

# Brush, Fire, and West Texas Rangeland<sup>1</sup>

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THE HISTORY of brush invasion of west Texas rangelands is relatively recent. Less than a hundred years ago the area was described as a vast, treeless grassland. During the past half century, prairie fires have largely been controlled. It is only natural to assume a relationship between the control of fire and the increase of brush. Although I firmly believe that there is a very close relationship between fire and the maintenance of grasslands, the relationship is not a simple one. The major brush that occurs on west Texas rangelands today is honey mesquite (*Prosopis glandulosa*), a relatively fire resistant species. My purpose today is to review the processes of the increase of brush and the decrease of fires and suggest some ways in which the two are related. Since our fire research projects are just beginning and our results are not fully complete, I will have to speculate on how fire can be used in the future in our grassland area.

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### THE INCREASE IN BRUSH

The density of brush on western ranges has increased in alarming proportions during the past half century. The extent to which brush is decreasing rangeland production in Texas is emphasized by a recent survey of the U. S. Soil Conservation Service. Smith and Rechenthin (1964) found 88.5 million acres, or 82%, of Texas grasslands were infested with one or more low value woody plants. They reported that about 54 million acres were covered with stands so dense that artificial treatment is necessary before range improvement can be made.

Yet in spite of efforts to control brush by artificial means, its density is increasing. The SCS survey showed that the area of honey mesquite alone has increased 1.5 million acres during the last 15 years (Smith and Rechenthin 1954).

Much has been written in the popular press during recent years about the "spread" of mesquite and other brush plants. The impression has been left that brush is a relatively recent invader—a foreigner brought to west Texas by livestock on trail drives to the northern rail heads.

Several recent papers have pointed out that the increase in brush in south Texas has been primarily an increase in density of brush and not an expansion of the range of the species involved (Box 1959, Johnston 1963, Lehmann 1965). In most instances, species have moved from draws and watercourses onto upland sites.

The invasion of brush on the High Plains of Texas has been much more recent than that described in south Texas. However, I believe that the same process is involved—it is a matter of increase in density rather than a range extension of species.

The glowing descriptions by early explorers of the treeless prairies of west Texas have given an impression that brush was not present. Captain R. B. Marcy (1850) was one of the first white men since Coronado's original crossing of the Southern High Plains to describe the grasslands:

When we were upon the high tableland, a view presented itself as boundless as the ocean. Not a tree, shrub, or any other object,

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either antimate or inanimate, relieved the dreary monotony of the prospect; it was the vast, illimitable expanse of desert prairie—the dreaded “Llano Estacado” of New Mexico; or in other words, the great Sahara of North America. It is a region almost as vast and trackless as an ocean—a land where no man, either savage or civilized, permanently abides; it spreads forth in a treeless, desolate waste of permanent solitude, which has always been, and must always continue to be, uninhabited forever; even the savages do not venture to cross it except at two or three places where they know water is to be found. The only herbage upon the barren plains is the very short buffalograss, and on account of the scarcity of water, all animals appear to shun it.

Marcy's description does not differ greatly from that of early cattlemen who ranched on the plains. In the 1870's before the cattle industry developed, the plains were described as “just landscape: buffalograss, no prairie dogs, no game, no trees, no nothing” (Nelson 1953). In 1885, after approximately seven years of grazing by domestic livestock, Rollie Burns, manager of the IOA Ranch in Lubbock County, Texas reported there was no wood for branding irons and no brush to which to tie horses (Holden 1932).

As late as 1906 Bray (1906) wrote the following description of the Texas high plains:

It is on these high grass plains that the complete masterfulness of the grassland type of vegetation impresses one. The monotonous level or billowly swells of a sea of grass unrelieved by the presence of taller plants like a shrub or tree, such as the ungrazed plains presented, could fasten upon the senses a conception of the power of victorious vegetation such as one might get in the depths of a virgin pine forest, or in the sunbeat chaparral jungle which are also an expression of dominant vegetation types.

Twenty years later Rickard (1927) described the same southern high plains as having “mesquite trees, much smaller than their neighbors farther east.” Today, the Soil Conservation Service reports that 73%, or 4,725,500 acres, of the High Plains grasslands are infested with brush (Smith and Rechenthin 1964).

The major increase in brush has taken place in the last 50 years, but evidence of mesquite in the area dates back to the first explorers. Marcy (1850) described an area immediately below the caprock

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escarpment near Big Springs as being covered with large mesquite trees, "evenly spaced as a peach orchard."

In addition, Abert described large numbers of mesquite trees in the Canadian River breaks in 1849 and Simpson (1849) reported mesquite north and west of Marcy's description of barren plains. These records clearly indicate that mesquite occurred along the watercourses of the plains prior to the coming of the white man.

### THE DECREASE OF FIRES

The spreading of brush from the watercourses and breaks to the prairies was noted by Smith (1895) in his study of southwestern ranges. He wrote:

Another factor which is tending to decrease the carrying capacity of the ranges, as a whole, is the rapid spread of prickly pear and thorny shrubs in the South and of the mesquite bean on the tablelands and higher prairies. . . .

Twenty years ago it was hard to find a mesquite bean on the open prairies that was larger than a small shrub. The only places where they occurred of any size were in the valleys and the "timber islands"—small scattered groves at intervals on the prairies, usually about some swale or along a ravine or rocky knoll. Since the more complete settlement of the country, fires are not allowed to sweep the prairies, on account of possible loss of livestock and improvements. There is nothing to check the growth of the mesquite bean, and they have grown to the size of small trees, at the same time largely augmenting in number.

Other early writers likewise connected the increase in woody vegetation with the decrease in prairie fires. Lehmann (1965) quotes early accounts of fires in south Texas and suggests a connection between fire and increase of brush on the Coastal Prairie. Bray (1901) wrote:

Apparently under the open prairie regime the equilibrium was maintained by more or less regular recurrence of prairie fires. This, of course, is by no means a new idea, but the strength of it lies in the fact that the grass vegetation was tolerant of fires and woody vegetation was not.

Cook (1908) also felt that the cessation of fires was one of the

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major factors that affected the increase of brush:

That such fires were evidently the cause of the former treeless condition of the Southwestern Prairies is also shown by the fact that trees are also found in all situations which afford protection against fires . . . Nor is there any reason in the nature of the climate or the soil why trees should not thrive over the vast areas of open prairie land.

More recently, Humphrey (1953, 1958, 1964), Lehmann (1965) and others have discussed fire as a major suppressant of brush on western rangelands. There is no doubt that fires were a constant and recurring part of the Texas High Plains ecology. Lightning strikes were common, and before settlement by man, fires raced across the prairies until confronted by a natural barrier.

Even after the High Plains grasslands were settled, fires were an accepted way of life. Rickard (1934, 1945) lists grass fires and drought as the two major hazards of ranching on the plains. He reported fires of over 1 million acres on the High Plains in November of 1906. He reported another in March of 1906 that burned a strip of eastern New Mexico 150 miles long and 60 miles wide (Rickard 1929). Haley (1929) described a fire that started in Crosby County, Texas in 1879 and burned thousands of square miles before it burned itself out. He cited many large prairie fires throughout the Panhandle of Texas where hundreds of cattle and thousands of sheep died. The Pitchfork Ranch was not able to work its cattle until July of 1897 because the hands were busy fighting fires (Elliot 1945). Most of the early west Texas ranchers reported fires were caused about equally by lightning and carelessness. Jackson (1965) traced the history of wildfires on the Great Plains and commented on the influence of present day wildfires to wildlife habitat.

As the ranching industry developed on the Texas High Plains, their methods of fire control became more sophisticated. Early day cowboys attempted to stop a prairie fire by killing the first cow they came upon, splitting her open, and dragging the bloody carcass between two horses. Today, bulldozers and fire trucks can be at a fire in minutes. Although many fires start each year, they seldom burn more than a few acres.

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### THE RELATIONSHIP BETWEEN FIRE, GRAZING AND BRUSH ESTABLISHMENT

Although brush has increased and the occurrence of fires has decreased, this relationship, like all in ecology, is complex and influenced by many factors. In addition to the decrease in fires, the increase in domestic animal grazing and the development of livestock water facilities have been major factors in the spread of brush from watercourses to the prairie uplands.

The development of underground water for livestock use made possible the spread of mesquite seed to the dry areas. Prior to water development, the only water for animal use was in the temporary playa lakes that dot the prairie. These seldom held water for more than a few months. The lakes were usually dry before the mesquite beans along the streams matured. Thus, they were not transported to the grassland areas.

I have observed similar situations developing in East Africa. Areas with only seasonal surface water such as the Haud in the Somali Republic, remain relatively free from brush until bore holes are developed. As soon as a well is dug, a village springs up, domestic animals are kept year long (Hartley, et al. 1966) and brush increases.

Excessive grazing before the turn of the century aided brush encroachment. The influx of livestock and the deterioration of grasslands has been described in detail by Box (1967). The livestock boom period of the 1880's can best be summarized in the words of Bentley (1898):

Men of every rank were eager to get into the cow business. In a short time every acre of grass was stocked beyond its fullest capacity. Thousands of cattle and sheep were crowded on the ranges where half the number was too many. The grasses were entirely consumed; their very roots were trampled into the dust and destroyed. In their eagerness to get something for nothing, speculators did not hesitate at the permanent injury, if not the total ruin, of the finest grazing country in America.

This large scale denudation sped the increase of brush through exposing mineral soil for a seed bed, reducing herbaceous competition for the seedling, and lowering both frequency and intensity of

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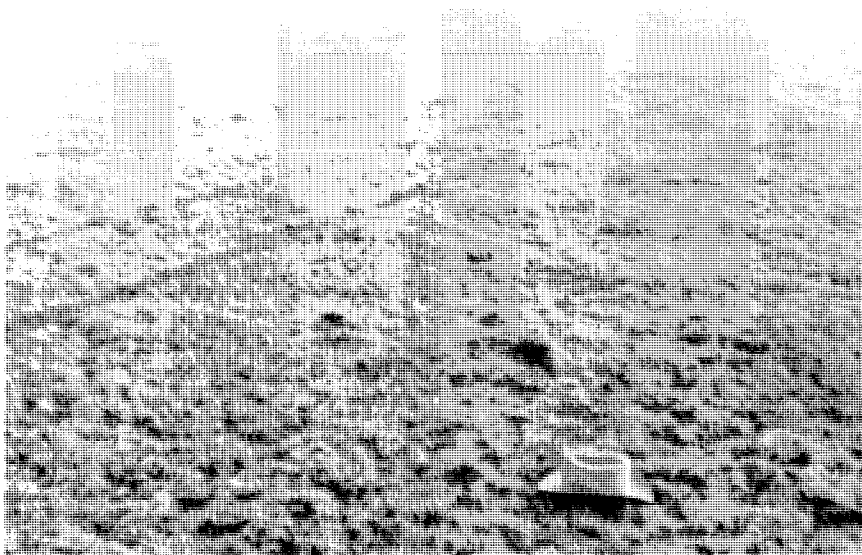


FIG. 1. A blue grama buffalo grass community in Carson County, Texas. This area burned in 1962. There is no significant difference in position or yield between this area and unburned areas adjacent to it.

fire due to reduction of fuel. Mesquite seedlings were allowed to develop into relatively fire resistant trees in the absence of hot fires. The reduction of fuel probably had more to do with reducing fires than all other fire control measures combined.

Velvet mesquite (*Prosopis juliflora* var *velutina*) seedlings have been shown to have limited susceptibility to fire. Cable (1961) found fire killed two-thirds of 6 to 12 month old mesquite seedlings. Reynolds and Bohning (1956) reported a 40% kill of mesquite trees less than two inches in diameter. Glendenning and Paulsen (1955) found a June fire killed 60% of mesquite trees less than 0.5 inch in diameter, 20% of those 1-2 inches and 11% of those over 5 inches. Cable (1965) also reported that mesquite kill decreased as stem diameter increased. Fisher (1947) reported a 31% kill of honey mesquite seedlings in a Texas study.

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Properly timed fires could be beneficial in retarding the invasion of mesquite seedlings into an ungrazed area. If the area was grazed only during the time of year when there were few ripe seeds for transport, and grass competition was vigorous, there would be little chance of brush establishing itself. Such was the case of the Texas High Plains.

### FIRE AND PRESENT DAY RANGELANDS

The west Texas rangelands today have varying densities of brush, mostly honey mesquite. Fire is not commonly recommended for range improvement. The only fires that occur are either accidental fires or experimental burns. I have examined several accidental fires in the west Texas area. All fires tend to top-kill mesquite immediately after the fire. Only a small portion of the mesquite trees are root-killed. The extent of kill appears to be related to the size of the tree and the intensity of the burn as reported for velvet mesquite in Arizona (Glendenning and Paulsen 1955, Reynolds and Bohning 1956, Cable 1961, 1965). The influence of three different single fires on the two most common shrubs on West Texas ranges is shown in Table 1.

TABLE 1: PERCENTAGES OF TWO WOODY PLANTS KILLED BY A SINGLE RANGE FIRE AT THREE LOCATIONS

Species	West Texas		West Texas		South Texas	
	% Top Killed	% Root Killed	% Top Killed	% Root Killed	% Top Killed	% Root Killed
<i>Condalia obtusifolia</i>	100	10	100	14	87	40
<i>Prosopis glandulosa</i>	100	10	76	11	72	10

We burned dense stands of tobosa grass (*Hilaria mutica*) in Garza County in April 1966. The mesquite trees had just begun their spring growth. All the trees were top-killed. About 10% were apparently root-killed. The percent mortality could not be adequately evaluated the first year following burning. Most of the trees resprouted from the base, but web worms and grasshoppers attacked the new sprouts and kept them eaten back to the base. No insects were found on the



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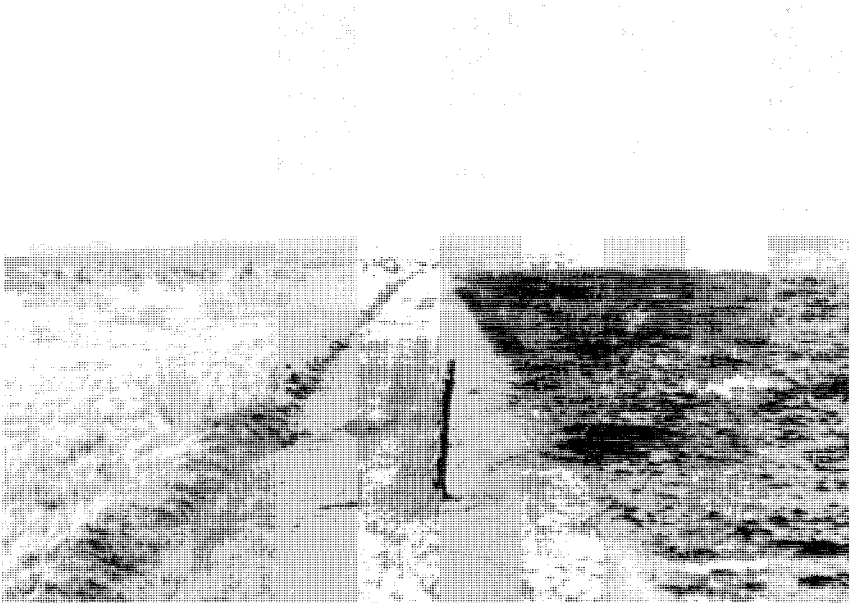


FIG. 2. An experimental burn in a tobosa grass area in Garza County, Texas. All mesquite trees on the burned area were top-killed but only about 10% were completely killed in the burn.

unburned plots. Dwyer and Gay (D. D. Dwyer and Charles Gay, New Mexico State University, personal communication) have also found insect damage to mesquite trees greater on burned areas than on unburned areas. This leads to the interesting speculation that not fire alone, but a combination of factors, may have killed larger trees before the advent of white man. We are following this lead in our current research.

Lote bush (*Condalia obtusifolia*) responded about the same as mesquite to the spring burn in west Texas.

In the summer of 1964 I examined an area of mesquite infested mixed prairie that had been burned by a wildfire in October 1963 (Table 1). The fire had occurred just before the mesquite leaves were killed by frost. There 75% of the mesquite and 100% of lote bushes were top-killed. Root-kill amounted to 14% of the lote bush and 11% of the mesquite.

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A late summer fire in south Texas top killed 87% of the lote bush and 72% of the mesquite (Box, Powell and Drawe 1967). The extent of root-kill on mesquite (10%) was no different than the west Texas burns. However, considerably more lote bushes (40%) were killed in the south Texas fires than in the west Texas burns.

The extent to which woody species are affected by fire is shown in Table 2. All are resprouting species. We have reburned this area,

TABLE 2: PERCENT MORTALITY AND PERCENT CANOPY REDUCTION OF WOODY PLANTS IN SOUTH TEXAS FOLLOWING A SINGLE BURN (BOX, ET AL. 1967).

Species	% Mortality	% Canopy Reduction
Acacia farnesiana	12	51
Acacia rigidula	14	61
Berberis trifoliolata	33	58
Celtis pallida	12	55
Condalia obtusifolia	40	87
Condalia obovata	10	68
Diospyros texana	10	83
Prosopis glandulosa	10	72
Zanthoxylum fagara	4	71

but do not have the results of the second year analyzed.

On all burns examined, single trees surrounded by dense grass suffered the greatest damage. Box *et al.* (1967) reported that trees in the center and leeward side of dense mottes received little damage. Fires carried only a meter or so into the windward side of tree clumps and stopped due to a shortage of dry fuel. The mottes or "brush islands" on the prairie so often mentioned by early explorers could easily maintain themselves in the presence of fire once they were established.

The herbaceous vegetation of west Texas rangelands are usually altered by a change in species composition, production, and vigor. Extent of alteration of the vegetation varies with the burn. I examined a February burn on a mixed prairie site where there was no significant difference between the burned and unburned areas in species composition, basal density, or number of dead plants.

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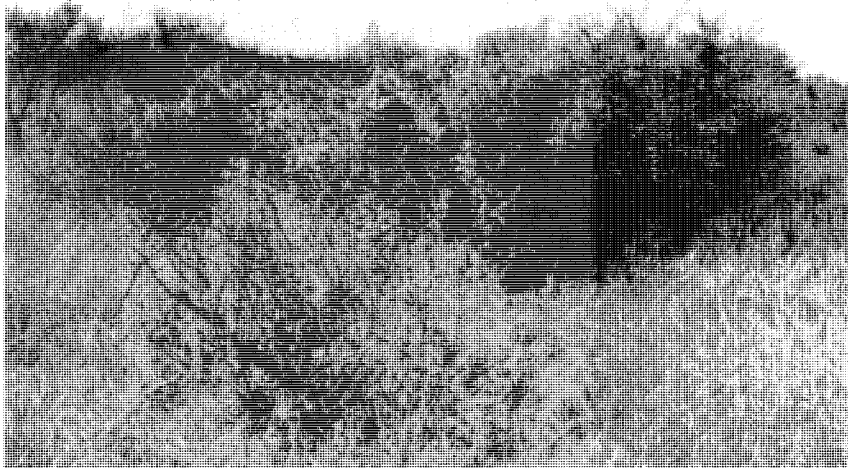


FIG. 3. A chaparral mott in south Texas one year following a burn. Note the number of dead plants around the outer area of the mott. Damage was greatest on the windward side and least on the leeward side.

On the other hand, the fall 1963 burn reported earlier, killed 25.7% of the silver bluestem (*Andropogon saccharoides*), 84.0% of the three awn (*Aristida longiseta*), 31.6% of the buffalograss (*Buchloe dactyloides*), 48.2% of the vine mesquite (*Panicum obtusum*), 40.0% of the plains bristlegrass (*Setaria leucopila*) and 72.5% of the sand dropseed (*Sporobolus cryptandrus*). Although all plants were harmed, those high in the successional scale, silver bluestem and buffalograss, were harmed least, and those low in the successional pattern, three awn and sand dropseed, were harmed most.

Trlica (1967) reported that a single fire, either in spring or fall, on mixed prairie vegetation in Carson County, Texas, improved species composition in favor of the better climax grasses. The extent of the damage on plants was always greater on "increaser" plants low on the successional scale.

### SUMMARY AND CONCLUSIONS

Brush has increased rapidly on the High Plains of Texas in recent years. This spread of brush does not represent an "invasion" so much as an increase in density and a moving of plants from lowland areas near water to upland sites. This movement was made possible by the development of surface water on the plains, excessive grazing by domestic livestock, and a decreasing frequency of prairie fires. Fires, even when they lower vigor and production of rangeland, tend to favor climax grass species. Fires tend to kill only about 10% of mature mesquite trees, but are somewhat more effective on those less than 0.5 inches in diameter. Burning alone is not an effective control of mesquite once it passes the seedling stage, but burning in combination with other ecological factors may offer promise for effective removal of mesquite from grassland areas.

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