

Goat Control of Brush Regrowth on Southern California Fuelbreaks

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California has a special environmental problem—4 million ha of tough, dense chaparral that will burn periodically unless management takes steps to maintain the brush at an immature growth stage. Ninety-three percent of the Descanso Ranger District, Cleveland National Forest, located 50 km east of San Diego, is covered with chaparral. Fuelbreaks are used to break up this vegetation for better fire management, and to facilitate protection of urban and watershed values. Fuelbreaks are wide strips of low-growing vegetation which provide a light volume of fuel per unit area, relative safety for firefighters, and a prepared backfiring line. The goal of fuelbreak construction is to reduce the size and number of disastrous forest fires.

Construction and maintenance of fuelbreaks is difficult and costly. Mechanical equipment, hand labor, prescribed fire, wild-fire, or a combination of these techniques is used to clear the mature brush. Regrowth from sprouting shrub crowns, or from seed, is immediate and abundant. Controlling this regrowth is one of the most difficult tasks facing land managers. Herbicides have long been used for this purpose, but brush control with herbicides is expensive, and results are somewhat unpredictable and not always satisfactory. Use of herbicides is also being criticized as damaging to the environment.

The use of goats to control brush regrowth may be a satisfactory alternative to both herbicides and mechanical equipment. Goats have long been used for this purpose in Africa, in brushy parts of the American Southwest, in Israel, and in Mexico. Du Toit (1972) observed in South Africa that when young regrowth dominated by *Acacia karroo* was allowed to "harden," it became less acceptable to goats. Davis et al. (1975) in Colorado determined that a high degree of Gambel oak control was possible, but that the mature brush should be treated mechanically, and regrowth produced. Elam (1952) observed that the favorite foods of goats on a ranch in the Sierra Nevada foothills of California were seedlings and new sprouts. Goats are potentially a source of income from a vegetation type considered almost worthless by many people in California. There is neither the threat of immediate escape and liability that is associated with use of fire, nor is there an environmental issue over goat browsing. Finally, some precedent for use of goats to control California brush is

found in the Amador County area, on the Los Padres National Forest and elsewhere (Elam 1952).

Early in 1976, an agreement was signed by a private owner of goats and the Descanso Ranger District, Cleveland National Forest, for a herd of goats to be placed on fuelbreaks. The Forest's objective was to maintain 80% of shrub regrowth at a height of 30 cm or less on fuelbreaks or on burned areas where maintenance of low fuel volume was needed. Forest personnel consider the use of goats as experimental and predict that 5 years will elapse before it becomes operational practice. The goat owner was seeking to produce a good harvest that could be marketed profitably. He predicted that a 100% kid crop and production of at least 1,000 kids annually would be needed to make the operation profitable.

Four hundred-forty goats were brought to the Pine Creek fuelbreak on July 20, 1976. The goats browsed in small fenced pastures on the fuelbreak, or were herded outside during the morning or afternoon or both and held within the fenced areas at midday and at night. The herder decided where the goats would browse. An additional 700 goats were added to the flock on August 17.

Test Site

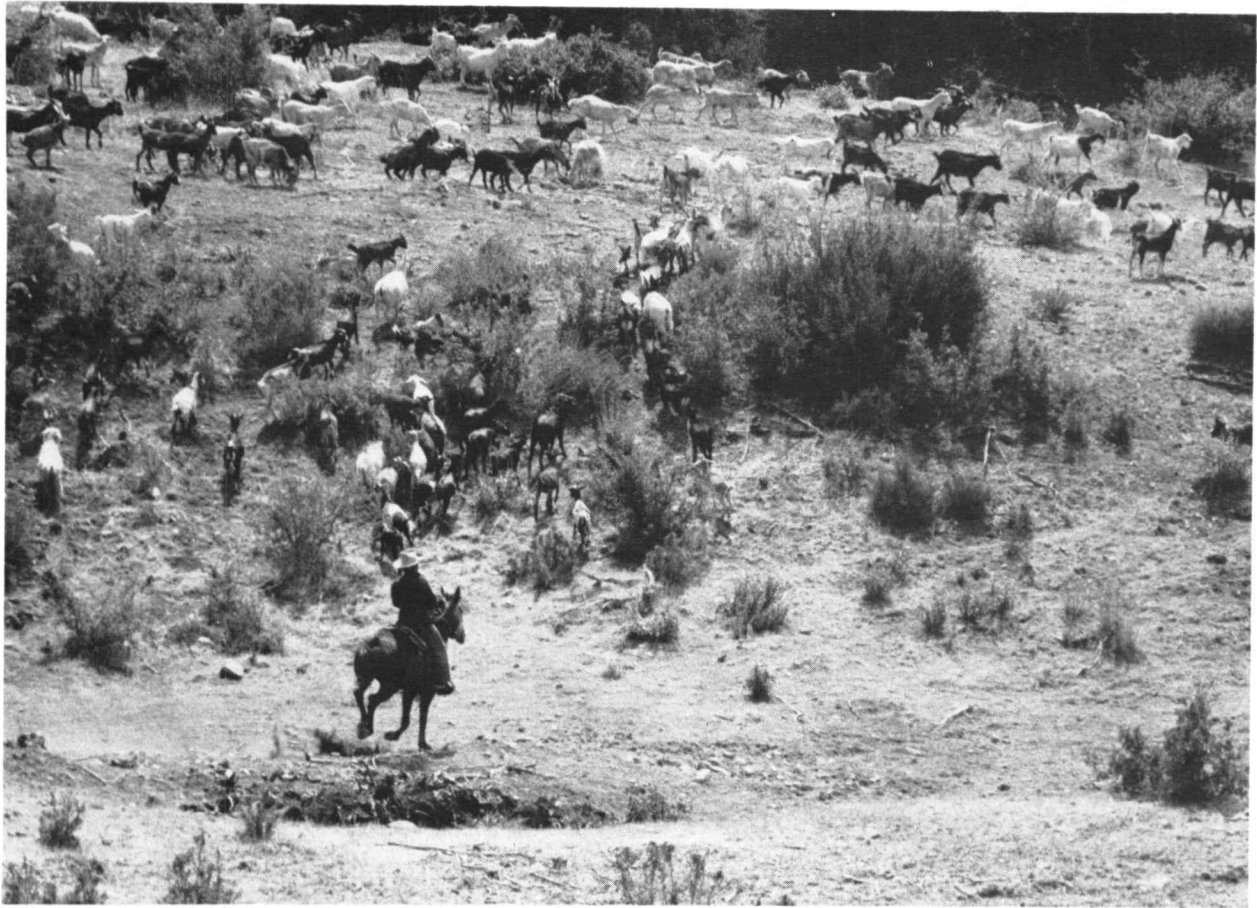
The fuelbreak area available for browsing consisted of 3,200 ha of canyon bottom, ridges, and intermediate flats and slopes at elevations of from 1,160 to 1,460 m.

Within the narrow to broad, usually dry canyon bottoms are coast live oak (*Quercus agrifolia*), scrub oak (*Q. dumosa*), big sagebrush (*Artemisia tridentata*), Mexican manzanita (*Arctostaphylos pungens*), California bush buckwheat (*Eriogonum fasciculatum*), and broom snakeweed (*Gutierrezia sarothrae*). Above the canyon bottoms is the chaparral. Chamise (*Adenostoma fasciculatum*), scrub oak (*Quercus dumosa*), birchleaf mountainmahogany (*Cercocarpus betuloides*), desert ceanothus (*Ceanothus greggii perplexans*), California buckwheat (*Eriogonum fasciculatum*), broom snakeweed (*Gutierrezia sarothrae*), and Eastwood manzanita (*Arctostaphylos glandulosa*) are the common woody species. Less common are scrub interior live oak (*Q. wislizenii frutescens*), white sage (*Salvia apiana*), whitethorn ceanothus (*C. leucodermis*), and southern honeysuckle (*Lonicera subspicata johnstonii*). Red shank (*Adenostoma sparsifolium*) is abundant on some sections of the fuelbreak, but not in the area where the goats were browsed. Annual grasses and forbs, or subshrubs such as penstemon, phlox, and mallows, are found in openings in the brush.

The fuelbreaks are generally 90 m wide, but up to twice this

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Editor's Note: This article is based on a paper presented by Mr. Green at the First International Rangeland Congress held in Denver, Colorado, August 1978. (One hectare equals 2.471 acres, one kilometer equals 0.62137 miles, 2.54 centimeters equals 1 inch, and 0.914 meters equals one yard.)



Goats being used to control brush regrowth

wide in some areas of broad valleys or flats. Mature brush on the fuelbreak containing the small fenced pastures was crushed with mechanical equipment and some of the brush accumulations burned in 1972. The 5-year-old scrub oak plants averaged about 1.2 m in height and 0.9 m crown diameter. Mountainmahogany plants averaged 1.3 m high, and about 0.9 m in diameter, but plants were less dense than scrub oak. Chamise and Eastwood manzanita were about 0.6 m high.

Sixty to 65% of the area of each pasture was covered with shrubs or the perennial subshrub *Penstemon spectabilis*. The remainder was a poor annual grass stand, or bare soil or rock.

The two most abundant shrubs in or near the small fenced pastures—birchleaf mountainmahogany and scrub oak—made up more than three-fourths of the shrub cover. Other shrubs, such as chamise and Eastwood manzanita, were locally abundant. California buckwheat could be found in all sampling areas. Showy penstemon was common in openings in the brush. Southern honeysuckle, redberry, and hollyleaf cherry were infrequent.

Results

Palatability

The two most abundant shrub species were among the most palatable to the goats. Birchleaf mountainmahogany was browsed first in any pasture, except for redberry and honeysuckle, which were found in only trace amounts. Scrub oak was almost as palatable, however, and use of scrub oak was never far behind that of birchleaf mountainmahogany.

Four hundred-forty goats were in Pasture #1 (1.0 ha) for 2 days and nights during July 1976. During this period, they

stripped an estimated 95% of leaves and small twigs to 1.6 mm diameter, from all birchleaf mountainmahogany plants. Use of scrub oak at the same time was about 80%, and might have been more had the oak plants been as open and available as the mahogany. This use pattern was repeated in several other small fenced pastures, although the goats were not in these pastures continuously.

Chamise and manzanita are abundant plants in the southern California chaparral, but the goats were not attracted to them in the 5-year-old growth stage. Chamise flowers were taken, but few of the leaves and twigs were used when browsing was free-choice. Neither were twigs of Eastwood manzanita or California buckwheat taken while the goats had some choice. Some species of *Ceanothus* are rated good browse plants for livestock and wildlife, but desert ceanothus in this study was browsed only under some duress.

The most palatable species of all was southern honeysuckle. It was eaten back until stems no smaller than 6 mm were left. Redberry was heavily hedged whenever it appeared.

During the summer of 1977, the goats were held briefly in an area containing big sagebrush and various chaparral species. Scrub oak was 2 m high, Mexican manzanita 46 cm, and desert ceanothus about 50 cm. Browsing on big sagebrush and scrub oak plants was rated an average 2.3 on a rating scale of 0 to 10 (10 indicating complete removal of leaves and twigs to 2 mm diameter; 0, no removal). Tips of sagebrush twigs were taken, with no sign of leaf browsing. Scrub oak twig tips and some leaves were taken. Chamise, hollyleaf cherry, and Mexican manzanita were very lightly browsed. Desert ceanothus and California buckwheat were not touched.

The goats browsed in six small (1 ha) pastures, and in one of about 8.5 ha (Pasture 7) periodically for several weeks. They

were taken outside the fenced pastures during the morning hours of most days, but spent nights, middays, and some afternoons in the fenced pastures. Most nights they were held in the small pastures, so that these were subject to somewhat more intensive use than Pasture 7. Under these "holding pen" conditions, use of less palatable species such as chamise, Eastwood manzanita, and California buckwheat approached but did not quite equal use of the palatable species. Up to 80% of leaves and small twigs of the unpalatable species were taken, but almost 100% of the mountainmahogany and scrub oak was browsed. In the less intensively browsed Pasture 7, use of the unpalatable species—chamise, California buckwheat, and hollyleaf cherry—was less than in Pastures 1 and 2 but browsing would have been negligible if the goats had not been confined there periodically.

Browsing Mature Brush

Land managers frequently talk of clearing mature brush with goat browsing, but on the basis of Forest Service experience, this does not appear to be a viable practice.

During early September 1976, about 2 ha of mature brush above the fuelbreak adjacent to Pastures 1 and 2 was fenced and designated as Pasture 8. From September 7 to 17, 1976, the goats were in Pastures 1, 2, 3, and 8 for 24 hours each day. From September 18 to October 16, they were in these same pastures at night, but were outside during the day. From October 17 to November 9, 1976, all the small pastures were accessible to the goats, at least at night.

Because the small pastures were already thoroughly browsed, the goats had little choice but to browse the dense mature brush in Pasture 8 after October 17. This brush was dominated by scrub oak and chamise, mostly less than 1.5 m high, and well within reach of the goats.

At first, the goats frequented openings and semitrails, but then were forced to work through the dense brush searching for accessible browse. Because they had little choice, they eventually took most of the browse within reach. Almost no herbaceous vegetation grew in Pasture 8, but woody regrowth and herbaceous vegetation alike were very closely browsed in the other small pastures.

Our experience is similar to that reported by Hatton (1913) while on the Lassen National Forest in northeastern California in 1908-09. Where the goats were concentrated and held, they girdled and killed about 75% of the manzanita and ate all the buds from tree seedlings. Hatton concluded that goats could be forced to kill almost any type of brush, if confined in enclosures, but would not damage unpalatable species if they could choose where and what they ate. The goat owner's objections gradually increased over the 2-year life of the Lassen Forest demonstration. He had trouble getting herders who would comply with the contract, and he could not tolerate the loss in weight and condition of the goats which were being forced to browse mature brush.

Browsing Young Brush Regrowth

During 1976, chaparral on part of the Tragedy Springs fuelbreak was disked, and most of the brush destroyed. A year later, the brush cover consisted of a light stand of chamise and desert ceanothus seedlings, sprout growth, plus a little old growth of scrub oak and chamise, and from small to trace amounts of other shrubs. Arrangements were made to concentrate the goats on about 10 ha of this regrowth, including construction of pens to hold them at night.

The band of 1,140 goats was on or near the 10 ha site for 7 days. During this time, all shrub species were browsed more than

anywhere previously, except in fenced holding areas. The few mountainmahogany plants had all leaves and small twigs removed, a rating of 10. Scrub oak regrowth was almost as closely used, and use was rated 9. Chamise utilization was the most we had seen, about 6.5. Use of desert ceanothus seedlings was rated 7, but the occasional old plants of the species rated only 3.5. Similarly, young California buckwheat use was rated 5, but a few plants not disked in 1976 were not browsed at all. The small Eastwood manzanita plants were heavily hedged. *Rhus trilobata* regrowth was browsed to a rating of 8 on some plants, but scarcely touched outside the area of goat concentration.

Inside the fenced area where the goats were held at night, all leaves and small twigs were removed, regardless of species.

Summary and Discussion

Two years of observation and data on goat browsing indicate that goats can control regrowth of southern California chaparral, and that goat grazing is an alternative to herbicides or other shrub control methods. Under free-choice browsing of 5-year-old regrowth, goats heavily browsed birchleaf mountainmahogany and scrub oak, and lightly browsed chamise, Eastwood manzanita, California buckwheat, and other shrubs. The goat population needed to be concentrated in particular areas in order to achieve uniform use of most chaparral species. This concentration was readily achieved by herding where seedlings and sprouting regrowth were less than a year old, but fencing seemed necessary where brush regrowth was 5 years old. Tight fencing was essential if goats were to be confined to mature brush, even though they might be herded out to other feeding areas during the day.

The use of goats to control woody plants is an old practice, but is receiving renewed interest in brush-covered areas of the American Southwest. In California, goat grazing is of particular interest for controlling brush regrowth on fuelbreaks, and may prove to be an alternative to fire, herbicides, or mechanical equipment.

Experience to date on the Descanso Ranger District, Cleveland National Forest, shows that goats readily browse 5-year-old regrowth of birchleaf mountainmahogany and scruboak growing on fuelbreaks. Under open-range browsing, they did not remove significant amounts of the abundant shrubs, chamise, Eastwood manzanita, and California buckwheat. To do so, they had to be confined within fenced areas. When small pastures were used to hold the goats at night, all leaves and small twigs were eventually removed from all species. Similarly, when the goats' choice was just mature chaparral, they ate what was within their reach, but only after considerable fencing problems, health problems, and soil disturbance. A more desirable approach was to concentrate the goats by herding them on areas where 1-year-old regrowth was available. Selectivity in browsing was greatly reduced, and the only fencing needed was for overnight holding. These results should be considered seriously when planning for use of goats to control brush on fuelbreaks.

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