THE HISTORICAL ROLE OF FIRE ON SOUTH TEXAS RANGELANDS

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INTRODUCTION

The human species developed and evolved in a fire environment - the grasslands and savannahs of Africa and Asia (Komarek 1967). Early man learned to use fire (Sauer 1950) but yet feared, revered, and even worshipped it. Modern man retains many of these conflicting emotions as conditioned by experience and tradition. Fire is thought of today as a useful servant but, at the same time, is still considered an agent of destruction.

Pastoral peoples have historically used fire as a tool in clearing lands or otherwise improving pasturalsands for their livestock. The advent of a more intensified agriculture and the need for more grass on smaller acreages coupled with the destructive aspects of wild fires has forced a change in philosophy away from the use of fire in land management. Increased technology in mechanical and chemical brush control techniques reinforced the attitude that fire was unnecessary and undesirable. Currently, however, a combination of factors are forcing yet another shift in attitudes back toward a reexamination of fire's potential on rangelands. Scifres (1980) lists several of these factors including economics, additional benefits, compatibility with wildlife needs, and our improved understanding of fire ecology.

There is an increased awareness of the vast difference between controlled, prescribed burning and wild uncontrolled fire. Research over the past 20 years has increased our understanding of both the rewards and penalties of the use of prescribed fire. Techniques of prescribed burning have been developed and tested. Many land managers are now much more amenable to burning than in the recent past. This renewed interest, however, should be tempered with caution and understanding. The state of the art should be examined and all possible knowledge obtained before "striking a match".

The use of fire in range management may be examined on the basis of the historical record. As Malin (1953) stated, "The first task is to ascertain and classify the historical evidence; and not until that has been done can biological investigation proceed with much profit." With this in mind, the purposes of this paper are four-fold. They are:

1. to explore the past and present aspect of south Texas ranges and explain changes that have occurred through time;

2. to trace historical events that have had a bearing on the present vegetation;

3. to develop a theoretical and conceptual framework on the role that fire has had in shaping the ranges of south Texas; and

4. to develop a foundation for materials to be presented in succeeding papers.
The area under consideration is generally bounded by Interstate 35 on the west and northwest, U.S. 90 on the north, the Gulf of Mexico on the east, and the Rio Grande on the south. This area encompasses the eastern portions of the Rio Grande Plains, the central and southern Coastal Prairies, and extensions of the Blackland Prairie vegetation regions.

PAST AND PRESENT GRASSLANDS IN SOUTH TEXAS

In order to analyze the influence a factor may have in ecological relationships, one must be able to isolate that factor and to measure any stimulus a change in factor intensity may have. Fortunately, we do have a historical record of fire in the south Texas area. We also have a record of general aspects of the vegetation over different portions of the area from 1580 to the present. In spite of inherent differences in observations and reporting by early travelers, a trend was established in vegetative change (Inglis 1964). Originally, the Rio Grande Plain was largely prairie that gradually was replaced by brush by the end of the 19th century. However, brush species have always been inhabitants of the area during historic times.

Pollen analysis from sites near Del Rio indicate that southwest Texas was relatively more moist around 8000 B.C. (Johnson 1963), but a drying trend had occurred by 2000 B.C. - 1000 A.D. Arid land trees and shrubs, such as mesquite, began to increase (Hester 1980).

The earliest historical records indicate that brush was, if not abundant, at least present in significant amounts. DeLeon, writing in 1580 of a Spanish land grant encompassing south Texas, described the country as:

"...an open country, with plains and few dense woods" ...
also, "there we find short pasture and the soil is alkali, with large and dense brush thickets..." (Duaine 1971).

Chapa (Duaine 1971) assisted DeLeon in exploring the Rio Grande near present day Reynosa in 1686. He described "level land" on the uplands but dense thickets within six miles of the river.

During the next 90 years several Spanish entradas traversed the Rio Grande Plains and Coastal Prairie regions of Texas. Captain Don Domingo Ramon traveled from near present day Eagle Pass to San Antonio in 1716 (Foik 1933). He described the area as "mesquite brush with plenty of pasturage."

Alarcon (Hoffman 1935) crossed extensive prairies southeast of San Antonio in 1718. However, on the shores of Tres Palacios and Karankawa Bays, he reported "nopal groves (nogal?), some mesquites, and clumps of small oaks and chaparral." In 1722, the Aguayo expedition explored eastward from San Antonio to the coast. Pena, diarist for the expedition recorded that "we traveled... through a woods sparsely covered with oaks and the rest of the way over a very level country" (Forrestal 1935).

Nicolas de Lafora, in 1766, traveled from Goliad to Laredo through the
middle of the Rio Grande Plains (Kinnaird 1958). He reported abundant pasturage
with some clumps of trees west of Goliad. However, once south of the Nueces
river he recorded gentle hills with mesquite, nopal, and grass. Abundant pas-
turage with nopal and shrubs were found below the confluence of the Frio and
the Nueces. A year later Solis traveled north from San Ygnacio, below Laredo,
to Goliad and noted "prairies and hills dotted here and there with chaparral,
mesquite, and prickly pear" (Forrestal 1931).

Jean Louis Berlandier made several trips through the Rio Grande Plains and
Coastal Prairies in the late 1820's and early 1830's (Berlandier 1834). In
general, the Rio Grande Plains were little changed from the late 1700's. Ex-
tensive prairies with mottes of brush were common. Stream beds were heavily
wooded. He noted oak mottes in the Hochheim Prairie area, and recorded scat-
tered mesquite and oaks on the upper Coastal Prairie. The lower coast was
largely open grasslands with scattered brush.

Traveler reports are much more common in the late 1830's and 1840's after
Texas gained its independence from Mexico and the country became more settled.
Immigrant guides (Bonnell 1840, Ikin 1841, Lawrence 1840), soldiers (Churchill
1935, Smith 1917, McClintock 1930, Furber 1857), and military reconnaissances
(Michler 1850, Hughes 1846) all noted aspects of the vegetation. Sibley (1967)
pointed out that travelers crossing the upper Coastal Prairie were impreased
by the abundant grasses, the "vast prairies," and the lack of trees. On the
lower coast, however, they often noted clumps of oak, mesquite, and other
brush species.

Throughout the latter half of the 1800's brush steadily increased in density
(Lehmann 1969, Bogusch 1952, Inglis 1964) and/or visibility (Johnston
1963). For the past 100 years the Rio Grande Plains has been known as the
brasada, monte, or brush country. The prairies referred to by early travelers
have disappeared and have been replaced by a complex of about 281 brush
species. The Coastal Prairie also has changed and is still changing. Open
prairies have been reduced in size as brush mottes have grown larger and join
together. More than 93% of the Rio Grande Plains and 34% of the Coastal
Prairie (excluding cultivated land) has some degree of infestation of brush
(Smith & Rechenthin 1964).

ECOLOGICAL FACTORS INFLUENCING VEGETATION

The vegetative complex in any area is the result of a multiplicity of
environmental factors--primarily soil characteristics, climate, and biotic
influences. The intensity and interactions of each will affect species com-
position, life form and aspect of the vegetative cover. Local relief and
topography will further modify each of these.

Soil

The south Texas area contains a diversity of soil types ranging in texture
from fine sands to clays. The "Wild Horse Desert" is an area of deep eolian
Sands. Sandy loam soils are located throughout the south Texas region. These may be deep or fairly shallow underlain with a clay horizon. The northern and central Rio Grande Plains are characterized by moderately deep to deep, moderately coarse to coarse-textured mixed soils. Caliche outcroppings and gravel ridges are common. Calcareous clays characterize much of the Coastal Plain. Stream beds contain deep alluvial, loamy, mixed soils.

**Climate**

The general climate of the area is humid, subtropical with hot summers and cool winters. The frost-free period is approximately 260 to 330 days. Average annual precipitation ranges from 18 to 32 inches but varies from month to month and year to year. The primary rainfall peak, April, May and June occurs because of thunderstorm activity while the late August and September peak results from tropical disturbances in the Gulf of Mexico (Box, et al. 1978). Periodic droughts are common and frequently are severe. Eleven drought periods occurred in the Mexican state of Coahuila from 1774 to 1863 (Harris 1975). Waldrip (1957) records extended droughts on the Rio Grande Plains in the years 1892-1902, 1916-1917, 1938-1939, and 1950-1956. Records indicate that rainfall amounts below 75% of average can be expected two out of every five years.

**Biotic**

Prior to the 1700's south Texas vegetation was not subjected to significant grazing pressure. Bison were found in the northern portions of the Rio Grande Plain and the Coastal Prairie but were rarely found south of the Nueces. The primary grazing animal was white-tailed deer. A few pronghorn antelope were also found in the region.

Horses, cattle, and sheep were introduced by the Spanish in the early 18th century (Lehmann 1969). Domestic livestock escaped, survived in a feral state, and multiplied so that most travelers reported "immense herds of wild horses" (Bonnell 1840, Holton and Butler 1956, etc.). Lehmann (1969), however, provides convincing evidence that livestock numbers were cyclic and never existed in numbers reported by early travelers.

Man has long existed in south Texas and northern Mexico (Epstein 1972). His influence on the ecology of the prairies will be discussed later.

Weaver and Clements (1938) proposed that vegetation is controlled chiefly by climate so that a "climatic climax" is eventually obtained. Disturbances would cause an earlier seral stage to establish and the process would repeat itself. Successional theory thus allows for forest, Savannah, and grassland climax communities under varying climate regimes. McBryde (1933) analyzed the vegetation of the Carrizo Sands in Texas and concluded that edaphic factors influence the composition and local distribution of plant associations and effects of climate are reflected in gradual changes. Wedel (Humphrey 1962) has carefully analyzed and evaluated our knowledge of grasslands and concluded
that climate is the major factor in determining vegetation. Some local conditions, such as hard pans, may maintain grasslands.

These viewpoints have their detractors however. Sauer (1950) believes that there is no evidence to support a climatic grassland climax. He cites different areas with similar climates supporting woodlands, brushlands, and grasslands. Moist prairies can support forests and arid plains can support xerophytic brush and shrub species (Stewart 1956).

Ecological characteristics of south Texas indicate that a shrubland climax should be the dominant vegetative complex. The mixed brush and Acacia ridge associations are probably the climatic determined communities in south Texas. Species composition and aspect are modified by soil characteristics and past management. If this was the case, some non-geographic ecological factor was responsible for the formation and maintenance of reported grasslands. A considerable number of writers believe fire has been a major determinant of early south Texas grasslands (Bray 1901, Cook 1908, Humphrey 1962, Johnston 1963).

HISTORICAL ASPECTS OF FIRE

If, indeed, fire has exerted an influence on south Texas vegetation the question remains as to what extent. Characteristics of fire such as causes, occurrences, and effects need to be examined in order to answer this question. The causes of fire may be divided into human and non-human (natural) sources. Occurrence characteristics, such as season of the year, frequency, extent, and intensity influence the impact fires have had on vegetation. Fire effects should be reflected in the relative tolerance of species to fire, adaptive mechanisms, and the visible aspect of vegetation.

Causes and Occurrences

Natural events kindled fires long before the advent of man in south Texas. Fuel, oxygen, and an ignition temperature source are the necessary ingredients. The first two components were relatively plentiful during most years. Natural heat may have come from several sources. Volcanic activity can be ruled out. Spontaneous combustion in canebrakes has been reported (Kilgore 1980, Bayley and Odum 1976). Canebrakes are relatively common in the upper Coastal Prairie and fires in these brakes have caused extensive prairie fires (Anon. 1834). In Texas, it is doubtful if many situations allowed fuel buildup and the heat necessary for combustion except in these brakes.

Wilcox (In Lott and Martinez 1953) perhaps was searching for causes when he suggested the possibility of "sparks from flint stones striking together as they were thrown by the running hoof of some animal." He does mention lightning as a source of fire in prairies near Laredo.
Lightning discharges have bombarded the earth daily throughout its history. These vary in number in both time and space in tune with global weather patterns (Komarek 1967). Komarek (1968) designates the south Texas area as part of the "central grasslands lightning fire bio-climatic region." It is an area of intense thunderstorm activity and the tall and midgrasses of the area are highly flammable. These factors combine with low rainfall, erratic weather patterns, many severe dry lightning storms, and searing droughts to form a highly critical fire environment (Komarek 1968). Given the fairly continuous fine fuel supply of grasses found on the Coastal Prairie under these conditions, lightning-caused fires probably were frequent. Records indicate that an average of 1 to 5 fires are ignited by lightning in this area per million acres each year (Schroeder and Buck 1977). Today, Texas Forest Service records indicate that only 1.2 to 2.2% of modern rural fires in Texas are started by lightning. In 1977, 2.2% of 4,929 fires covering 449,867 acres involved lightning (Ken Burton 1980).

The incidence of grass fires must have increased dramatically when humans settled in south Texas. Archeological evidence suggests that the Rio Grande Plains has been occupied throughout the period of 5000 B.C. to 1000 A.D. (Nunley and Hester 1966) and into the 1500's (Hester, et. al 1975, Hester, White, and White 1969). The numerous groups of interior Indians belonged to a Coahuiltecan cluster whereas Karankawa bands roamed the coast (Newcomb 1961). Karakawas were present from the late prehistoric period until the mid-1800's (Campbell 1958, Cherry and Torrance 1973). There is some evidence of commerce between the coastal and inland Indians. Seashells have been found in interior middens (Hester 1970).

The Coahuilecans occupied a well-defined area of south Texas but led a wandering life dictated by food supplies (Newcomb 1961). Their use of fire ranged from ceremonial to insect control. Alvar Nunez Cabaza de Vaca (Smith 1871) related that, in 1534, coastal Indians burned smoky fires to drive off mosquitos. Also,

"The Indians of the Interior have a different method, as intolerable, and worse even than I have spoken of, which is to go with brands in the hand firing the plains and forests within their reach, that the mosquitos may fly away, and at the same time to drive out lizards and other like things for them to eat. . . . . They are accustomed also to kill deer by encircling them with fires. The pasturage is taken from the cattle, by burning, that necessity may drive them to seek it in places where it is desired they should go."

Ehrenberg (Churchill 1935), Newcomb (1961), and Hodge (1907) all relate instances of burning of grasslands for hunting purposes. DeLeon (Duaine 1971) gives a lengthy discourse on Indian customs in the 1600's including their use of fire for food preparation, signaling, and ceremony. Solis (Forrestal 1931) inspected the Goliad and Refugio missions in 1767 and reported on Indian uses of fire.

The early Spanish entradas are strangely silent on the subject of fire.
Berlandier (1834) indicates that south Texas was occupied by roving bands of Lipan Apaches and Comanches in the late 1820's and 1830's. The country around Gonzales was "the abode of Tonkawas, Karankawas, and Comanches." He makes several references to burning of the prairies by Indians. Berlandier (1834), on the Nueces River between Laredo and San Antonio, reported that the Mexican soldiers journeying with him "fired the prairies in order to lodge more freely." Also, northeast of San Antonio that:

"camp fires that travelers leave there sometimes, stirred by the winds, are communicated to the grass, the latter set fire to the trees, and the forest is set afame. The fire produces great ravages."

Later he wrote that on the Coastal Prairie near Refugio:

"......rattlesnakes fleeing the grassy areas which were on fire, that the Indians or the travelers had destroyed."

The majority of travelers in Texas in the 1830's described only the area north of the Nueces River since few journeyed across the unwatered land south of the river. Most travelers mentioned the presence of fire on the upper Coastal Prairie. Thomas Drummond, a naturalist, apologized to a colleague for the lack of insects in Texas due to "frequent burning of these lands" (Geiser 1937). Others refer to the use of fire as a management practice (Parker 1836, Anon. 1834). Mary Austin Holly relates an experience of a friend purposely igniting the prairie near present day Freeport (Hatcher 1933).

Benjamin Lundy, an abolitionist with dreams of locating a sanctuary for freed slaves, traveled south Texas and northern Mexico in the 1830's (Lundy 1847). Near Agua Dulce creek he observed that "......trees would soon grow up, in the lower places, if the fires were kept down." He also remarked on smoke in the air due to the Indians burning the grass on their hunting grounds near Gonzales.

Ehrenberg (Churchill 1935), while traveling to San Antonio during the Texas revolution, records a prairie fire attributed to Indians. He later escaped the Fannin massacre and described his path between the Guadalupe and Lavaca rivers as a "bare plateau, the grass on which had recently been burnt."

The advent of the 1840's brought a renewed surge of travel across the Coastal Prairie and onto the Rio Grande Plains. Naturalists, settlers, immigrant guides, and soldiers recorded incidents of fires on the prairies. Ikin (1841) refers to the "annual burning of dry grass on the prairies....." The Reverend A.B. Lawrence (1840) describes the prairies and explains the lack of timber is due to accidental or purposeful burning. Bracht (Schmidt 1931) bemoaned the fact that Texas had a lack of forested land. His observation was:

"That region produces excellent grass and possesses rich black
soil. He who knows these regions will have observed that, as soon as the needless prairie fires cease, small brush and young forests appear within a space of few years without the assistance of man."

Explorations and activities associated with the war with Mexico brought many persons into the south Texas area and Rio Grande Plains proper. Settlers were using fire to "burn weeds and old pasturage, so as to make room for new grass" on the upper coast (Hollon and Butler 1956). Accidents and carelessness probably remained the primary human cause of fires south of the Nueces. Bollaert observed prairie fires near the Nueces in 1844 (Hollon and Butler 1956). Hendricks (1919) observed that the prairie had burned as the result of escaped campfires near the San Miguel Creek and the Rio Frio.

General Taylor’s troops marched from Corpus Christi into Mexico in the spring of 1846. Several members of this army reported on evidence of fire south of Corpus Christi. McCall (1868) saw burned prairie near Agua Dulce; Smith (1917) and Henry (1950) both reported that Mexicans had fired the prairie in front of the army; and McClintock (1930) reported areas burned south of San Patricio by fires spread from soldier and Indian camps. Furber (1857) also observed as he crossed the sands of Kenedy and Jim Hogg counties that "the vast prairie had recently been run over by fire, and the young grass had not well sprung up."

In the 1850’s, Frederick Clingsted (1857) traveled through Texas. He recorded that a companion was attempting to burn off a small circle of grass so a campfire could safely be used. A gust of wind caused the fire to escape and spread across the prairie. He also recorded evidence of a recent fire near Gonzales and, later, "saw the sun go down, buried and swollen, in the smoke of a distant prairie fire." Clingsted also described a man “firing the prairie” between the Guadalupe and San Antonio rivers near Victoria.

Further south, in 1852, Bartlett (1854) observed a prairie fire near the western edge of Kleberg County.

Burning for pasture improvement was still practiced in the 1880’s (Holdsworth 1980, John M O'Brien 1980). Accidental burns also occurred with the accompanying attitude that fire was detrimental (Meek, quoted in Lehmann 1969). Range conditions were changing on the Rio Grande Plains so that by the turn of the century Smith said that "grasses exist so sparsely that the destruction of brush and cactus by fire is almost out of the question...." Burning was still practiced on the Taft Ranch near Sinton in 1909 (Stephens 1964).

Fire Characteristics

Characteristics of fires such as season of burning, frequency of burning, the extent of area and intensity of the fires can, in most cases, only be inferred from the literature. The often fragmentary, biased approach of writers leaves an incomplete record of such characteristics. Each will be discussed separately.
Season: It is logical to assume that most fires occur during periods when fuel is dry. In south Texas this occurs most often in the summer and winter months. Thunderstorms are more common in the summer so lightning-caused fires would occur most often at that time. Mosquitoes are most troublesome during the summer so insect control fires would have been set by the Indians during these months. Hunting fires on the Rio Grande Plains were probably limited to late winter and spring as de Vaca (Hallenbeck 1940) relates the Indians subsequently subsisted on prickly pear tunas and various sea foods.

References to winter and spring fires outnumber summer and fall references three to one. Fires were set twice a year for management purposes (Hollon and Butler 1956, Ikin 1841) on the upper Texas coast. Parker (1836) stated:

"The prairies are all burnt over twice a year -- in mid-summer and about the first of winter....."

Frequency: The only inference that can be made in regard to frequency of fires is discussed above. Ikin (1841) refers to the annual burning of pastures. Bracht (Schmidt 1935) uses the term "frequent fires in winter."

Extent: Presettlement prairie fires were evidently large and extensive. On the Coastal Prairie, with no natural fire breaks except streams, the continuous fuel load could feed a fire for miles. The Rio Grande Plains was similar except in the more arid portions where shallow ridge vegetation may have formed a discontinuity. This would limit fires to the valleys, ramadero sites, and hillsides. Stream beds usually did not provide sufficient fine fuel to carry a fire.

LaSalle's company (near present day Jackson County) traveled over "plains that had been burnt" (Joutel 1714). Drummond (Geiser 1937) complained that the whole country from the Rio Colorado to the Guadalupe (a distance of 80-90 miles) was barren of grass because of a recent burn. In 1838, a member of a recreational outing intentionally set fire to the prairie near the mouth of the Brazos with the result that a "line of flame extended right and left 8 or 10 miles" (Hatcher 1933). Similar fires were reported near Rnahuac that burned for over a week over a wide area (Anon. 1834). Ehrenberg (Churchill 1935) described a range fire between San Antonio and Gonzales after which his company marched an entire day.

Taylor's army often marched for a day over burnt prairies (Smith 1917). McClintock (1930) stated:

"The troops and Indians had left fire where ever there was water, which getting in the dry grass had burned over the whole surface of the country. In places no grass was to be found for a distance of 20 to 30 miles."

These accounts should not be regarded as unusual. In August, 1980, a
range fire between Sonora and San Angelo burned nearly 40 square miles (Corpus Christi Caller-Times 1980). A recent fire in Coahuila, Mexico, burned 17,000 acres.

Intensity: Intensity of fires depend on fuel loads and strength of the wind. In the Coastal Prairie fire fuel load is usually high and winds from the Gulf are strong enough to create a fairly intense fire.

Such may not be the case over much of the Rio Grande Plains. The area is subject to periodic droughs and fuel supply varies. However, even the poorer range sites (shallow ridge) in Jim Wells County during unfavorable years had the capability of producing 1000 lbs. of forage/acre (Menzenmayer 1979). This is enough fuel to carry a moderate fire. The more favorable sites during wet years could produce up to 8000 lbs. of forage/acre/year. Sites in Starr County could produce from 300 lbs. to 6000 lbs. per acre depending on the year (Thompson, Sanders, and Williams 1972). Intensity of fires would have varied from area to area and from year to year. Valley areas would have been more susceptible to hot fires in three out of five years because of drouth patterns.

Range fires were evidently very common in south Texas. Most fires occurred during the drier months of the year and probably covered large areas. They were fairly frequent, burning the same area regularly. Intensity varied with fuel load. Prior to grazing, enough fuel was generally present to carry a fire hot enough to affect woody vegetation.

Effects of Fire: Several characteristics of grasslands result directly from the influence of fire. Species composition will reflect those plants most tolerant to frequent fires. Fire tolerant plants have developed survival mechanisms that resist fire influences. Also, frequent fires may alter the visible aspect of an area—the appearance of the vegetation.

The climax grass species in south Texas are mostly warm season, perennial bunchgrasses. The interior, more arid regions supported buffalograss and curly mesquite grass. All of these grasses are relatively fire tolerant. Common native grasses today include the windmillgrasses, threeawns, fall witchgrass, and some lovegrasses. Under a burning program and good management, desirable native grasses such as plains bristlegrass, California cottontop, pink pappusgrass, and vinemexquite will reoccupy the site (Scifres 1980). This situation shows that the desirable, nutritious native range grasses of south Texas can withstand fire, are assisted by it, and probably developed under it.

The shrub complex in the area also exhibit mechanisms that enable it to tolerate fire. Ninety-five per cent of the upland shrubs on the Rob and Bessie Welder Wildlife Foundation in San Patricio County sprout from the root crown when the top is removed. Others, such as live oak, have the ability to root sprout and form large colonies.

The visible aspect of vegetation in south Texas has often led to confusion
in the literature. The extensive prairies were often visibly dominated by grasses but actually contained many small shrubs (Furber 1857, Bartlett 1854, McClintock 1930). Several travelers in early Texas remarked that the brush exhibited a "peach orchard" effect (Malin, quoting Marcy in 1854 [1953], Lundy 1847, Lawrence 1840). The pruned lower branches and lack of undergrowth could well be the effect of fire. Wright, Bunting and Neuenschwander (1976) reported that a fire within 1.5 years of seedling emergence would kill up to 100% of the survivors but not harm the mature trees. Holdsworth (1980) remarked that "...there was a bush here and there...The mesquites were what we called 'gotch'...you could see under them for some distance." Secondary succession and grass regrowth could also lower invasion success of mesquite and other shrubs (Sciﬁres, Brock, and Hahn 1971).

Brush was often noted on the shallow caliche ridges. The lower grass production in these areas would negate a continuous hot fire. Blackbrush and other shrubs were well established here (Holdsworth, 1980) and were not damaged to a great extent by fire.

LAND USE, REDUCTION OF PRAIRIE FIRES, AND VEGETATIVE CHANGE

Lehmann (1965) describes the Coastal Prairie as an assemblage of prairies bounded by woodlands. Early travelers on the Rio Grande Plains spoke of thickets and mottes of brush. In the late 1800's these woodlands and thickets began to close together. This basically has been a function of several interacting factors.

Cattle and sheep have been pastured in south Texas since 1717 (Lehmann 1969). Their numbers have fluctuated according to climatological, sociological, and political conditions. Localized overgrazing took place, particularly near the few watering areas, but generally was not a problem. Livestock consumption of beans, pods, and other fruits from shrubs and the deposition of these seeds in the overgrazed areas assisted in vegetative change. The nomadic livestock could move to new pasturage thus deferring used areas. Most of south Texas was fenced by the 1890's, and fencing did much to promote brush increase by restricting livestock movements and promoting overgrazing (Bogusch 1952).

At the turn of the century ranges were being plowed, farms were being established, and roads were being built. This had the effect of isolating many previously large blocks of rangeland. Ranchers were becoming increasingly careful of fire and discouraged its use.

The previously good grass cover had restricted seedling establishment of brush. Seeds were held off the ground and periodic fires destroyed them and young seedlings. Larger plants were top killed. Grazing allowed this cycle to be broken. Fires eventually were reduced because of lack of fuel and rancher diligence. As a result, woody plants began to spread. Evidence of this is occurring today on Kansas bluestem prairies protected from fires (Bragg and Hulbert 1976).
The evidence from historical and modern sources points out that inter-
actions of climate, soil, and land use, as modified by fire, have created the
vegetational complex we have today. Lehmann (1969) appears to be correct in
his view that brush spread as white man settled the country—and broke the
age-old cycle of fire.

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