Management Strategies for Gambel Oak Communities

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The Gambel oak community usually occurs as a woodland varying from small shrubs to medium-sized trees on mountain foothill ranges between the pinyon-juniper and ponderosa pine zones. Mature stands of oak are characterized by relatively dense clumps of trees ranging from 15-30 feet tall interspersed with many open spaces occupied by shrubs, grasses, and forbs. These communities contain useful forage and wood products as well as providing valuable wildlife habitat. Gambel oak is the dominant overstory species on about 9.3 million acres of rangeland in the southwestern United States (Kuchler 1964). Over 90% of this area lies within the states of Colorado, Utah, and Arizona (Harper et al. 1985). In southwestern Colorado, the optimal elevation for Gambel oak is 7,000 to 9,000 feet. Gambel oak often achieves full tree form on gentle to moderate slopes with relatively deep soils in areas where about 20 inches of annual precipitation is available (Brown 1958). The combination of ecological aspects and management considerations of Gambel oak communities pose a number of interesting questions for natural resource managers.

Management Uses

Herbaceous Forage Production

Production of herbaceous forage for domestic and wild animals in Gambel oak communities is controlled by precipitation and site conditions. Several studies have shown that herbaceous forage production can be up to several times greater in the openings between Gambel oak clumps than oak canopies (Moinat 1956); this phenomena is particularly noticeable with young oak sprout stands. As these stands mature and begin to express their self-thinning characteristic (Brown 1958), they become more open, and herbaceous production may increase beneath the canopies.

Oak Forage for Domestic Animal Use

Harper et al. (1985) reported that "cattle and sheep utilize oak only after the more desirable plant species are diminished." Goats, however, prefer Gambel oak foliage to other available forages when oak foliage is plentiful (Davis et al. 1975). Several researchers have reported that goats perform well on diets consisting mainly of oak foliage as long as these diets also contain other nutritious forages that are lower in tannin content than oak (Nastis and Malechek 1981).

Fuelwood

Gambel oak was occasionally used by early settlers for firewood, but extensive harvesting of the species for fuelwood is limited (Harper et al. 1985). Interest in use and management of Gambel oak for fuelwood has recently grown for a variety of reasons. The use of oak wood, with its superior heat-producing qualities, as a major home energy source began to increase during the energy crises of the 1970s (Wagstaff 1984). Increased demand, coupled with large areas of oak communities, accessible and in close proximity to major population centers, has generated considerable interest in management of the species (Harper et al. 1985). Wagstaff (1984) found fuelwood volumes in north-central Utah ranging from 6.5 to 130 cords per acre of merchantable oak, and estimated retail stumpage prices ranged from $20 to $425 per stocked acre. Shuster (1984) reported that contractors paid up to $9.60 per cord to thin mature Gambel oak stands in southwestern Colorado. From these factors, Wagstaff (1984) concluded that "Gambel oak can successfully and economically be managed for fuelwood where markets exist and competitive uses of the land are limited."

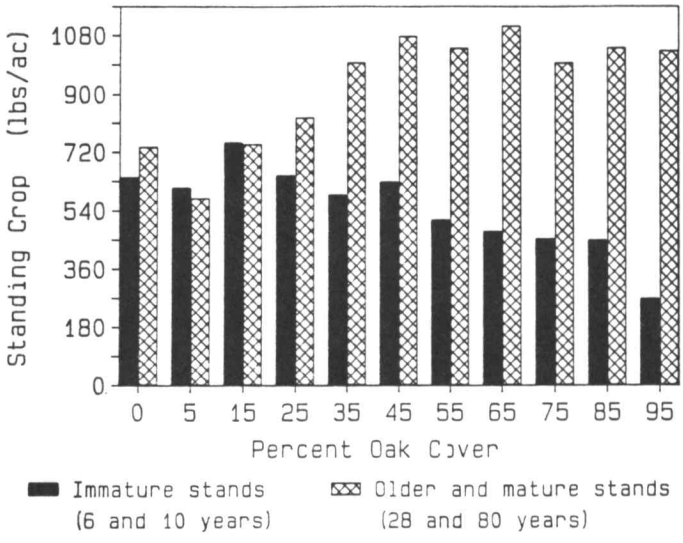

Fig. 1. *Standing crop of herbaceous forage (lbs/acre) in mature and immature Gambel oak stands.*

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Fig. 2. *Dense sprouts of Gambel oak following complete removal of oak crowns.*

Wildlife Use

Gambel oak communities in Colorado provide valuable habitat for wildlife, most notable as winter range for big game animals. Since availability and condition of winter ranges affect big game populations (Kufeld 1983), oakbrush communities play an important role in big game ecology. Because many species of game and nongame wildlife are dependent upon oak associations (Reynolds et al. 1970), management strategies for Gambel oak rangelands that contain prescriptions for maintaining or improving these valuable habitats are required.

Management Control Efforts

Much of the rangeland occupied by the Gambel oak type has excellent production potential of forage for domestic livestock; considerable efforts have been made to clear and control oak on these ranges. A doubling of forage production and a 60% increase in animal weight gains per acre resulted from Gambel oak control in southwestern Colorado (Marquiss 1972). Additional benefits included increased availability of forage and enhanced livestock handling. However, benefits derived from any control method are typically short-lived since complete elimination of Gambel oak is rare. Oak is a natural part of the vegetation. Creating open grasslands by removing mature oak stands is a short-term remedy, and recurrent treatments are necessary to control oak growth.

The major problem associated with Gambel oak control is prolific sprouting that occurs from oak roots, rhizomes, and basal stems following treatment (Engle et al. 1983). Treated ranges often develop a thicket-like appearance that complicates future control efforts. The productive life-span of most oak control projects is limited by rapid and abundant resprouting that follows treatment.

Methods of Oak Control

Fire—The extent and density of Gambel oak in west-central Colorado has been influenced more by fire than by any other factor (Brown 1958). Although prolific sprouting following burning of oak stands has been documented (Plummer et al. 1970), research has shown that Gambel oak sprouts can be limited by seeding competitive grasses following fire. Kufeld (1983) recommended that "prescribed burning rather than spraying or chaining be used to manage Gambel oakbrush rangelands for elk, deer, and cattle."

Herbicides—Many studies have shown herbicides to be ineffective in controlling Gambel oak both as a mature plant and as a sprout. Applications of 2,4,5-T, 2,4,5-TP (Silvex), and picloram are effective in killing Gambel oak foliage. However, prolific sprouting following herbicide application produced less desirable ranges than the original stands (Marquis 1973). Vallentine and Schwendiman (1973) and Van Epps (1974) demonstrated nearly complete control of Gambel oak stems (with minimal subsequent sprouting) with a mixture of picloram and Silvex, and with fenuron, but the application rates were too high to be economically acceptable.

In Texas, tebuthiuron has shown good control of oak species associated with Gambel oak. Scifres et al. (1981)

demonstrated 99% control of blackjack oak and post oak 3 years after a spring treatment of tebuthiuron. Tebuthiuron was also reported to give good control over Harvard oak (Jacoby et al. 1983), a species that is known to hybridize with Gambel oak. However, Bartel and Rittenhouse (1982) concluded that tebuthiuron should not be considered an acceptable herbicide for controlling Gambel oak in southwestern Colorado because of poor brush control and severe damage to the herbaceous understory following treatment.

Recent studies in southwestern Colorado with glyphoate and glyphosate:triclopyr-picloram combinations showed excellent stem and plant kill of Gambel oak, and nearly complete root-sprout suppression for a minimum of five years (Rittenhouse and Bartel 1986, unpublished report). Treatment costs and damage to the understory may be high with these herbicide combinations.

Mechanical Manipulation—Common mechanical treatments used to break down oakbrush stands include chaining, roller chopping, root plowing, brush raking, and bulldozing. Chaining, probably the most popular method, appears desirable when judged on a short-term basis (Bartel and Sims 1978), but the prolific sprouting that follows treatment and results in dense thickets in just a few years makes this control method unsatisfactory.

Biological Control—In a goat browsing study in southwestern Colorado, Davis et al. (1975) reported that goats could be effective in oakbrush control programs: "the oakbrush must first be treated mechanically to allow the animals full access to all the foliage" (Davis et al. 1975). However, the use of goats to control oakbrush is problematic. In the absence of a viable market, use of goats is impractical in many situations (Engle et al. 1983).

A Colorado Study

A study of Gambel oak was conducted in southwestern Colorado on the Mancos District of the San Juan National Forest and adjoining lands near Mancos, Colorado. Oak-serviceberry and oak-herbaceous associations in the study area typically have 2500-3500 oak stems per acre, most of which are less than 4 inches in diameter. However, Borman (1981) reported up to 15,500 stems per acre on recently roller-chopped areas.

Mature Gambel oak stands that had been mechanically disturbed 6, 10, and 28 years ago, and adjacent untreated stands estimated to be 80 years old, were identified in the research area. These stands were sampled from early June to late August in 1984 and 1985 for percent oak canopy cover with the use of a spherical densiometer (Lemmon 1956) and for peak standing crop of the herbaceous forage (considering only the palatable grass and forb species) by a double sampling technique (Carande and Jameson 1986). Sites were sampled for herbaceous peak standing crop with 15 plots of 0.1m^2 within 11 oak cover classes, ranging from 0 to 99% on ungrazed sites. All forage production values reported are expressed as oven-dry weights.

Gambel Oak and Herbaceous Forage Relationships

The relationship among oak cover, peak standing crop of herbaceous forage, and oak stand age in southwestern Colorado is shown in Figure 1. For immature stands, maximum forage production decreases with increasing oak cover while the reverse is true with older and mature stands. Although all ages of oak stands have frequently been treated in the past, these findings show that age and structure of Gambel oak sprouts and trees strongly influence production of herbaceous forage around them, and suggest that stands of different age should be treated differently (Fig. 2 and 3).

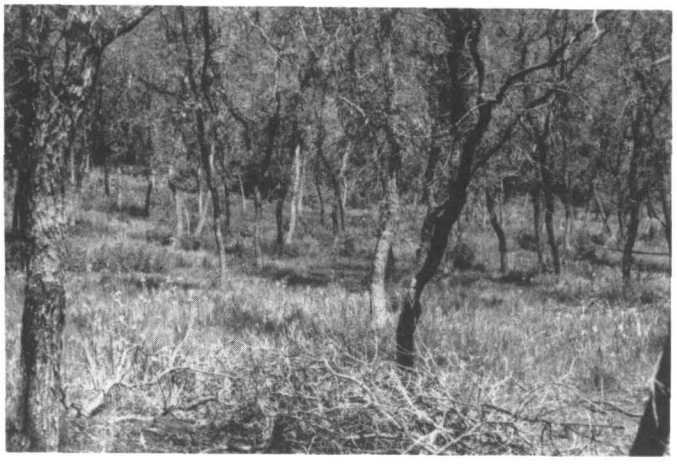

Fig. 3. *An older stand of Gambel oak that has been thinned.*

Management Recommendations

Because dense Gambel oak sprout stands in southwestern Colorado that are 6-10 years of age reduce forage production, we recommend that such stands, if treated, be only thinned to maintain less than 35-45% average oak cover. Thinning programs should be designed to promote growth of the remaining stems and to result in some forage increases for domestic and wild animals. Spot treatments could be advantageous on selected patches of dense sprout thickets (Vallentine and Schwendiman 1973).

In stands of 28-80 years of age, livestock access may be enhanced by thinning to 45% average cover, but such treatments will not result in increased forage production (Fig. 1). However, thinning of older stands below critical cover values may result in vigorous sprouting and in a decrease of herbaceous forage production. Additional research needs to be conducted to determine "safe" lower thinning levels for mature stands and critical indicators for a stand to be considered "mature."

A partial wood harvest is an alternative for older mature stands that have accumulated marketable fuelwood. A partial harvest designed to maintain or improve the mature stand structure may be preferable to a complete harvest that would most likely return the area to a sprout-dominated community. With complete harvest of a mature

Gambel oak stand, resource managers would then need to consider thinning the immature stands in the following few years.

Need for an Integrated Management Approach

There are numerous reasons for advocating an integrated approach to management of Gambel oak rangelands. First is the recognition that control methods currently available to completely eradicate oak from its native range are ineffective, costly, and largely result in less desirable ranges in just a few years following single applications. Secondly, a method of Gambel oak management is needed that recognizes the advantages and problems each kind of control treatment offers. Third, Gambel oak control programs should be directed at long-term control, in view of the persistence of oak in its native range; thus, programs that incorporate and evaluate multiple control applications over time are desirable. Lastly, management emphasis is shifting from destruction of Gambel oak to investigation of inherent values associated with rangelands where Gambel oak is a natural dominant, specifically in the area of fuelwood management (Engle et al. 1983, Wagstaff 1984, Harper et al. 1985).

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