FORAGE YIELD INCREASED BY CLEARCUTTING AND SITE PREPARATION

JOHN J. STRANSKY, Wildlife Habitat and Silviculture Laboratory[a], Southern Forest Experiment Station, Forest Service — USDA, Nacogdoches, TX 75962

LOWELL K. HALLS, Wildlife Habitat and Silviculture Laboratory, Southern Forest Experiment Station, Forest Service — USDA, Nacogdoches, TX 75962

Abstract: Total forage yield (TFY) on a pine-hardwood forest site in east Texas was sampled before and 1 growing season after clearcutting (1972 and 1973), also 1 and 3 growing seasons after planting site preparation by burning, choping, or KG blading (1974 and 1976). Total forage yield was only 359 kg/ha in the uncut forest, but 2217 kg/ha after clearcutting. On control plots (no site preparation), TFY peaked in the first growing season after clearcutting with 2917 kg/ha, but by 1976 decreased to 1983 kg/ha. On burned plots, TFY peaked the first growing season after burning (3540 kg/ha) and remained steady till 1976. On chopped plots, TFY rose from 3053 kg/ha in 1974 to 3619 by 1976, and on KG-bladed plots from 2935 to 3774 kg/ha, because browse growth increased.

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Clearcutting, site preparation, and planting are efficient means of harvesting and regenerating southern pines (*Pinus sp.*). However, there is considerable disagreement as to how these silvicultural practices affect other land uses and values.

The present study was conducted to find out how forage yields and plant species composition are affected by various site preparation methods after clearcutting of a pine-hardwood forest in east Texas. These data are needed to help clarify the effects of clearcuts on wildlife habitats.

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STUDY SITE

Study plots were established in 1972 on a nearly level to gently sloping upland forest tract in Jasper County, TX (Stransky 1976). The site had never been cleared for cultivation but it had probably been grazed by livestock.

Before clearcutting in the fall of 1972, the area supported a pine-hardwood forest about 45 years old. Tree basal area averaged 24 m^2/ha, 18 m^2 in pine and 6 m^2 in hardwoods. The greatest number of trees were in the 9 cm diameter class and the highest basal area in the 43 cm class.

Principal tree species of the overstory were loblolly pine (*Pinus taeda* L.), shortleaf pine (*P. echinata* Mill.), southern red oak (*Quercus falcata* Michx.), post oak (*Q. stellata* Wangenh.), water oak (*Q. nigra* L.), willow oak (*Q. phellos* L.), sweetgum (*Liquidambar styraciflua* L.), and blackgum (*Nyssa sylvatica* Marsh.).

The midstory was about 30 years old, consisting mainly of the same trees as the overstory plus American holly (*Ilex opaca* Ait.), red maple (*Acer rubrum L.*) mockernut hickory (*Carya tomentosa* Nutt.), and flowering dogwood (*Cornus florida* L.).

Small woody stems (less than 5 cm dbh) formed a dense, almost impenetrable understory. Vines made up 47% of the understory, shrubs 34%, other hardwoods 10%, oaks 6%, and pines 3%.

[a] Maintained in cooperation with the School of Forestry, Stephen F. Austin State University

Prominent shrubs were American beautyberry (*Callicarpa americana* L.), yaupon (*Ilex vomitoria* Ait.), blackberry (*Rubus* spp.), blueberry (*Vaccinium* spp.), and southern wax-myrtle (*Myrica cerifera* L.) Prevalent vines were yellow jessamine (*Gelsemium sempervirens* (L.) Ait. f.), muscadine grape (*Vitis rotundifolia* Michx.), and greenbriers (*Smilax* spp.). Longleaf uniola (*Uniola sessiliflora* Poir.), devil's grandmother (*Elephantopus tomentosus* L.), and twinberry (*Mitchella* repens L.) were the most abundant herbaceous plants. Plant nomenclature follows Gray's Manual of Botany (Fernald, 1970).

METHODS

Site treatments.

During February and March 1974 the following site preparation treatments were applied to 0.6 hectare (ha) plots in a randomized block design with 3 blocks:

Control—no site preparation, all woody stems greater than 2.5 cm in diameter at breast height (dbh) were cut.

Burn—all stems greater than 2.5 cm dbh were cut and burned with the logging slash. Fanned by a steady wind of about 20 km/hour, the head fire consumed the tops of all herbaceous plants, most shrubs and small trees, nearly all leaf litter, and all but the large branches of the logging slash.

Chop—logging slash and all stems were cut with a chopper and burned. The chopper resembles a huge lawn roller equipped with cutting blades parallel to the long axis of the cylinder. Pulled by a large crawler tractor, the chopper cut nonmerchantable trees and shrubs into small chunks and crushed the debris into the surface soil.

KG—all stems were cut with a KG blade, and the logging slash was raked off the plots and burned. The KG blade resembles a straight razor and is mounted at an angle on the front of a tractor. It sheared off all stems in its path, and in the cutting process greatly churned up the soil surface.

Chopped plots were prepared in October 1972, but heavy rains prevented completion of other treatments. Chopped plots were rechopped in 1974 when the other site treatments were applied.

All plots were handplanted with 1-0 loblolly pine seedlings at 2.4 by 3 m spacing in mid-March of 1974.

Vegetation measurements.

Vegetation was inventoried and forage yield sampled on 20 1 m^2 quadrats equally spaced within each 0.6 ha plot, in the summer of 19723 before timber cutting, and in the summers of 1973, 1974 and 1976. The annual growth of all herbaceous and woody plants was clipped up to a height of 1.5 m, dried at 70 C, and weighed to the nearest 0.1 g. We grouped these data to show yields in kilograms per hectare (hg/ha) for grasses, grasslike species, legumes, composites, other forbs, pines, oaks, other trees, shrubs, and vines.

For all data, differences among treatments were tested by analysis of variance at the 0.05 level of significance.

RESULTS AND DISCUSSION

Forage yield.

Before clearcutting (1972).

Total forage yield in the uncut timber ranged from 309 kg/ha to 383 kg/ha (Table 1). Browse species contributed 86% of the total. Differences between assigned treatment plots were not significant for any forage group.

Species contributing most to browse yields were yaupon, yellow jessamine, and sweetgum. Longleaf uniola, twinberry, and devil's grandmother constituted 91% of herbage yields.

TABLE 1. Forage yield in kilograms per hectare before and after clearcutting and site preparation

Plant Groups	Site Treatment: Control 1972	1973	1974	1976	Burn 1972	1973	1974	1976	Chop 1972	1973	1974	1976	KG 1972	1973	1974	1976
Browse																
Shrubs	129	864*	702	712	133	675*	679	1133*	138	387*	255*	1227*	131	313*	220	822*
Vines	64	528*	306*	167*	43	397*	250	274	65	171*	89*	219*	60	195*	105*	131
Pines	19	1*	4	4	3	0*	0	0	16	1*	0	0	1	6	3	0
Oaks	40	488*	462	366	63	433*	269	151	44	99	60	147	28	157*	61	121
Other Trees	58	475*	481	363	97	502*	539	540	61	218*	93*	230*	46	240*	135	193
Total browse	310	2356*	1955	1612	339	2007*	1737	2098	324	876*	497*	1823*	266	911*	524*	1267*
Herbage																
Grasses	31	267*	375	160*	9	274*	908*	522*	15	709*	862	669	24	220*	928*	387*
Grasslikes	4	57*	231*	98	0	140*	149	283	10	219*	518*	611	10	108	490*	1502*
Legumes	1	4	3	4	1	0	7	1	1	12*	13	16	1	2	2	7
Composites	12	167*	148	73	5	88*	633*	165*	8	232*	972*	378*	5	37	756*	436
Other forbs	24	66	72	36*	7	22*	106*	58	25	85*	191*	122*	3	8	235*	175
Total herbage	72	561*	829	371*	22	524*	1803*	1029*	59	1257*	2556*	1796*	43	375	2411*	2507
Total forage	382	2917*	2784	1983*	361	2531*	3540	3127	383	2133*	3053*	3619*	309	1286*	2935*	3774*

* Significantly different from previous year's yield at .05 level.

After clearcutting (1973).

One growing season after the clearcut, forage yields ranged from 1286 kg/ha to 2917 kg/ha (Table 1). On the average, this was a sixfold increase over the previous year. Herbs increased more than browse plants, and in 1973 herbs constituted 31% of the total forage. Yields of both browse and herbage were relatively low on plots that were to be KG bladed because these plots, unlike the others, carried many leftover culls and small trees throughout the 1973 growing season.

Browse species contributing most to forage yield in 1973 were American beautyberries, muscadine grape, willow oak, and sweetgum. Panic grasses (*Panicum* spp.) replaced longleaf uniola as the dominant herbaceous species. Other herbs showing large increases were sedges (*Carex* spp.), rushes (*Juncus* spp.), and the composites fleabane (*Erigeron* spp.), dogfennel (*Eupatorium* spp.), and wild lettuce (*Lactuca canadensis* L.).

After site treatments (1974 and 1976).

On control plots, browse yields peaked in 1973 when most growth from small trees and shrubs was within the 1.5 m zone. But by 1974 browse yields had begun to decline because small trees and shrubs were growing beyond 1.5 m, and because the developing canopy was shading the vines. For the same reasons, browse yields continued to decline in 1976. Herbage yields were highest in 1974 but by 1976 had decreased significantly, primarily because of overhead competition from shrubs and small trees. The net result was that on the unprepared control plots total forage yields were highest in 1973, the first growing season after clearcutting, but by 1976 yields have decreased by nearly one-third.

On burned plots, the topgrowth of woody plants was destroyed, and the subsequent regrowth in 1976 was mainly as sprouts from the plant bases. Except for some fast growing oaks, most browse growth remained within the 1.5 m height zone in 1976, so yields stayed high. Herbage yields were highest in 1974, the first year after burning, mainly as a result of an influx of annual composites. By 1976 the competitive influence of

woody plants was obvious, and yields of all herbaceous groups except grasslike plants had decreased significantly. The net effect for burned plots was that total forage peaked the first growing season after the burn and held fairly steady the next 2 years, with browse gaining in relative dominance.

On chopped plots, repeat chopping in early 1974 apparently killed many woody plants or retarded their growth, so browse yields were relatively low. But with prolific resprouting and because nearly all growth was within the 1.5 m zone, yields were high in 1976. Herbage yields were highest in 1974 but significantly less in 1976 as competition from browse increased and composites decreased. Chopped plots were the only ones on which legumes contributed a significant amount of forage. The overall effect was that total forage yields increased through 1976, mainly because growth in all classes of browse forage was still within the 1.5 m zone.

The KG treatment destroyed many browse plants, so yields were low in 1974. Even though yields increased by 1976, they were lower than for any other treatment, probably because there were fewer plants. Herbage responded quickly to site preparation and yields were high the first growing season. With the exception of grasslike plants, the yields of herbage were less in 1976 than in 1974. Reasons for the high yield of grasslike plants in 1976 are unknown. Because of increased yields in browse and grasslike plants the net effect was that forage yields increased through 1976 on the KG plots.

Total available forage in 1976 was greatest on the mechanically prepared plots. It was lowest on the dense control plots, with the burned ones being intermediate.

Species Composition

The uncut forest in 1972 contained 63 woody, but only 34 herbaceous plant species. After clearcutting, herbaceous species rose to 83; composites quadrupled and grasses more than doubled. Woody plant species, however, decreased from 64 to 55 after the cut.

After site treatments, the number of herbaceous species remained essentially the same (86) as it was after clearcutting (83). Legumes increased with chopping, and composites and grasses increased with chopping and KG blading. The number of woody species remained unchanged on the control and burned plots but decreased from 51 to 47 after chopping and from 52 to 38 after KG blading.

SUMMARY

Site treatments significantly increased herbage production, though on burned plots herbage yield was less than on chopped and KG treatments. Burning did not reduce browse significantly as did chopping and KG blading. Total yields were similar with all three site treatments, but the proportion of herbage to browse was different.

Clearcutting and site preparation temporarily altered the food availability of the forest site. After the site treatments were imposed, habitat conditions were unfavorable for animals, such as squirrels (*Sciurus* sp.), which are associated with mature stands of timber. In contrast, food conditions were improved for animals associated with early stages of plant succession. For example, three growing seasons after site treatment we saw more cottontails (*Sylvilagus floridanus*), and bobwhite quail (*Colinus virginianus*) on the area than we had noticed in the uncut forest.

LITERATURE CITED

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