Appendix F

Recommendations for Prescribed Burning in West Texas

Prescribed burning is a cost-effective tool for managing woody brush encroachment and improving plant species composition and wildlife habitat. Prescribed burning is conducted with a strategic plan that includes management objectives, weather conditions, fuel loads (woody and herbaceous), protection of livestock and human structures, personnel required to implement the burn, and safety of the fire crew.

The Role of Fire in Desert Grasslands[1]

Many grasslands in the Chihuahuan Desert have given way to higher densities of shrubs in the past 100 years, but the mechanisms contributing to the shrub invasion are not well understood. Thornber (1907, 1910), Griffiths (1910), Wooton (1916), Leopold (1924), and Humphrey (1958) were convinced that fire was the primary mechanism that controlled shrubs in the southwestern deserts where adequate fine fuels were present. Thornber (1910) attempted to document this evidence, “That such fires burning over the mesas and foothills have not been uncommon in times past may be judged by the fact that in many places abundant remains of charred stumps of at least 10 years duration are frequently met with.” Wooton (1916) commented on fires severe enough to kill woody plants 10-12 feet tall.

When examining the role of fire in desert grasslands, it is necessary to consider all biological and environmental factors operating simultaneously on this ecosystem. For example, seedlings of mesquite and other shrubs sprout most vigorously following years of abundant fall precipitation (Wright et al. 1976). However, grassland fires were common during the dry seasons following 1-2 years of average to above average rainfall because of improved fine fuel loads and continuity. Therefore, a high percentage of invading shrub seedlings could have easily been killed by fire. For those areas that escaped fire, competition from healthy grasses would substantially reduce the number of woody plant seedlings. Vigorous perennial grasses compete strongly with mesquite seedlings (Martin 1975, Wright et al. 1976). Experiments on the Santa Rita Experimental Range showed that 16 times as many mesquite seedlings were established on bare areas as in vigorous stands of perennial grasses (Glendening and Paulsen 1955). Wright et al. (1976) found similar results in Texas with no surviving mesquite seedlings in a healthy stand of tobosagrass. Even if shrubs become established in a vigorous stand of perennial grasses, their growth rate is slowed substantially compared to shrubs growing among grasses in low vigor. Competition with healthy grasses is a key factor in suppressing shrub densities and growth.

Frequent drought, insects, diseases, rodents, and jackrabbits would have also taken their toll on young mesquites and other shrubs. In areas that escaped fire for 10-20 years, these factors could have kept young invading shrubs suppressed to less than ½-

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[1] Much of the text included in this section is from Wright, H. A., and A. W. Bailey. 1982. Fire Ecology: United States and Southern Canada. John Wiley and Sons, New York. 501 pp.

inch in diameter. A fire at this time would kill approximately half of the invading shrubs (Glendening and Paulsen 1955) and would have kept most of them in a non-seed-producing state. Thus, several factors interacting together, with the help of fire and no grazing by domestic livestock, could have kept shrubs out of the southern desert grasslands.

Overgrazing was promoted by forest administrators in Arizona during the early 1900's to reduce fire hazard and promote the growth of trees. This practice helped to prevent wildfires and allowed brush to invade the grasslands (Griffiths 1910). Overgrazing in desert grasslands, especially during drought, had a similar effect (Chew and Chew 1965). Griffiths (1910) and Leopold (1924) concluded that before 1880 when livestock production became prevalent, the southern desert grasslands produced more grass and that fires occurred at approximately 10-year intervals. The dry-season wildfires temporarily reduced grass densities, but without livestock grazing the grasses recovered quickly (2-5 years). Ten years after a fire, enough fine fuel had accumulated to support another fire – a fire capable of suppressing or killing woody seedlings that had begun to invade the grassland. The relatively poor seed production, slow establishment, and slow growth rate of shrubs would have permitted their control with a fire about every 10 years. The key to preventing shrub invasion of productive grasslands seems to be periodic fires, frequent enough to prevent seed production by shrubs. Creosotebush shrubs do not produce seeds until they are at least 13 years old, and significant numbers of fruit appear only after 18-20 years of growth (Chew and Chew 1965). With competition from biotic and abiotic factors, mesquite may also have taken this long to produce seed.

Today, grazing by domestic livestock is the greatest barrier to the potential use of fire in desert grasslands, especially in black grama ranges. Grazing has reduced fine fuels for fires and allowed shrubs to invade (Chew and Chew 1965, Martin 1975). In addition, grazing too heavily or too soon after fire can prevent the recovery of grasses that is needed after wildfire or prescribed burns. There currently are opportunities to use prescribed fire in desert grasslands to prevent further shrub invasion and, to some degree, reverse the trend. In many areas of the Trans-Pecos, however, a major reclamation program involving brush control, light stocking rates, and grazing deferment would be required to restore desert grasslands before fire could be introduced into a management program. The most common application of fire in the Trans-Pecos today is in tobosagrass and sacaton flats.

Benefits of Fire

In the past, wildfire and a few poorly planned and executed prescribed fires have received considerable public attention. These fires have been blamed for "destroying forests" or "destroying prairies." Fire does not destroy the land – it only causes changes in the vegetation community. Historically, rangelands in Texas evolved under periodic grazing (nomadic herds of bison, elk, pronghorn) and periodic wildfire. The exclusion of fire from rangeland ecosystems eventually will lead to a decline in the overall health and diversity of those plant communities.

Because range plants evolved under a pattern of grazing and fire, they are adapted to periodic top-removal. In fact, most plants subjected to periodic top-removal through grazing or fire are more vigorous and productive than those that are “protected”. Removing old growth and litter build up from bunchgrasses helps increase production of new leaves, which are necessary for replenishing the roots with starches and carbohydrates through photosynthesis. Other benefits of fire include increased palatability of forages, a temporary (2-4 months) increase in plant nutrients (fertilization effect), and the suppression of undesirable woody plants.

Livestock benefit from increased nutrient content of forage, improved accessibility to the re-growth, and reduced grazing effort and energy expenditure. Wildlife benefits include healthy diverse plant communities on a large scale and at various stages of growth that provide food and cover.

Rangeland fires in early winter stimulate the production of cool-season annuals and perennial forbs, including a group of plants referred to as “legumes” (pea family). This includes plant species such as Illinois bundleflower, Texas snoutbean, wild bean, pine deervetch, and black dalea. Most legumes are highly preferred by deer and contain high levels of crude protein and various other key nutrients. Most legumes are extremely valuable to upland birds such as scaled quail in that they are some of the best seed-producers. Perhaps even more important, legumes and other forbs attract an abundance of insects. The presence of insects can mean the difference between a “boom or bust” year for upland gamebirds and wild turkeys. Quail and turkey hens rely upon insects for protein and calcium, and insects can be an important water source for quail hens just prior to and during nesting. The young chicks are solely dependent upon insects for food during their first few weeks of life.

Periodic fire tends to promote seed germination and growth of perennial bunchgrasses and favors them over less desirable “invader” species of grasses, forbs, and shrubs. Increased perennial bunchgrasses translates to increased forage production for livestock, improved quality of nesting cover, and improved hiding cover for deer and antelope fawns.

The most beneficial burning programs for wildlife incorporate a multi-year rotation so that 10-15% of the property is burned each year. This schedule will allow 7-12 years between burns for any given area. For larger properties, it is more beneficial to burn several smaller blocks rather than one large block each year. This pattern is especially important in grass monocultures that are often found in Conservation Reserve Program (CRP) acreages. The freshly burned blocks can provide good brood habitat for upland birds and turkeys, as well as high quality grazing for deer or pronghorn. During the following year, these blocks will provide excellent nesting cover for upland birds. The blocks with 2 or 3 years growth will serve as nesting cover and escape cover for birds and as potential fawning grounds.

Effects of Fire on Vegetation

The effects of fire on vegetation are often evaluated by land managers within a year after the fire. However, vegetation changes occur very gradually in arid regions like the Trans-Pecos because plant growth and reproduction is relatively slow. Vegetation changes caused by lack of fire and/or improper grazing occur over decades. Likewise, effects of fire on vegetation types must be evaluated over a period of years rather than months. Although immediate impacts can be important (e.g., forb production), habitat improvement in the Chihuahuan desert is a gradual and long-term proposition.

The growth stage of forbs at the time of the burn can have a substantial effect on the current and following year's production. Forbs are prolific seed producers, but an untimely burn can reduce forb reproduction and wildlife food. This situation normally is not a concern in the Trans-Pecos because when forbs (and grasses) are green and growing, the vegetation usually will not "carry" a fire. Prescribed burns conducted in early to mid-winter with good soil moisture promotes late winter annuals and allows rapid recovery of perennials. A late winter burn conducted after many annual forbs have germinated will reduce their abundance.

Perennial grasses are well-adapted to periodic top-removal by fire. The growing points during dormancy are located near or below the soil surface, and perennial bunchgrasses are deep-rooted. This allows them to recover faster than most other classes of vegetation following a fire and to take advantage of the reduced competition. Annual grasses may be killed by fire after they germinate but may be promoted if burning occurs before germination. The differences in growth cycles between warm and cool season grasses allow the timing of a burn to enhance one class over the other. For example, a late winter fire favors the production of perennial, warm season grasses. Most semi-desert fires result in a short-term (1st year) reduction in perennial grasses. The vast majority of fires result in a greater density and biomass of perennial grasses within 2-3 years after the burn, especially if rested from grazing. Of course, the timing and magnitude of the grass response will be dictated by rainfall conditions during the first few years after the fire. Invader grass species such as annual threeawns are easily damaged by fire. Plains lovegrass, sideoats grama, blue grama, hairy grama, tobosagrass, cane bluestem, little bluestem, Arizona cottontop, and tanglehead all respond well to fire. Vine-mesquite tends to increase in sacaton communities that are burned in winter. Black grama seems to recover from fire more slowly than any other southern desert grass. Drought following fire will lengthen the recovery period for black grama (Nelson 1934, Reynolds and Bohning 1956), and if drought is compounded with moderate grazing, black grama may never recover to its preburn basal area (Canfield 1939). If black grama ranges are burned, they should be rested for 2 consecutive years of average or above average summer precipitation. Then if grazing is resumed, stocking rates should be light.

Most species of cholla, prickly pear, and other cacti are damaged by fire, but most cactus plants recover quickly, especially following fires of low severity. Moderate to severe fires produce relatively high mortality rates on cacti, except for plants isolated from fine fuels. Barrel and hedgehog cacti are susceptible to fire, with documented mortality rates exceeding 60%. Average mortality rates for cholla are approximately 50%, while prickly pear is slightly less susceptible with kill rates averaging about 30%. Prickly pear mortality rates are highly variable and may range from 20-80%. These mortality rates include the interactive effects of fire, insects, disease, and post-fire grazing by livestock, deer, javelina, and rabbits. Cholla and prickly pear usually do not recover from intense fires for at least 13 years (Cable 1967). Sotol is reduced by moderate to severe fires (30-70% mortality) and lechuguilla is severely reduced by fire when growing among fine fuels (up to 80% mortality).

Non-sprouting shrubs are easily killed by fires, even if the foliage is not consumed. However, the vast majority of woody species in the Trans-Pecos are “sprouters,” meaning that they sprout from a bud zone at or below the soil surface after being top-killed. These shrubs are difficult to kill with a low severity fire, especially after they grow beyond the seedling stage. Shrubs in the Trans-Pecos are much more susceptible to an intense fire occurring in the warm season (e.g., May or June), particularly if they are stressed from drought.

A number of woody species in the mixed shrub community (Chihuahuan scrub) may become so dense that they create problems for livestock production and certain wildlife species. However, the woody species that are most often a problem for landowners in the Trans-Pecos are redberry juniper, honey mesquite, creosotebush and tarbush. Saltcedar is a “problem species” along the Pecos River, the Rio Grande, and along some other permanent bodies of water.

Redberry juniper is difficult to manage with fire unless the bud zone (sprouting region) is above the ground. A mortality rate of 60-80% can be expected as long as this condition exists. The period of time that the bud zone is above ground is determined by the soil site. For shrubs growing on shallow, rocky soils, the bud zone will usually migrate beneath the soil within 10-15 years. Bud zones on shrubs growing in deep soils may grow beneath the soil surface within 8 years. Mature stands of juniper are difficult to manage with fire because of the lack of fine fuel on these sites. In this situation some of the trees must be dozed or grubbed and left to dry for a year. This will provide additional fuel for a hotter fire that will help to ignite the crowns of the remaining trees. When burning a mature stand of juniper, firebreaks should be at least 300 yards wide and numerous “spotters” should be on-site to watch for burning material that may be lifted and transported as far as 1,000 feet. If a mature stand of junipers is successfully burned, a burning plan should be developed that provides for another fire in 7-12 years or before the seedlings are more than 4-5 feet tall.

Honey mesquite is moderately affected by fire, depending upon its age, the number of dead basal stems with insect borer activity, weather at time of burning, and the amount of fine fuel. Unless very young, green mesquite trees are very hard to kill with one fire. Young seedlings that are 1.5 years of age can be killed with a hot fire. Saplings that are 2.5 years old are severely harmed and often killed, but shrubs 3.5 years old are fairly resistant to fire. After mesquites have invaded a site and begun producing seed, it may not be possible to completely control them with fire. But fire can be an important tool in reducing mesquite densities, plant height, seed production, and future encroachment of this shrub. Studies have shown that plants that have been previously top-killed with herbicide, fire or drought are more susceptible to fire mortality.

Tarbush is a desert shrub that tends to occupy range sites in relatively pure stands or as a co-dominant with creosotebush. Tarbush is part of the desert shrub community that often invades grasslands (primarily tobosa) following many years of heavy grazing but especially in the absence of fire. This shrub can be controlled easily during the initial stages of shrub encroachment (young plants and adequate fine fuels). It is much more difficult to manage mature stands of tarbush that lack adequate fine fuels to carry a fire. Herbicide treatment (tebuthiuron) may be effective in reducing shrub competition and promoting sufficient grass production to carry a fire 3-5 years post-treatment. Mechanical treatment (aerator, chisel, heavy disc) is probably more effective in promoting the growth of fine fuels (grass) by reducing shrubs and improving rainfall infiltration. On sites supporting low to moderate fine fuels, grazing deferment and periodic fire can be used to effectively manage tarbush shrubs.

Creosotebush is similar to tarbush in that it can be managed with fire under certain conditions. The amount of damage to creosote shrubs is dictated by the fuel load, air temperature, humidity, age of the plants, and season of the burn. Shrubs will resprout if the root crown is not killed by the fire. Cool-season fires usually only top-kill mature creosote shrubs, but may kill a relatively high percentage of young plants. Warm-season fires kill a much greater proportion of shrubs than cool-season fires. Intense fires, particularly in June and July, can produce mortality rates that approach 100% (Brown and Minnich 1986, White 1968, White and Ehrenreich 1968). A common problem occurring in mature stands of creosote is the lack of fine fuels to carry a fire. Mahall and Callaway (1991) suggest that root-mediated allelopathy prevents other plant species and possibly even creosote seedlings from establishing between mature creosote shrubs. Soils under some creosote shrubs tend to be water repellent because of associated soil microorganisms (Adams et al. 1970). This hydrophobic condition, along with soil loss, prevents the establishment of herbaceous plants that could serve as fine fuels for a fire. Mechanical treatment provides the greatest potential for reducing shrub competition and improving soil hydrology for grass restoration and the implementation of fire as a management tool.

Recommendations for Prescribed Burning:

Land managers attempting to use prescribed fire as a management tool should have a fire plan prepared by the local County Extension Agent, Natural Resource Conservation Service, or TPWD Biologist. The plan should include landowner objectives, desired weather conditions, equipment arrangements, personnel considerations, firelane installation, and grazing management considerations (pre- and post-burn). The local fire departments, law enforcement officers and neighbors in the immediate area should be notified prior to the burn date.

General Recommendations for a Cool-season Prescribed Fire:

Relative humidity of 30% to 50%
Wind speed of 5 to 10 miles per hour
A minimum fuel load of 1,200 lbs. per acre
Temperature 60 to70 degrees

Prescribed burning under the weather conditions listed above will result in a relatively "cool fire" and will not top burn desirable trees.

Burn in late December or early January for maximum forb growth.
Burn in late February or March to improve grass quality and species composition.
For highly erodible soils, burn as late as possible in the dormant season to allow a quick green up and lessen the possibility of soil erosion.

The backfire should be burned with 40% to 50% relative humidity. Before setting the headfire, the blackline should be at least 100 yards wide for grass fires and at least 300 yards wide for brush pile fires.

Avoid conducting prescribed fires when temperatures are greater than 80°F., when the relative humidity is lower than 20%, and when wind speeds exceed 20 miles per hour. These are wildfire conditions -- the topping of trees by fire will probably occur and the chances of fire escape increases substantially. An exception to this rule is appropriate when a prescribed burning plan specifically requires a very intense fire for the control of certain woody species (although high winds are undesirable). However, burning under severe weather conditions requires a very experienced fire boss and crew.

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