters was composed of C4 grasses such as thin paspalum (*Paspalum setaceum),* knotroot bristlegrass (*Setaria geniculata),* Texas grama (*Bouteloua rigidiseta*), and hooded windmill grass *(Chloris cucullata)*, which give way to grasses such as three-awns (*Aristida spp)*, red grama (*Bouteloua trifida)*, grassburs (*Cenchrus incertus)*, and windmillgrass (*Chloris verticillata)* under prolonged, heavy grazing by cattle.

The major woody species in mixed brush communities are honey mesquite, black brush *(Acacia rigidula)*, agarito *(Berberis trifoliolata)*, brasil *(Condalia obovata)*, Mexican persimmon *(Diospyros texana)* lime pricklyash *(Zanthoxylum fagara)*, spiny hackberry (*Celtis pallida*), pricklypear (*Opuntia engelmannii*), and lotebrush *(Ziziphus obtusifolia),* among others. Husiache is also a component of these communities.

Management Implications

Historically, fires burned in the summer and early winter in the RGP and CP, and, currently, summer fires are more effective in suppressing woody plant growth than are cool season burns. Prescribed fire has been used successfully to suppress woody plants in the eastern RGP and CP, however, fire does not kill brush. Research indicates that fire does reduce brush cover (Box and others 1967; Dodd and Holtz 1972), and two or more burns are more effective in reducing brush than a single fire (Box and White 1969). Gordon and Scifres (1977) found that prescribed burning, particularly when combined with chemical or mechanical methods, was effective in restoring rangeland heavily infested with Macartney rose (*Rosa bracteata*). Rasmussen and others (1983) found that in a fire regime the cool season Texas wintergrass (*Stipa leucotricha*) increased with increasing huisache (*Acacia smallii*) canopy up to approximately 40 percent canopy coverage of the woody invader, but that total herbage production declined beyond 40 percent canopy. Therefore, to promote cool season plants, a certain amount of properly spaced woody cover maintained by prescribed fire may be desirable for both cattle and wildlife.

To suppress brush, the most effective burns are those used in combination with chemical or mechanical treatments. For example, huisache can be removed with chemical or mechanical means, but is only temporarily reduced solely by fire. So, fires reduce canopy cover and productivity of woody plants and enhance herbaceous growth. It can be used to increase the wildlife value of the habitat by causing resprouting of woody plants and by increasing forb growth. Fire also increases both chemical and mechanical defense mechanisms in certain woody species.

Since fire suppresses but does not kill most species of resprouting brush, this can be used to great benefit in wildlife habitat management. Top growth removal of brush by fire stimulates succulent regrowth for consumption by browsing wildlife, and it can create habitat diversity. Hot fires may be used in a patchwork design, alternated within burned areas. Cool fires, burned over a whole range interspersed with brush mottes, will burn around mottes and will leave portions of the range unburned thus creating greater diversity.

Timing of burning has a strong influence on the composition of the plant community following the fire and has profound effects on animal communities through effects on habitat. Plant species composition can be altered by timing of burning, thus the manager can create a plant community desirable for wildlife (Hansmire and others 1988). Late winter burning reduces forb populations and benefits grasses; whereas, early winter burning is followed by normal forb populations. In addition to reducing forbs, late winter burns may reduce the amount of other cool season plants, particularly Texas wintergrass.

Several studies have concentrated on the influence of repeated fires on both woody and herbaceous vegetation. More recently, summer prescribed fire has been implemented in an

attempt to suppress woody plant encroachment. An area was established on the Welder Wildlife Refuge in 1975 to assess the effects of repeated cool season fires on CP vegetation. A non-burned control was located adjacent to the burned block. The area was initially burned in the winter of 1974 and then was subsequently reburned in 1977 and 1980.

Repeated burning effectively suppressed woody vegetation. After the 1974 fire there was almost total top removal of woody species. The 1977 fire, which was extremely hot, burned through most of the smaller chaparral mottes. On the windward side of a motte the 1977 fire removed 100% of the cover. On the leeward side of a motte, depending upon wind speed during the fire, there were protected areas where some woody plants avoided topkill. In the larger mottes, i.e., those greater than 20 feet in diameter, woody plants survived in the center and on the leeward side of the motte. Fine fuel was essentially nonexistent within mottes. Only crown fires burned completely across a large motte. Whole mottes survived in the cooler 1980 burn, even some of the smaller mottes less than 20 feet in diameter. Individual woody plants between mottes were top-killed. Following the third burn, canopy cover was reduced from the original 40% to less than 2%. By the summer following the third burn, there appeared to be a reduction in the amount of cover of all woody species. However, one year after the burn, all species were growing vigorously. Weedy herbaceous vegetation was abundant in the mottes totally top killed by the fire.

Long periods between burns allow brush to regrow to its former height and density and possibly increase in density. A prescribed fire program to suppress brush in South Texas should be designed to be burned every 3 to 4 years. Otherwise, brush regrowth is so rapid that any greater time sequence between burns will allow the brush to grow to the point that fire can no longer be used as an effective tool for suppressing regrowth.

Fire is also an effective tool in removing excess mulch accumulations that occur during wet cycles under conservative grazing. On the Welder Refuge, fine fuel loads from 4,500 pounds per acre to 16,000 pounds per acre were burned (average 5,500 pounds per acre). Large amounts of fine fuel form a mat that may not be penetrated by light and actually acts to suppress plant growth. There is an increase in herbage production in the year following the initial burn, because more light penetrates to the soil surface and nutrients are released to the soil from decadent plants.

On the Chaparral Wildlife Management Area, rangeland was subjected to two winter prescribed burns and a winter burn followed by a summer fire. Prescribed burning can manage woody vegetation without dramatic reduction in woody plant diversity, which is common with many traditional mechanical treatments. However, percent woody plant cover was reduced by 50 percent and 41 percent on winter and winter-summer combination burned sites, respectively. Woody plant density declined by 29 percent and 23 percent on winter and winter-summer combination burned sites, respectively (Ruthven and others 2003). Density of guayacan (*Guajacum angustifolium*), wolfberry (*Lycium berlandieri*), and tasajillo (*Opuntia leptocaulis*) was less on all burning treatments. Percent cover of spiny hackberry and density of pricklypear declined on winter burned sites. Inclusion of summer fire into the burning regime did not increase the decline in woody plants. Fire does create a post-fire environment, which results in the decline of many woody plant species. It is unclear to what degree other environmental factors, such as herbivory and competition between woody plants and among woody and herbaceous vegetation, may have interacted with fire to produce woody plant declines.

Combinations of winter and summer burns can effectively reduce the cover of honey mesquite, twisted acacia, Texas persimmon, lotebush, wolfberry, and tasajillo. Canopy cover of spiny hackberry and density of pricklypear decline following multiple winter burns. Soil moisture at the time of fire application may have a greater impact on woody vegetation response than season of burn.

Both summer and winter burning are effective at reducing honey mesquite cover, which may promote increases in herbaceous vegetation following fire. Summer burning following significant rainfall is effective in managing honey mesquite, while maintaining desirable woody species such as spiny hackberry. If reducing total woody plant cover is a management goal, burning during winter following periods of little or no rainfall is recommended.

Summer and winter prescribed fire produce similar responses from herbaceous vegetation (Ruthven and Synatzske 2002). Warm season annuals, such as croton (*Croton* spp.), were more prevalent on burned sites. However, increases in annuals did not persist into the second growing season following burning. Cool season annuals demonstrated little response to summer or winter burns. Perennials such as erect dayflower (*Commelina erecta*) and beach goundcherry (*Physalis cinerascens*) increase following summer and winter burns, whereas silky evolvulus (*Evolvulus alsinoides*) and hoary blackfoot (*Melampodium cinereum*) decrease following summer fires. Grass density decreased following summer fire; yet, productivity was similar among treated and nontreated sites one year post burn.

Initial burns on native RGP rangelands should be conducted on a 2-year interval until the desired structure of woody vegetation is achieved. Once desired goals are met, as stated earlier, maintenance burning on a 3- to 5-year frequency is adequate. Grazing strategies that allow for substantial deferment to produce adequate fuels to carry fire are critical to the successful application of fire on both CP and RGP rangelands. Other considerations to be taken into account are the highly unpredictable weather patterns in South Texas. Short-term periods of drought are common and rainfall can be highly variable between locations. Drought can severely impact production of fine fuels necessary to carry fire and may require flexibility in burning schedules. One should plan on burning as the opportunity arises since, if a critical burn is missed, conditions may not allow burning for several more years.

As stated earlier, fire may be integrated with other practices in brush management systems. An evenly-distributed, fine fuel load of 2,500 to 3,000 lb/acre is considered adequate

for an effective burn. However, rangelands supporting moderate to heavy brush cover are characterized by seriously reduced and patchy herbaceous cover (Scifres and others 1982, 1983), resulting in inadequate fine fuel load. Because of the dependence on an adequate load of evenly distributed fine fuel, burning of brushy South Texas rangelands usually is a treatment subsequent to an initial method that uniformly reduces the brush canopy and releases the fine fuel. Moreover, prescribed burning often increases the effective life of initial treatments and compensates for characteristic weaknesses of several of the methods. Because of this utility, fire-based Integrated Brush Management Systems (IBMS) can take maximum advantage of several methods, including fire, over a relatively long time period. (Scifres and others 1985).

Prescribed burning has been evaluated following applications of herbicide sprays and of pellets as broadcast or individual plant treatments. It has also been effectively used in conjunction with various mechanical methods for brush management as both herbicide and mechanical applications reduce brush canopies and release fine fuel for prescribed burning. Prescribed burning then suppresses surviving woody plants, removes rough forage plants, promotes legumes and other desirable forbs usually damaged by sprays, promotes uniform distribution of livestock grazing, expedites secondary succession and improves botanical composition of grass stands. South Texas mixed brush is characterized by all of the problems and potentials described above. In most cases, burning is impossible until the brush canopy is reduced and fine fuel is released.

In 1999, an IBMS was installed in a mixed brush community on La Copita Demonstration Ranch and Research area. An outline of the State of Texas was superimposed on a DOQQ map of a pasture and coordinates around the perimeter of the map were recorded. Using a backpack GPS unit these coordinates were located around a 35 acre parcel of rangeland and staked. A D-8 Caterpillar tracked tractor then pulled a "rolling chopper- aerator" around the perimeter before chopping the area within the perimeter.

As expected, brush regrowth after top removal was rapid. In September, 2002, the 35 acres was divided into several plots and a variety of herbicides and mixes of herbicides were applied to each. Efficacy varied dependent upon species and herbicides treatment but, overall, canopy was reduced by 90% the first year. By the second year plants/acre were reduced by 50%. In spite of being part of a grazing program air dried forage production in the fall of 2003 was 280 lbs/ac in the control—open pasture; 320 lbs/ac in the control—brushy pasture; and 1500–2800 lbs/ac. in the chopped and sprayed pasture

Brush regrowth of those species not killed by the herbicide treatments was rapid. In February, 2004, the "State of Texas" was burned with a prescribed fire. The fire further thinned the brush stand, the species mix of forbs and grasses was enhanced and wildlife, such as bobwhite quail and white-tailed deer, prefer this pasture to non-treated pastures. Measurements of cattle grazing also indicate a preference for this pasture.

Summary

In summary, fire affects vegetation by suppressing woody growth, removing excess buildup of litter, and stimulating herbage production. Fire will not kill the majority of South Texas woody plants because of their resprouting characteristics, although there is an indication that repeat burns may kill a small percentage of plants of certain species. Timing of burning is one of the most important factors to consider in planning a burn. Fire stimulates growth of forbs following the top removal of woody plants in dense mottes of brush.

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