Livestock: Biological Control in Brush/Weed Management Programs

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Integrated brush management is defined as "The development and implementation of a sequence of control treatments designed to reduce the effect that brush has on preferred plant species over a number of years" (Brock 1985). Since the mid 1950's it was accepted that rarely would one treatment control pest plants in rangelands. This led to the concept of integrated pest management in forage production systems. A systematic approach to aid the implementation of integrated brush management programs has been described by Scifres and coworkers (1985). The approach relies on using the available tools of fire, chemical, mechanical, and biological treatments in a sequence to provide control of the pest plant with the goal being favorable forage responses with minimal ecological disturbance and economic inputs. It is often forgotten that livestock grazing may have a role in the integrated approach to brush and weed management.

An organism that has an action leading to the destruction of another organism (host), or weakens it so that pathogens attack it or make it noncompetitive with other organisms, is said to be a biological control agent. To meet the traditional concept of an effective biological control agent the following critria are necessary:

1. The agent should be specific to the host or have a narrow range of alternate hosts.
2. Alternate hosts are not economically valuable.
3. Target species/alternate hosts are not ecologically important to the stability of the ecosystem.

Biological control of pest plants is being utilized in pasture and range management, but the number of cases involving domestic livestock compared to other treatment methods (fire, mechanical, and chemicals) is relatively small. For livestock to be effective as biological control agents the following 4 conditions must also be met:

1. Effective control of livestock is necessary.
2. Target plants must be accepted by the livestock as forage.
3. Other forage plants must be present to replace the target species.
4. Differential susceptibility of the target plants to grazing at some time of the year to aid in the control strategy.

Livestock do not fit the typical concept of a biological control agent because of their wide dietary selection. In general, as biological control agents cattle have been utilized the least, with sheep and goats being the more common domestic biological control agents. Cattle primarily use grass, forbs to a lesser degree, and browse the least in their diets. Improper cattle management is commonly one of the reasons for rangeland weed infestations. As a consequence, use of cattle as a biological control agent has not been seriously entertained by range-weed scientists. Sheep are characterized as grazers that utilize large quantities of forbs, some browse, and grasses. Goats are categorized as being browsers that utilize high quantities of woody plants in their diets; however, they also use all classes of forage (Merrill 1972).

There also is some variation as to forage selection within animal species. Angora goats have a tendency to graze herbaceous plants while Spanish goats use more of the browse component (Bryant et al. 1979). Diet selectivity and potential dietary overlap of livestock classes needs to be well understood when using grazers as biological control agents.

To effectively carry out a complete control program, range managers using integrated pest management techniques should know the pest plant's life history. The times when the plant roots and shoots grow, flowers appear, seed is set and seed germinates should also be known to effectively time biological control treatments. By using knowledge of the pest's life cycle, grazing treatments to maximize its control can be planned.

The use of systematic grazing systems would intensify utilization of the target plant, as critical stages allow the more preferred forages to improve, or at least not be damaged by the grazing activity, and would be the best way to ensure plant control. Deferred grazing or intense-short duration grazing plans lend themselves as a framework in which planned grazing of a target species can be accomplished.

Cattle

Cattle grazing appears to offer the least potential as biological control agents for pest plants. Cattle have been reported to control Johnson grass in fescue pastures but specific data have not been provided. A single late season heavy grazing by cattle practically eliminated aspen regeneration in west-central Canada (Fitzgerald and Bailey 1984). Aspen biomass was only 2.5% of the total on the area grazed late in the season compared to an area grazed early in the season, which had 29% aspen in its total biomass. In a recently implemented time control grazing program, increasing stock density to 5 cows/ha (2 cows/acre) in the early spring is being used to inflict physical damage to leafy spurge in Montana (Parman 1986). The land manager believes repeated animal impact will eliminate leafy spurge dominance and allow desirable forage plants to increase on the area. These were the only examples of cattle grazing or activities to control specific unwanted plant materials found in a review of research for this paper.

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Sheep

The most widely researched weed control program with sheep, in the United States, is with leafy spurge. Johnston and Peake (1960) reported that four years of grazing of leafy spurge by sheep was needed for its control. Lacey et al. (1984) reported that sheep grazing was an excellent method of controlling large infestations of leafy spurge. Sheep grazing reduced leafy spurge cover from 60% to 5% after 13 years of grazing in the Northern Great Plains. Although sheep did not "eradicate" the weed, a good management system kept it from spreading. Good grazing management on leafy spurge-infested range would include grazing by sheep in the spring when leafy spurge plants are several inches tall, rotating grazing schedules so that leafy spurge plants do not go to seed, and if sheep are grazing spurge plants after seed set, the animals should be held about 5 days to allow viable seed to pass through the digestive system (Lacey et al. 1984). Sheep apparently neither prefer nor avoid leafy spurge. It is reported that sheep begin increasing consumption of the target plant after about 3 weeks into the spring grazing period. During the growing season 40–50% of the sheep diet may be leafy spurge (Landgraf et al. 1984).

Other examples of sheep as biological agents include the following. Sharrow and Mosher (1982) reported that stands of tansy ragwort, a biennial weed, have been reduced by sheep grazing. The primary action was that populations of tansy ragwort were controlled by reduced ability to produce seeds. Bendall (1973) found that sheep grazing in winter and early spring in Tasmania greatly reduced slender thistles while perennial grasses improved. Continuous sheep grazing depressed thistle populations but was not as effective as was more intensive winter grazing of thistle rosettes. Michalk et al. (1976) used sheep to control a problem grass in southeastern Australia. The pest plant was a barley grass which produces long awns. These awns physically damaged grazing animals and lowered the wool grade. In their study, early autumn and late winter grazing, before awns formed, controlled the barley grass.

Goats

Probably the most well-known domestic grazer that functions as a plant control agent is the goat. Recent citations extol the virtue of the goat as a biological control agent for undesirable shrubs on rangelands. Goats have been used as the sole brush management agent in Texas and in Southern California chaparral. Goat browsing will control many chaparral shrubs including scrub oak and mountain mahogany. Concentrating populations of goats by fencing and/or herding has been cited as a way to increase control of California chaparral (Green et al. 1979).

Goats in combination with other brush management treatments, especially mechanical techniques, tends to improve the efficacy of brush control. The other treatments initiate shrub regrowth, which goats prefer as forage compared to mature plant parts and most likely also create a decreased carbohydrate supply in the shrubs.

Merrill and Taylor (1976) reported from the Edwards Plateau of Texas an average of 83% brush canopy mortality following chaining as an initial treatment followed by 5 years of goat browsing to control the regrowth of target plants. In Colorado, Gambel oak that was initially mechanically treated (undercut or rollerchoped), followed by systematic goat grazing resulted in high levels of control. Two defoliations by goats per year resulted in 95% oak control after 5 years (Davis et al. 1975). Similar high levels of oak control were reported by Wiedemann et al. (1980) from research conducted in west-central Texas. Bigelow shin oak that was mechanically shredded and heavily goated for two years resulted in a 99% kill of the oak regrowth. Shredding, 2 seasons of less intense goat browsing, and aerial sprays of 2,4,5-T produced similarly high kills. Without goat browsing, mechanical and chemical control was erratic, with oak mortality ranging between 16 to 40 percent. It is speculated that the higher mortality associated with goat browsing/spraying was from decreasing carbohydrate reserves in the oak regrowth.

Angora goats were introduced as biological control agents on Arizona chaparral that had been prescribed burned as the initial brush control treatment (Knipe 1983). After autumn burning the area was seeded. Goats began grazing about 6 months later. The Angora goats showed a high potential to control most shrub regrowth, but also consumed seedling grasses. A deferred grazing system was initiated which allowed the development of a successful grass stand while brush regrowth was suppressed by the goat browsing.

Several authors have stressed that grazing mixed livestock classes holds high potential for vegetation management and a review of the subject was reported by Baker (1985). When grazing is directed to a particular plant species or group of plants, biological control may be achieved. Combining domestic livestock grazing with other cultural treatments into an integrated brush/weed management plan has the potential to produce very good management of undesirable plants in pastures and on rangelands.

The research effort in the use of livestock for weed control seems to be minimal. The potential for viable research seems immense. Very little is known about the impact short-term rotational-intensive grazing programs, especially those utilizing cattle, may have on less desirable forages. The combination of technology in weed, range, and animal sciences in well-defined long-term research is needed to describe the role that planned livestock grazing has in the integrated pest management approach for pasture and rangeland improvement.

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Quo Vadis Quercus—An Interim Solution

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The composition and structure of California's hardwood forests has been modified over time to accommodate various uses, and until recently, few people questioned the effect of this conversion. Removal of hardwoods has been an accepted way of life, where they have been viewed as unwanted vegetation in the path of agricultural crops, range improvement, and construction of freeways, dams, and houses.

On the other hand, people have placed value on recreation and wildlife habitat associated with hardwoods. They have come to appreciate the aesthetic qualities of oaks and, especially in urban areas, to pass laws to protect these trees. Thus, questions are being raised about the loss of wildlife habitat, degradation of soil and water quality, and even the ability of the resource to regenerate itself.

Private owners hold over 70 percent of the state's hardwood rangelands. Ranchers are currently struggling in a fiercely competitive market, where demand for beef has slackened and prices have remained low. This has increased pressures to cut hardwoods for firewood and to subdivide ranches. Clearing oaks has resulted in the fragmentation and conversion of what once was a contiguous resource land base. Consequently, an approach to the hardwood conversion issue has evolved. This approach takes the strength of our traditional rural experience, but mixes in new elements appropriate to today's urban California.

Hundreds of thousands of acres of hardwoods on rangelands have been harvested or converted since 1945. While the quantitative effects of such removals on wildlife, soil erosion, and water quality have not been determined, intuitively we recognize that changes have occurred. Whether, as argued by preservationist groups, these changes have created a crisis situation for the hardwood resource and are occurring at such a rate that strict governmental intervention is warranted, is still up for debate. However, we feel the solution to the problem must be equally balanced between the severity of the situation and the probability of success in accomplishing the desired result.

In June of 1985 we reported in *Rangelands* on the emerging hardwood controversy in California (Walt et al. 1985), a controversey that is a result of a set of complex social, biological, and management factors which poised landowner and land use rights issues against the call for greater resource protection.

Blue oak-digger pine woodland at Fort Hunter Ligget, Monterey County. Photos by Lynn Huntsinger

Since 1981, much debate has been heard concerning the status of the hardwood resource, its management or mismanagement, and whether state government should take an active role in protection through regulation. In response to this controversy, the California State Board of Forestry (BOF) began a thorough fact-finding mission in 1980 to determine the status of the hardwood resource. Adequate time was allowed to gather and establish short-term programs to address only the most pressing problems. This article, thus, describes the development of an interim solution to the hardwood issue and the BOF's hardwood policy.

Past Events

Based on studies conducted in 1981-83, it was clear that critical information about the hardwood resource was lack-

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