Reprinted from JOURNAL OF WILDLIFE MANAGEMENT, volume 31, number 3, pages 432-437. July 1967.

DEER FORAGE IN A LOBLOLLY PINE PLANTATION[1]

ROBERT M. BLAIR, Southern Forest Experiment Station, U. S. Forest Service, Nacogdoches, Texas

Abstract: Browse yields in a 30-year-old plantation thinned at ages 20 and 25 years were directly related to the amount of pine removed and varied from 154 lb (oven-dry) per acre under light thinning to 199 lb/acre under heavy thinning. At plantation age 35, five growing seasons after a third thinning, browse yields were inversely related to pine-thinning intensity, ranging from 255 lb/acre in lightly thinned stands to 195 lb/acre in those heavily thinned. Many of the young hardwoods and shrubs had grown beyond the reach of deer and formed a multilayered midstory that inhibited plant growth beneath. Midstory density increased with intensity of pine thinning.

In recent years more than 12 million acres of uplands in the South have been planted to pines. Even though the primary objective is to grow merchantable timber on these lands, the plantations offer food and cover for deer and other wildlife. Limited cattle grazing is also afforded, though herbage is often scarce.

A study was initiated in 1957 to find how yields of understory vegetation, especially deer browse, were influenced by different intensities of intermediate thinning in a loblolly pine (*Pinus taeda*) plantation. The study was in central Louisiana on the Alexander State Forest, an area supervised by the Louisiana Forestry Commission. Pines were then 30 years old and plots within the plantation had been thinned twice—at plantation ages 20 and 25—to specified basal areas.

[1] Contribution from the Wildlife Habitat and Silviculture Laboratory, maintained at Nacogdoches, Texas, by the Southern Forest Experiment Station in cooperation with Stephen F. Austin State College.

Combined yields of herbage and browse in 1957 were greatest where thinning had been heaviest, but a midstory of invading hardwoods was developing and it, like the understory vegetation, was densest where thinnings had been heaviest (Blair 1960). This paper describes the timber and understory vegetation in 1962, five growing seasons after a third pine thinning in the winter of 1957–58.

THE STUDY PLANTATION

The plantation is on a relatively flat area of fine sandy loam soil with moderately good surface and internal drainage. Pine seedlings were planted in 1928 at a spacing of 8×8 ft. The site is about average for loblolly pine, and expectable heights of the trees at 50 years of age are 77–87 ft.

In early 1948, when pines were 20 years old, randomized 0.4-acre plots were thinned to residual basal areas of 100, 85, and 70 square feet per acre, representing light, medium, and heavy cuts. The plots were rethinned to the same levels in 1953 and 1958. Except in 1948, when an occasional hardwood was cut for pulpwood, only pines were removed. Each thinning intensity was replicated four times. The plantation is managed for high-quality sawtimber on a long rotation. Fire has been excluded.

The timber stands and yields of understory vegetation were sampled in October of 1957 and 1962, immediately before pine thinnings. Pines and hardwoods 1.6 inches diameter at breast height (dbh) and larger were inventoried by 1-inch diameter classes on the central 0.1 acre of each 0.4-acre plot.

To evaluate changes in forage, the current season's growth of leaves and stems on understory vegetation was clipped from the ground to a height of 5 ft on nine 1-milacre quadrats within each 0.1-acre plot. Herbaceous growth was sampled separately by major vegetal classes. Browse, consisting of twigs and leaves of shrubs, hardwood reproduction, and woody vines, was sampled by species or species groups. Clipped plant material was dried to a constant weight at 65 C and then weighed.

For an estimate of the total browse available in winter, dried twigs, less leaves, of deciduous and semi-evergreen browse species were combined with the leaves and twigs of evergreen species.

The determination of palatable and nonpalatable browse species was based on local observations and on studies by Goodrum and Reid (1959) in the southern longleaf pine belt and by Lay (1956*b*) in the loblolly pine–hardwood type of east Texas.

TIMBER STOCKING AND COMPOSITION

In 1957 pine basal area ranged from 118 square feet per acre in lightly thinned stands to 92 square feet with heavy thinning (Table 1). Hardwoods and large shrubs formed a multilayered and scattered midstory beneath the dominant pines. Both the stocking and basal area of midstory hardwoods were directly proportional to the intensity of pine removal. Below the midstory was an understory of woody and herbaceous plants.

The hardwood component increased after pines were again thinned early in 1958. By the fall of 1962 stocking increases were 44 percent for light thinning, 8 percent for moderate thinning, and 11 percent for heavy thinning. As in 1957, the midstory hardwoods were most numerous in heavily thinned stands.

The basal area of hardwoods had increased and was greater in relation to pine in 1962 than in 1957 (Table 1). Under light thinning, for example, about 5 percent of the total overstory basal area was hardwood in 1957, whereas by 1962 the proportion was nearly 8 percent. In heavily thinned stands, where competition from dominant pines

Table 1. Timber stand characteristics of trees 1.6 inches dbh and larger in the fall of 1957 and 1962 (means of four 0.1-acre plots per thinning intensity).

Stand and Stocking Data	Light Thinning		Medium Thinning		Heavy Thinning	
	1957	1962	1957	1962	1957	1962
Trees per acre						
Pine	238	182	225	158	172	120
Hardwood	175	252	195	210	272	302
Total	413	434	420	368	444	422
Basal area (sq ft/acre)						
Pine	118	121	107	106	92	89
Hardwood	6	10	10	13	14	19
Total	124	131	117	119	106	108
Average dbh (inches)						
Pine	9.5	11.1	9.3	11.2	9.9	11.6
Hardwood	2.4	2.7	3.0	3.4	3.1	3.4

was least, hardwoods increased from 13 percent of the total basal area in 1957 to nearly 18 percent in 1962.

The maximum diameter (breast height) of midstory hardwoods in 1962 was 7 inches. Stems 5–7 inches in diameter were most numerous in moderately and heavily thinned stands.

Sweet gum (*Liquidambar styraciflua*) was the most prevalent hardwood over all intensities of thinning. Black gum (*Nyssa sylvatica*) was second. Also present were southern red oak (*Quercus falcata*), water-oak (*Q. nigra*), red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), tree sparkleberry (*Vaccinium arboreum*), and haws (*Crataegus* spp.).

UNDERSTORY VEGETATION

Browse

Throughout the study period browse was the principal plant component in the understory of all stands. Yields were directly related to pine-thinning intensity in 1957, but inversely related in 1962 (Table 2). Current woody stems, with leaves, averaged 67 percent of the total understory growth in 1957 and 76 percent by 1962.

In 1962 browse yields were 66 percent greater than in 1957 under stands lightly thinned and 27 percent greater under stands moderately thinned. With heavy thinning, production was essentially unchanged.

In late summer of 1957 browse considered palatable to deer ranged from 90 lb (oven-dry) per acre under light thinning to 138 lb/acre under heavy thinning (Table 3). Palatable species averaged 64 percent of the total browse yield. During the next 5 years palatable browse increased under all thinnings, but percentage increases were inversely related to thinning intensity, ranging from 99 percent under lightly thinned stands to 7 percent under stands heavily thinned. Palatable browse averaged 73 percent of the total in 1962.

Yields of nonpalatable species were similar under all intensities of thinning in 1957 but decreased with heavier thinnings in 1962.

Palatable browse declined sharply following leaf fall and averaged only 71 lb/acre for all thinnings in the late fall and winter of 1957, as compared to 113 lb/acre in summer. In 1962 palatable winter browse averaged 111 lb/acre, 32 percent less than in summer.

Table 2. Pounds of oven-dry browse and herbage per acre in October, 1957 and 1962, under pine stands thinned at different intensities (means of 36 1-milacre quadrats per thinning intensity).

	LIGHT THINNING		MEDIUM THINNING		HEAVY THINNING	
VEGETATION CLASS	1957	1962	1957	1962	1957	1962
Browse	154	255	179	228	199	195
Herbage						
Grasses	38	58	70	51	70	49
Grasslike plants	3	2	7	4	5	4
Forbs						
Composites	7	3	10	3	10	3
Legumes	2	2	2	4	3	4
Miscellaneous	11	10	8	11	12	11
Total herbage	61	75	97	73	100	71
Total yield	215	330	276	301	299	266

Woody vines supplied most of the palatable browse, especially during late fall and winter. In 1957 they averaged 61 percent of the palatable browse in the summer and 84 percent in the winter. Although vines produced more forage in 1962, they comprised only 56 percent of the palatable browse during the summer and 72 percent during the winter. Alabama supple-jack (*Berchemia scandens*), Carolina jessamine (*Gelsemium sempervirens*), and the greenbriers (*Smilax bona-nox, S. glauca, S. lanceolata,* and *S. rotundifolia*) gave the greatest yields.

The highest yielding palatable shrubs and small trees were American beautyberry (*Callicarpa americana*), flowering dogwood, black gum, blackberries and dewberries (*Rubus* spp.), Elliott blueberry (*Vaccinium elliottii*), water-oak, and willow-oak (*Q. phellos*). Collectively, they produced 32 percent of the palatable browse in 1957 and 42 percent in 1962.

Predominant species of nonpalatable browse were red maple, sweet gum, southern wax-myrtle (*Myrica cerifera*), southern red oak, blackjack oak (*Q. marilandica*), and low-growing blueberries (*Vaccinium* spp.).

Timber Stand–Browse Yield Relationships

The associations between the timber stand and browse yields in 1957 and 1962 were evaluated by regression and correlation analyses in which dependent variables were the dry-matter yields of total browse in lb/acre (Y_1) and their logarithmic transformations (Y_2). Independent variables were the basal area of midstory hardwoods (X_1) and pine (X_2) per acre and their squares and logarithmic values, tested singly and in all possible combinations.

The analyses indicated that in 1957 the growth and survival of browse were governed mainly by the combined influence of midstory hardwoods and dominant pines. Neither the basal area of pines nor hardwoods, when tested separately, accounted for a significant ($P < 0.05$) amount of variation in browse yields. However, when pine and hardwood basal area were incorporated into a multivariable regression, the total overstory accounted for 62 percent of the variation in yields ($P < 0.01$). The 1957 relation was best expressed by the function $\hat{Y}_1 = 766.7 - 10.63\,(X_1) - 4.682\,(X_2)$.

By 1962 many young hardwoods and shrubs that contributed browse in 1957 had

Table 3. Pounds per acre of oven-dry browse available in summer and winter of 1957 and 1962 (means of 36 1-mil-acre quadrats per thinning intensity).

Class of Browse and Season	Light Thinning		Medium Thinning		Heavy Thinning	
	1957	1962	1957	1962	1957	1962
Palatable						
Late summer	90	179	112	167	138	147
Winter	57	118	72	113	85	103
Nonpalatable						
Late summer	64	76	67	61	61	48
Winter	19	17	33	23	16	19

grown beyond reach of deer, into the lower midstory. The relation between browse yields and density of the multilayered midstory was inverse, and was best expressed by the curvilinear function $\hat{Y}_2 = 3.269 - 0.8047\ (X_8)$, where X_3 is the logarithm of the hardwood basal area. Midstory hardwoods accounted for 69 percent of the variation ($P < 0.01$) in yields of total browse. The pine canopy was so high and thin by 1962 that it offered little competition to the understory. Basal area in dominant pines, when tested alone, accounted for only 10 percent of the variation in browse.

Herbage

In 1957 herbage production was directly related to intensity of thinning. It ranged from 61 lb/acre under light thinning to 100 lb/acre with heavy thinning, averaging 33 percent of the total understory growth (Table 2). By 1962 yields varied little between thinning intensities, averaging 73 lb/acre or 24 percent of the total growth. This change appeared closely associated with the basal area of midstory hardwoods. In heavily thinned stands, where hardwood basal area was greatest, herbage declined by 29 percent during the 5-year period. In moderately thinned stands the decrease was 25 percent. Under light thinning, where hardwood basal area was the least, yields increased 23 percent. Plantation stands such as these have little value for livestock grazing.

Grasses were the main herbage producers, generally contributing about 70 percent. In 1957 grass yields under moderately and heavily thinned stands were almost twice as great as under stands lightly thinned. By 1962 moderately and heavily thinned stands produced slightly less grass than those lightly thinned, probably because of the increased competition from shrubs and midstory hardwoods.

Pinehill bluestem (*Andropogon divergens*), broom-sedge (*A. virginicus*), longleaf uniola (*Uniola sessiliflora*), and several species of panicums (*Panicum* spp.) were the most numerous grasses.

Grasslike plants and forbs were scarce under all thinning intensities and contributed even less forage in 1962 than in 1957. Beak-rushes (*Rhynchospora* spp.) and razor sedges (*Scleria* spp.) were the principal grasslike plants. Principal forbs were the composites grassleaf goldaster (*Chrysopsis graminifolia*), bonesets (*Eupatorium* spp.), and ironweed (*Vernonia texana*); and legumes milk-pea (*Galactia regularis*) and tick-clovers (*Desmodium* spp.); and the miscellaneous forbs skullcap (*Scutellaria* spp.), three-seeded mercury (*Acalypha gracilens*), and ruellia (*Ruellia caroliniensis*).

DISCUSSION AND CONCLUSIONS

Deer browse is generally sparse in young unthinned loblolly pine plantations, consisting mainly of scattered hardwood reproduction and shade-tolerant shrubs and woody vines. As the dense pine canopy is opened by thinnings, browse species respond in direct proportion to the degree of pine removal. However, within 10 years after the stands are opened initially, much of the woody understory grows beyond the reach of deer to form a midstory cover of hardwoods and large shrubs. This mid-

story, in turn, progressively inhibits plant growth in the understory. Schuster and Halls (1963) observed the suppressive influence of a hardwood midstory within older stands of a shortleaf–loblolly pine–hardwood mixture in east Texas.

To provide a substantial source of browse through the middle and late years of a plantation, intermediate thinnings should be coordinated with management practices aimed at developing woody undergrowth and keeping it within reach of deer. This objective can be accomplished, without hindrance to the growth and harvest of pine products, by selective felling of large hardwoods that are not important as fruit or mast producers for wildlife. Such trees could be felled during each thinning operation.

Prescribed burning at the proper interval, as reported by Lay (1956*a* and 1957), can also serve to improve forage supplies in a plantation by keeping palatable woody growth within reach of deer and improving its nutrient quality.

LITERATURE CITED

BLAIR, R. M. 1960. Deer forage increased by thinnings in a Louisiana loblolly pine plantation. J. Wildl. Mgmt. 24(4):401–405.

GOODRUM, P. D., AND V. H. REID. 1959. Deer browsing in the longleaf pine belt. Proc. Soc. Am. Foresters Meeting 1958:139–143.

LAY, D. W. 1956*a*. Effects of prescribed burning on forage and mast production in southern pine forests. J. Forestry 54(9):582–584.

———. 1956*b*. Some nutrition problems of deer in the southern pine type. Proc. Annu. Conf. Southeastern Assoc. Game and Fish Commissioners 10:53–58.

———. 1957. Browse quality and the effects of prescribed burning in southern pine forests. J. Forestry 55(5):342–347.

SCHUSTER, J. L., AND L. K. HALLS. 1963. Timber overstory determines deer forage in shortleaf–loblolly pine–hardwood forests. Proc. Soc. Am. Foresters Meeting 1962:165–167.

Received for publication November 28, 1966.