

Effects of Angora Goat Browsing on Burned-Over Arizona Chaparral

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This study is part of the USDA Forest Service Rocky Mountain Forest and Range Experiment Station program researching effective, economical, and environmentally safe methods of converting chaparral to brush-grass mosaics.

Research over the last quarter century has shown that conversion of Arizona chaparral to grass significantly increases water and forage yields, reduces fire hazard, and may improve wildlife habitat.

Total rainfall and its distribution throughout the range of Arizona chaparral is adequate for establishment of grasses. Precipitation ranges from 16 to 30 inches annually, with about 55% falling primarily as rain from November through April and the remaining 45% from May through October. To date, the only entirely effective and environmentally acceptable means of controlling shrubs and promoting grass establishment is the root plow. Its use is limited to less than 8% of the chaparral acreage because of rugged topography and the rocky character of soils. Fire is effective for opening up mature stands. However, the only species of importance killed are manzanita and desert ceanothus and germination of their seeds is stimulated by fire. The major dominants, shrub live oak and mountain-mahogany, sprout vigorously and regain dominance before herbaceous plants can become well established. Foliage spray herbicides of the phenoxy group,¹ such as 2,4-D, 2,4,5-T, silvex, and mixtures thereof, have been used but they do not provide adequate control without several successive annual applications. Soil-applied herbicides, such as fenuron, picloram, and karbutilate are potent brush killers but they are also toxic to herbaceous plants. Several years may be required following their application for vegetation establishment. Regardless of how shrubs are controlled, several years are required for grass establishment because it is not possible to plant the seeds. The terrain is too rugged and rocky for use of conventional seedbed preparation and seed planting equipment. Thus, conversion by techniques presently in use leaves much to be desired.

In view of the foregoing, and since public concern about environmental quality has become a powerful force in resource management, we need a more efficient, economical, and environmentally safe method for conversion of chaparral. Following prescribed burning and seeding, browsing with goats to trample seeded grasses into the soil and to

retard recovery rate of the sprouting shrubs may be an effective tool for use in chaparral conversion. If goat use will hold the shrubs in check until a grass cover becomes established, the conversion can be maintained by periodic prescribed burning, or by continued goat browsing.

The objective of this study was to determine if prescribed burning, seeding, and goat browsing in the fall can be a useful tool for conversion of Arizona chaparral.

Study Area

The study area was a 210-acre enclosure on the Tonto National Forest, 10 miles northeast of Payson, Ariz. This area was representative of a typical mature stand of chaparral. The species of major importance in the area (shrub live oak and mountain-mahogany) were the most common dominants over the entire range of the Arizona chaparral (Knipe et al. 1979). Other shrub species common to the type were also represented, e.g., manzanita, desert ceanothus, yellowleaf and Wright silktassel, skunkbush, sugar sumac, hollyleaf buckthorn, and cliffrose.

The area was burned in the fall, 1979, instead of in the spring as is the usual practice because cyclonic winter rains are less apt to result in erosion of the freshly bared soil than would convectional summer storms. Burning chaparral also results in a hydrophobic property in the soil which restricts infiltration. This property may be less detrimental in the winter because the precipitation is less intense and the hydrophobic layer may be dissipated prior to the start of the summer rains by chemical, microbial, and root activity; trampling; leaching; and freezing and thawing.

The burn eliminated top growth over 80% of the area, leaving 20% in a mosaic pattern for wildlife cover and esthetic purposes. The main channel, dominated by ponderosa pine, Arizona walnut, juniper, and Gambel, Emory, and Arizona white oak trees, was retained for wildlife habitat.

The area was broadcast-seeded with weeping lovegrass in the fall immediately after burning and fenced with a seven-wire electric fence powered by a New Zealand type energizer. The fence was designed to keep livestock in and predators (primarily coyotes) out. Wires were spaced close together near the ground and increasingly further apart toward the top. The height of the fence was limited to 54 inches so that deer and elk movement into the area was not restricted.

A conservative stocking rate of approximately 1 goat unit per acre was used. Two hundred forty-two Angora wethers were introduced into the area in June. Wethers were used for 3 reasons: kidding is a highly specialized operation; wethers are larger than nannies and less susceptible to predation; and in the event some goats escaped, they would not estab-

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¹The herbicides discussed in this report have been used experimentally; their use does not imply that they are recommended or registered for watershed use. The use of any herbicide for project or commercial purposes must conform with regulations of the Environmental Protection Agency and be registered for the intended use.



Grass stand in the summer-deferred pasture in November 1981. Note nontreated area in background depicting area as it appeared prior to initiation of the study. (Forest Service Photo)

lish a self-perpetuating feral herd.

The plan was to burn and seed the area and, when the shrubs had started to sprout, introduce goats to trample the grass seed into the soil and suppress shrub growth through browsing. We thought that possibly the young, tender, and presumably palatable shrub sprouts would be preferred over establishing grasses. The literature indicates that goats prefer browse and eat a relatively small percentage of grasses. The goats took only about 1% grass in this study but about 1% was all we had. The goats were eating or pulling up a high percentage of grass seedlings. The area was immediately divided into 2 pastures and the goats were kept in 1 pasture until the end of the growing season (June 11 to November 1, 1980). Except for the period from June 11 to July 1, the other pasture was deferred during the 1980 summer growing season.

After the grasses had matured and set seed the goats were moved to the summer-deferred pasture. This pasture was used until May 1, at which time the summer 1980 grazed pasture was seeded and the goats put in it for 3 weeks to trample the seeds into the soil. A good stand of grass in the summer-deferred pasture was established during the first growing season and increased in density during the second. The summer-use pasture was pretty much sacrificed from the standpoint of conversion to grass during the first growing season but recovered considerably during the second.

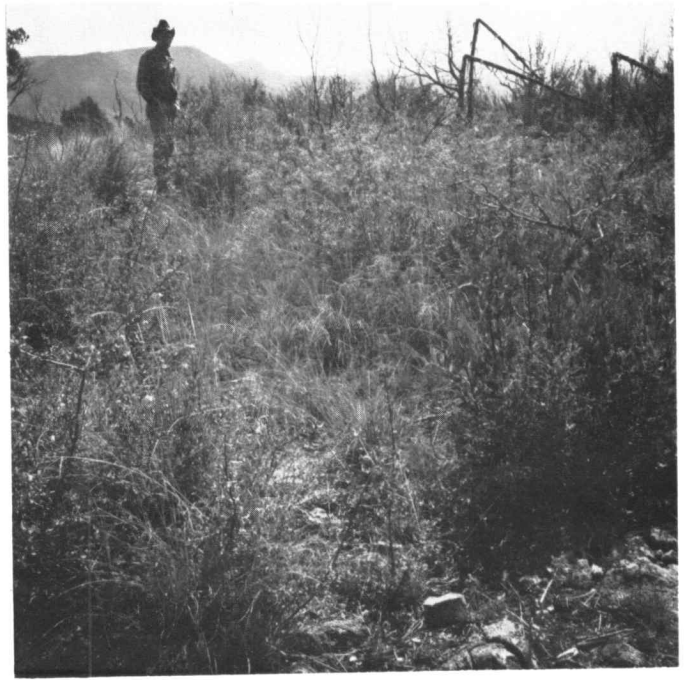
There was some use in the area by elk and deer prior to introduction of the goats, with use of herbaceous species relatively high. The most used shrubs during the first 16 days after introduction of the goats were shrub live oak, sugar sumac, and skunkbush. Heavy use of the palatable skunkbush was expected, but it was also expected that the goats would take mountain-mahogany and Wright silktassel more readily than shrub live oak and sugar sumac. With the excep-

tion of sugar sumac, the percent plants browsed were also representative of estimated percent biomass removed during the first 3 weeks of use. A high percentage of the plants of this species were browsed, but very little biomass was removed as only the tips of the sprouts were taken.

The use pattern changed greatly after the first 3 weeks. Between the third and fourth weeks (June 27 to July 8) the use of mountain-mahogany increased from 55% to 89%, and after 6 weeks (by July 23) it was being heavily used both with respect to percentage of plants and biomass removed. Use picked up after the first week but did not approach that of oak, skunkbush, and sumac until July. Heavy use of the relatively palatable Wright silktassel did not occur until about 2 months (August 8) after introduction of the goats. Thereafter, use of this species was about equal to that of mountain-mahogany. Manzanita and desert ceanothus, often important to the Arizona chaparral, were of relatively little importance in this study. Most plants of these species were killed by the fire and seedlings did not reach sufficient size for browsing until late in the growing season. Use of the mature plants was negligible. However, goats relished desert ceanothus seedlings and took manzanita seedlings sparingly, often at times when preferred species were in short supply.

The palatable forbs (lambquarter and morning-glory) and grass were heavily used from the start. Of the 2 important half shrubs in the area, snakeweed and rough menodora, snakeweed received the heaviest use. The relatively light use of rough menodora is surprising because this species is relished by deer, elk, and cattle and it was anticipated that it would be highly palatable to goats. Juniper was taken readily by the goats, but percent biomass used was light because much of the foliage was out of reach.

Species preferences were the same when the goats were turned into the summer-deferred pasture in November, the



Grass stand in the summer-use pasture in November 1981—two views (Forest Service photo).

only exceptions being that the dry grass and forbs were not used as heavily as during the growing season.

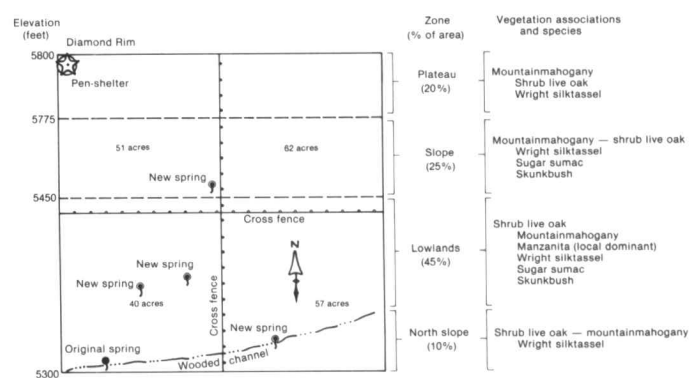
The percent of plants browsed of a particular species did not necessarily reflect percent of biomass removed. All plants of all species but rough menodora were browsed, but some had very little biomass removed. Juniper, snakeweed, and sugar sumac were good examples of this relationship. Biomass consumption of Wright siltassel was less than mountain-mahogany because its stems became larger before heavy use began and these larger stems were not totally taken.

On June 1, when the goats were introduced, the height of the most important shrub species was about the same in both the browsed and nonbrowsed pastures. Percent reductions in height of the most important shrubs (shrub live oak, mountain-mahogany, and Wright siltassel) varied as a result of browsing. The most used species during the first 6 weeks (June 11 to July 23) was shrub live oak; heights of plants of oak were reduced from an average of 1.7 to 1.47 feet during this period. Growth of mountain-mahogany kept pace with browsing during this period and growth of Wright siltassel exceeded browsing use. However by September 11, about 9 weeks after introduction of the goats, use of shrub live oak was not sufficient to prevent increase in height growth because the goats were beginning to concentrate on mountain-mahogany and Wright siltassel. By the end of the growing season, height of browsed mountain-mahogany plants was 67% less than nonbrowsed plants and average height of browsed Wright siltassel plants was 44% less than nonbrowsed plants. Although shrub live oak use was less than use of mountain-mahogany and Wright siltassel, height of browsed plants was 28% less than nonbrowsed plants.

Because of restrictions imposed by topography and accessibility, the holding pen and shelter were placed in one corner of the area. We thought that the herd should be penned nightly as a precaution against predation losses so the goats

were salted in the pen and shelter area to induce them to come in at night. This resulted in an undesirable use pattern; a quarter-circle area extending about 400 feet out from the penning area became a heavily used "sacrifice zone." The problem was magnified because the vegetation composition within the zone was predominantly mountain-mahogany and Wright siltassel, which are more palatable than shrub live oak—the major dominant. This "sacrifice zone" could have been reduced or possibly prevented had it been possible to centrally locate the pen-shelter site and salt the goats in outlying areas. It appears that the electric fence is effective against predation (no losses have occurred) so it is probably not necessary to pen the herd nightly.

Treatment (prescribed burning and browsing) resulted in a decrease in shrub cover, increases in grass and water yield, and elimination of the fire hazard. Wildlife use was not measured, but indications are that there has been an increase in as a result of opening up the area.



Schematic (not to scale) map of study area showing zonation of species distribution and percentage of total area of each zone (total acreage is 210 acres).

There was a fair stand of grass over the entire study area by the end of the second week of July. Most of the seedlings were from spring emergence and some were from late June and early July rains. Precipitation in the area totaled 8 inches during the growing season; almost 16 inches fell during the 1980-81 winter months and grass production increased in the summer-deferred pasture. The stand was better than is characteristic of seedlings in the Arizona chaparral following burning. We believe this was at least partially due to "seed planting" as a result of trampling by the goats. It remains to be seen if goat browsing controls shrubs and maintains and/or increases the grass stand without overusing the area. The grasses made good growth in spring 1981 as the goats fed primarily on new shrub leader growth. The goats were removed from the area when an abundance of grass seedlings emerged in summer 1981 and returned and confined to the eastern half of the study area during the 1981-1982 winter months.

Conversion of chaparral by goat browsing will require some form of intensive grazing management (e.g., the Savory Method or a put-and-take method) to protect the area during the critical period of grass establishment. Shrub cover can be controlled sufficiently to result in increased

water yield and elimination of fire hazard. Whether or not this can be accomplished while establishing an acceptable grass cover remains to be seen. Predation has not been a problem with the electric fence. Shelter may be required to protect the goats during inclement weather. It appears that trampling does effectively "plant the seed" and enhance seedling establishment.

Goats utilized a far wider range of vegetation than other domestic livestock and resident big game. Species such as sumac, snakeweed, prickly pear, juniper, and century plant are used more heavily than by other animals common to the area. Chaparral species most preferred by goats are comparable to those of other domestic livestock and resident big although the palatable desert ceanothus and rough menodora were taken but sparingly. Thus, goat browsing in the Arizona chaparral can generally be expected to result in heaviest use of species preferred by cattle, deer, and elk.

Literature Cited

Knipe, O.D., C.P. Pase, and R.S. Carmichael. 1979. Plants of the chaparral. USDA. Forest Service Gen. Tech. Rep. RM-64, 54 p. Rocky Mountain Forest and Range Experiment Station, Fort Collins Colo.



Coming Events:

Grassland Congress

For the first time in history, the International Grassland Congress will be held in Asia. The XV International Congress will be held in Kyoto, Japan, August 24-31, 1985.

Information is available from The Secretariat, XV International Grassland Congress, c/o National Grassland Research Institute, Nishinasuno, Tochigi, 329-27, Japan.

Monitoring Proceedings

Proceedings of the International Conference on "Resource Inventories or Monitoring Changes and Trends" held in August 1983 at Oregon State University will be available in January. A special price of \$20 per copy is offered for orders received by December 31, 1983. Subsequent price is \$25.

Checks payable to OSU College of Forestry should be sent to the Accounting Office, College of Forestry, Oregon State University, Corvallis 97331.

Also available from the university is the Oregon Landsat Mosaic, a satellite map of the state of Oregon produced with 40-meter resolution data and a scale of 1:500,000. Contact ERSAL, Oregon State University.

Semiarid Lands Symposium

Proposed for Mendoza, Argentina, in November 1984 is a symposium on "Improved Utilization of Natural Resources and Rangelands in Semiarid Regions." The symposium is being organized by CADIA (Argentine Center of Agronomic Engineers), INTA (National Institute of Agropastoral Technology), and IADIZA (Argentine Institute of Arid Lands Research). On the international steering committee are Dr. Gerald Thomas, representing the Society for Range Management, and Dr. Cyrus McKell, representing the AAAS Committee on Arid Lands.

High Altitude Revegetation

The biennial High Altitude Revegetation Workshop will be held on March 5 and 6, 1984, at Colorado State University. For agenda and registration information, contact Julie Etra, Secretary, H.A.R.C., Department of Agronomy, Colorado State University, Fort Collins, CO 80523 (telephone information-303/491-6354 or 491-6517).

The High Altitude Revegetation Committee through its biennial workshops and annual field tours intends to promote understanding of rehabilitation procedures and materials and natural-resource values and potentials which must be addressed when fragile subalpine and alpine ecosystems are to be modified by activities. Although the theme of the workshop is high-altitude revegetation, much information is also applicable or can be adapted to lower-elevation situations.

Agroforestry in the Southern US

33rd Annual LSU Forestry Symposium, April 4-5, 1984, at the Capitol House Hotel, Baton Rouge, La., is sponsored by the School of Forestry & Wildlife Management and the Louisiana Cooperative Extension Service, Louisiana State University Agricultural Center.

High costs and lower cattle prices are forcing cow-calf producers to consider moving from improved pastures back to forest range, where calves can still be produced for profit. This symposium will focus on new profit opportunities for both the cattle owner and the timber grower under the agroforestry concept. Speakers will describe the forest range resource and its potentials and problems. Regulated, well-managed forest grazing operations will be described. The possibilities for using improved forages under pine timber stands will also be discussed.

Contact: Dr. Mark K. Johnson or Dr. Norwin E. Linnartz, School of Forestry & Wildlife Management, Louisiana State University, Baton Rouge 70803 (phone 504-388-4131)