Use of Range Grasses on Burned-over Brush and Timber Land in California

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WITHIN THE PAST 20 years, range grasses have become increasingly important for seeding on burned-over brush and timber land in California. About 125,000 acres per year are now being sown. The introduction and development of these grasses was largely for the improvement of grazing by livestock. However, seeding of range grasses has proved valuable for watershed improvement and water is the number one problem in much of the State. Allied with watershed improvement has been the cover grasses provide to reduce flood danger after wildfire has removed brush or trees from mountain slopes.

Long range plans for fuel breaks have been developed by Bentley and White (1961). These fuel breaks are strips of grass that break up the extensive brushfields to aid in the control of destructive wildfires. The grass strips may follow ridges, benches, or swales. The width may vary from 200 to 400 feet and extend from a few hundred feet to several miles in length. One of the pilot models was planned for the San Dimas Experimental Forest and totaled 2400 acres or 14 per cent of the entire area.

GRAZING ON CALIFORNIA'S WILDLANDS

Grazing is one of the oldest agricultural pursuits originating in California with the Spanish in the early mission days from 1769 to

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1823. Zivnuska (1965) states that the present wildlands of the State consist of about 65 million acres, generally hilly or mountainous. Furthermore, these wildlands yield annual water supplies estimated to average more than 68 million acre feet per year. Two-thirds of the total wildland area, about 45 million acres, provides an important source of forage for both domestic livestock and game animals. The range forage alone is estimated to provide about 12 million animal unit months of grazing by domestic stock.

FIRE ON WILDLANDS OF THE STATE

The Mediterranean type of climate, with extensive sclerophyllous brushfields which occur in California, is conducive to serious wildfires. Rainless summers each year over most of the State allow the soil and vegetation to dry. During this period, daytime temperatures are often high; the humidity may at times become very low, and high winds may blow. This combination of factors makes extremely hazardous conditions for wildfires. The fire season may not be limited to late spring, summer, and fall. Especially in Southern California rainfall may be highly erratic. Autumn rains may commence early in September but occasionally the dry season may continue until February. Also, in the mountains of Southern California desiccating winds may blow from the interior deserts. These are called Santa Ana winds and blow towards the Pacific Ocean. The low humidity and high velocity of the Santa Ana winds provide extremely hazardous conditions for wildfires in the winter and spring.

The frequency of past fires in the timber region of the Sierra Nevada mountains has been debated. Wagener (1961) found a frequency of about eight years average between fires and by counting tree rings and relating fire scars to the year of burns reported that this frequency held true before the middle of the 16th century for one area and for two other areas back to the 17th century. Intervals between fires were as short as two years or as long as 21 years.

CONTROL BURNS

The California State Division of Forestry began issuing permits for control burns for range improvement about 1945 (Burcham,

1959). He reports a considerable acreage of brush-covered land being burned. From 100,000 to 150,000 acres are burned each year and about 450 permits are used annually. In 15 years from 1945 to 1960, about 5,700 ranchers conducted planned burning on more than 1.6 million acres to control brush and improve grazing.

Considerable research has gone into determining the most effective use of control burning as a tool for land clearing. Shantz (1947) recommended that the chaparral be broken down into dominant species and the many communities recognized and placed in their successional relationships, and the life history, physiology, ecological and soil relations studied. Sampson (1948) cautioned against heavy grazing that reduces desirable plants, broadcast burning to kill brush and unpalatable vegetation, leaving the soil exposed to erosion, and letting brush regenerate to occupy the land more than formerly occurred.

A warning against clearing off the forests by cutting and fire, to reduce them to useless fields of bracken, is given by Shantz (1947). He warns especially about the regions of relatively heavy rainfall, such as the Pacific Northwest and the temperate rain forests of Central Africa and New Zealand. Bracken fern thrives on fire and fire thrives on bracken fern. According to Shantz a third of the natural vegetation of the earth's surface was effected by fire. Except for pine lands and monsoon forests, and the Mediterranean type, which includes the chaparral of California, the forests of the world are not fire types. We should determine the role of fire in the extension of brush areas and also the role of fire in destroying brush, and the most feasible and economical methods of clearing potential agricultural land from brush. There is little evidence that fire alone can accomplish this result.

RESEARCH TO IMPROVE BRUSHLAND CONVERSION TO GRASS

The effective use of 2, 4-D and 2, 4, 5-T as selective herbicides in controlling brush sprouts and seedlings while grasses are being established has been described by Leonard and Harvey (1965) for California species and conditions. The widespread use of 2, 4-D and 2, 4, 5-T has given considerable impetus and effectiveness in converting brushland to grassland. Love and Jones (1952) described

certain steps in removing brush by fire or mechanical methods and revegetation of the cleared areas with grasses. The State was divided into seven zones based mainly on precipitation but with some elevational considerations. Grasses were recommended for the zones and classified as long-lived perennials, short-lived perennials, and desirable annuals.

Considerable research and development have resulted in improving the effectiveness, safety, and cost of use of control burning as a tool for land clearing as reported by Arnold, Burcham, Fenner, and Grah (1951). Study was given to selection and preparation of areas to be cleared to utilize natural barriers or control lines to surround the area. Then, proper ignition techniques were developed. It was found advisable to use flame throwers. Pre-treatment may be justified by smashing the brush with a bulldozer a few weeks ahead of burning. This permits the brush to dry and more of it to be in a horizontal position. County organizations of ranchers have greatly helped the program by providing experienced crews in preparing and burning brushland.

BRUSH FOR WATERSHED COVER

Comparisons between land covered by brush and adjacent plots where brush has been burned have frequently shown loss of soil by erosion from the bare areas. Steepness of gradient, litter on surface of soil or organic matter within the soil, texture of soil, intensity of rainfall, and amount of herbaceous vegetation are important factors which vary from site to site but determine the amount of soil lost from the burned over land. Sampson (1944a) concluded that heavy burning of slopes in excess of about 30 per cent gradient will accelerate erosion in proportion to the degree of grazing and trampling. He found soil-moisture relations showed such slight quantitative differences in freshly burned versus unburned chaparral soils as to be of little ecological or economic importance. At depths below about two feet, the soil moisture percentage was consistently somewhat higher in recently burned areas.

Sampson (1944b) seeded cultivated grasses, but abundant brush sprouts and seedlings choked out the grasses. These experiments were conducted before the use of selective herbicides became prevalent.

Also, some varieties of grasses are available now that may be better adapted, and more effective equipment is available for seeding. The Interagency Range Seeding Committee and the U.S. Forest Service Equipment Development Laboratory (Anonymous, 1959) have designed a rangeland drill. It is being widely used in California by the U.S. Forest Service, the Bureau of Land Management, and the Bureau of Indian Affairs for establishing grass on land cleared of brush by fire. It is important that an adequate stand of grass be obtained as early as possible after the fire. The findings of Sampson are as true today as earlier. An adequate cover of grasses or forbs is difficult to establish if selective herbicides are not used to control sprouting or seedling brush of the chaparral species.

WATER YIELD FROM BRUSHLAND VERSUS CLEARED LAND IN GRASS

The University of California has experimental watersheds at their Hopland Field Station. Prof. Robert Burgy, hydrologist for the project was quoted in the Western Livestock Journal (Anonymous, 1965) concerning results from the 12-year-old experiment. After trees and brush are removed from a mountainside the equivalent of between five and ten inches of additional rainfall per year were obtained in an area where the average annual rainfall is about 35 inches. The slopes are seeded with grasses and clovers soon after the control burn. For seven years before the watershed was treated and for five years afterward, Burgy measured both surface and underground runoff from the canyon.

Never in man's memory had the small stream bed in the canyon bottom held water after the first week in July, until the brush and trees were killed five years ago and it has never been dry since. There was the same general amount of erosion during the five years after the watershed was treated as before. Between 50 and 60 giant oak trees scattered over the 210 acre slope were untouched or only singed by the fire. They were intentionally left as shade for the sheep and because they look good, Burgy stated.

The improvement of stock water facilities along with other greatly improved forage conditions occurred when personnel of the Mendocino National Forest control burned and seeded to grass the

Grindstone area between Elk Creek and Alder Springs, west of Willows, California. This Grindstone area was heavy chaparral dominated by chamise but having also some wedgeleaf ceanothus, scrub oak, and poison oak. The area was control burned, drilled to a mixture of range grasses and broadcast sprayed with 2, 4-D to control the sprouts and seedling chaparral species. The chamise proved very susceptible to the first spray treatment but some late emerging wedgeleaf ceanothus had to be spot sprayed the second year after the fire. This area has become very important as a demonstration of complete change-over from heavy chaparral, too dense for livestock use, to open grassland with high grazing capacity and excellent watershed cover. The most surprising feature was the development of a pond of water that has continuously provided water for livestock and game animals since the chaparral was eliminated. Before treatment there was a complete absence of any free water for livestock or game. Eradication of the high-water-using brush permitted a seep to develop which was directed by bulldozer work to a small wash in which a small dam was built to impound water. The pond has not gone dry but has provided a permanent supply of water, although drought years have occurred since the chaparral control was initiated.

INCREASED WATER YIELD BY CONVERTING TO GRASS IN SOUTHERN CALIFORNIA

Southern California, more than any other part of the State, has shown concern about water problems, whether excessive, causing floods, or deficient for irrigation and domestic or industrial use. An example will be cited where converting from brush to grass increased water yield of a desirable type according to Hill and Rice (1963). Monroe Canyon, a portion of the San Dimas Experimental Forest, was treated to control riparian woodland vegetation on 38 acres along the canyon floor. The cleared area varied in width from 100 to 400 feet and extended for a distance of 1.3 miles through the 875-acre watershed. An adjacent 740-acre watershed was left untreated for comparison. After clearing, the area was hand sprayed to kill sprouts and seedlings of brush and weeds. Native grasses

quickly occupied the area and provided good soil protection. The total gain in streamflow was 52.2 acre feet of water from 39.2 inches of rainfall during the first two years after treatment.

SEVERAL EXAMPLES OF IMPROVED GRAZING PLUS ASSOCIATED VALUES

The increased grazing capacity of the Grindstone area cannot be expressed on a percentage basis because there was no grazing for domestic livestock prior to the conversion from brush to grass. Since conversion and for about 10 years it has been grazed at moderate intensity each summer. A surprising amount of forage has been produced giving approximately 1.1 animal unit per month per acre. Also, the opening of the heavy, dense chaparral has great value for fire control purposes. The perennial grasses, including hardinggrass, big bluegrass, tall fescue, and intermediate wheatgrass remain green through the early summer. If a wildfire should start at any time in the vicinity, this open grassland makes easy access for quick control. This project was the beginning of the fuel break program developed by Bentley (Bentley and White, 1961).

It is paradoxical that within one mile of the Grindstone conversion project, in 1953, several missionaries and a forest ranger employed by the U.S. Forest Service lost their lives fighting an incendiary fire in the chaparral. The brush was thick and difficult to walk through with sufficient dead and dry material to be highly flammable. A change in the wind direction from up-canyon to down-canyon caused the disaster. The Mendocino National Forest has been increasing the conversion program of brush to grass and their fuel breaks now total more than 4600 acres.

Another outstanding project in converting chaparral to grass has been carried out on the private land of Mr. John Guthrie, president of the American National Cattlemen's Association, near California Hot Springs. He has demonstrated the feasibility of converting from brush to grass in the foothills of the south Sierra Nevada mountains. Mr. Guthrie is a permittee on the Sequoia National Forest and has cooperated with the U.S. Forest Service in the improvement of some of his spring range at low elevations. This improvement at lower foothills will relieve the spring rush of livestock to the high

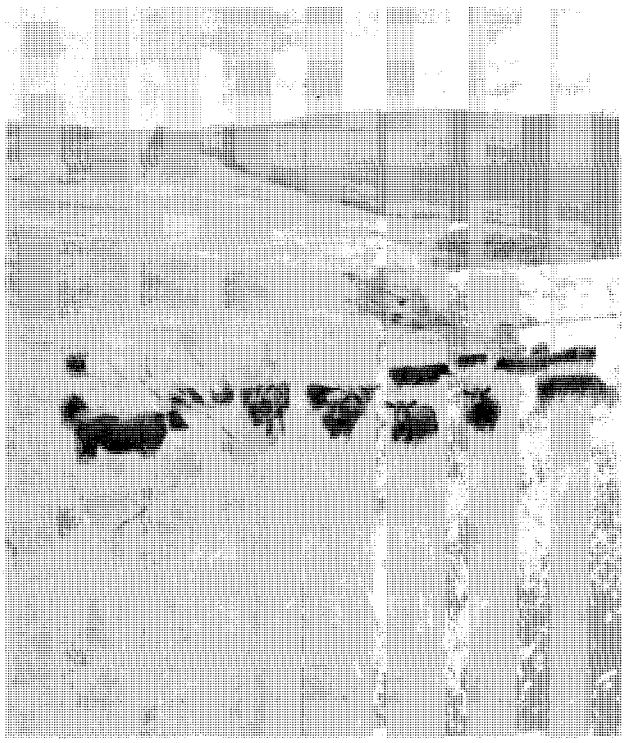

FIG. 1. Watering place developed on the Grindstone seeding area made possible by controlling chaparral vegetation and converting to perennial grasses for grazing by domestic livestock and game animals. U. S. Forest Service photo.

elevation ranges of the Southern Sierra Nevada mountains before the grasses have had an opportunity to make enough growth for best grazing value.

The ecology of the lower Sierra Nevada foothills makes conditions somewhat different from the Grindstone area. For example, the chaparral was dominated by more clumpy wedgeleaf ceanothus, California buckeye, and scrub oak with very little chamise. An excellent understory of resident annual grasses of Mediterranean origin occurred throughout the area with adequate seed to occupy the land upon removal of the brush by bulldozer and by burning. Watering places were developed and provided abundant water after the brush was cleared as shown by Fig. 1.

Personnel of the Sequoia National Forest cleared brush from a

FIG. 2A. Coarse chaparral stems being disked down permit drilling of perennial grasses in conversion from brush to grass. This Bear Creek seeding area is in Sequoia National Forest. Photo by Donald R. Cornelius.

part of the Bear Creek allotment near Springville. A control burn in 1956 consumed much of the brush but heavy stems had to be disked down as shown in Fig. 2A. Although dominated by chamise, other important chaparral species were ceanothus, yerba santa, scrub oak, red bud, and poison oak. Yerba santa became more abundant as vigorous sprouting occurred after the burn. A mixture of grasses was drilled and such perennials as tall fescue, hardinggrass, intermediate wheatgrass, and smilograss were proved to be very well adapted. After spraying for control of sprouting and seedling brush plants, this area was used for summer grazing at one head per acre per month (Fig. 3). The Gill Ranch was the permittee and had ample spring forage on lower foothill ranges. However, until the long lived perennial grasses were sown for use in late July and August, there was a deficiency in green forage for summer grazing at this elevation (about 3000 feet above sea level).

Extensive conversion of brushland to grassland is being carried out on the Los Padres National Forest. About 7,500 acres are being

FIG. 2B. Perennial grasses established on land in conversion from brush to grass by seeding and by spraying brush sprouts and seedlings with selective herbicide. Bear Creek seeding area, Sequoia National Forest. Same area as shown in Figure 2A. Photo by Donald R. Cornelius.

converted to fit into a comprehensive fuel break program. Advantage is taken of certain wildfires such as the Refugio Burn (Fig. 4 and 5) and the Coyote Burn near Santa Barbara last year to provide ridges, benches, and swales with sufficient soil depth and suitable gradient to permit the drilling of grasses. Seeding of perennial grasses as recommended by Green, Edmunson, Cornelius, and Evanko (1963) and accompanied by adequate spraying with selective herbicides will aid complete conversion and will greatly benefit combined uses of grazing, fire control, and watershed value.

GRASSES FOR FLOOD CONTROL

Flood control by watershed protection along with the complete conversion program for selected areas is an additional benefit from grasses on burned over land. Annual ryegrass has been successfully sown by airplane or by helicopter on about 25,000 to 100,000 acres per year for the past 10 years. Colman (1951) pointed out the

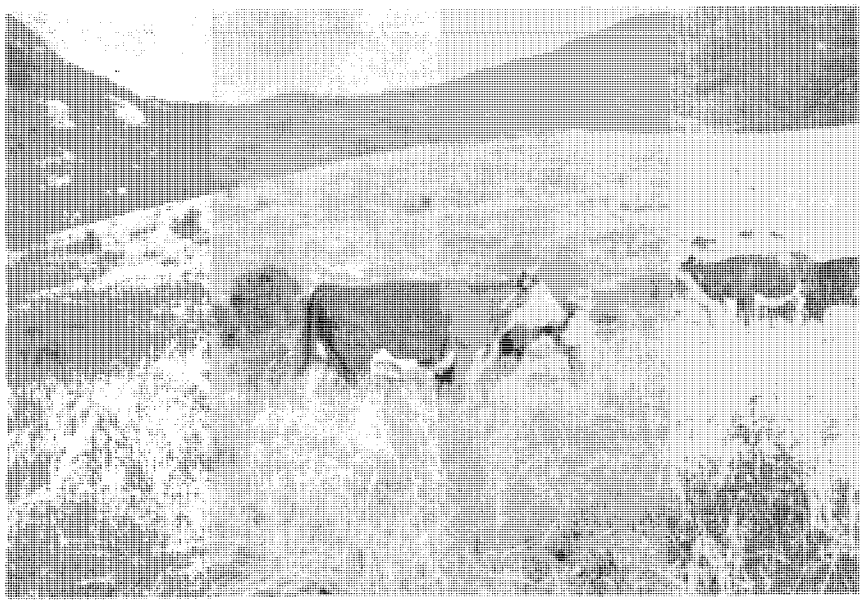

FIG. 3. Grazing perennial grasses in July and August when resident annual grasses are dry. Cattle gain 2 pounds per head per day when grazing the green vegetation of the perennial grasses during the summer period. Photo by Donald R. Cornelius.

terrible hazards and potential destruction that might result occasionally from floods when the cover of large mountain slopes in southern California is completely removed by fire. Chaparral occupies roughly 70 per cent of the mountain land between San Luis Obispo and the Mexican border. In November 1933, seven square miles of chaparral burned above Montrose and La Crescenta, suburbs of Los Angeles. A severe storm struck on New Year's Day and flood waters drowned 30 persons, damaged 483 homes, and caused five million dollars damage. Seeding grass or any vegetation under this situation would not have prevented the flood. However, given six weeks or more of favorable moisture and temperature, ryegrass will commence to hold soil and as a heavy growth develops as shown in Fig. 5 will benefit slopes by holding soil and reducing the head of flood water that reaches the canyons below.

In 1957, personnel of the California Division of Forestry began a program of emergency revegetation of burned watersheds as described in their Annual Report (Anonymous, 1957). It was stated

FIG. 4. Wildfire, Refugio Burn, on Los Padres National Forest used for experimental plots by U. S. Agricultural Research Service and University of California Extension Service. Farm Advisor Ray C. Geiberger is shown hand seeding plots. Photo by Donald R. Cornelius.

FIG. 5. Excellent stand, growth, and ground cover of annual ryegrass at same location shown one year earlier in Figure 4. Cover such as this reduces erosion and flood hazards. Grazing is furnished for game animals and domestic livestock. Photo by Donald R. Cornelius.

that seeded annual and perennial grasses or legumes, have had a material effect in reducing storm runoff and erosion from late winter and spring storms that have occurred the first year after the fire. Taking 1957 as an average year, 25,606 acres were sown for this purpose by the State Division of Forestry. Over 154,000 pounds of seed of various species—mostly annual ryegrass—were sown between Oregon and the Mexican border. Edmunson and Cornelius (1961) found Wimmera ryegrass better adapted to Southern California than the Italian or commercial annual ryegrass (*Lolium multiflorum*). The Wimmera ryegrass (*Lolium rigidum*) flowered earlier and matured seed each year and therefore persisted better than the later flowering ryegrass. The longer dry summers of Southern California interfered with seed formation of the commercial annual ryegrass and stands deteriorated after the first year.

GRASS SEEDING ON BURNED-OVER TIMBER LAND

The use of grass on burned over timber land at elevations ranging from 5000 to 7500 feet above sea level has been successful on the Modoc, Lassen, Klamath, and Tahoe National Forests. The grasses have been sown, usually by airplane, to control erosion after the fire, to provide grazing, and to reduce encroachment of brush onto the land. Cornelius and Talbot (1954) reported a successful seeding of smooth bromegrass made in November 1947 in the Warner Mountains on ash from a July wildfire in ponderosa pine and white fir at an elevation of 6000 feet. Average precipitation was 25 to 30 inches. Forage production three years after the burn was 1 and ⅓ tons per acre, enough for two animal units per acre per month. This forage was suitable for grazing in mid-summer when green forage is generally scarce in the State (Fig. 6).

Another successful seeding on a drier part of the Modoc National Forest was the Mears Burn area shown in Fig. 7. Cornelius and Evanko (1957) describe this timber-producing area as ranging in elevation from 4,500 to 5,500 feet with annual precipitation from 12 to 18 inches. The cost of seeding 7,000 acres by airplane was about $4.00 per acre or approximately $28,000. The increased forage converted into beef during the four year period, 1952 and 1956,

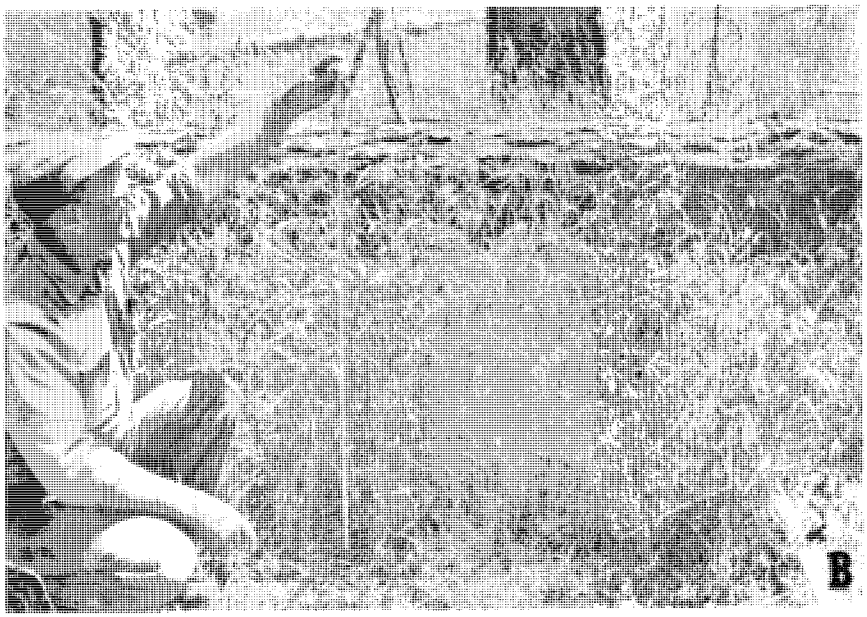

FIG. 6. Smooth bromegrass grown by airplane seeding on burned over pine and fir forest land, Modoc National Forest. The grass provides excellent ground cover against erosion, flood danger, and encroachment of brush onto the land. Also, the bromegrass at the high elevation, 6000 feet above sea level, provides excellent green grass for grazing in mid-summer when green forage is lacking throughout the state. Shields Creek Burn. Photo by Donald R. Cornelius.

when beef averaged 16¢ per pound, amounted to approximately 742,000 pounds or a gross return of $118,720.

CONCLUSIONS

The ecology of converting from brush to grass has received considerable attention during the last 20 years. Fire alone is usually not sufficient to make complete conversion. Likewise, the use of selective herbicides or mechanical treatment alone has not been satisfactory in controlling established brush without burning.

The steps to successful conversion of brushland to perennial grass cover have been presented by Evanko (1960) as follows:

1. Crushing brush to insure clean, safe burning.
2. Burning when danger of fire escape is minimum.

FIG. 7. Wildfire Burn, Modoc National Forest. Broadcast seeded by plane to mixture of smooth bromegrass, crested wheatgrass and timothy in fall, 1951. U. S. Forest Service photo.

3. Drilling seed of adapted perennial grass species to insure successful stand establishment.
4. Chemical control of sprouts and seedlings to prevent redominance by brush species.
5. Utilization of herbaceous cover by livestock and wildlife to realize forage and fire control benefits.

The economics of converting from brush to grass and the returns to be derived thereby are not always easy to determine. Too much emphasis may be placed on the returns from grazing by domestic livestock which is usually easier to calculate. Other distinct and valuable advantages include increased water yield, flood control, fire control, feed for game animals, and esthetic values which are not so easily appraised in economic studies. These additional values are real and may exceed the returns obtained through livestock gains but they are intangible and difficult to assign a dollar

value. In most cases these intangible values may be obtained concurrently with livestock use. The multiple use concept prevails on all public land and is gaining favor on some private land.

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