yards of these lakes, so deer did not have far to travel to reach water. Deer feeding on the green vegetation continued to drink water, possibly due more to the proximity of the river than to their need for free water.

The concentrating of deer due to attraction of surface water, green vegetation, etc., could have a significant effect on deer censuses. Any factor resulting in unequal distribution of deer throughout the area to be censused could adversely affect census results.

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# GROWTH AND FORAGE QUALITY OF FOUR SOUTHERN BROWSE SPECIES


R. M. BLAIR and L. K. HALLS[1]


Rusty blackhaw (*Viburnum rufidulum*), yaupon (*Ilex vomitoria*), common greenbrier (*Smilax rotundifolia*), and yellow jessamine (*Gelsemium sempervirens*) are major sources of deer food in upland pine-hardwood forests of the South. In the study reported here, the quality of forage on these plants was related to their rate of growth.

Rusty blackhaw is a deciduous shrub; yaupon, an evergreen shrub; greenbrier, a deciduous vine; and yellow jessamine, an evergreen vine. The plants studied were growing near Nacogdoches in east-central Texas in a well-stocked pine-hardwood timber stand. Shortleaf and loblolly pines dominated the overstory. The understory contained a multilayered assortment of hardwoods and shrubs.

The study area had not been burned or grazed by livestock for at least 10 years. The soil is fine sandy loam with good surface and internal drainage.

## PROCEDURES

Plant growth and forage quality were studied simultaneously for one year beginning in March 1964. Prior to the initiation of spring growth, the terminal branches on three vigorous medium-sized unbrowsed plants of each species were selected. A narrow band of paint was placed at the base of the terminal bud on each as a reference for measurement. Only terminal branches were measured because a previous growth study (Halls and Alcaniz, 1965) showed that their growth patterns were similar to those of lateral branches.

From the onset of spring growth, twig lengths were recorded at weekly intervals until July, and at monthly intervals thereafter through December.


[1] The authors are on the staff of the Wildlife Habitat and Silviculture Laboratory which is maintained at Nacogdoches, Texas, by the Southern Forest Experiment Station, Forest Service, U.S.D.A., in cooperation with Stephen F. Austin State College.

Twig tips and leaves were collected from each species for chemical analysis. Collections were made at two-week intervals until July, at monthly intervals from July until February, then at two-week intervals again until spring growth resumed. The sections cut from shrubs were two inches long, those from vines were four inches long. The attached leaves were retained. Each replicate sample of current growth was composited from several proximate plants, and only material less than five feet above the ground was collected. Sample material was never clipped from the same plant twice or from the plants on which twig elongation was measured.

After collection, the leaves were removed from the twigs, and the twig and leaf samples were placed in separate air-tight containers. The green samples were weighed, dried to a constant weight at 70° C in a forced-draft oven, and reweighed. The three replications of twig and leaf fractions were analyzed separately to determine the contents of protein and phosphorus. E. A. Epps, Jr., Chief Chemist, Feed and Fertilizer Laboratory, Louisiana Agricultural Experiment Station, performed the analyses using standard procedures (Association of Official Agricultural Chemists, 1960).

Protein and phosphorus contents are reported as percents of dry weight. They do not represent actual amounts in the plant. A decrease in the concentration of a constituent does not necessarily mean the plant lost protein or phosphrous. It may indicate that the constituent did not increase in the same proportion as dry matter.

Weather data were recorded at a station less than a half mile from the study site. Rainfall in 1964 was 7.6 inches below the long-time average of 46 inches. Rainfall from November 1963 through April 1964 was slightly above average. Thus, soil moisture was ample during the early spring growth period.

A minor dry period occurred in May and an extreme drought coupled with high temperatures occurred from late June to mid-August 1964 (Table 1).

TABLE 1 — CLIMATIC DATA ON THE STUDY AREA DURING 1964 AND A PORTION OF 1965.

| Date | Total precipitation (inches) | Mean temperature (°F) |
|---|---|---|
| 1964 | | |
| January | 3.27 | 45 |
| February | 2.02 | 42 |
| March | 4.07 | 54 |
| April | 8.18 | 73 |
| May | 0.89 | 72 |
| June | 4.16 | 77 |
| July | 0.50 | 82 |
| August[1] | 3.44 | 83 |
| September | 3.21 | 75 |
| October | 1.86 | 52 |
| November | 3.71 | 57 |
| December | 3.30 | 49 |
| 1965 | | |
| January | 3.77 | 46 |
| February | 4.55 | 48 |
| March | 2.70 | 51 |

[1] All rainfall occurred during last half of the month.

The last spring freeze in 1964 occurred on March 26 and the first fall freeze was on October 22. This frost-free period of 208 days was nearly a month less than the long-term average of 236 days.

All four species had a large spring growth flush, and, with the exception of yaupon, grew relatively little during the rest of the year (Fig. 1). These growth patterns for the four study species were reported previously by Halls and Alcaniz (1965).

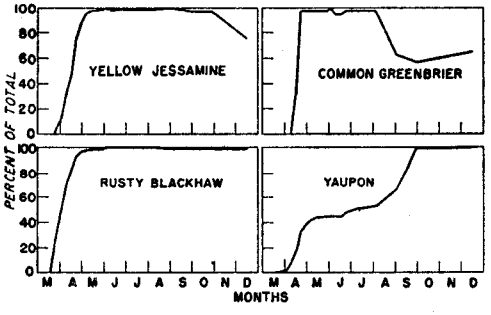


Figure 1.--Cumulative elongation of shoots. Elongation ceased and many stems died back during a severe drought in July and early August.

Rusty blackhaw twigs began elongating on March 18, yellow jessamine on March 24, common greenbrier on April 9, and yaupon on March 19. By May 7, blackhaw had completed 98 percent of its growth; yellow jessamine, 96 percent; and greenbrier, 97 percent. In fact, greenbrier had virtually completed its elongation by April 23, 14 days after it started to grow. The duration of the spring flush may have been reduced in some species by a minor drought in May.

Dieback explains the decreases in length shown in Figure 1 during the summer and fall. Droughts and insect attacks were the probable causes of dieback.

### GROWTH BEHAVIOR

Yaupon exhibited a distinctly different growth pattern. When the initial growth flush was completed on May 21, only 44 percent of elongation was completed. Growth was slow from late May until early August when a second major flush of growth began. This second flush, which continued until late October, accounted for 47 percent of total elongation.

The data for rusty blackhaw, yellow jessamine, and common greenbrier agree with the findings of other studies involving various species in the Temperate Zone (Cook, 1941; Farnsworth, 1955; Illick, 1919; Jacobs, 1965; Kozlowski, 1964; Kramer, 1943). With most species, elongation begins early in the spring and most of it is completed in a relatively small proportion of the frost-free season.

## BROWSE QUALITY

*Dry Matter.* The leaves and twigs of all species were lowest in percent dry matter (15 to 30 percent) in early spring when growth was most active (Fig. 2). After the first flush of growth, leaf dry matter-content increased until early June when it reached a level that was maintained until leaves fell — about 32 percent for greenbrier, 38 percent for jessamine, 41 percent for rusty blackhaw, and 46 percent for yaupon. Even during the late-season growth flush, the leaf dry-matter content of yaupon did not vary appreciably.

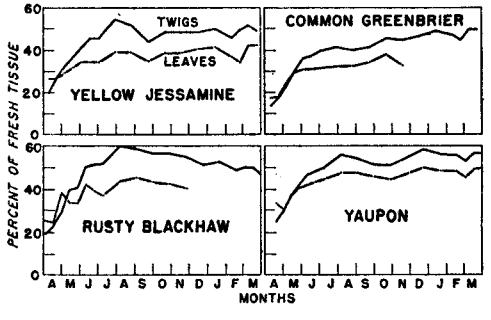


Figure 2.--Dry matter in leaf and twig tissue as a percent of fresh weight.

After early July, the dry-matter content of twig tips changed only slightly throughout the rest of the year. The dry-matter content of yellow jessamine remained virtually

unchanged, whereas that of greenbrier increased steadily but at a low rate until the following spring. Dry-matter content of rusty blackhaw twigs decreased slightly in late winter, and that of yaupon temporarily decreased about five percent during the late summer flush of growth.

*Protein.* For all species, leaf protein content, expressed as a percent of oven-dry weight, was highest in the period of most rapid growth in early spring. The protein content of rusty blackhaw and greenbrier leaves decreased steadily at a low rate throughout the summer, but protein in the leaves of yaupon and yellow jessamine increased slightly during the late summer period of regrowth. Yaupon leaves had the highest percentage of protein; rusty blackhaw leaves contained the least.

Usually, leaf tissue had a higher proportion of protein than twig tissue. Leaf and twig protein contents are shown in Figure 3. As with leaves, protein in twigs was highest in early spring. Levels in yaupon, greenbrier, and yellow jessamine were similar and generally greater than those of rusty blackhaw.

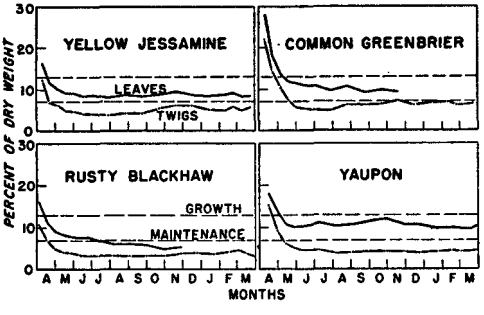


**Figure 3.--Protein content of leaves and twigs and levels believed to be required for deer maintenance and growth.**

Only during the spring growth flush did the protein content in the leaves of all species and in the twig tips of greenbrier and yaupon reach levels believed necessary for deer growth (Table 2). Twigs of yellow jessamine and rusty blackhaw never had sufficient protein for deer growth, but they did have enough for maintenance when they were rapidly elongating.

Table 2. Months in which protein and phosphorus concentrations (oven-dry base) equalled or exceeded levels considered necessary for maintenance (M) and growth (G) of white-tailed deer1/

| Species and Plant Parts | Nutrient | 1964 Apr | May | June | July | Aug | Sept | Oct | Nov | Dec | 1965 Jan | Feb | Mar |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Yellow jessamine | | | | | | | | | | | | | |
| Leader tips | Protein | M | | | | | | | | | | | |
| | Phosphorus | | | | | | | | | | | | |
| Leaves | Protein | G | M | M | M | M | M | M | M | M | M | M | M |
| | Phosphorus | | | | | | | | | | | | |
| Rusty blackhaw | | | | | | | | | | | | | |
| Twig tips | Protein | M | | | | | | | | | | | |
| | Phosphorus | | | | | | | | | | | | |
| Leaves | Protein | M | M | M | | | | | | | | | |
| | Phosphorus | M | | | | | | | | | | | |
| Common greenbrier | | | | | | | | | | | | | |
| Leader tips | Protein | G | M | | | | | | | | | | |
| | Phosphorus | M | | | | | | | | | | | |
| Leaves | Protein | G | M | M | M | M | M | M | M | | | | |
| | Phosphorus | G | | | | | | | | | | | |
| Yaupon | | | | | | | | | | | | | |
| Twig tips | Protein | G | | | | | | | | | | | |
| | Phosphorus | | | | | | | | | | | | |
| Leaves | Protein | G | M | M | M | M | M | M | M | M | M | M | M |
| | Phosphorus | M | | | | | | | | | | | |

1/ Based on the research of Magruder et al. (1957), the daily protein requirement is considered to be 13 to 16 percent of dry-matter intake for deer growth, and about 7 percent of dry-matter intake for maintenance. Phosphorus requirements are considered to be about 0.56 percent for growth and 0.30 percent for maintenance.

Although protein levels in all plant parts were below the needs for deer growth from May until growth resumed the following year, the leaves of the two evergreens, yellow jessamine and yaupon, contained sufficient protein year around for deer maintenance. This is of special significance during winter when nutritious forage is often scarce.

Protein in the leaves of greenbrier, a deciduous species, exceeded the minimum for maintenance until the leaves fell. The amount in rusty blackhaw leaves, however, was deficient from July to leaf abscission in the fall.

Except for greenbrier during May, protein in twig tips of all species was below maintenance requirements from late April until plant growth resumed the following year.

*Phosphorus.* Phosphorus tends to accumulate in actively growing tissue (Cook and Harris, 1950). Thus, its content was highest for all species in early spring. As shoot elongation slowed, phosphorus content declined rapidly (Fig. 4). After June there was no discernible change in phosphorus content in the leaves of yellow jessamine, rusty blackhaw, and greenbrier, but the proportion in yaupon leaves increased slightly during the second growth flush. Phosphorus in the twigs of all species was slightly higher in early spring than during the remainder of the year. Yaupon and blackhaw leaves generally had more phosphorus than their twigs, but there was no consistent difference between the leaves and twigs of yellow jessamine and greenbrier.

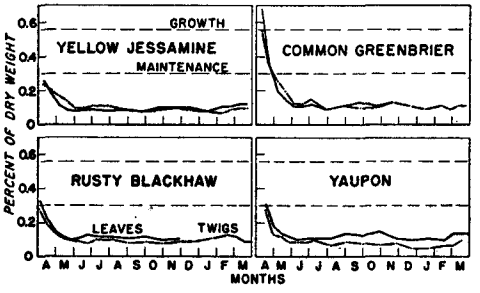


**Figure 4.--Phosphorus content of leaves and twigs and levels believed to be required for deer maintenance and growth.**

For most of the year phosphorus was severely deficient in the leaves and twigs of all species (Table 2). During an exceedingly brief period in early spring, the leaves of greenbrier contained sufficient phosphorus for deer growth, and the leaves of yaupon and blackhaw and the twig tips of greenbrier contained enough phosphorus for maintenance. Thereafter, the phosphorus concentration in both leaf and twig tissues was far below the minimum needed for animal maintenance.

## CONCLUSIONS

The quality of browse in the species studied was clearly related to the rate of plant growth. Protein and phosphorus appeared to be adequate for deer growth in some species and plant parts for a short period in early spring when shoot elongation was most rapid. During the rest of the year, when most of the plants made little or no growth, the levels of protein and phosphorus in all species were considerably lower than in early spring. In yaupon, the only species that had two growth flushes, the protein and phosphorus contents of twigs and leaves increased slightly during the second growth flush — not nearly as much as during the spring flush. Plant parts are most succulent when they are growing rapidly, and thus they are likely to be more palatable as well as more nutritious during growth flushes than at other times.

In all four species, leaves contained a higher proportion of protein than did twigs. Only in April when growth was most rapid was protein content of twigs sufficient for deer maintenance. Hence, the leaves of the evergreens, yaupon and jessamine, are especially valuable because of their relatively high protein content throughout the year, and their availability for winter browse.

Enough phosphorus to maintain deer was present in leaves or twigs

only during the spring growth flush. Clearly, deer cannot satisfy their minimum requirements for phosphorus from the plants studied. Other sources of phosphorus must be present.

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# REPRODUCTIVE STUDIES OF SOME ALABAMA DEER HERDS*


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## ABSTRACT

White-tail deer (*Odecoileus virginianus*) were collected on twelve different areas of Alabama to obtain reproductive data. The earliest average conception date was December 4 for Black Warrior Management Area in north Alabama where there was some breeding as early as November 10. Latest average conception date was February 11 for Fred T. Stimpson Sanctuary in south Alabama where some breeding occurred as late as March 21. Conception dates are thought to be influenced by the genetic stock. Fetal sex ratios were nearly 50/50 on all areas. Production per adult doe varied from 2.0 fawns on Barbour Management Area to 1.1 in Baldwin County.


## INTRODUCTION

Prior to 1960 there were little data on reproduction within white-tail deer herds in Alabama. A previous paper (Lueth, Francis X., 1956, The Birth Dates of Alabama Deer, Proc. SE Assoc. of Game and Fish Comm. Meeting, Daytona Beach, Florida, Oct. 2-5, 1955) reported birth dates of some Alabama deer as determined by tooth development.


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