## Mechanical Renovation of Rangelands for Increased Forage Production and Carrying Capacity

## Gerald E. Schuman and Frank Rauzi

Mechanical renovation treatments have been imposed on western rangelands to increase forage production for nearly 50 years. These renovation practices have included numerous variations and combinations of a wide range of mechanically imposed surface modification techniques.

Three mechanical renovation treatments were imposed on a shortgrass range site in southeastern Wyoming in April 1979 in an attempt to clarify and document the benefits of renovation: improved forage production and subsequent livestock carrying capacity (details of this study are reported by Griffith et al. 1985). Native vegetation on the site consisted of blue grama, buffalograss, western wheatgrass, needle-andthread, Junegrass, and Sandberg bluegrass, with blue grama being dominant. The treatments used were:(1) a single ripping treatment 2-3 inches wide and 4 to 6 inches deep on 16 inches spacing which removed 28% of the native sod in strips (blue grama and western wheatgrass); (2) a double ripping treatment which was accomplished by ripping the area twice at right angles, resulting in 60% removal of the native sod; and (3) a contour furrowing treatment which resulted in furrows 24 to 30 inches wide by 6 to 8 inches deep and 5 feet apart and dammed at 20-foot intervals (Figure 1). The renovated plots were not seeded and an untreated area adjacent to the renovated plots was used for comparison.

Western wheatgrass has been shown to respond to mechanical treatment because of its rhizomatous habit (Rauzi 1975) and is used by the Soil Conservation Service as a guide for determining whether range renovation is feasible. Western wheatgrass production increased due to mechanical renovation by 3 to 6 times above that of the untreated area (see Figure 2) and represented 20 to 36% of the total production on the renovation treatments compared to 10% on the untreated rangeland. This is an important change in forage composition when you consider that Samuel and Howard (1982) reported that cattle selected western wheatgrass on a shortgrass range site similar to that in this study. Blue grama production decreased an average of 26% on the three renovation treatments compared to the control. This is the only major species that exhibited a decrease in production; however, it was more than offset by the large increase in western wheatgrass. Needle-and-thread showed a general increasing trend for all three renovation treatments. Wight and Sid-



Fig. 1. Mechanical renovation of a shortgrass range site: (a) control and single ripping, (b) double ripping, and (c) contour furrowing.

doway (1972) noted that needle-and-thread became dominant on abandoned cultivated lands in this region, because of its ability to become established on disturbed sites. Buffalograss production showed a 2 and 4-fold increase over the untreated control plots, for the single and double ripped treatments. However, the high variability in the buffalograss population and density on the study area resulted in these differences not being significant and its production decreased over the 4-years. The forbs, mostly lambsquarter and fireweed summercypress, exhibited a 2 to-5 fold increase on the

Authors are soil scientist and retired soil scientist, USDA-Agricultural Research Service, High Plains Grasslands Research Station, 8408 Hildreth Road, Cheyenne, Wyo. 82009.

Editor's Note: This paper was requested following publication of the paper "Mechanical Renovation of a Shortgrass Prairie for Increased Herbage Production" by L.W. Griffith et al. which appeared in the January 1985 issue of the *Journal of Range Management.* 



Fig. 2. Average herbage production of major species as a result of mechanical renovation of a shortgrass range site, Cheyenne, WY. 1979-1982. (Agsm = western wheatgrass, Bogr = blue grama, Buda = buffalograss, Stco = needle-and-thread).

renovation treatments. This type of response is expected since the mechanical disturbance reduced nutrient and moisture competition and created an ideal seedbed for these forbs to invade. During the 4-year study period, the forb production decreased from 466 to 127 lb/acre on the two ripping treatments and 947 to 214 lb/acre on the contour furrow treatment. These amounts were similar to or approaching the 147 lb/acre of forbs produced on the untreated plots in 1982.

Forage production benefits of the renovation treatments were more pronounced in the below-normal spring (April-June) precipitation year of 1980. The 1980, April through June, precipitation was only 56% of the average for the other years and only 43% of the 110 year long-term average. The treatments appear to have resulted in more effective infiltration and storage of the precipitation and enabled greater forage production. Average production of the mechanical renovation treatments was 94, 157, 81, and 53% greater than the control in 1979, 1980, 1981, and 1982, respectively.

Estimates by other researchers (Fisser et al. 1974, Rauzi 1975, Wight and White 1974) as well as this study (Griffith et al. 1985) have predicted the renovation treatments to be effective for 15 to 25 years. Longevity of these mechanical renovation treatments will be dependent upon the range site (soils), climate, and management of the area.

The three mechanical renovation techniques that we evaluated will result in an increased livestock stocking rate. Livestock stocking rates were calculated assuming 50% of the mid-grasses and 20% of the shortgrasses would be utilized by cattle and a grazing intake of 30 lb/day. With the above utilization rates and the forage production of the control and renovation treatments, the stocking rates shown in Figure 3 were calculated. Increased carrying capacity was experienced the year of renovation (1979); however the treatments responded more fully in 1980, 1981, and 1982.

The use of annual weeds by livestock has been shown to be important. In Nebraska, Streeter et al. (1968) reported lambsquarter comprised between 25 to 45% of the forage consumed by cattle. In early June the crude protein was 25%



Fig. 3. Average calculated stocking rate of three mechanical renovation treatments on a shortgrass range site, Cheyenne, Wyo.

but had decreased to 12.5% by early July. Marten and Anderson (1975) also reported that sheep found lambsquarter as palatable as oats and it had greater crude protein and greater digestibility than oats. Rommann (1983) and Sherrod (1971) found the crude protein content of fireweed summercypress ranged from 25 to 13% in May to July, respectively. If we were to consider the weeds in our stocking rate calculations, the values shown in Figure 2 would be as much as 20% greater. The percent utilization of these forbs is not fully understood but it is known that at early phenological stages they are highly palatable and can be heavily grazed, therefore their influence on stocking rate would be positive, particularly during the initial years of renovation. Other research has also shown that shortgrass rangeland treated with a range pitter was stocked 25% heavier than moderately grazed rangeland over a 24-year period at the Archer Substation in Southeastern Wyoming (Rauzi 1968).

Economic considerations of these renovation treatments are extremely important in today's ranching environment. Renovation costs averaged about \$12.50 (single ripping) and \$16.50 (contour furrowing) per acre. With private grazing fees of \$10 to \$15 per AUM, the increased carrying capacities would pay for the renovation costs in four to five years. Utilization of a percentage of the forbs normally encountered in the initial years of renovation would reduce the pay back period. Therefore, with the reported life of these renovation treatments, these increases in carrying capacity would result in significant economic benefits. The ripping treatments on this range site appear to be as effective as the more drastic contour furrowing treatment and can be accomplished with a wide diversity of implements and does not have as great of a power requirement as the contour furrow. In many cases ripping can be done with available equipment, thereby reducing renovation costs.

#### Literature Cited

Fisser, H.G., M.H. Mackey, and J.T. Nichols. 1974. Contour-furrowing and seeding on nuttall saltbush rangeland in Wyoming. J. Range. Manage. 27:459-462. Griffith, L.W., G.E. Schuman, F. Rauzi, and R.E. Baumgartner. 1985. Mechanical renovation of shortgrass prairie for increased herbage production. J. Range Manage. 38:7-10.

Marten, G.C., and R.N. Andersen. 1975. Forage nutritive value and palatability of 12 common annual weeds. Crop Science 15:821-827.

Rauzi, Frank. 1975. Severe mechanical and chemical range renovation in northeastern Wyoming. J. Range Manage. 28:319-326.

Rommann, L.M. 1983. Kochia— Forage or Weed? p. 96-97. In: Proceedings 39th South Post. Forage Crop Imp. Conf.

- Samuel, M.J., and G.S. Howard. 1982. Botanical composition of summer cattle diets on the Wyoming High Plains. J. Range Manage. 35:305-308.
- Sherrod, L.B. 1971. Nutritive value of Kochia scoparia. Agron. J. 63:343-344.
- Streeter, C.L., D.C. Clanton, and O.E. Hoehne. 1968. Influence of advance in season on nutritive value of forage consumed by cattle grazing western Nebraska native range. Res. Bul. 227, Nebraska Agricultural Exper. Sta., Lincoln.
- Wight, J.R., and F.H. Siddoway. 1972. Improving precipitation-use efficiency on rangeland by surface modification. J. Soil and Water Conserv. 27:170-174.
- Wight, J.R., and L.M. White. 1974. Interseeding and pitting on a range site in eastern Montana. J. Range Manage. 27:206-210.

Ż

# The Importance of Oak to Ranchers in the California Foothill Woodland

### Mitchel P. McClaran and James W. Bartolome

The California foothill oak woodland extends over several million acres along the eastern slope of the Coast Ranges and the western slope of the Sierra Nevada. Tree cover varies from open savannas to dense woodlands dominated by blue oak. Less common associates are interior live oak and digger pine. Annual grassland species are the major understory components throughout this vegetation type (Griffin 1977). More than 80% of the woodland is privately owned and the dominant product of the area is range livestock with firewood, wildlife, and water as secondary products (Plumb 1981).

Located in the central interior of the state, Tulare County covers approximately three million acres. Foothill oak woodland represents more than 15% of the county, most of it is privately owned (Figure 1). Cattle ranching is the dominant land use, although residential pressures are increasing. With respect to these characteristics, the foothill woodland in Tulare County typifies much of California.

The value of oak cover for various land management objectives has generated considerable debate among resource managers (Pillsbury 1983). As is typical in such debates, the ranching landowner has been conspicuously absent from this dialogue. Several authors have suggested that an understanding of the value systems and cultural practices in the ranching community can assist in the development of necessary and acceptable management plans and policies (Smith and Martin 1972, Simpson 1975, and Houghton 1978). This study describes the importance of oak to the ranching community for various management objectives and relates this importance to ranch characteristics such as size, location, and abundance of oak cover.

In September 1981 a questionnaire was mailed to the 62 members of the Tulare County Cattlemen's Association who owned property in the foothill oak woodland. A second mailing was made in November 1981. A total of 63% of the questionnaires were returned.

Ranch characteristics of interest were: ranch location, ranch size, length of family ownership, amount of oak cover, presence of small trees, and the expected change of oak cover in 20 years (Table 1). The possible management objectives for keeping oaks were: to provide shade, increase property values, increase understory forage production, soil stability, provide browse, and to provide wildlife habitat. The objectives that required tree removal were: firewood income, understory forage production, water yield, access for stock and vehicles, and home use of the wood. To describe the importance of oak for management objectives we asked the rancher to chose one of four responses (very important, fairly important, not very important, and not a reason) that best reflected the importance of oak for each management objective requiring either the maintenance or removal of trees on his ranch (Table 2).

The ranchers showed a great deal of variation in their responses to the importance of oak management objectives. However, length of ranch ownership was the only ranch characteristic that was unrelated to the importance of oak for management objectives.

The ranchers expressed considerable insight into the rela-

Authors are graduate research assistant and associate professor, Department of Forestry and Resource Management, University of California, Berkeley 94720.

Acknowledgments:

Without the assistance and patience of the members of the Tulare County Cattlemen's Association, and Mike Chrisman and Bob Miller, this study would not have been attempted or completed.