THE ROLE OF FIRE IN THE COASTAL PRAIRIE

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HIGHLIGHT

Fire played an important role in the development of Coastal Prairie vegetation, but recently has been eliminated by man's activities. This has resulted in an encroachment of woody species into the native vegetation. Prescribed burning can be used as a tool for manipulating Coastal Prairie vegetation. Fire effectively suppressed most woody species while encouraging grass and forb growth. Timing of burning, conditions during the burn, and grazing management prior to and following the burn are the primary management considerations. By proper timing of the burn, the appropriate set of conditions during the burn, and regulation of grazing prior to and following the burn, the manager can regulate composition of the post-burn plant community. Prescribed burns conducted during the dormant season have little direct impact on wildlife populations. Long-term beneficial effects of improved plant productivity and increased edge and diversity created by a properly conducted burn designed for wildlife habitat improvement far outweigh short-term detrimental effects of the fire.

INTRODUCTION

Fire has played a role in the development of vegetation over much of the earth, especially in the development and maintenance of grasslands such as the Texas Gulf Coastal Prairie.

The Texas Coastal Prairie is an important ranching area which historically has supported vast herds of domestic animals and wildlife (Oberste 1953). There is good evidence that present native vegetation is different from that encountered by the first Spanish explorers nearly 450 years ago (Box et al. 1979). There appears to have been a change from prairie-like vegetation to dense shrublands and woodlands. Cessation of fires has been suggested as a major cause of this change (Lehmann 1965). Heavy grazing by livestock, wet and dry cycles in climate, mechanical brush control, and intensive agriculture also have contributed to this change. Reasons for consideration of fire as a vegetation management tool in this region, therefore, include the reduction of woody plant cover and heavy accumulations of herbaceous mulch.

HISTORY OF FIRE AND GRAZING IN THE COASTAL PRAIRIE

Lehmann (1965) presented an excellent history of fires in the Coastal Prairie from 1528 to 1940. He reported the early use of fire by Indians to control mosquitoes, to aid in hunting, and to discourage settlers from invading their hunting grounds. Later, in the early 1800's during colonization encouraged by Mexico, settlers annually burned prairies to provide green feed for livestock. Lehmann (1965) concluded that "in a real sense, therefore, the upper coastal prairies were the tinderbox of Texas: the region where fire, purposeful and otherwise, burned most often, and for the longest time...
Nowhere else in Texas, perhaps nowhere else in the whole Plains Region, however, were such large stores of combustible material produced...And, because of Nature's unique protective system of fire guards, and feed reservoirs in low spots and stream 'bottoms', nowhere else could stockment burn with less danger of being without feed until the next growing season'.

The Coastal Prairie has a long history of grazing use. As early as 1768, de Solis reported that the general area around the early missions supported large herds of wild cattle and native wildlife. Settlers brought large herds of cattle and horses to the area in the early 1800's. Numbers of domestic animals increased, and by 1841 herds of 1,500 to 2,000 wild horses were reported on the prairies of San Patricio County (Kennedy 1925). Livestock numbers continued to increase until after the Civil War and the advent of trail drives to rail heads farther north. There remained, however, more live-stock in south Texas than the markets could handle. Evidence of extreme stocking rates is available in photographs taken by Coffey (1909) in San Patricio County showing severely denuded pastures on Victoria clay soils. Although few records exist of exact grazing pressures, it can be surmised safely that by recent times overgrazing had reduced fuel loads to such an extent that fires would no longer burn across many native pastures unless areas were deferred to build up fuel for a fire.

**THF COASTAL PRAIRIE ENVIRONMENT**

The Texas Coastal Prairie occurs on a low, flat plain dissected by streams originating farther inland. Saltwater marshes occur near the coast and freshwater marshes and intermittent lakes occur farther inland.

The plants of the Coastal Prairie are mostly of tropical or subtropical origin. The flora is complex; more than 1400 species of flowering plants occur in a 50-mile radius of Corpus Christi (Jones 1975, Gould and Box 1965).

Present vegetation includes cordgrasses (Spartina spp.), sedges (Cyperaceae), and rushes (Juncaceae) in saltwater marshes, and aquatic grasses and forbs in freshwater marshes. Streams are lined with deciduous hardwood trees and chaparral (mixed-species stands of thorny shrubs). Grassland or chaparral vegetation occurs on well-drained upland areas. Most authorities agree that the original natural vegetation of these upland areas was a tallgrass prairie (Kuchler 1964, Weaver and Clements 1938).

Most soils of the area have formed from the Beaumont and Lissie formations of Pleistocene age. These formations have been reworked by recent streams and winds, and may be overlain by alluvium and aeolian sands. Thus, the major soil types vary from fine sands to heavy clays.

The climate of the Coastal Prairie is humid and subtropical with long, hot summers and short, mild winters. Freezing temperatures occur intermittently only for brief periods, thus plant growth can occur any month of the year. The frost-free period is 300 days or more. Rainfall fluctuates between years and in cycles of wet and dry periods which may extend over several years. Average annual rainfall is about 35 inches, with minimums of about 14 inches and maximums of about 41 inches. Rainfall may occur in any month, but peaks
of rainfall occur in spring and during the fall hurricane season. Daily rainfall totals of over 16 inches have been recorded. Prevailing southeasterly winds blow from the Gulf of Mexico throughout the year. Cold fronts bring northerly winds during winter. Relative humidity is high yearlong, heavy dews may occur nightly, and fog is common in winter and early spring.

**MANAGEMENT CONSIDERATIONS FOR PRESCRIBED BURNING IN THE COASTAL PRAIRIE**

Prescribed burning is a promising tool for use on Coastal Prairie range-lands. In times of rising energy costs, burning is attractive as an economical method of manipulating vegetation, whether used alone or in combination with other methods.

Burning should not be attempted unless a rigid set of management conditions can be met. Often in the past, the manager-or landowner has had a bad experience with fire because all criteria for a successful burn were not met. We are just now learning many of the details of successful burning in the Coastal Prairie.

The most important part of any burning program is the grazing management plan. Burning cannot be successful unless the grazing use of the area is coordinated with the burning program. The two most important considerations in designing a burning-grazing program are scheduling of burning and grazing periods and proper timing of the burn. The management program must allow sufficient time for plants to regain vigor after burning before livestock are allowed to graze. Much of the adverse sentiment about fire has resulted when wildfires burned rangeland and the manager could not or did not remove live-

stock to allow the range to recover. If the manager cannot arrange a graze-

rest schedule that will allow the burned pasture to rest until plants have regained vigor, then the range should not be burned.

Timing is critical in a prescribed burning program. This is an area about which we know little and must learn considerably more. A manager probably can create varying types of post-burn plant communities by manipulating the date of the prescribed burn.

Historically, fires burned in the summer and early winter in the Coastal Prairie. Lehmann (1965) quotes two authorities on this: (1) Parker writing in 1836 and (2) Ilkin writing in 1841. He quoted Parker as saying that prairies near the coast were "...all burnt over twice a year---in mid-summer and about the first of winter. Immediately after the burning, the grass springs up again; so that there is abundant supply all the year round." Although most of our recent experience has been with winter burning, summer burning may have potential for management of the more productive areas (Drawe and Kattner 1978).

Burning may be done when vegetation is dormant and dry enough to carry a fire. In the Coastal Prairie this may occur in July and August, during the normal "summer drought", or during winter, after the second or third frost. Frost may occur any time after mid-November.

Grazing management must be scheduled to consider not only plant responses after the fire, but also creation of adequate fine fuel loads to carry a fire.
A minimum of 2500 pounds per acre of fine, evenly distributed fuel is generally considered necessary to carry an effective but manageable fire. Many Coastal Prairie ranges do not accumulate this much fuel because yearlong, continuous grazing is used. On the other hand, fuel accumulations of up to 16,000 pounds per acre may occur under moderate stocking and periodic deferments.

Burning in the Coastal Prairie is unlike burning in any other region where fire is used as a management tool. During a wet cycle such as that from 1963-80, there are very few days when a burn can be carried out. The summer drought has been non-existent during the recent wet cycle, thus limiting burning to the winter. Heavy dew, fog, and high humidities are common during winter. Burning, therefore, is limited to those days when dry northerly winds blow after the passage of cold fronts. Since it is the tendency of early and late cold fronts to be weak, many lasting for only a day or two, this further restricts the burning period. In my experience, the best time for burning in the Coastal Prairie in terms of climatic conditions is from about December 15 to March 1, i.e., the "dead" of winter for this area.

Preparation for the fire must be accomplished well in advance in the Coastal Prairie, particularly during wet cycles. Because of high precipitation, fire lanes should be in place before the fall rainfall peak occurs. This means that in areas with heavy vegetative cover which will require mowing and double-disking, fire lane preparation should begin immediately after spring rainfall ends.

EFFECTS OF FIRE ON COASTAL PRAIRIE VEGETATION

The effects of fire on Coastal Prairie vegetation have not been studied until recent times. In a thorough review of the literature, the earliest study mentioned by Vogl (1974) was that of Box et al. (1967).

Most research to date (Box et al. 1967, Box and White 1969, Dodd and Holtz 1972, and Gordon and Scifres 1977) indicates that fire has reduced brush cover on Coastal Prairie ranges, and two burns have been more effective in reducing brush than a single fire (Box and White 1969). Gordon and Scifres (1977) found prescribed burning, particularly when combined with chemical or mechanical methods, was effective in restoring range heavily infested with Macartney rose (Rosa bracteata).

Studies on the Welder Wildlife Refuge since 1974 have concentrated on the influence of repeated fires on both woody and herbaceous vegetation. Detailed data have been collected on research plots, whereas much valuable information has been obtained by subjective analysis of larger management burns. Fire research on the Welder Wildlife Refuge has been designed to determine (1) the influence on the ecosystem of the removal of accumulations of mulch and (2) the possibility of the suppression of undesirable brush species.

The current fire research program on the Welder Refuge was initiated in early 1974. These were some of the first fires on the Refuge since the cessation of burning in the early 1900's. In 1974 the Coastal Bend was in the midst of a wet cycle. Average annual rainfall had increased from 30 inches
in 1965 to 35 inches in 1974 at the Welder Refuge. In some years rainfall was as high as 40 inches. In addition, since 1954 refuge managers had followed a conservative grazing program in which each individual range unit was periodically deferred. This combination of extremely wet years and conservative deferred grazing management had allowed accumulation of excessive amounts of mulch. There had been essentially no livestock on the refuge for almost a year prior to the initial burning of 4,000 acres of the area. This also contributed to the build-up of mulch. Prior to burning each area, data were collected on brush cover, herbaceous cover and composition, and herbaceous production. Many of these initial management burns have been repeatedly burned during the past 6 years.

A series of three 50-acre blocks were selected in the Chaparral-Mixed Grass community on Victoria clay soils in 1975 to more accurately assess the effects of repeated fires on Coastal Prairie vegetation. Each of these three blocks was assigned a treatment: (1) burn as often as possible, (2) burn every 3 years, or (3) burn every 5 years. All three areas had been burned in 1974, therefore initial preburn vegetation data were available.

Over the past 6 years other burns have been conducted to study specific objectives. We examined the effects of two successive mid-March burns, in 1974 and 1975, on the composition and cover of vegetation. Currently, we are studying the influence of fire on vegetation in the Mesquite-Mixed Grass community on Victoria clay soils. The latter study is designed to determine the effects on vegetation of fire in combination with oiling and low energy grubbing of huisache (Acacia farnesiana). Huisache was removed initially by oiling or grubbing. Fire was then superimposed over the oiling and grubbing treatments resulting in a combination of treatments including burning only, burning and oiling, burning and grubbing, oiling only, and grubbing only. Particular interest is being assigned to the effects of fire and other treatments on forb and grass cover and herbaceous stand composition.

One research objective is to determine the effect of fire on woody species and its suppressive effect on particular woody species. The combination of oiling and/or grubbing and burning is particularly effective in suppression of huisache. Oiling is a promising practice when combined with burning. The use of the low energy front-end gruber on a crawler type tractor may be desirable on sandy soils (Bontrager et al. 1979); however, on heavy clay soils the cost is higher than oiling. Also, grubbing leaves such a rough terrain on clay soils that this may be a detrimental factor. Roughness was not a problem and grubbing may be as economical as oiling on sandy soils. Both oiling and grubbing were effective and economical in stands of trees up to 150 trees per acre. However, when the number of trees exceeded 150 per acre, costs were prohibitive. In stands of huisache with greater than 150 trees per acre burning was not an effective tool. There was not enough fine fuel on the ground to carry the fire through a dense stand. In dense stands therefore, it may be desirable to roller chop or chain and defer grazing to allow herbaceous fuel to build up so a fire will carry through the area.

Repeated burning has effectively suppressed woody vegetation. The 50-acre plot burned as often as possible has been burned four times since 1974.
It has been possible to burn this plot every year or every other year, depending on the amount of fine fuel buildup. In drier years burning may not be possible annually. It may take more than two years to build up sufficient fuel for a fire if the area is not deferred from grazing. (Our plots receive moderate grazing pressure.) Fuel loads on the areas burned every 3 years or every 5 years have been adequate.

The three repeat-burn study plots are in Chaparral-Mixed Grass communities with a 40 to 45% woody cover. After one fire there was almost a total elimination of woody cover. One extremely hot reclamation fire burned through most smaller chaparral mottes. On the windward side of a motte the fire destroyed 100% of the cover. On the leeward side of a motte, depending upon wind speed during the fire, there have been protected areas where some woody plants avoid topkill. In larger mottes, i.e., those greater than 20 feet in diameter, woody plants survived in the center and leeward side of the motte. Fine fuel has been nonexistent within mottes. Only crown fires have burned completely across a large motte. The whole motte has survived in cooler maintenance burns, even in the case of some of the smaller mottes less than 20 feet in diameter. During maintenance or reclamation burns, individual plants between the clumps have been top-killed.

Essentially all chaparral species resprout. These species may regain their original size in 18 to 22 months (Hamilton and Scifres in press). On the area burned as often as possible, burning every 2 years reduced 40% cover to zero. Prior to the second burn the cover was essentially 40% again.

On the area burned every 3 years, fine fuel accumulations have been adequate and canopy cover reduction of chaparral has been as great as the area burned as often as possible. After the third burn on both areas it appears that there has been a loss of many individual woody plants, and vigor of individual chaparral plants appears lower. Therefore, our recommendation may be to burn every 3 years.

Burning every 5 years may be a good recommendation for the rancher/land manager interested in preserving most of his brush for wildlife cover. If the primary interest is in suppressing brush it will be necessary to burn more often. On the area burned every 5 years, reductions in brush cover comparable to the burn-as-often-as-possible treatment and the burn-every-3-year treatment have been obtained. However, the long period between burns has allowed the chaparral to regrow to its former height and density and possibly increase in density. These are only preliminary results from a long-term study, and conclusions may be changed as additional data are gathered.

Individual plant response of the chaparral species has been monitored to some extent. Following the first fire on the burn-every-third-year plot, 100 plants of each species of chaparral were examined 3 months after the fire and again 1 year after the fire. It appears that the most susceptible plant to fire was agarito (Berberis trifoliolata). Agarito burns "explosively" and usually burns completely down to ground level in a hot fire, thus possibly sustaining more physiological damage than other species. Three months after the fire essentially 100% of the agarito appeared to be dead. About 20% of the Mexican persimmon (Diospiros texana) appeared to be killed. Regrowth was
not suppressed on the other 10 or 12 chaparral species. One year after the burn, all species including agarito and Mexican persimmon were regrowing vigorously. Following the third burn on the burn-every-third-year plot, there appeared to be a reduction in the amount of cover of all chaparral species. Data on individual species response after three fires have not been analyzed; however, it appears that agarito is the most susceptible species with an apparent death of many agarito plants. Some mottes have been almost totally top-killed after three fires. Many decadent stumps of all chaparral species are apparent. Weedy herbaceous vegetation is growing in the mottes that have been totally removed.

Results of these studies indicate also that fire is an effective tool in removing excess mulch accumulations that occur during wet cycles under conservative grazing. One of the problems to the range resource manager in the Coastal Prairie is that during wet years extreme accumulations of mulch can occur. On the Welder Refuge during the burns in 1974, fine fuel loads from 4,500 pounds per acre to 16,000 pounds per acre were burned (average 5500 pounds per acre). Greater amounts of fine fuel form a mat that may not be penetrated by light and actually acts to suppress plant growth. We found an increase in herbage production in the year following the initial burn.

INTEGRATION OF FIRE WITH GRAZING MANAGEMENT SYSTEMS

Another aspect of the Welder Refuge range research program is the study of integration of fire and grazing management. In a separate but associated study (Drave and Cox 1979), the effects of continuous grazing, Merrill four-pasture, deferred-rotation grazing, and short duration grazing on Coastal Prairie vegetation are being studied. Burning is integrated with this grazing system research. Each pasture is burned to remove heavy mulch accumulations or to remove heavy cover of woody plants. The refuge is divided into 13 pasture units. One of these units is continuously grazed, four are utilized in the deferred-rotation system, and seven are utilized in the short duration system. Grazing pressure has varied between one animal unit to 12.5 acres to 1 animal unit to 14.5 acres, but grazing pressures are maintained at a constant rate across systems.

The flexibility provided in the short duration system has made it possible to burn any unit on that system in any given year. It is possible on the short duration system to defer a pasture to build up fuel for a fire then burn the entire unit. If necessary, we can skip that unit during the next grazing period to allow plants to recover. Over the past 6 years we have burned each of the seven pastures on the short duration system at least once. One pasture has been burned three times. In the short duration system, a pasture may be grazed for 2.5 to 6 weeks. Each pasture is thus grazed twice each year and is rested about 5.5 months between grazing periods. This lengthy rest period allows accumulation of fine fuel for a fire. It also allows plants to mature, presenting grazing animals with less palatable vegetation. Therefore fire is of great benefit to both plants and animals. We have found that crude protein content in grasses on Victoria clay on the Welder Refuge increased after a fire.

107
Fire has been beneficial on the four-pasture, three-herd deferred-rotation system. The pastures on the four-pasture, deferred-rotation system are about 1000 acres in size. Cattle remain on the same pasture for 1 year, then the pasture is deferred for 4 months. Cattle graze some portions of these large pastures while leaving other portions ungrazed. Plants become "wolfish" and less palatable on ungrazed areas. Burning ungrazed areas will improve palatability of the plants, their nutritional status, and distribution of grazing animals. Burning normally is not recommended unless whole range units can be burned. However, under good management where pastures receive periodic deferrals and where range condition is high, grazing abuse does not occur.

On the Welder Refuge burns are scheduled so that the area can be rested after each burn. However, when we have burned 100-200 acres of a 1000-acre pasture, cattle have concentrated on the burned area for 2-3 months following deferment. Plants on the burned area have been heavily utilized during that period. However, during most years plants recovered within 3-6 months even under grazing. With adequate rainfall in the Coastal Prairie, vegetation grows faster than grazing animals can utilize it. Also, plants in other portions of the pasture eventually become more palatable and desirable than those on the burn, therefore the burned area is not overgrazed for an extended period. We have burned portions of each of the units on the four-pasture, deferred-rotation system over the past 6 years, and it has not been necessary to alter the graze-defer pattern to build up fuel for a fire.

The interaction of fire, soils, and grazing pressure can alter the burning program just described. Large areas of Nueces fine sand soils occur in two pastures on the deferred-rotation system on the Welder Refuge. Vegetation on these less fertile soils is not as stable as that on Victoria clay soils. Two prescribed burns 2 years apart with the combination of moderate grazing pressure caused a reduction in the amount of preferred grasses. The reduction was even more apparent in areas traditionally more heavily used by livestock.

Burning has not been possible on the continuously grazed pasture without fencing out a portion of that pasture, because fuel accumulations have not been sufficient. We fenced out a 90-acre research plot on the continuously grazed pasture, allowed it one growing season to accumulate fine fuel, and burned it during winter 1978. The area was deferred from grazing for one growing season following the burn. Burning and continuous grazing probably are not compatible.

EFFECT OF FIRE ON WILDLIFE POPULATIONS

Fire has a varied impact on animal populations depending on fire characteristics, size and shape of the area burned, and cover available to animals during the fire. The primary impact of fire on wild animal populations is the effect on the habitat. If the fire-altered habitat is enhanced for a particular species then that species can be expected to increase after the fire, and vice versa. Therefore, changes in animal species diversity and population density can be expected following fire. Better knowledge of these changes would allow the manager to attain predetermined objectives.

108
Public sentiment against fire has occurred because of thoughts about cute, fuzzy little animals screaming death cries of agony in fires. The Smokey-the-Bear syndrome which occurred in the United States from the time of the conservation movement until sometime in the 60's was, in part, based on this public sentiment. These feelings were based mostly on information from wildfires in national forests and grasslands. A prescribed burn has completely the opposite effect on wild animal populations.

Prescribed burning can easily be designed to have the least initial or direct impact on wildlife populations and create the greatest benefit for those populations following the fire. If done during the dormant season, i.e., winter in the Coastal Bend, fire will have little direct impact on animal populations. Those few detriments will be outweighed by the benefits derived from the increased post-burn productivity of the ecosystem. Although animal species composition may change for a short time, the area will return to normal pre-burn species composition and density within 2-3 years following the fire. A cool fire which allows some unburned areas within the major burn will create more edge and further enhance animal populations. A patchwork of relatively small burned and unburned areas also can be used to create more edge.

Fire has been used to maintain open grass areas beneath the coniferous forest while suppressing the secondary successional growth of woody hardwood species (Lay 1956, Stoddard 1963). Thus, burning has benefited ground nesting birds such as bobwhite quail (Colinus virginianus) and the eastern turkey (Meleagris gallopavo silvestris). Fire is an important component of the habitat of the Attwater’s Prairie Chicken (Tympanuchus cupido), an endangered species of grouse in the Texas Coastal Prairie (Chamrau and Dodd 1972, Kessler 1979).

Studies of the effects of fire on wildlife populations at the Welder Refuge are in the initial stages; however, some general impressions about the effect of fire on animals can be made: Burning during winter lessens mortality since most animals are less active at this time. Rarely do we see any animals, other than an occasional snake, directly killed by the fire, especially if we burn on a cold day. During only one fire have I noticed any significant direct kill of wild animals, and this occurred during a fire in late winter of 1979-80 when we burned on a very warm day. Before the fire we noticed quite a few active animals, especially rodents and rabbits running ahead of, into, and away from the fire. Some actually caught fire because they did not escape fast enough. Conversely, on a cold day any animal that is out often is more curious about than afraid of the fire. On many occasions I have seen white-tailed deer (Odocoileus virginianus texanus) traveling back and forth through the flames of a cool fire and in the smoke immediately in the flame front. Once I approached to within 15 feet of a young buck who seemed more interested in the fire and smoke than he was in a human being. We normally see increased numbers of raptors circling above the smoke of the fire, probably in search of small mammals that they detect moving around on the ground. As an example of the number of dead animals that we might find following a typical 40-50 acre burn, a thorough search of the area usually results in less than 6 snakes, 6 rodents, 1 armadillo (Dasypus novemcinctus), and possibly a cottontail rabbit (Sylvilagus floridanus) or two. In summary, the direct impact of fire on animals during the dormant season is minimal.
Fire can benefit wildlife by increasing food supplies. Powell and Box (1966) reported increased deer and cattle use of brush resprouts after mechanical treatment. They attributed the increased use to greater palatability and higher nutrition in the more succulent resprouts. In current research, we also are finding increased deer use of brush resprouts after a fire. Not only does top removal create resprouts which are more palatable, but also the new growth is more available. Top removal reduces the overall height of brush plants and removes the restriction to browsing caused by sharp thorns and stiff, old growth.

Wildlife, particularly game species such as turkey and quail, may be suppressed by excessive accumulations of mulch. Quail prefer open foraging areas. The wild turkey, although a woodland or woodland margin bird, ranges into open grassland areas, but will not venture into areas where heavy accumulations of mulch or extremely tall and rank herbaceous growth occurs. Both species of birds prefer some open ground. Therefore, removal of heavy mulch accumulations would be beneficial not only to vegetation but also to wildlife.

Roth (1979) studied mockingbird (Mimus polyglottos) feeding behavior in the Coastal Prairie. He found that a tall, dense forb-grass layer, such as that found on unburned areas at the Welder Refuge, caused more aerial feeding and feeding in shrubs than on an area at Seadrift, Texas where the shrub layer was similar but the herbaceous layer very short and sparse. This resulted in lower mockingbird densities and no nesting on the heavily vegetated area, and higher densities and good nesting success on the more open area. This suggests that in heavily vegetated areas, burning may be of benefit to this non-game species.

The white-tailed deer prefers mid-successional stages of vegetation. Over the 20 years since the Refuge was established, the successional stage of the vegetation changed from weed stage to mid-successional stages (Box et al. 1979). Also, Chamrad (1968) and Drawe (1968) found that deer in the Coastal Prairie prefer forbs. With advanced succession and heavy mulch accumulations, forb production appears to be suppressed. Scifres and Kelly (1979) found increased forb production with prescribed burning. We also hoped that fire would remove excessive mulch accumulations and promote forb growth. The answer to this question is not completely clear at this point, and probably lies more in timing of burning than in any other factor. For example, in the study of two consecutive late winter burns, we found that forbs, particularly perennial forbs such as bundleflower (Desmanthus virgatus), frogfruit (Phyla incisa and P. nodiflora) and wild petunia (Ruellia nudiflora), were suppressed. Conversely, in current studies of burning, oiling, and grubbing it appears that forb populations are promoted by fire. The fires of the latter study were burned at an earlier date. A fire in early winter or in the dead of winter when all plants are dormant would not suppress forb growth, but a fire which occurred after growth initiation on cool season plants would kill any growing herbaceous plant. In particular we have noticed varying responses from but generally a reduction in, the amount of Texas wintergrass (Stipa leucotricha) after a late burn.
Wilson (1978) studied the effects of fire on bobwhite quail populations on the Welder Wildlife Refuge. She found that fire increased the numbers of bobwhite quail on study plots. The plots were 40 acres in size, rather small to attribute the increases in quail numbers to the fire. Quail were being drawn into burned areas to feed. No increase was detected in overall population numbers in the general area of the burn.

Currently, we are studying the effect of fire on tick (Amblyomma spp.) populations. A fire during a time when ticks are still active will destroy most of the tick population. Lehmann (1965) reports Drummond, an early naturalist traveling in the Coastal Prairie, as stating in 1834 that: "I am sorry to say that I have found no insects, as they are very scarce in these and all prairie countries, owing to the frequent burning...".

We are also studying the effects of fire on rodent populations on the Welder Wildlife Refuge. There is a general decrease in rodent numbers on burned areas. This is attributed mainly to the cover requirements of rodents. Without sufficient cover rodents will be present in extremely low numbers, since without cover they are more susceptible to predators. However, after herbaceous cover regrows, rodent numbers begin to increase on the burned area.

SUMMARY

Prescribed burning shows potential as an economical method of vegetation manipulation; however, much of the current information is preliminary, making it imperative that managers use caution in its application. Any management program involving burning and domestic animal grazing must allow plants time to regain vigor after burning before livestock are allowed to graze.

Repeated fires can be used to suppress growth of woody vegetation in the Coastal Prairie. Three repeat burns have killed many chaparral plants, and caused former chaparral communities to take on the aspect of a grassland community. Heavy woody cover can be manipulated through combinations of mechanical methods and fire.

Less well known are the effects of fire on herbaceous plant composition. A single fire can be used to remove excessive mulch accumulations, increase herbaceous production, and improve vigor of herbaceous plants. Burning in winter after the initiation of growth by cool-season plants appears to eliminate cool-season annuals and to suppress cool-season perennials.

Prescribed burning can be combined with a grazing management system to benefit both livestock and the habitat. Benefits include improved palatability and nutrient content of forage plants and improved grazing distribution.

Wildlife habitat can benefit from prescribed burning through careful planning of timing and conditions of the burn. Minimal direct impact occurs to existing wildlife populations if cool fires are used during winter. A patchwork of block burns can add edge and variety to the habitat. The latter, plus increased herbage production, can act to increase post-burn wildlife populations.
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LITERATURE CITED


