Grazing and Overstory Effects on Rotationally Burned Slash Pine Plantation Ranges

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Abstract

Light, moderate, or heavy grazing did not affect total herbage production in rotationally burned slash pine plantations approaching the first pulpwood thinning. However, carpetgrass tended to replace pinehill bluestem in the composition in proportion to grazing intensity. Grazing since tree regeneration has not affected tree crown cover, but heavy grazing reduced tree basal area. Increased tree dominance decreased herbage production, as predicted by earlier studies.

Much southern forest range is subjected to concentrated use. The same tract of land is often intensively managed for timber, grazed yearlong, and hunted heavily, year after year. Such management practices as livestock grazing, timber establishment and growth, and prescribed burning often cause major changes in the plant community. Knowing what plant changes to expect will aid planning for effective resource use.

Seasonal grazing effects on southern bluestem (*Andropogon* spp.) ranges have been reported (Duvall 1962; Duvall and Linnartz 1967), as have yearlong grazing effects on slash pine (*Pinus elliottii*) plantations 8-10 years old (Pearson and Whitaker 1974b). Several aspects of herbaceous understory-tree overstory relationships have also been studied, including herbage quality (Wolters 1973), prescribed burning (Grelen 1976), and plantation age (Pearson and Whitaker 1974a).

This paper reports some effects of grazing and tree overstory development in 13- to 16-year old rotationally burned slash pine plantations before their first pulpwood thinning.

Study Methods

The study was conducted on three range units of the Longleaf Tract, Palustris Experimental Forest, in central Louisiana. These range units had originally supported longleaf pine (*Pinus palustris*), but during early logging days they had been clearcut and converted to an open grassland. After more than 30 years in a grassland condition, the range units were regenerated to slash pine at the rate of 25% of each unit per year (1961-1964). Approximately 2,000 trees per hectare were initially established (Pearson et al. 1971).

Understory vegetation on the study area was typical for longleaf-slash pine-bluestem ranges (Grelen 1978), *Andropogon* being the most prominent genus. Rainfall averages 147 cm annually. Soils vary from poorly drained silt loams on level topography to well-drained sandy loams with slopes up to 10%.

Cattle grazed each of the three range units yearlong at a moderate intensity until 1960. Thereafter the individual units were grazed at different intensities designated as light (approximately 30% of the herbage removed), moderate (approximately 45%), and heavy (approximately 60%). The breeding herds were supplemented annually from 1960 through 1972 with about 180 kg/head of cottonseed cake (41% protein) fed from November through May; 120 kg/head of grass hay fed during late winter or on cold, icy days; and free choice minerals (Pearson and Whitaker 1972). In 1973 self-fed liquid supplements available yearlong replaced the cottonseed cake as a protein source (Grelen and Pearson 1977). Rotational grazing was encouraged by prescribe burning a different portion of each unit each winter. Successive quarters of each unit were burned during the 4 years of pine regeneration. After the fifth year successive thirds were burned.

Annually from 1961-1964 five pairs of 0.04-hectare plots were randomly located within the most recently regenerated portion of each range unit. Each pair consisted of one plot left open to grazing and one which was fenced. A distance of one chain separated grazed plots from fenced plots to avoid the effects of concentrating cattle along the fence. No cattle grazed the fenced plots for the 13 to 16 growing seasons since the plots were established, thus ungrazed control plots were present within each range unit for a reference as to grazing and site effects.

This study included the oldest (1961) and the youngest (1964) regeneration areas and totaled 10 plot-pairs in each of three range units.

Twelve temporary subplots (0.22 m^2) were systematically located within each fenced plot and its paired open plot during the autumn of 1976. Each subplot was measured for tree canopy cover (Pearson and Jameson 1967) and for basal area (Grosenbaugh 1952). The frequency and percent crown cover for vines, shrubs, and hardwoods up to 1.5 m high were recorded. Herbaceous species frequency and botanical composition by weight were estimated visually. Total herbage production was determined by clipping, ovendrying, and weighing, and was corrected for utilization by ocular estimate (Pechanec and Pickford 1937).

Paired *t*-test and regression procedures were used in the statistical analyses.

Results and Discussion

Grazing Effects

No grazing intensity tested significantly affected total herbage production as compared to the ungrazed control plots. However, grazing did affect the botanical composition (Table 1). The percent composition of pinehill bluestem (the most important cattle forage species in the area) was reduced by all grazing intensities. Conversely, carpetgrass (*Axonopus affinis*) greatly increased as grazing intensity increased. Carpetgrass was nearly absent under light or no grazing but increased to over 50% of the composition under heavy grazing. Composites declined under heavy grazing which differs from the results in

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Table 1. Herbage and tree characteristics under different grazing intensities.

Measurement and taxa	Grazing intensity					
	Light		Moderate		Heavy	
	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
Total herbage production (kg/ha)	666	814	540	557	336	325
Composition (% by weight)						
Grasses						
Pinehill bluestem (*Andropogon scoparius* var. *divergens*)	[1]37	53	[1]8	23	[1]2	21
Other bluestem (*Andropogon* spp.)	24	21	18	9	11	13
Panicums (*Panicum* spp.)	6	5	16	10	10	11
Paspalums (*Paspalum* spp.)	[2]t	1	2	3	1	2
Carpetgrass (*Axonopus affinis*)	t	0	[1]15	1	[1]51	1
Other grass	18	9	9	17	9	10
Total grasses	85	89	68	63	84	58
Grasslike plants	[1]2	2	12	6	7	8
Forbs						
Legumes	2	3	t	t	t	2
Composites	10	6	18	28	[1]5	26
Other forbs	1	1	2	3	4	6
Total forbs	13	10	20	31	9	34
Tree crown cover (%)	82	81	85	85	87	90
Tree basal area (m^2/ha)	26	28	24	27	31	35

[1] Significantly different from ungrazed conditions at 0.05 level.
[2] Less than 0.5%.

younger plantations (Pearson and Whitaker 1974b). The increase in carpetgrass may account for part of the decrease of composites.

Heavy grazing has previously been shown to reduce survival of young pines. In these stands of 13- to 16-year-old trees, grazing did not affect tree canopy cover. But heavily grazed plots did have significantly less tree basal area than adjacent ungrazed plots (Table 1), probably because of the reduction in tree numbers during the first year after planting (Pearson et al., 1971).

The effects of grazing intensity on shrub and vine crown cover could not be determined precisely because the prescribed burning schedule has maintained shrub and vine crown cover at such a low level (Table 2). Only on the moderately grazed range unit (whose ungrazed plots supported the most crown cover of the three range units) was the shrub and vine crown cover significantly reduced. The species principally affected was blackberry (*Rubus* spp.).

Although the herbaceous plants appeared to react in a consistent manner to grazing intensity, the effect of soils on shrub and vine cover may have to some extent outweighed the effect of grazing. Shrubs and vines appeared to be more abundant on the poorly drained, heavier-textured soils (Fig. 1). Distribution of soils and soil drainage conditions are the apparent reasons for the significantly greater abundance of shrubs and vines in the moderately grazed range unit. This greater abundance makes statistical detection of grazing impacts more likely. The results therefore should not be interpreted to mean that moderate grazing is necessarily more influential on shrubs and vines than other grazing intensities.

Overstory Effects

Herbage production has continued to be related to characteristics of the tree stand as these slash pine stands have grown. The relationship between herbage production and tree canopy cover, $Y=3582-35.76X$ (where Y=herbage dry weight in kg/ha and X=% tree canopy cover), was very similar to the relationship

Table 2. Shrub and vine crown cover (%) under different grazing intensities.

Taxa	Grazing Intensity					
	Light		Moderate		Heavy	
	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
Waxmyrtle (*Myrica cerifera*)	.01	.38	3.56	6.38	1.22	1.11
American beautyberry (*Callicarpa americana*)	.04	.01	.25	.00	.00	.00
Sumac (*Rhus* spp.)	.02	.12	.01	.59	.00	.00
Blackberry (*Rubus* spp.)	.36	.81	[1].28	4.08	.10	2.48
Huckleberry (*Vaccinium arboreum*)	.15	.32	.13	.14	.01	.00
Greenbrier (*Smilax* spp.)	.00	.00	.04	.08	.00	.01
Carolina jessamine (*Gelsemium sempervirens*)	.00	.00	1.22	.71	.00	.00
Alabama supplejack (*Berchemia scandens*)	.00	.00	.13	.03	.00	.00
Oaks (*Quercus* spp.)	.67	.19	.23	.12	.50	.18
Other shrubs	.22	.08	.04	1.98	.08	.02
Other vines	.00	.03	.00	.00	.00	.35
	1.47	1.94	[1]5.89	14.11	1.91	4.15

[1] Significantly different at 0.05 level from ungrazed conditions.

Fig. 1. *Variation in shrub and vine frequency: (a) lack of shrubs and vines on well-drained site; (b) abundance of shrubs and vines on poorly drained site.*

described when trees were younger and smaller (Pearson and Whitaker 1974b). The decreases from 1,099 kg/ha in 1971 to 540 kg/ha in 1976 demonstrates the decline in average herbage production as tree canopy cover increases. Basal area of the trees in these 13- to 16-year-old stands can also be used to predict herbage production, although the correlation coefficient is lower than when canopy cover is the predictor ($-.75$ for basal area and $-.81$ for canopy cover). The relationship is $Y=1539-34.96X$ (where X=tree basal area in m^2/ha). The differences in herbage production among range units are primarily related to variation in pine overstory canopy cover and basal area (Table 1).

Botanical composition also changed as tree basal area and canopy cover increased. On both grazed and ungrazed plots, forbs replaced grasses to a statistically significant degree between 1971 and 1976. Among grasses, pinehill bluestem and panicums (*Panicum* spp.) decreased most, while among forbs, composites increased most, except under heavy grazing.

Shrub and vine crown cover declined by nearly one-half from 1971 to 1976 (Pearson and Whitaker 1974b). This decline was likely caused by a reduction in shrub and vine vigor as the overstory pine canopy closed.

Conclusions

Grazing and tree canopy closure have predominant and predictable effects on rotationally burned herbaceous understory in the longleaf-slash pine-bluestem ecosystem. Removal of up to 60% of herbage by cattle does not cause measurable changes in total herbage production; however, increasing intensities shifts the plant composition from a predominance of bluestems toward a predominance of carpetgrass. Closure of the pine canopy results in an approximately linear decrease of herbage production, and an increase in proportion of forbs in the composition. While grazing and tree canopy closure appear to reduce shrub and vine cover, soils appear to also be very important in influencing the cover of these plants. Light to moderate grazing had no measurable effect on the regenerated pine stand.

The forage supply on southern pine forest range is thus greatly influenced by development of the tree stand. Available forage is normally reduced to less than one-half that of an open grassland within 10 years after slash pine is established (Pearson and Whitaker 1974a, Grelen 1976). Conversely, forage production can be expected to increase rapidly if the trees are thinned or completely harvested. Therefore, forage supplies often change substantially within a period of several years. In order to provide reasonable stability of livestock forage supplies, a variety of tree stand ages should be present within the boundaries of each livestock operation so that young tree stands with higher herbage yields will always be available. This requires a cooperative effort on long range planning for coordination of both grazing and forestry needs.

Literature Cited

Duvall, V.L. 1962. Burning and grazing increase herbage on slender bluestem range. J. Range Manage. 15:14-16.

Duvall, V.L., and Norwin E. Linnartz. 1967. Influences of grazing and fire on vegetation and soil of longleaf pine-bluestem range. J. Range Manage. 20:241-247.

Grelen, H. E. 1976. Responses of herbage, pines, and hardwoods to early and delayed burning in a young slash pine plantation. J. Range Manage. 29:301-303.

Grelen, H.E. 1978. Forest grazing in the South. J. Range Manage. 31:244-250.

Grelen, H.E., and H. A. Pearson. 1977. Liquid supplements for cattle on southern forest range. J. Range Manage. 30:94-96.

Grosenbaugh, L.R. 1952. Plotless timber estimates—new, fast, easy. J. Forest. 50:32-37.

Pearson, H.A., and D.A. Jameson. 1967. Relationship between timber and cattle production on ponderosa pine range—The Wild Bill range. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo. 10 p.

Pearson, H.A., and L.B. Whitaker. 1972. Thrice-weekly supplementation adequate for cows on pine-bluestem range. J. Range Manage. 25:315-316.

Pearson, H.A., and L.B. Whitaker. 1974a. Forage and cattle responses to different grazing intensities on southern pine range. J. Range Manage. 27: 444-446.

Pearson, H.A., and L.B. Whitaker. 1974b. Yearlong grazing of slash pine ranges: effects on herbage and browse. J. Range Manage. 27:195-197.

Pearson, H.A., L.B. Whitaker, and V.L. Duvall. 1971. Slash pine regeneration under regulated grazing. J. Forest 69:744-746.

Pechanec, J. F., and G.D. Pickford. 1937. A comparison of some methods of determining percentage utilization of range grasses. J. Agr. Res. 54: 753-765.

Wolters, G.L. 1973. Southern pine overstories influence herbage quality. J. Range Manage. 26:423-426.