Herbage Production On a Gambel Oak Range in Southwestern Colorado[1]

NED W. JEFFERIES
Assistant Range Conservationist, San Juan Basin Branch Experiment Station, Colorado State University, Hesperus, Colorado.

Highlight

Herbage production and regrowth following grazing were greater in openings than under oaks. Soil moisture was greater under the oaks throughout the season.

Gambel oak *(Quercus gambelii)*, an important component of the mountain-brush type in Colorado, was estimated by Brown (1958) to occupy over one million acres in nearly pure stands. It also occurs on several million acres as a major species associated with pinyon pine, juniper, ponderosa pine, aspen, and spruce. Yet relatively few studies have been aimed at understanding the effects of Gambel oak on range forage production and additional information is needed for proper management of these ranges.

Moinat (1956) compared herbage yields under oaks and in the interspersed openings in southwestern Colorado. He found on a grazed range, that the openings produced 564 pounds more herbage (grasses and forbs) than the areas under oaks. On the other hand, Brown (1958) found production of grasses and sedges to be similar under the oaks and in openings in west-central Colorado.

Procedure

In 1962, a study was made of oak and associated vegetation on two locations at the San Juan Basin Experiment Station in southwestern Colorado. The station, located in the foothills (7600 feet elevation), has moderately deep silt-loam soils and annual precipitation averaging 18.5 inches.

One study site was on an area with a history of heavy use by cattle. Cover estimates of the understory vegetation were made on 9.6-square-foot plots using the point-observation-plot method (Stewart and Hutchings, 1936). The 648 samples were so located that 324 were under the oak canopy and the remainder were in openings. Herbage weights of forbs and grasses were estimated separately using a double-sampling technique (Wilm, et al., 1944). Estimates were corrected using regression analysis and then converted to oven-dry weight based on samples dried 24 hours at 105° C.

A similar area which had been protected from grazing for 15 years, was sampled using similar techniques. Twenty-five samples were located under the oaks and 25 in the openings. Herbage weights were obtained by clipping and the understory cover was estimated by the point-observation-plot method. Production of Gambel oak was not determined since cattle make little use of the oak as long as herbaceous vegetation is available (Forsling and Storm, 1929).

Soil samples were collected periodically during the summers of 1962 and 1963 for gravimetric determination of soil moisture. Regrowth data were collected on two moderately grazed Gambel oak pastures in 1963 using the caged plot method (Klingman, et al., 1943).

Results

Herbage production was lower on the heavily grazed site than on the protected area and grasses made up a higher percentage of the total herbage production on the protected site (Table 1). This indicates that heavy grazing caused a reduction in the higher yielding grass species and that they were replaced with less desirable plants. Production of both grasses and forbs was significantly higher in the openings than under the oak, although the differences in pounds per acre were small.

Effect of oak overstory on production of grasses.—Moinat (1956) noted that the shallow soil moisture (1-3 feet) was depleted earlier in the openings. The 1962 and 1963 study also showed that soil moisture was initially lower in the openings and was depleted earlier (Figure 1). Competition with oak plants for early moisture does not appear to be the factor limiting herbage production under the oak canopy since most of the herbaceous understory is composed of cool season species which develop when soil moisture levels under the oaks are high. Previous studies indicating that the oak roots in this upper soil layer are mostly reproductive structures with few feeding rootlets would support the concept of limited competition with grasses (Baker and Korstian, 1931).

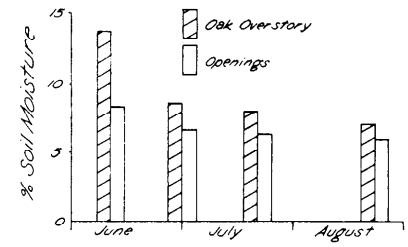

FIGURE 1. Average soil moisture (0-24") in openings and under oak.

Table 1. Oven-dry herbage production of grasses and forbs in openings and under oak.

	Open Parks		Under Oaks		Difference
	Pounds Per Acre	Percent of Total	Pounds Per Acre	Percent of Total	Pounds Per Acre
Grazed					
Grass	143.8	56.7	109.9	58.0	33.9**
Forbs	110.0	43.3	79.5	42.0	30.5**
Total	253.8		189.4		64.4**
Protected					
Grass	294.3	74.6	272.2	86.7	17.1
Forbs	99.9	25.4	42.2	13.3	57.7**
Total	394.2		319.4		74.8*

** Difference significant at .01 level.
* Difference significant at .05 level.

[1] *A contribution of the Colorado Agricultural Experiment Station, Colorado State University, Fort Collins. Scientific Series No. 977, Colorado Agricultural Experiment Station.*

Shading may be the factor restricting forage production under the oaks, since maximum growth of forage plants is related to a high interception of light (Sprague and McCloud, 1962). Moinat (1956) found the maximum noon light readings under the oaks to be 40-200 foot candles compared to 9,000-10,000 foot candles in the openings. Light measurements were not made in this study but this factor should be investigated further.

Herbage regrowth or late summer growth of grasses under the oak canopy was less than that of grasses growing in the open (Table 2). This may be due to the summer dormancy of Kentucky bluegrass *(Poa pratensis)*, a major component of the oak understory. Kentucky bluegrass contributes a much larger portion of the cover under the oaks than in the openings (Table 3) and it makes much of its vegetative growth before the oaks leaf out in the spring. Plants under the oaks mature more slowly than those in the openings and retain a higher moisture content throughout the season.

Grazing influence on vegetation.— Grasses made up a greater part of the cover on the protected area than on the grazed area (Table 3). Blue grama *(Bouteloua gracilis)* was more abundant on the area receiving heavy livestock use. Needleandthread *(Stipa comata)* was most abundant on the protected area since it is heavily selected by the grazing cattle. Mountain muhly *(Muhlenbergia montana)* is now absent on these pastures, although old range surveys indicate that it formerly made up an appreciable part of the understory. Halfshrubs and shrubs such as snakeweed *(Gutierrezia sarothrae)* and rabbitbrush *(Chrysothamnus* spp.) are nearly absent on the protected areas, however, on the heavily grazed areas they make up an appreciable part of the cover.

Table 2. Herbage regrowth of grasses (in pounds, oven dry) on grazed pastures between mid-July and mid-September, 1963.

	Openings	Oak Overstory
Pasture A	232	118
Pasture B	272	130
Average	252**	124

** Difference significant at the .01 level.

Table 3. Percent cover of the understory on a heavily grazed area and an area protected from grazing for 15 years.

	Grazed		Protected	
	Open	Oak	Open	Oak
Kentucky bluegrass	1.4	3.3	3.7	5.2
Needleandthread	1.6	.1	3.2	.6
Western wheatgrass	.3	.1	.2	—
Blue grama	2.5	.1	1.1	—
Other grasses	.8	.7	.6	—
Total grasses	6.6	4.3	8.8	5.8
Total forbs	6.0	3.1	3.3	2.0
Low brush species[1]	2.7	—	—	—
Total understory	15.3	7.4	12.1	7.8

[1] Snakeweed and rabbitbrush spp.

Summary

In 1962, a study was made of the vegetation on a Gambel oak range in southwestern Colorado. Observations of ground cover and herbage weight were made at two locations: one protected for 15 years and the other subjected to heavy grazing by cattle. Soil moisture measurements were taken throughout the summers of 1962 and 1963.

Total herbage production in both the protected and the grazed areas was significantly greater in the openings than under the oak. The protected area produced 55.3 percent more herbage in the open parks and 68.6 percent more herbage under the oak canopy than did the grazed area. Grasses made up a higher percentage of the production on the protected area than on the grazed area.

Competition between oakbrush and understory grasses for early moisture does not appear to be the factor limiting herbage production under oak stands. Soil moisture becomes limiting to plant growth in the openings earlier than under the oak canopy, however, late summer regrowth is less under the oaks. Greater forage production in openings would indicate that oakbrush control could be expected to increase carrying capacities of oak dominated ranges. However, further studies are needed to determine cost and benefit ratios and to develop an understanding of the relationship between oak and forage production.

LITERATURE CITED

BAKER, F. S. AND C. F. KORSTIAN. 1931. Suitability of brushlands in the Intermountain Region for the growth of natural or planted western yellow pine forests. U.S. Dept. Agr. Tech. Bul. 256. 83 p.

BROWN, H. E. 1958. Gambel Oak in West-central Colorado. Ecology 39:317-327.

FORSLING, C. L. AND E. V. STORM. 1929. The utilization of browse forage as summer range for cattle in Southwestern Utah. U.S. Dept. Agri. Circ. 62. 29 p.

KLINGMAN, D. L., S. R. MILES, AND G. O. MOTT. 1943. The cage method for determining consumption and yield of pasture herbage. Amer. Soc. Agron. J. 35:739-746.

MOINAT, A. D. 1956. Comparative yields of herbage from oak scrub and interspersed grassland in Colorado. Ecology 37:852-854.

SPRAGUE, V. G. AND D. E. MCCLOUD. 1962. Climatic factors in forage production. Forages. Iowa State University Press. p. 359-367.

STEWART, G. AND S. S. HUTCHINGS. 1936. The Point-Observation-Plot (square foot density) method of vegetation survey. Amer. Soc. Agron. J. 28:714-726.

WILM, H. G., D. F. COSTELLO, AND G. E. KLIPPLE. 1944. Estimating forage yield by the double sampling method. Amer. Soc. Agron. J. 36:194-203.