Sustainable Agriculture Research and Education Project:
Goats for Vegetation Management

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Introduction

Goats have been used for over a hundred years in Texas to control brush and weed problems. Only recently have people outside of Texas discovered the utility of goats for controlling brush and weeds. Brush and weeds are progressively becoming more of a problem because of changes in the ecosystem and increased costs for traditional methods of control. Brush and weeds are steadily decreasing forage production of range and pastures. Brushy undergrowth greatly increases the fire hazard of forested areas. Brush and(or) weeds decrease the biodiversity of ecosystems, affecting not only native plant species but also animal species from tiny invertebrates all the way to the wildlife or cattle that forage in the ecosystem. Goats can be effectively used to profitably control most brush and weed problems, reducing fire hazard, increasing biodiversity and range carrying capacity, and improving aesthetics. While goats are capable of solving vegetation management problems, success depends on proper application of the technology to a specific problem.

Vegetation in Oklahoma

Much of Oklahoma was originally a grassland savanna, that is a grassland with a few clusters of woody species. These woody species remained as minor components of the ecosystem due to the combined effects of browsing by deer and elk and periodic fires. Settlement and cultivation of Oklahoma almost eliminated periodic fires. Another major factor is the loss of over half of the topsoil from much of Oklahoma soil due to erosion from cultivation or overgrazing. As a consequence, water infiltration rate and storage in the topsoil are reduced and, therefore, a greater proportion of stored water is in the subsoil. This gives a competitive advantage to woody species that have deeper root systems to obtain water and are good at absorbing and holding plant nutrients, whereas grasses, which obtain most of their water from the topsoil, are placed at a severe competitive disadvantage. Since these changes are permanent, brush and weeds will always be a major problem on eroded areas.

Fire, which provided natural control of brushy species for hundreds of years, is being reintroduced as prescribed burning for vegetation management on grasslands. However, due to the risks and consequent liability of fire getting out of control and the cost of burning, fire is not being applied as much as it needs to be. Herbicides used to be an important component of vegetation management, but their use continues to diminish due to increased chemical and application costs, and spraying itself may be ethically unacceptable to the public. In addition, herbicides may kill non-target species and reduce rather than restore natural biodiversity. Costs of mechanical controls such as mowing or bulldozing have increased with costs of fossil fuel and the results, while dramatic, are only temporary, lasting a few months to a few years at most. For the most part, the standard methods of vegetation management that were utilized yesterday cannot be applied in a cost effective manner today.

Goats As A Vegetation Management Tool

Because goats would be expected to have to consume some part of the plant if they are going to control it, the natural question is what plants do goats consume? Dietary preferences of goats are determined by maternal training and relative abundance of plants when they were young. Goats do modify their diets in limited amounts due to what their peers select. We have also observed different preferences in the same batch of animals at different locations, which may indicate that environment
(plant growing conditions) plays a role in animal preferences. Therefore, it cannot be conclusively stated that goats will or will not eat some plants, but some good generalizations can be made. Some species such as blackberry, green briar, winged sumac, winged elm, poison ivy, ironweed, and sericea lespedeza are highly preferred by goats. Some species are moderately preferred, such as post oak, multiflora rose, sunflower, ragweed, hickory, hawthorne, tall thistle, buckbrush, and eastern red cedar. Some plants such as Osage orange, Illinois bundleflower, hackberry, and giant ragweed are preferred to lesser degrees and goats will be less effective at controlling these species unless the particular group of goats has a stronger than normal preference for those plant species. Goats do eat some grass if it is available, but it likely makes up only 20-30% of the diet if sufficient palatable browse is available.

Stocker goats may be used to control vegetation as an alternative to a nanny-kid herd. Stocker goats offer advantages in not having labor and nutrient requirements for reproduction, no over-wintering, and relatively simple management. Wether and doe kids may be purchased in the early summer and sold in the fall. Langston University did a research project using stocker goats to control sericea lespedeza in Kansas. Starting weights ranged from 35 to 65 lb and did not affect live weight gain. Goats can gain 25 lb during the summer and the price roll back may be negligible, especially if animals could be held and sold just prior to Thanksgiving. Profit would be expected to be $5-10 per head. A nanny-kid operation, while requiring much more management and other inputs, has greater profit potential. Nannies have the expense and labor of wintering, breeding, and kidding, but a profit potential of $20-35 per head. Since most of the same animals are used each year and animals can be on a health program, there are potentially fewer health problems.

Goats can be grazed in a complementary manner with cattle or horses to control unwanted vegetation. Goats prefer browse and broadleaf weeds that are generally not consumed by the other two species. This can be a very profitable arrangement since the other species is paying the pasture cost and the only additional costs are for modifying the fence to hold goats. Weed control costs are eliminated. Parasite problems are reduced with co-species grazing and overall pasture productivity and salable product per acre are increased. Goats are also a form of diversification, helping to cushion changing prices in the cattle market.

Fencing is one of the biggest limitations in the use of goats for vegetation management due to its cost and lack of flexibility. Permanent fence such as 1047 goat wire, while very secure, is expensive to put up, costing about $2,500 per mile for materials plus labor. Additional cost may be incurred in clearing vegetation from the fence line. This cost can only be justified if an area will be grazed for several years. Some organizations will assist in providing materials or labor for fencing to solve their vegetation management problem. Permanent fence has an advantage in that it requires a minimum of maintenance, which may be especially advantageous in areas with limited access. Electric fence offers advantages of portability and low cost ($800-1,200/mile) but requires more maintenance and greater skill to install and maintain. If electric fence is not maintained, it will fail to confine animals. Three practices critical to the successful use of electric fence are to put the fence up right with quality materials, train animals to electric fence before turning them out, and maintain the fence by checking the voltage every day (4,500 v minimum) and correcting the problem before the goats find out about it. If an area has a decent barbed wire fence around it, there are several ways that the fence can be modified to hold goats. Several strands of barbed wire may be added down low with stays used between posts. Goat net wire, such as 1047 or 9-39-12, can be hog-ringed on the front of barbed wire. Or, the lowest strand of barbed wire can be moved up between the second and third strand and a short net wire (7-26-12) can be placed down low. Another option is the addition of one or two strands of electric fence on offsets between the ground and first strand of barbed wire and between the first and second strand of barbed wire.

Several people have expressed an interest in herding goats because it would save the labor and expense of putting a fence up. However, finding herders that will live with the goats is the biggest limitation. While Basque shepherds may be obtained on a federal program, they have not stayed long with goats. I do not know of anyone in Oklahoma or anywhere else herding goats successfully. There
may be a possibility for herding during the day and putting in a portable electric fence for the night, but again, labor is a limitation.

What stocking rate is a common question that is difficult at best to answer. In contrast to cattle, the proper stocking rate is not as critical for making a profit. It is necessary to defoliate most of the above ground herbage if vegetation is to be controlled. In general, defoliation must be repeated for several years to achieve vegetation control. However, most woody species are much less tolerant of defoliation than grass, enabling the browse to be stressed by defoliation while applying minimal stress to grass. Stocking rate is affected by soil productivity, rainfall, and quantity of accumulated biomass. There are tradeoffs in stocking rate and productivity. A higher stocking rate will result in greater defoliation and control, but production, whether weight gain or kidding or weaning rate, will be reduced. Forage requirements are different for stocker goats vs brood goats. A nanny goat and her kids will consume 2,500 lb of forage in a year, whereas stocker goats will consume 300-500 lb of forage during the summer grazing season. Generally, 1.5 nanny goats per acre of solid brush or weeds or 3-4 stocker goats is a good starting point. Stocking rate will have to be gradually reduced over years as brush and weeds disappear. A more practical approach is to start with a small group of goats that you can manage, let them multiply and then sell goats as the brush and weeds disappear.

Health is an important consideration is using goats for vegetation management because it is often difficult to collect animals for treatment. It is best to vaccinate and deworm new animals directly off the truck and release them to pasture to reduce stress. New animals often get pinkeye, sore mouth, and sometimes footrot; however, unless a disease is life threatening, it is usually not practical to catch an animal for treatment. Brood goats may be kidded on pasture, making it difficult to assist, but goats have been kidding without assistance for many years. Herding dogs can be helpful to collect animals for working or treatment.

Custom Grazing by Goats

There are many opportunities to use goats for custom grazing. I get calls every 2 months from cattlemen who want the services of goats without the stigma of owning goats. The pay will vary from free grazing to getting paid a fee per animal day for grazing. Some government entities, while unable to pay cash, can provide payment in kind such as assistance in purchase and installation of fence and provision of water and(or) providing daily animal care. Some organizations that can use goats for vegetation management include the Army Corps of Engineers, especially around lakes, and the Forest Service, which needs vegetation control for fire prevention. Municipalities have lakes and drainage ways to be maintained to reduce fire hazard or improve aesthetics. Some communities are interested in vegetation management for reducing the risk of fire and are often able and willing to pay for custom grazing. Some river authorities have vegetation problems such as salt cedar that need to be controlled. There are property owners that have brush and weeds that will give you free grazing. However, in all these situations, fencing, water, and labor for daily management of the animals are major concerns that need to be provided for.

Recent Langston University Projects

Langston University has been working with goats for vegetation management for 15 years. Some of the projects were to control shinnery oak in western Oklahoma, a forest plantation in southeastern Oklahoma, sericea lespedeza in Kansas, and more recently two years of study in collaboration with six Native American Nations using goats to control various vegetation problems.
Shinnery Oak

On the project to control shinnery oak in western Oklahoma, significant progress was made in controlling the oak in only 3 years. This was surprising in that most of the shinnery oak was 10 feet or higher and had a 4-inch trunk diameter. The site had 95% ground cover by shinnery oak and only 5% ground cover by grass. Yes, the first year, the goats grazed all the grass, but it did come back. By the end of the third year, brush had been reduced to 50% ground cover and grass and forbs had increased to 50% ground cover. Another finding was that soil nitrogen increased from 1 to 20 lb per acre over the study, phosphorus increased from 5 to 22 lb per acre, and potassium increased from 133 to 348 lb per acre. This is important in that it takes approximately 20 lb of available nitrogen and phosphorus for native grasses to become established. The shinnery oak absorbed these soil nutrients and the grass was starved for nutrients. Goats correct this problem in that they eat the brush and release the soil minerals in their urine and feces, enabling the establishment of native grass species.

Lespedeza

Work in Kansas showed that goats preferentially consumed sericea lespedeza, but it took 3 years of severe defoliation to kill established perennial plants. During the first 2 years of the study, goats consumed more than 75% of the sericea lespedeza foliage. Sericea lespedeza cover decreased by 12% and plants were much shorter than plants in the ungrazed area (14 vs 33 inches). Smooth brome grass cover increased by 19%. Seed production of sericea was decreased from 979 to 4 seeds per stem. Goats also controlled all the red cedar, sumac blackberries, sand plum, multiflora rose, and buckbrush. Goats also consumed the few thistles that were in the field. Goat numbers were decreased as sericea was controlled to save the grass for grazing by cattle. Grass gradually filled in where it had been choked out by sericea lespedeza.

SARE Project

Overview. We have been conducting a large vegetation management study at six locations in Oklahoma for 2 years in collaboration with six Native American Nations (Figure 1). This project was supported by the USDA Sustainable Research and Education (SARE) program, and provided a very rich learning experience in that the sites were all so different. The primary project goal was to increase appropriate employment of goats in sustainable vegetation management in grazing lands of the south-central US.

Pasture establishment began in mid-November, 2001 and ended in mid-May, 2002. Net wire fence was used for pasture perimeters. Interior fences to separate pastures were either net wire or electric, with use of solar chargers at some sites. Herbicide was applied to electric fence lines at the beginning of the grazing season, and there was occasional weed-whipping. Water was provided in a variety of ways, e.g., pond, spigot, gravity flow from a tank periodically filled by pumping from a nearby creek, and barrels and pickup truck. There was at least one guard dog at each location, which effectively prevented any losses to predators.

A key component of this project was the thorough assessment of vegetation conditions before and after each grazing season. In the spring, permanent transects were laid in each of the study pastures along which ground cover and canopy cover of woody vegetation were measured before and after each grazing season. Soil samples were also taken from each of the pastures before grazing to analyze for fertility. At the same time, the dry-weight-rank technique was used to measure forage in numerous permanent quadrats, the locations of which were marked with a Global Positioning System (GPS) meter. Currently, collected data and samples are being analyzed. Another important measure was body weight change of goats at each site along with sheep at one location and cattle at another, with weight determined at the beginning and end of the grazing season and every 1-2 months within. In addition, fecal samples were collected to monitor need to deworm and also to assess specifically what plants were consumed by fecal microhistology.
Figure 1: Six research and demonstration site of the SARE project.

_Caddo Nation_. The Caddo Nation site was located near Gracemont and Anadarko, Oklahoma. There were 10 acres of tribal land, with two 4-acre pastures for grazing and one 2-acre control, ungrazed area. There was much lovegrass and smooth sumac, and the site had not been grazed for many years. Because of the large amount of grass, one treatment entailed co-grazing with 12 sheep and 12 goats in 2002 and 10 of each species in 2003. The second grazing treatment was stocking of 24 goats (6 per acre) in 2002 and 20 (5 per acre) in 2003. One of the desirable effects of grazing noted was the breaking up of large, thick bunches of lovegrass residue from previous years that was smothering current growth, which also enhanced the rate of decomposition and nutrient cycling. The goats consumed various browse plants present including patches of sand plum and buckbrush. The consumption of sumac, which was the dominant brushy species, did not begin until late summer. Honey locust and black locust trees were heavily debarked.

The goats consumed honey locust and sand plum first at the Caddo location. They also killed a stand of black locust, which was 20-ft tall by debarking them; the second year, they were falling down, which greatly opened the area up. However, we did not achieve our objectives at this location. The location had about 60% cover by smooth sumac, 15% by sand plum, 10% by black and honey locust, and the remainder by love grass. The goats consumed little of the sumac at this location and did not control it. Several factors may have contributed to this. Apparently the sumac at this location was not as palatable as it was at other locations, but this was the driest location. Toward the end of the season the goats had only sumac to consume and did not have a variety of plants to consume. At several of the locations, we used different stocking rates in different pastures the first year and the same rate the second year. Goats on the higher stocking rates defoliated more brush, but weight gains were reduced. Since animal gains are what pay for vegetation management, lighter stocking rates are preferable and it will take only a year or two longer to achieve control.

_Cherokee Nation_. The Cherokee Nation site was located near Tahlequah, Oklahoma. The 20-
acre plot of tribal land hosted native grass species like big bluestem, little bluestem, broomsedge, and Indiangrass, as well as introduced species such as bermudagrass and fescue. However, there was a large population of brushy plant species, among which were multiflora rose, oak and persimmon sprouts, sumac, blackberry, buckbrush, and wild rose. Also prevalent were weeds such as common ragweed. Previously the area was mowed once yearly. Objectives of the activity were to compare effects of goat grazing with other potential means of control (i.e., mowing and herbicide). Thus, the plot was divided into eight pastures. Two 5-acre pastures were grazed by goats at 6 per acre in 2002 and 4 per acre in 2003; two 2-acre pastures were mowed as normally done; two 2-acre pastures were treated with conventional herbicides; and two 1-acre pastures did not receive intervention to serve as a control treatment. By the end of the grazing season, goats had defoliated all undesirable plants including blackberry, buckbrush, sumac, sprouts of persimmon, and various weedy species.

The blackberries were so thick that you could not walk through them. At the beginning of the second year, you could walk through the blackberries with only modest difficulty. Spraying 2 years in a row killed almost all the woody plants and greatly stimulated grass, but also killed the legumes. Mowing, while keeping the woody species low, made them bushier and did not help the grass. Before grazing, in dense stands of brush you could not see for over 30 ft. But, by the end of the first grazing season there was a distinct browse line and you could see for over 200 ft, which also was noted at the Osage Nation site.

**Choctaw Nation.** The Choctaw Nation site was located near Antlers, Oklahoma at the farm of a tribal member. The approximately 22-acre pasture consisted of a wooded area, predominantly post oak with a brushy understory vegetation component. Grasses included bermudagrass and bahiagrass with significant weed presence. The pasture had been previously grazed by cattle and used for hay production. The area was divided into three 7.3-acre pastures. The objective of this activity was to compare effects of grazing goats alone, co-grazing of goats and yearling crossbred beef heifers, and grazing cattle alone. Stocking rates were set low to allow hay production, with harvest in July. Goats were placed May 28 and grazing ceased on November 8. The goats kept the brushy understory of the woody area well under control and spent considerable time in the open grassy area. Woody plants heavily browsed include American beautyberry and low-hanging branches of winged elm.

**Greater Seminole Nation.** The Greater Seminole Nation site was situated near Seminole, Oklahoma. As with many of the other sites, the area had not been used in agriculture recently and, thus, has become overgrown with many different brushy plant species and trees of various sizes. An 11-acre plot of tribal land located on the southeast corner of the Mekusukey Mission grounds was used. Notable plants present included poison ivy, sericea lespedeza, persimmon, oaks of various species and sizes, ragweed, buckbrush, blackberry, sumac, and eastern red cedar. The site was divided into two approximately 4.5-acre pastures plus an ungrazed 2-acre control area. There were two stocking rate treatments used with the 4.5-acre pastures in 2002, 4 and 8 goats per acre. However, in 2003 both pastures were stocked with 4 goats per acre.

**Osage Nation.** The Osage Nation site was located on tribal land at Grayhorse Village, close to Fairfax, Oklahoma, and was the northern most site. The site had a variety of brushy plants and trees, such as honey locust, sumac, and eastern red cedar. The objective of the activity was to determine effects of different stocking rates with a very dense complex mixture of woody plant species. The 15-acre area was divided into three 5-acre pastures, one being an ungrazed control. Different stocking rates employed in 2002 were 4 and 8 goats/acre. However, in 2003 both pastures were stocked with 4 goats per acre. In addition to consumption of tree leaves and establishment of a distinct browse line, the goats debarked a number of small trees (i.e., 8-12 ft high) in dense stands, particularly winged sumac. The second year there was some root sprouting, which goats took care of and by the end of the second grazing season, these plants were falling over. A similar thing happened to the scattered sumac at the Greater Seminole Nation site.

**Sac and Fox Nation.** The Sac and Fox Nation site was located near Stroud, Oklahoma. The site
was a 20-acre plot of tribal land with a variety of invasive plant species, including eastern red cedar, green briar, black locust, blackjack oak, and post oak, and there were some native grasses present. The objective of this research/demonstration activity was to compare effects on vegetation conditions of an overgrown site and animal growth of continuous moderate stocking of goats with short periods of high stocking rates. This activity has particular relevance to the potential for custom grazers moving goats from farm to farm for short periods of time. The site was divided into four pastures, one 8 acres in size and the other three each 4 acres. One 4-acre control pasture was not grazed, and the other two were grazed by 3 or 6 goats per acre in 2002 and 2 or 3 goats per acre in 2003. The 8-acre pasture was subdivided into four 2-acre paddocks; goats were placed in this area at a rate of 6 per acre in 2002 and 3 goats per acre in 2003. Rotations were every 10 or 11 days, slightly more frequently than initially planned.

Goats ate all the poison ivy early in the first season, which was beneficial to several of the people working with this study. At this location, which was mostly mature forest, the goats cleaned out the understory and surprisingly made some headway on reducing the forest. This was due to natural death of trees that the goats may have hastened by partial debarking. The goats kept all the sprouts down and so no sprouts became established to replace the dead trees. The canopy did become noticeably more open in only 2 years of grazing. The goats were fairly aggressive against red cedar; they not only defoliated it, but debarked it and as a result killed more red cedar on this location than at any other location. For some reason, the goats had a stronger preference for red cedar at this location.

Fecal Egg Counts. As most or all goat producers are well aware, internal parasitism is a very important consideration. Therefore, we used this project as an opportunity to determine how use of goats for vegetation management in a variety of settings might impact internal parasitism and necessary control methods. Goats were dewormed with Moxidectin (0.5 mg/kg body weight) prior to the study and were transported to the study sites in mid-May to early June. Goats were weighed and fecal samples were taken every 1-2 months. Fecal egg counts (eggs per gram; EPG) were estimated by a modified McMaster technique. Location had a major effect on EPG, with month and the interaction between year of grazing and location having significant effects but being of lesser importance. Many animals had 0 EPG throughout most of the grazing season at most locations. Fecal egg counts increased with increasing time spent grazing (2, 3, 8, and 25 EPG). There was a significant location by year interaction because of one location having high EPG in both years and a second and third location having high EPG in different years. The one location with high EPG both years had greater annual rainfall than other locations. At the locations that had high EPG in only one year, animals were observed to graze grass closely during the grazing season even though browse was available. It appears that location is an important consideration affecting internal parasitism and recommendations for its control, but the effects can be different in each year.

Live Weight Gain. Factors affecting carrying capacity and animal performance were also addressed in this project. In the first year of grazing, yearling goats were taken to each site in May-June and weighed every 1-2 months. Animals were removed when forage availability became limiting, usually late summer or fall. Goats were heavily stocked to provide maximum vegetation control. Doe and wether Alpine, Angora, Spanish, and Boer x Spanish crossbred goats were used in the first year. Average daily gain was significantly affected by site, period of grazing, breed, and gender. Wethers gained more than doelings (3.3 vs -4.1 g/day). Alpine and Angora goats gained less weight than meat breeds and crossbreeds. Goats gained the most live weight the first grazing period and less subsequently as forage availability was reduced (12.7, -9.3, and -13.6 g/day). Gain per hectare was not influenced by site or stocking rate, whereas the number of grazing days/ha significantly differed among sites (range 237-1,109 days) due to different forage production. Gain/ha had little relationship to stocking rate, a consequence of grazing to remove all available herbage. Total gain for the season was affected by site, gender, and breed. When goats are grazed at a high stocking density to control vegetation, forage productivity is the greatest factor in determining carrying capacity although sex and breed can have effect.
Summary

There is a significant amount of knowledge that goats can be effectively used to control vegetation. However, the challenge is to work out the application. Fencing is the foremost problem that has to be resolved to use goats for vegetation management. The next most important decision is the use nannies or stocker goats. Some decision has to be made on stocking rate. A business and animal management plan and budget need to be developed to make sure that the business can not only be conducted in the first year, but also in the future. There are sufficient brush and weeds in the US to produce more goat products than can be consumed here and therein lies a great potential for profit as well as improving the environment.

Building fences at the various sites.
Transect #3 at the Caddo site in 2002.

Transect #3 at the Caddo site in 2003.

Transect #80 at the Cherokee site in 2002.

Transect #80 at the Cherokee site in 2003.
Transect #43 at the Choctaw site in 2002.

Transect #43 at the Choctaw site in 2003.

Transect #103 at the Osage site in 2002.

Transect #103 at the Osage site in 2003.
Transect #22 at the Seminole site in 2002.

Transect #22 at the Seminole site in 2003.

Transect #68 at the Sac & Fox site in 2002.

Transect #68 at the Sac & Fox site in 2003.
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