



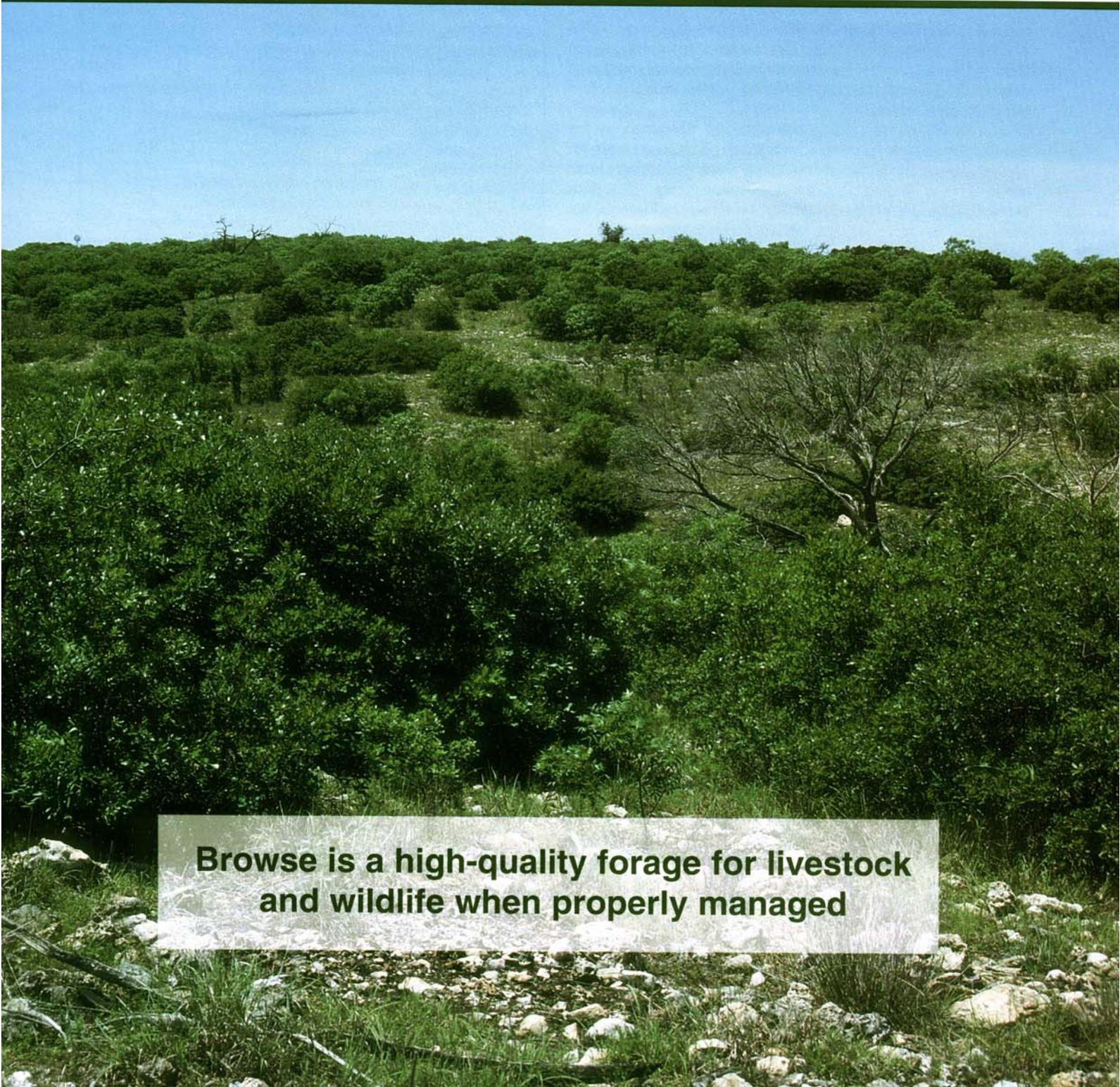
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The Use and Management of Browse in the Edwards Plateau of Texas

Temple, Texas

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A wide-angle photograph of the Edwards Plateau in Texas. The landscape is dominated by dense, green brush and shrubs covering rolling hills under a clear blue sky. In the foreground, a rocky, light-colored path or clearing is visible, with some green grass and small plants growing between the rocks. A semi-transparent white box is overlaid on the lower portion of the image, containing text.

**Browse is a high-quality forage for livestock
and wildlife when properly managed**

When ranchers and range professionals consider the term range management, they often think merely of managing grass for use by cattle. However, in the Edwards Plateau, a variety of domestic and wild ruminants use rangeland. Woody plants, as well as grass, are an important source of forage.

WOODY PLANTS: BROWSE OR BRUSH?

Many ranchers and range professionals regard woody plants as pests. Woody plants compete with grasses for moisture, nutrients, and sunlight. They also invade where they are not wanted and make animal husbandry difficult. However, all woody plants are not alike and can be divided into two broad categories: browse and brush.

Browse is the leaves and tender twigs of woody plants which are used as forage. Brush is defined as woody plants which increase to undesirable levels and are not considered important forage plants. By these definitions, browse producing plants can be regarded as an asset, while brush is often regarded as a liability.

One of the rangeland management dilemmas in the Edwards Plateau is learning how to manage browse plants for forage production while at the same time managing brush infestations to minimize the problems they cause. The principles outlined here are specific for the Edwards Plateau, but also apply to other regions where browse management is needed.

BROWSE AS A RENEWABLE FORAGE RESOURCE

Browse is used as forage in the diets of all domestic and wild ruminants in the Edwards Plateau (Table 1). In many ranching situations, browse contributes just as much of the total forage consumed as grass. The nutritional value of browse is higher than grass, making it a high quality forage. The nutritional value of some common browse plants as compared to some grasses is presented in Table 2.

Past and present land management also determines browse production. Brush management practices, livestock and deer management all affect the amount and quality of browse produced. One ranch may have a very high production of brush such as cedar, but only a low production of desirable browse. An adjacent ranch under different management may have good available browse production, and little or no brush problem. Yet another ranch with even different management

TABLE 1

IMPORTANCE OF BROWSE TO RANGELAND ANIMALS IN THE EDWARDS PLATEAU

| ANIMAL | APPROXIMATE ANNUAL % BROWSE IN DIET | APPROXIMATE ANNUAL BROWSE CONSUMPTION LBS/HEAD | APPROXIMATE ANNUAL BROWSE CONSUMPTION LBS/ANIMAL UNIT |
|-------------------|--|--|---|
| Cattle (cow) | 10 | 913 | 913 |
| Sheep | 23 | 327 | 2095 |
| Goat | 50 | 511 | 4562 |
| White-tailed deer | 65 | 830 | 5931 |
| Axis deer | 30 | 575 | 2738 |

Sources of information: Compilation of eight separate studies conducted by NRCS, Texas A&M, TPWD, and Texas Tech in the Edwards Plateau.

TABLE 2

RELATIVE NUTRITION PROVIDED BY BROWSE AND GRASS DURING GROWING SEASON

| PLANT | AVERAGE CRUDE PROTEIN | AVERAGE DIGESTIBILITY |
|-------------------|--------------------------|--------------------------|
| BROWSE | | |
| Live oak | 11 | 45 |
| Shin oak | 12 | 50 |
| Elbowbush | 12 | 67 |
| Greenbriar | 20 | 68 |
| Skunkbush sumac | 12 | 75 |
| Roemer acacia | 18 | 63 |
| Hackberry | 14 | 61 |
| Bumelia | 18 | 59 |
| GRASS | | |
| Little bluestem | 5 | 44 |
| Sideoats grama | 6 | 43 |
| Buffalograss | 10 | 46 |
| Curlymesquite | 7 | 40 |
| Texas wintergrass | 10 | 40 |
| Silver bluestem | 7 | 46 |

Sources of information: TAEX and NRCS

may have good total browse production, but it may be unavailable to animals. Browse that is out of reach of animals is not a forage resource. Different management schemes can be applied to each of these situations to maintain or increase browse production.

WOODY PLANTS HAVE OTHER VALUES

Woody plants have values in addition to their use as forage. The variety of native woody species in the Edwards Plateau has ecological functions often overlooked. Some of these ecological values include: nutrient cycling; nitrogen fixation; organic matter enrichment of soil; site modification, which allows interception of runoff and deep percolation of rainfall; creation of micro-sites favorable to many plants and soil micro-organisms; and habitat for hundreds of wildlife and invertebrate species. Although these functions may not be obvious, they are still important to the healthy operation of the rangeland ecosystem.

PRINCIPLES OF BROWSE MANAGEMENT

The basics of managing browse are similar to the basics of managing grasses. Some are good forage producers, while others are not. Some are quite productive, but not very palatable. Some species will decline under poor management, while others will take their place.

SELECTIVITY

Animals selectively graze and browse some plant species in preference to others. Over a period of years, this uncontrolled selectivity will eliminate the best plants and favor the increase of the less desirable plants. This is why some woody species have developed into major brush problems while others have disappeared. This order of selection is somewhat predictable and enables managers to group woody plants into four classes according to preference (Table 3).

TABLE 3

COMMON WOODY PLANTS OF THE EDWARDS PLATEAU BY CLASS

| CLASS I | CLASS II | CLASS III | CLASS IV |
|---------------------|--------------------|-------------------|-----------------|
| Kidneywood | Hackberry | Live oak | Mesquite |
| Littleleaf leadtree | Bumelia | White shin oak | Cedar |
| Texas sophora | Clematis | Vasey shin oak | Lotebush |
| Carolina buckthorn | Roemer acacia | Skunkbush sumac | Condalia |
| Mountain mahogany | Redbud | Evergreen sumac | Javelinabush |
| Texas mulberry | Elm | Flameleaf sumac | Agarita |
| White honeysuckle | Grape | Littleleaf sumac | Whitebrush |
| Texas oak | Greenbriar | Hogplum | Persimmon |
| Hawthorn | Virginia creeper | Peachbrush | Catclaw mimosa |
| Rusty blackhaw | Carolina snailseed | Feather dalea | Mountain laurel |
| Shrubby boneset | Poison ivy | Catclaw acacia | Mexican buckeye |
| Plum | Western soapberry | Fragrant mimosa | Pricklyash |
| Inland ceanothus | Ephedra | Guajillo | Cenizo |
| | Possumhaw | Blackbrush | Pricklypear |
| | Elbowbush | Fourwing saltbush | |
| | Netleaf forestiera | | |

DEGREES OF USE

Browse plants, just like grasses, respond differently to different levels of utilization. Both research and practical ranch experience have shown that plants remain productive and healthy when they are grazed or browsed moderately. The old range management principle - "Take Half and Leave Half" - is a good rule of thumb for browse as well as grass. This ensures adequate leaf surface to convert sunlight to plant energy. At this level of use, browse plants are a totally renewable and sustainable source of forage.

When browse plants or grasses are heavily used for prolonged periods, the plants will lose vigor, decline in productivity, and cease to successfully reproduce. With insufficient leaf surface to maintain itself, the weakened plant is more vulnerable to drought and other stresses, and will die prematurely. Without adequate reproduction, plants are gradually reduced or eliminated from pastures.

Class I plants are highly preferred. These woody plants are sought out and browsed in preference to other plants. They often show heavy use and poor reproduction even with low numbers of browsing animals. Although Class I plants are very nutritious and palatable, they normally are not abundant enough to contribute significantly to animal diets.

Class II plants are moderately preferred. This class of woody plants can contribute significantly to animal diets. On ranches with excessively high goat and/or deer numbers, these plants will be heavily used, in poor vigor, and will not be successfully reproducing.

Class III plants are not preferred. They are abundant on many ranches, often make up the bulk of the browse diet and are often the key plant on which to base management decisions. The nutritional quality provided by these plants is frequently below optimum for browsing animals.

Class IV plants are the last to be used and will only be consumed when there is little else available. When these plants show significant use, it is a sign of severe browse deterioration. Class IV plants are usually the plants that become brush problems. Since they are not readily consumed, they have a competitive advantage and often reproduce with abundance.

One important principle to apply to the concept of preference is that availability dictates consumption. If there are no Class I or II plants available, the Class III plants, even though they are not considered preferred, become the most preferred species available to animals.

An exception to the general order of preference may occur when only a few individual plants of a Class III or IV species are present. Browsing animals sometimes will heavily use these few non-preferred plants to possibly add variety to the diet.

Another exception to the preference order occurs seasonally when certain Class III or IV plants are putting out new growth. At this time, these plants are temporarily equally preferred as some Class I or II plants. For example, agarita, a Class IV plant, is preferred for a short time in spring when shoots are tender, before the leaves become spiny.



Moderate use on this hackberry can be visualized by removing growth beyond the blacklines. Browsing about half of the production will keep the plant healthy and productive.

The use of browse can be expressed as the percentage of the annual growth of available leaves and twigs removed by browsing animals. Browse utilization can be divided into three degrees of use:

| | |
|--------------|-------------------|
| Light Use | 0 - 40% Browsed |
| Moderate Use | 40 - 65% Browsed |
| Heavy Use | 65 - 100% Browsed |

Light Use of browse plants does not allow for the most efficient use of the range resource since much forage goes unused. Light use of Class I, II, or III plants is generally not possible on ranches that have moderate or high goat numbers or a high deer density. Light use will allow formerly heavily browsed range to recover, maximize woody cover for wildlife, and provide optimum nutrition for a quality deer program.

Moderate Use should be the management goal for species that are considered the important forage species on a



Heavy use on browse such as netleaf forestiera greatly reduces plant vigor and forage production.

ranch. Moderate use will maintain browse species in a condition to produce maximum sustainable forage. Moderate use of important browse species is generally compatible with good livestock production, good wildlife production, and good ecosystem health.

Heavy Use of a browse species will result in reduced vigor and productivity and inadequate reproduction. Extremely heavy use will virtually eliminate available production and lead to the death of low-growing shrubs. Heavy use is not compatible with good livestock or wildlife production or with ecosystem health.

MANAGING KEY SPECIES

Browse use must be considered on a species-by-species basis due to selectivity. In any given pasture, there will always be different levels of use on various species. Cedar may show light use; live oak, proper use; and hackberry, heavy use. In order to manage the browse resource, managers must choose a key species or a group of several similar key species upon which to base management.

The key browse species in most ranch situations should be the most preferred class of plant that makes up a significant part of the total browse production. It would not be realistic in most cases to achieve proper use on Class II plants if they made up only five percent of the available browse production. This would be desirable for the browse resource, but would result in only light use on the dominant Class III plants. Proper use on the dominant Class III plants would be the usual management objective in this case but at the expense of the more desirable Class II plants.

HOW TO JUDGE USE

Degree of use is best judged at or near the end of the growing season, which is late fall for most deciduous species and late winter for live oak and evergreen species. Use is judged only on the current year's twig and leaf production that is within reach of browsing animals. Current year twig growth will usually have a different color or texture, and can be distinguished from two- or three-year-old twigs.

The most common way for managers to judge use is to compare representative unbrowsed twigs with representative browsed twigs. Unbrowsed twigs can usually be found above browsing height or in a protected area. By visually comparing the two sets of twigs and their leaf production, it is relatively easy to place the degree of use into one of the three categories.



Moderate use (left) and heavy use (right) on live oak sprouts can be judged by comparing twig length.

Having a good, mental image of unbrowsed, moderately browsed, and heavily browsed twigs of the major species will help managers to more instinctively judge use.

PERIODIC DEFERMENT

Periodic deferment or rest from livestock is also important to the health of the browse resource. In fact, it is often required to achieve moderate use on the better species due to browsing selectivity.

These temporary rest periods are best provided under some kind of planned grazing schedule, often called a grazing system. A grazing system is simply a grouping of pastures through which a herd or herds of livestock are rotated, giving one or more pastures a rest from grazing or browsing. An example of an effective grazing system is a three pasture - one herd system, where one pasture is grazed while the other two are rested at any one time. Grazing systems should not be rigid plans, but should be flexible and customized for each unique ranch unit.

The key to the success of a grazing system for browse is the frequency and length of the rest. Rest periods should ideally be provided every year. The length of the rest should be four- to six-months for browse. Typical rest periods designed for grass management are shorter (two- to four-months) and are not adequate for browse in most cases. Since browse grows slower, longer rest periods are needed to allow regrowth between grazing periods. Grazing systems can be designed to properly manage both grass and browse by using faster rotations for cattle and slower rotations for goats.

In reality, browse does not get completely rested during the deferment periods of a grazing system. Deer move between pastures and browse all pastures all the time. So, a deferment for browse is actually only a period of lighter browsing. Although this is not ideal, it is usually adequate to achieve the desired result. In situations where the deer population is very high, it may be difficult to obtain good browse management, even with a grazing system.

READING BROWSE SIGNS

The current condition of browse is the result of how it was managed in past years. It is important for managers to be able to recognize the signs of past use of woody plants and to "read" the status and trend of the browse resource.

HEDGING

Hedging is the growth form of woody plants that develops over a period of years when terminal twigs are browsed, causing multiple lateral twigs to develop. As these lateral twigs are browsed, a compound, multi-branched twig arrangement develops.

Moderate hedging is not harmful to a plant, since adequate leaf surface is retained. This growth form keeps more of the production within reach of animals, and actually stimulates greater leaf and twig production than would occur under very light browsing.



Hedging is the growth form that develops as shrubs are browsed. Moderate hedging of white shin oak helps keep production within reach of animals yet maintains good vigor.



Hackberry subjected to long-term heavy use shows severe hedging, reduced leaf size and dead branches. This plant died one year after the photograph and was about 20 years old.

Severe hedging creates a network of short, stubby branches with limited leaf production. Severe hedging hurts plant vigor and greatly decreases browse production. Another sign of heavy use associated with hedging is a reduction in size of leaves and twigs. Leaves of heavily browsed plants may be only 25 to 50 percent as large as normal leaves. As severe hedging continues, branches and twigs will die, often causing the death of the entire plant. This gradual loss of plants reduces forage production and the value of the range for browsing animals.

BROWSE LINES

Browse lines develop on taller shrubs and trees subjected to heavy browsing by the removal of branch, twig, and leaf

growth within reach of animals. The traditional caricature of a "tree" with an exposed trunk and an elevated canopy is not the natural growth form of most woody species in the Edwards Plateau.

The progressive hedging and reduction of low-growing branches is how browse lines begin. The appearance of newly-forming browse lines will be an obvious thinning of growth up to the browsing height. At this stage, a person will be able to see some daylight through the lower sections of shrubs and trees, but there will still be branches and leaves to obscure vision.



Browse lines are indicative of long-term heavy use, which kills lower branches and twigs. The amount of browse available to livestock and deer is greatly reduced in this pasture.

As animals continue to severely hedge these lower branches, the branches will die and break off. The appearance of a very distinct browse line is unmistakable and allows one to see for long distances under the browsed height. The height of browse lines varies with the animal. White-tailed deer normally browse only to three to four feet. Goats, which can browse standing upright on their hind legs, will create browse lines at four to five feet. Certain large exotics can browse to a six-foot height or more.

When browse lines occur, available browse is greatly reduced even though total browse production will often be great above the browse line. Trees may remain healthy even with excessive browsing which causes browse lines. However, the browse resource is slowly deteriorating since seedlings will never be allowed to establish.

REPRODUCTION

Adequate reproduction does not occur on heavily browsed species. It is essential that browse plants reproduce periodically in order to maintain themselves in the plant community. The presence of seedlings and young plants is the sign that a species is reproducing. Managers should get into the habit of occasionally looking specifically for seedlings and young plants of some of the more important species.

If Class II and III plants are not reproducing well, the browse resource is in decline and a management warning is being sounded. Across much of the Edwards Plateau, the older plants of the better species are gradually dying with few or no young plants to take their places. If this trend continues, eventually, the better browse plants will be eliminated only to be replaced by low quality brush. Since this happens slowly, one plant at a time, it often goes unrecognized.



Good browse plants die prematurely due to heavy use, and reproduction is seldom successful. As the better plants fail to replace themselves, the brush species continue to reproduce.

ANIMAL CONDITION

The physical condition of animals is another sign that can be used to assess browse condition. Since deer rely on browse more than any other animal and are seldom maintained with supplemental feed, deer performance can be a good secondary indicator to managers. Average fawn crops below 50 percent, field dressed weights of mature does below 60 pounds, mature bucks below 100 pounds, and an abundance of spikes indicate poor browse condition and poor nutrition.

BROWSE CONDITION

By looking at both the degree of use on the current year's growth and the signs of past use, the manager can determine the condition of the browse resource. Table 4 summarizes the symptoms of good, fair, and poor browse conditions and suggests appropriate management for each.

TABLE 4

GUIDELINES TO DETERMINE CONDITION OF BROWSE RESOURCE

| BROWSE CONDITION | USUAL SYMPTOMS | MANAGEMENT NEEDED |
|------------------|--|--|
| GOOD | Some Class I plants should exist, but may exhibit heavy use. Many Class II plants exist and will be moderately used with only moderate hedging. Reproduction is occurring on some Class I and II plants. Class III plants may be abundant, but use will be light with no sign of a browse line beginning to develop. | Maintain current management. Increase in numbers of goats, deer or exotics possible. |
| FAIR | Several species of Class II plants should exist although they will be heavily used. Class III plants will be abundant and moderately used with some reproduction. Class IV plants may be abundant, but use on them will be light. | Maintain current stocking rate. Initiate grazing system and browse stimulation. |
| POOR | Class I and II plants may not be present at all, but if so, will be severely hedged, with distinct browse lines and no young plants. Most Class III plants will also be heavily used with limited reproduction. Class IV plants will commonly be used at moderate or even heavy levels. | Reduce goats, deer or exotics 33 to 50 percent. Initiate grazing system. Apply browse stimulation. |



A browse line on Class IV plants such as cedar is a sign of extremely heavy browsing and poor browse condition.

MANAGEMENT SYSTEMS FOR BROWSE PRODUCTION

RECOVERY OF DETERIORATED BROWSE

Recovery of a browse resource damaged by past management is the goal of some managers, but is a long process requiring long-term commitment. Browse recovery often takes longer than grass recovery, and managers must be patient, not



A newly caged root sprout of Texas sophora, a Class I plant, shows extent of use. Annual browse production is very limited.



Texas sophora 11 months later shows the value of rest periods, and the ability of some browse plants to produce large amounts of forage.

expecting overnight results. In many cases, a decrease in stocking rates and the initiation of a grazing system will begin the recovery process. In other cases, a prolonged initial rest of one to three years followed by proper stocking rates and a grazing system may be needed.

PROPER STOCKING RATES

Any management system intended to maintain or increase browse production must include proper stocking rates as its cornerstone. Achieving proper use on the key browse species is directly dependent upon correct stocking rates. Stocking rates based upon range condition and grass production have been successfully used for years on cattle ranches, but are not generally suitable for stocking combinations that include goats and deer.



Adjusting stocking rates on heavily-used shin oak pastures will allow them to respond with good production of root sprouts.

Determining proper stocking rates for browsers is best accomplished by examining the range and making common sense judgements about needed adjustments. If any of the signs of heavy browse use are evident, animal numbers can be assumed to be in excess of carrying capacity. The logical response then is to reduce the number of browsers. Significant adjustments of 33 to 50 percent below existing numbers are often needed to achieve moderate use. Sometimes only the ratio of cattle to sheep to goats to deer needs to be adjusted without decreasing the total stocking rate.



Hedging on Class IV plants such as agarita and an abundance of grass indicates an improper combination of livestock. A reduction in goats and deer and an increase in cattle or sheep will help correct the imbalance.

On most ranches, deer consume a significant portion of the total browse used. Many ranches have too many deer, and a reduction in deer numbers is needed to avoid overuse of browse. Ranchers should know approximately how many deer they have so that they can make plans to harvest the proper number. A deer census every one or two years is needed. The annual harvest of does as well as bucks is required on most ranches to keep deer densities at the proper level.

There are more sophisticated computer-assisted methods for estimating proper stocking rates for browsers or combinations of browsers and grazers. These methods depend on accurate measurements of grass, forb, and browse production for each range site on the ranch. These procedures, although time consuming, are useful to the serious manager.

STIMULATING BROWSE PRODUCTION

On healthy or recovering browse range, there are some specific treatments that can be used to dramatically increase browse production. These treatments are not recommended for deteriorated range still being heavily browsed. Such treatment, without improved management, would be detrimental to the browse resource.

The basis behind stimulating browse production is mostly a matter of changing the growth form to make it more available. Physical damage to the top growth of most browse species will cause prolific basal sprouting or root sprouting. This damage can be caused either by mechanical means or fire. Chaining, roller chopping, dozing, firewood harvest, or prescribed burning will all cause most woody species to respond with increased



Shin oak responds with prolific root sprouts following a prescribed burn. Available browse production is about 60 pounds per acre for each one percent canopy.

available production. Available browse can often be increased five-to ten-fold using these methods. They are especially useful in stimulating live oak and shin oak, the two most common browse plants in the Edwards Plateau. Moderate use of newly stimulated browse is especially important since it is totally available to browsers and more vulnerable to damage by heavy use.

Normally, the mechanical renovation methods are carried out in strips or irregular patterns to retain taller cover and aesthetic value. Most prescribed fires will occur in such a pattern that significant areas of taller trees and shrubs will remain.

Another excellent way to increase browse production is to selectively remove competing brush species. If cedar is



Desirable browse production can be stimulated by selective removal of brush species. Hand cutting of blueberry cedar allows increased production of shin oak and evergreen sumac in addition to better grass production.

grubbed or hand cut, the remaining oaks, sumacs, and other browse plants will respond with increased growth. Prescribed burning can then be used as a follow-up practice.

Fire should be an integral part of most ranch operations in the Edwards Plateau. Not only does periodic fire stimulate browse production and temporarily increase nutritional quality, but it also is a very effective control of small blueberry cedar, pricklypear, and tasajillo.

BIOLOGICAL CONTROL OF SHRUBS

The intentional use of goats to control or suppress woody plants has been widely employed. Under certain management goals, this is a legitimate practice if done correctly. However, it is normally considered a brush control practice, not a browse

management practice. The goal of biological control is to kill or suppress plants, not to maintain or enhance woody forage production. Obviously, the more desirable Class I, II, and III plants will be more susceptible to control than will the true brush plants. Biological control can be utilized to convert a browse-grass range to a grassland, which may be desirable to the rancher interested only in cattle. However, it is not beneficial to the long-term production of goats or deer. Unfortunately, the unintentional, unplanned biological control of desirable woody species due to heavy browsing is slowly occurring over much of the region.

CONCLUSION

Many livestock producers in the Edwards Plateau regard the abundance of woody vegetation as a great problem without distinguishing between brush and browse. If browsing animals are important to a ranching operation, then the proper management of browse should be an important conservation objective. Managers should be able to identify the common browse species on their ranch and determine the current status of the browse resource.

If indicators of excessive browsing are present, then the numbers of goats and/or deer (and possibly exotics) are too high and should be reduced. As stocking rates or stocking combinations are adjusted, browse stimulation practices applied, and a grazing system utilized, ranches should eventually be able to increase numbers of browsing animals. If the browse signs indicate light use, then the manager has the option of increasing browse animals to utilize the resource.

Assistance is available from the Natural Resources Conservation Service, Texas Parks and Wildlife Department, or Texas Agricultural Extension Service to help interested ranchers with the proper management of browse.



On properly managed browse range, live oak sprouts are present and provide large amounts of forage.

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