

CHANGES IN WILDLIFE HABITAT COMPOSITION FOLLOWING BRUSH CONTROL PRACTICES IN SOUTH TEXAS¹

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Most South Texas rangelands are covered with varying degrees of brush. Although this brush usually reduces the carrying capacity for domestic livestock, it provides suitable habitat for such big game animals as white-tailed deer, javelina, and wild turkey. However, since domestic animal production is reduced on dense brushlands, many landowners practice some form of noxious plant control.

Brush composition in the South Texas area is complex; it is not uncommon for as many as eight or ten species to make up the plant composition commonly referred to as "chaparral." Since most species differ in physiological responses to herbicides, chemical treatment of brushlands is seldom completely successful. Too often control of one species releases another more noxious one. Therefore, widespread use of such mechanical brush control measures as root plowing, chaining, shredding, etc. is practiced.

It has been estimated that prior to 1958, over 9,600,000 acres of South Texas brushlands had been treated for brush control (Carter, 1958) and many thousands of acres of brush have been cleared each year since that time. Until recently, little thought was given to the effects of the large-scale brush control treatments on wildlife populations and habitat. Lehmann (1960) proposed methods and techniques for incorporating brush control practices with game management objectives. The effect of brush control on the diet and movements of game populations has been studied by Davis *et al.* (1962) and Davis and Spicer (1963).

The effects of brush control on wildlife populations varies with the environmental conditions. Goodrum and Reid (1956), Reid and Goodrum (1957), and Goodrum (1960) reported brush control to be detrimental to some forms of wildlife. Halls and Crawford (1960) found the most desirable deer ranges in areas of disturbance in the forest of Arkansas. In California, Biswell *et al.* (1952) found mule deer to be four times more abundant on brush-controlled areas than on untreated ranges.

Each game habitat is desirable or undesirable in relation to the combination of plant species present. Each plant species in the habitat responds to brush control practices in a different manner. Therefore,

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the game manager may actually manipulate the relative amounts of various plants by using different "control" techniques. The field is no longer one of "brush control" but one of habitat manipulation or "brush management."

The South Texas area offers a unique challenge to wildlife workers. The flora is especially rich, containing more than 1300 species (Jones *et al.*, 1960) of flowering plants of tropical and subtropical origin (Gould and Box, 1959). Plant production is relatively high, with seasonal peaks in the spring and in the fall (Box, 1960). Distinct plant communities occur in relation to the soil types of the area (Box, 1961). The great diversity of habitats and available organisms to fill them present ideal conditions for evaluating the effects of brush manipulating techniques.

In general, brush-control practices change the wildlife habitat in two ways: by altering the composition, height and density of plant cover, and by changing the relative availability of food plants. Almost all mechanical brush control methods used in South Texas totally destroy cover for big game unless blocks or strips are left specifically for cover purposes. However, regrowth of treated plants begins almost immediately, and within five to fifteen years, cover is generally adequate for wild animals.

Food availability is changed in several ways. On areas where the soil has been severely disturbed, such as by root plowing or bulldozing, the early successional stages are filled with forbs and annual plants which offer increased seasonal production. Animals tend to concentrate on such areas where the weedy plants are young. Likewise, resprouting of brushy species provides palatable browse which is easily accessible.

Since brush species respond differently to treatment, the relative composition of browse plants is affected differently by each control treatment. This change in composition is one of the most important changes in the habitat for game animals.

The extent to which brush control alters composition was demonstrated by a study on the Welder Wildlife Foundation near Sinton, Texas. In 1960, brush-control plots were established on two soil types on the Welder Refuge. Several areas, each approximately 80 acres in size, were cleared with a root plow on Medio Fine Sandy Loam and on Victoria Clay. The blade was drawn behind a crawler tractor and held approximately 8 to 12 inches below the soil surface. In 1961, portions of the root plowed areas were raked with a large root rake drawn behind a crawler tractor in an attempt to pull the remaining shrubs from the soil.

Fifteen 100-foot line intercepts were established on each area that

TABLE 1. RELATIVE PERCENT COMPOSITION OF WOODY SPECIES ON TWO SOIL TYPES FOLLOWING BRUSH CONTROL PRACTICES IN SOUTH TEXAS

Plant	Medio FSL			Victoria Clay		
	No Treatment	Root Plow	Rake & Root Plow	No Treatment	Root Plow	Rake & Root Plow
<i>Acacia farnesiana</i>	2.0	4.3	10.6	1.0	3.7	3.7
<i>Acacia rigidula</i>	18.5	5.3	3.8	21.0	7.4	13.7
<i>Acacia tortuosa</i>	10.0	8.2	3.8	1.1	2.7	7.5
<i>Berberis trifoliolata</i>	T	T	T	19.9	46.2	11.2
<i>Calliandra conferta</i>	1.0	49.3	47.5	3.3	4.6	12.5
<i>Celtis pallida</i>	7.4	5.3	6.5	1.1	9.2	25.0
<i>Condalia sp.</i>	5.0	1.0	12.5	19.3	8.2	6.2
<i>Diospyros texana</i>	4.0	1.0	2.3	1.9	T	1.2
<i>Prosopis glandulosa</i>	44.5	2.9	4.1	1.1	3.7	12.5
<i>Zanthoxylum fagara</i>	3.0	2.8	4.6	1.6	12.9	6.2

had been root plowed, root plowed and raked, and on check areas that had not been treated. Data from the intercepts were used to compare the relative abundance and availability of the major woody plants on areas that had been subjected to each type of control.

The Medio Fine Sandy Loam site had been a live oak savannah (*Quercus virginiana*) with the interspaces between the live oaks filled with chaparral approximately six feet tall. Ten species of brush plants were present in the chaparral complex. Mesquite (*Prosopis glandulosa*) was the dominant shrub, comprising 44% of the total vegetation (Table 1). Mesquite, blackbrush (*Acacia rigidula*), and screw bean (*Acacia tortuosa*) made up approximately two-thirds of the total brush cover.

Following root plowing and raking, none of the three most abundant shrubs contributed as much as 5% to the total composition. Other species, rather obscure in the original composition, increased greatly. False mesquite (*Calliandra conferta*) made up almost half of the woody cover on the brush controlled areas. False mesquite, huisache (*Acacia farnesiana*), and lote (*Condalia sp.*) increased from a total of only 8% in the original vegetation to almost two thirds of the composition following root plowing and raking.

Several woody species maintained essentially the same percentage composition before and after root plowing. For instance, varying amounts of granjeno (*Celtis pallida*), Mexican persimmon (*Diospyros texana*), and prickly ash (*Zanthoxylum fagara*) existed under different treatments, but the differences between treatments were not statistically significant.

Cactus densities are generally increased by mechanical brush control techniques. Both tasajillo (*Opuntia leptocaulis*) and prickly pear (*Opuntia lindheimeri*) were present on the Medio Fine Sandy Loam plots. Tasajillo increased 600% after root plowing (Table 2). Apparently the original plowing broke many of the older plants and scat-

TABLE 2. REACTION OF TASAJILLO (*OPUNTIA LEPTOCAULIS*) TO BRUSH CONTROL PRACTICES ON MEDIO FINE SANDY LOAM.

	Check Plot	Root Plowed	Root plowed & raked
Density	0.2	1.4	0.4
% increase in density	—	600.0	100.0
Relative % Composition	0.4	19.8	4.1

tered them over the area. The subsequent raking killed some of those already established.

Prickly pear was not present in sufficiently large quantities to obtain an adequate sample with the sampling method used in this study. However, observations of other South Texas brush-control projects showed that prickly pear may be scattered by root plowing.

The Victoria Clay site was dominated by a Chaparral-bristlegrass Community. Blackbrush, lote bush, and agrito (*Berberis trifoliolata*) comprised approximately two-thirds of the composition (Table 1) before control practices. After control, blackbrush, mesquite, false mesquite, and granjeno comprised about two-thirds of the vegetation on the clay sites. Agrito and prickly ash increased in relative abundance after root plowing only, but decreased where the root-plowed area was raked. The root plow loosened the plants in the soil, but they apparently re-established themselves unless plowing was followed by raking.

There was a significant interaction between brush species and soil types. Over 98% of the mesquite plants were killed by brush control practices on the fine sandy loam while only 18.7% and 81.2% were killed by root plowing, and root plowing and raking, respectively, on clay soils (Table 3). Granjeno populations were reduced by three-fourths or more on sandy soils, but actually increased on clay soils.

Some of the differences in species response may be explained by the soil types on each site. Victoria Clay is a grumosol, primarily composed of montmorillonite. When moisture is available, the clay tends

TABLE 3. PERCENT REDUCTION IN DENSITY OF WOODY SPECIES ON TWO SOIL TYPES IN SOUTH TEXAS FOLLOWING BRUSH CONTROL.

Species	Medio Fine Sandy Loam		Victoria Clay	
	Root Plowed	Root Plowed & Raked	Root Plowed	Root Plowed & Raked
<i>Acacia farnesiana</i>	(27.3)*	(57.1)*	0.0	25.0
<i>Acacia rigidula</i>	92.6	95.0	91.3	86.7
<i>Acacia tortuosa</i>	84.2	91.3	28.5	42.8
<i>Berberis trifoliolata</i>			74.8	95.6
<i>Calliandra conferta</i>	(750.0)*	(941.4)*	65.9	31.8
<i>Celtis pallida</i>	89.2	78.9	(105.8)*	(241.2)*
<i>Diospyros texana</i>	95.0	95.0	—	84.0
<i>Prosopis glandulosa</i>	98.7	98.8	18.7	81.2
<i>Zanthoxylum fagara</i>	84.6	69.2	86.5	34.8

* Numbers in parenthesis indicate a percent increase in density.

to stick to the plant roots and such resistant species as mesquite may survive. On the other hand, the Medio Fine Sandy Loam is easily shaken from the plant roots and the treated plants are more easily killed.

Screw bean and huisache increased greatly on sandy soils after control, but were either reduced in abundance or exhibited no change when control was attempted on clay soils. Observations of brush control projects in the local area showed that huisache was usually the dominant brush species on old root-plowed areas. Evidently, huisache seed can lie dormant for many years and sprout when the soil has been disturbed.

Mexican persimmon, blackbrush, prickly ash, and agrit were reduced in density on both soil types by plowing and raking. However, their reaction to treatment was essentially the same for both soil types.

Data from this study show that many individual brush species do not respond the same to similar treatments on different soil types. Likewise, plants of different species on the same soils will differ in response to various treatments. The combination of the dozen or more mechanical brush-control practices now in use in South Texas with the innumerable soil types present offer possibilities for the game manager to manipulate the habitat to obtain the type and density of browse species he desires for the game population concerned.

Numerous observers have reported deer moving into brush-controlled areas to feed (Davis *et al.*, 1962, 1963). Preliminary results from experimental brush control plots on the Wedder Wildlife Refuge indicate that deer use areas controlled by different methods at different times of the year. For instance, areas where the soil has been disturbed are used most heavily when the weedy plants are in the young and tender stages. Therefore, newly root-plowed areas offer a good source of seasonal feed for a deer herd. On the other hand, when the herbaceous plants are dry or dormant, deer prefer areas that have been cleared by chopping or shredding. The large shrubs have been reduced in height and there is an abundance of fresh regrowth for the animals.

Brush control is an established range improvement practice in South Texas. The land is almost totally privately owned, and the owners must make a profit from their ranching operation. Therefore, brush control is likely to increase rather than decrease in the future.

Brush removal affects game populations through change in cover and food availability. Research must answer the questions of the amount and kind of both food and cover that is necessary for the maintenance of optimum wildlife populations. Systems of brush

management can be designed that will allow for rotational control to provide adequate regrowth for cover. Brush-control methods can be selected that will yield the best possible combination of food and cover plants on each soil type. Both the rancher and the game manager must think in terms of a brush-management program other than brush eradication. With proper research information and advanced planning, brush ranges may be managed for increased yields of both wild and domestic animals. The problem is simply one of keeping the correct successional stages present in the desired proportions and distributions.

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DISCUSSION

MR. CHARLES WALLMO (Arizona): You suggest that there are benefits in terms of food for deer and detriments in terms of cover as a result of brush clearing. Presumably there are patterns and percentages that would be most desirable and also most desirable time sequences if these food benefits are lost in time.

Can you make any suggestions regarding desirable patterns and desirable time sequences of treatment?

MR. BOX: We have started some preliminary studies on just this thing but we do not have data on it as yet insofar as the length of time it takes for these plants to regrow, the patterns to develop, etc. However, there is a very definite relationship in connection with all of this.

We know that using certain types of control, where you simply knock the brush down, such as shredding, roller chopping and so on, we get an immediate regrowth. My idea is to work this into some range management practice where we can actually rotate our brush control in order to have open spaces for deer. This

438 TWENTY-NINTH NORTH AMERICAN WILDLIFE CONFERENCE

is, in effect, the thing I talked about earlier—to have some food available low on the ground to keep the deer happy. Then, in 15 years, we can control the areas that are left and also, by that time, some of these other plants will have grown back.

I think it is a matter of understanding the principle well enough to know when to control plants and when to leave them for cover purposes. As I say, we are just starting these studies and I have not received the information on it as yet.

VICE CHAIRMAN TOWNSEND: I would like to make one small comment on this paper.

It is extremely interesting to me, being in the business of multiple use and land management, that we have come from the point of brush eradication to brush treatment when we found we could not kill all of it. Now we are apparently getting down to business with brush management. It is very heartening to me and I am sure to many of us here, that this type of research is being carried on. Of course, it is certainly necessary.

ELK AND DEER HABITAT USE OF A PINYON-JUNIPER WOODLAND IN SOUTHERN NEW MEXICO¹

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Pinyon-juniper woodland is valuable winter, and sometimes year-long, range for elk, deer, and livestock in Arizona and New Mexico. This woodland is also found in Colorado, Utah, and Nevada. Total acreage amounts to about 74 million acres (U. S. Congress, 1936). Maintenance and improvement of productive capacity of this woodland can greatly benefit both game and livestock.

Within the recent history of livestock grazing in Arizona and New Mexico, juniper has greatly thickened and even spread into some adjacent grasslands (Parker, 1945). Stockmen have been duly concerned about this increase and spread. As a result, pinyon-juniper clearing techniques, such as cabling, dozing, burning, and hand-chopping have been rather widely used to restore grasslands (Cotner, 1963). From two- to five-fold increases in herbaceous understory valuable to livestock have often resulted from clearing (Reynolds, 1959).

Questions are often raised as to how pinyon-juniper clearing for livestock affects big-game habitat, what specific treatments might be most beneficial to big game, and if some compromise in treatments would be desirable.

This is a preliminary report on some major habitat uses of a pinyon-

¹This preliminary report outlines progress on a cooperative study of the U. S. Bureau of Sport Fisheries and Wildlife, the New Mexico Game and Fish Department, and the Rocky Mountain Forest and Range Experiment Station, and the Gila National Forest, U. S. Forest Service.

²In cooperation with Arizona State University. General headquarters is at Fort Collins, Colorado, in cooperation with Colorado State University.

juniper area in southern New Mexico by deer and elk. From current findings, management implications are proposed as to how livestock range and game habitat improvement practices might be coordinated for better overall land use.

STUDY AREA

The study is located on the Fort Bayard Administrative Site of the Gila National Forest near Silver City in southern New Mexico. This area is about 3 miles wide and 6 miles long. Elevation ranges from 6,000 to 7,000 feet. Since 1870, annual rainfall has averaged 18.67 inches, with annual variation from 5.7 to 31.2 inches.

Topography is broken by numerous drainages, and varies from fairly level benchlands to small knolls. Numerous permanent springs are well distributed over the area. At the higher elevations, dense stands of pinyon-juniper and shrubs are characteristic; at intermediate elevations, the tree canopy is more open and there is more perennial grass in the understory; at the lower elevations, trees and shrubs are confined largely to ridgetops, and fairly open grasslands extend along the drainages.

The Fort Bayard Administrative Site was originally established as a military reservation in 1869. Continued, yearlong livestock grazing gradually deteriorated the area. Extensive corrective and restorative actions were taken in 1937, such as excluding all livestock, except for a few pack and saddle animals. In 1941, the U. S. Forest Service was assigned administrative responsibility for the area. Since then, light grazing by horses has continued.

DATA COLLECTION

Data on accumulated pellet groups of elk and deer, topography, and vegetation characteristics were obtained on a grid of 16 sample areas per section. At each sample area, density of trees and shrubs was determined on 1/10-acre, circular plots. Production of herbaceous understory was estimated on four transects of 1 by 12 feet in cardinal directions about the center of the sample area. Exposure was noted as a compass bearing, and slopes were measured with an Abney level. Accumulated pellet groups were counted on four 25- by 2-foot transects overlying the herbage transects. Because of limitations on the interpretation of accumulated pellet groups, conclusions with regard to pellet group differences are restricted to major relative and general comparisons of habitat use.

VEGETATION RELATIONS

The main trees³ in the study area are pinyon, *Pinus edulis* Engel.; alligator juniper, *Juniperus deppeana* Steud.; wavyleaf oak, *Quercus*