# SOME NUTRITION PROBLEMS OF DEER IN THE SOUTHERN PINE TYPE [1]

*By* DANIEL W. LAY
Buna, Texas

A major problem of deer management in the South is recognition of optimum levels of stocking. This level is reached before a general browse line is in evidence and while it is difficult to demonstrate the shortage of food. This is because of the quality deficiencies of all plants due to low soil fertility; and also because much of the available herbage is not palatable to deer.

Recent surveys of deer ranges in East Texas have revealed disturbing evidence that problems of overpopulation, range deterioration, and die offs are common. Since deer are building up throughout the South, it is timely to consider the problems of nutrition, recognition of signs of trouble, and possible solutions.

Livestock in the South generally require fertilized supplementary pastures and/or winter feeding to obtain a diet of adequate quality. Where neither is provided, calf crops rarely exceed 50 per cent, weights are light, mortality is high and profits are negligible. This points to the weakness of the southern range low quality especially in winter.

The minimum desirable nutrition levels for cattle as reported by Campbell and Cassady (1951) are about 8 to 9 per cent crude protein (moisture free basis), 0.20 to 0.25 per cent calcium, and 0.18 to 0.21 phosphorus. On the air dry basis with 15 per cent moisture, these minimums are 6.8 to 7.8 per cent protein, 0.17 to 0.21 calcium, and 0.35 to 0.40 phosphoric acid.

Fraps and Fudge (1940, p. 18) say a fair nutrition level for beef cattle is 6.00 to 10.40 protein, 0.16 to 0.30 calcium, and 0.33 to 0.66 phosphoric acid, air dry basis. The composite winter cattle diet on forested range in coastal Louisiana was reported by Campbell et al (1954) to be 3.92 protein, and 0.09 phosphoric acid, air dry basis.

Nutritional requirements of deer in the South have not been defined. However, there is some evidence from other sections that the above levels for cattle are approximately correct for deer. Einarsen (1946) reports the crude protein requirement of Oregon deer is at least 5 per cent. Leopold et al (1951) found in California a critical protein level of 7 or 8 per cent, 40 per cent starvation having occurred when the diet dropped below 7 per cent. French et al (1955) found in Pennsylvania pen-feeding that 13-16 per cent protein and 0.25 phosphorus was necessary to obtain optimum growth of deer. Although these citations vary, there is general agreement that as quality of the forage declines, weights and reproduction decline (Morton and Cheatum, 1946; Dahlberg and Guettinger, 1956; and Goodrum and Reid, 1954).

Quantity requirements are fairly well defined. A 100-pound deer needs about 2.5 pounds of air dry forage per day, according to Nichol (1938), Smith (1950), and Davenport (1939). By green weights this averages 7.3 pounds in spring, 6.3 in summer, 5.8 in fall, and 5 in winter.

## THE QUANTITY AND QUALITY OF AVAILABLE HERBAGE

A series of browse studies in southeast Texas at the State Forest in Newton County provides some information on available herbage in unburned flatwoods pine-hardwood type.

Quantity determinations were made by estimating seasonal growth on 27 permanent 2 by 48-foot plots in a 58-acre deer pen. Results were slightly lower than those from nearby plots which were clipped and reported last year (Lay, 1955). The air dry standard with 15 per cent moisture content is used throughout.

The available herbage (including browse, herbs, and grasses-sedges) totaled 187 pounds per acre in spring, 220 in summer, 151 in fall, and 137 in winter. As shown in Table I, the major portion of the herbage is browse. These weights

1 Contribution of Federal Aid in Wildlife Restoration Project, Texas W-63-R. Presented at the Southeastern Association of Game and Fish Commissioners meeting in Little Rock, Arkansas, October 8, 1956.

are thought to be fairly representative of fully stocked pine stands. The herbage supply is most limited in winter and next most limited in fall.

The seasonal difference in carrying capacity is greater than these weights suggest because forage removed during the growing season is partially replaced by new growth. That removed in fall and winter causes little or no regrowth.

TABLE I

AVAILABLE FORAGE BY SEASON AND PALATABILITY GROUP FROM EIGHT ESTIMATES OF 27 PLOTS IN 58-ACRE DEER PEN, NEWTON COUNTY

(In Pounds Per Acre at 15 Percent Moisture Level [2])

| *Palatability Group* | *Spring* | *Summer* | *Fall* | *Winter* |
|---|---|---|---|---|
| Desirable Browse | 59 | 78 | 67 | 58 |
| Intermediate Browse | 76 | 82 | 54 | 55 |
| Undesirable Browse | 36 | 41 | 22 | 21 |
| Herbs | 8 | 5 | 2 | 1 |
| Grasses-Sedges | 8 | 14 | 6 | 2 |
| TOTAL | 187 | 220 | 151 | 137 |
| Estimated Total Available to Deer Under Optimum Utilization | 58 | 68 | 52 | 47 |
| Percentage Available to Deer | 31 | 31 | 34 | 34 |

[2] The average percent of air dry forage in green forage by season is: spring 34, summer 40, fall 43, and winter 50.

The seasonal composition of the browse on the study area, Lay (1956), is summarized in Table II. The phosphoric acid is deficient except in spring. From summer through winter, it is 0.16 to 0.15 per cent, or about half of the minimum requirements.

Crude protein is approximately 12 per cent in spring, 8 in summer, 7 in fall, and 6 in winter. Calcium is more than adequate at all seasons. Quality as well as quantity is most limited in winter.

The analyses summarized above are for evergreen and deciduous species. A range with fewer evergreens would have a more critical deficiency in quality and quantity. Table III lists the 25 species and their winter protein and phosphoric acid content. Evergreen species were distinctly superior with 7.56 protein and 0.16 phosphoric acid. The deciduous species contained only 4.06 protein and 0.14 phosphoric acid. The samples, which were analyzed by the State chemist, consisted of two-inch tips of current growth from a composite of at least 10 plants. Four-inch tips were clipped from vines. Samples were oven-dried immediately. All collections were made on unburned site with a full stand of loblolly pine.

TABLE II

AVERAGE PROTEIN AND PHOSPHORIC ACID CONTENT OF THREE CATEGORIES OF UNBURNED DEER BROWSE BY SEASON

| *Category of Species* | *No. of Species by Season* | *Spring* | | *Summer* | | *Fall* | | *Winter* | |
|---|---|---|---|---|---|---|---|---|---|
| | | *Protein* | $P_2O_5$ | *Protein* | $P_2O_5$ | *Protein* | $P_2O_5$ | *Protein* | $P_2O_5$ |
| Desirable | 4-10-4-12 | 11.39 | 0.35 | 8.20 | 0.16 | 7.43 | 0.16 | 6.55 | 0.15 |
| Intermediate | 4-7-4-8 | 14.26 | 0.38 | 8.79 | 0.18 | 6.68 | 0.16 | 5.39 | 0.14 |
| Undesirable | 2-5-2-5 | 10.25 | 0.27 | 6.96 | 0.15 | 6.19 | 0.13 | 6.05 | 0.15 |
| Av. All Species | 10-22-10-25 | 12.31 | 0.35 | 8.10 | 0.16 | 6.93 | 0.16 | 6.16 | 0.15 |

TABLE III

PROTEIN AND PHOSPHORIC ACID COMPOSITION OF AIR DRY BROWSE IN JANUARY BY PALATABILITY GROUP

| *Species and Palatability Category* | *Evergreen or Semi-Evergreen* | | *Deciduous* | |
|---|---|---|---|---|
| | *Protein* | $P_2O_5$ | *Protein* | $P_2O_5$ |
| DESIRABLE SPECIES | | | | |
| St. Peterswort (*Ascyrum stans*) | 7.74 | 0.20 | ... | ... |
| Rattan (*Berchemia scandens*) | ... | ... | 5.15 | 0.10 |
| Titi (*Cyrilla racemiflora*) | 4.99 | 0.10 | ... | ... |

TABLE III—*Continued*

PROTEIN AND PHOSPHORIC ACID COMPOSITION OF AIR DRY BROWSE IN JANUARY BY PALATABILITY GROUP

| *Species and Palatability Category* | *Evergreen or Semi-Evergreen* Protein | $P_2O_5$ | *Deciduous* Protein | $P_2O_5$ |
|---|---|---|---|---|
| Ash (*Fraxinus* sp.) | ... | ... | 3.47 | 0.15 |
| Yellow Jessamine (*Gelsemium sempervirens*) | 7.17 | 0.14 | ... | ... |
| Yaupon (*Ilex vomitoria*) | 6.94 | 0.16 | ... | ... |
| Red Bay (*Persea borbonia*) | 6.98 | 0.14 | ... | ... |
| Water Oak (*Quercus nigra*) | 7.24 | 0.15 | ... | ... |
| Sassafras (*Sassafras albidum*) | ... | ... | 3.96 | 0.14 |
| Sawbrier (*Smilax glauca*) | 8.49 | 0.17 | ... | ... |
| Laurel Greenbrier (*Smilax smallii*) | 12.79 | 0.23 | ... | ... |
| Viburnum (*Viburnum molle*) | ... | ... | 3.64 | 0.15 |
| Average for Desirable Species | 7.79 | 0.16 | 4.05 | 0.13 |
| INTERMEDIATE SPECIES | | | | |
| French Mulberry (*Callicarpa americana*) | ... | ... | 4.55 | 0.13 |
| Dogwood (*Cornus florida*) | ... | ... | 4.49 | 0.17 |
| Gallberry (*Ilex coriacea*) | 5.08 | 0.10 | ... | ... |
| White Bay (*Magnolia virginiana*) | 9.44 | 0.20 | ... | ... |
| Black Gum (*Nyssa sylvatica*) | ... | ... | 3.19 | 0.12 |
| White Oak (*Quercus alba*) | ... | ... | 3.89 | 0.13 |
| Sweetleaf (*Symplocos tinctoria*) | 7.91 | 0.15 | ... | ... |
| Muscadine (*Vitis rotundifolia*) | ... | ... | 3.85 | 0.14 |
| Average for Intermediate Species | 7.71 | 0.15 | 3.99 | 0.14 |
| UNDESIRABLE SPECIES | | | | |
| American Holly (*Ilex opaca*) | 6.73 | 0.14 | ... | ... |
| Sweetgum (*Liquidambar styraciflua*) | ... | ... | 4.42 | 0.15 |
| Wax Myrtle (*Myrica cerifera*) | 9.45 | 0.12 | ... | ... |
| Loblolly Pine (*Pinus taeda*) | 7.11 | 0.20 | ... | ... |
| Tree Huckleberry (*Vaccinium arboreum*) | 5.31 | 0.14 | ... | ... |
| Average of Undesirable Species | 7.15 | 0.15 | 4.42 | 0.15 |
| Average of 15 Evergreen Species | 7.56 | 0.16 | ... | ... |
| Average of 10 Deciduous Species | ... | ... | 4.06 | 0.14 |

## PALATABILITY RATINGS OF BROWSE SPECIES FOR DEER

Any attempt to rate a large number of species as to their palatability is hazardous and requires some hedging. These ratings are tentative and represent observations in eastern Texas and western Louisiana. Basic work was done with quarterly observations in a 58-acre deer pen stocked with 2, 3, and 4 deer. The original flora was exceptionally complete, having been protected from fire, livestock, and deer for at least 20 years. The seasonal nature of palatability is largely ignored in these ratings.

The palatability of a given species may vary from one soil to another—not to mention from one state to another. It may appear to vary where availability of other species changes the degree of choice. The greatest opportunity to misread palatability is on fully-stocked or overstocked ranges. On some ranges in Texas only traces of the original desirable species remain and such species as wax myrtle and cedar are used heavily. This does not indicate that the two species are palatable.

In most cases palatability for deer is the same as for cattle, however, cattle show more taste for sweetgum, magnolia, sumac, holly, tree huckleberry, sweetleaf, and dogwood. On ranges stocked with both deer and cattle, this could confuse palatability ratings.

The ratings are listed in three categories: desirable, intermediate, and undesirable. Tables I and II include the breakdown of herbage weights and browse composition by these three groups. They are used also in estimating that part of the herbage which is available to deer (when no cattle are present). Optimum annual utilization is tentatively placed at 50 per cent. Thus, 50 per cent of the desirable browse (and herbs) is the amount of that category that can be used.

This limits the utilization of intermediate species to about 30 per cent, and that of undesirable species to about 5 per cent, because this is the approximate ratio normally found for the three groups. If intermediates were used 50 per cent, the desirables would be used far in excess of their tolerance.

In order to condense the results of browse surveys which provide records of density and utilization for a large number of species, it appears practicable to use the records of the common species (those on at least one plot in five), divide them into three categories, and obtain the average degree of utilization for each category. This provides three percentages which may be useful as a summary yardstick of the range condition.

Although much more testing is required to refine this method, one example will show its possible use. Two deer pens in Louisiana and one in Texas were compared in February, 1956. One was overstocked with 3 deer on 40 acres, one was fully stocked with 2 deer on 40 acres, and one was understocked with 3 deer on 58 acres. Species and soils varied too widely for direct comparison of utilization species-by-species.

TABLE IV

TENTATIVE PALATABILITY RATINGS OF EAST TEXAS BROWSE SPECIES FOR DEER

DESIRABLE SPECIES

St. Peterswort (*Ascyrum stans*)
Rattan (*Berchemia scandens*)
Titi (*Cyrilla racemiflora*)
Ash (*Fraxinus* sp.)
Yellow Jessamine (*Gelsemium sempervirens*)
Large-Leaf Holly (*Ilex longipes*)
Yaupon (*Ilex vomitoria*)
Virginia Willow (*Itea virginiana*)
Japanese Honeysuckle (*Lonicera japonica*)
Red Bay (*Persea borbonia*)
Water Oak (*Quercus nigra*)
Blackberry (*Rubus* sp.)
Sassafras (*Sassafras albidum*)
Greenbrier (*Smilax* sp. except *S. pumila*)
Viburnums (*Viburnum molle, V. acerifloium, V. prunifolium, V. rufidulum*)

INTERMEDIATE SPECIES

Pawpaw (*Asimina triloba*)
Azalea (*Azalea* sp.)
Cross Vine (*Bignonia capreolata*)
French Mulberry (*Callicarpa americana*)
Buttonwillow (*Cephalanthus occidetalis*)
Fringe Tree (*Chionanthus virginica*)
Dogwood (*Cornus florida, C. stricta*)
Red Haws (*Crataegus* sp.)
Gallberry (*Ilex coriacea*)
Deciduous Holly (*Ilex decidua*)
White Bay (*Magnolia virginiana*)
Red Mulberry (*Morus rubra*)
Black Gum (*Nyssa sylvatica*)
Virginia Creeper (*Partnenocissus quinquefolia*)
Sloe Plum (*Prunus umbellata*)
Chokecherry (*Pyrus arbutifolia*)
Willow Oak (*Q. phellos*)
White Oak (*Quercus alba*)
Poison Oak (*Rhus toxicodendron*)
Poison Sumac (*Rhus vernix*)
Willow (*Salix* sp.)
Storax (*Styrax* sp.)
Sweetleaf (*Symplocos tinctoria*)
Elm (*Ulmus* sp.)
Viburnum (*Viburnum nudum*)
Muscadine (*Vitis rotundifolia*)

UNDESIRABLE SPECIES

Bluebeech (*Carpinus caroliniana*)
Hickory (*Carya* sp.)
Chinquapin (*Castanea floidana*)
Red Bud (*Cercis canadensis*)
Persimmon (*Diospyros virginiana*)
Beech (*Fagas grandifolia*)
Silverbell (*Halesia diptera*)
Holly (*Ilex opaca*)
Red Cedar (*Juniperus virginiana*)
Sweetgum (*Liquidambar styraciflua*)
Lyonia (*Lyonia ligustrina*)
Magnolia (*Magnolia grandiflora*)
Turkey berry (*Michella* sp.)
Wax Myrtle (*Myrica cerifera*)
Hop-Hornbeam (*Ostrya virginiana*)
Pine (*Pinus* sp.)
Wild Peach (*Prunus caroliniana*)
Black Cherry (*Prunus serotina*)
Post Oak (*Q. stellata*)
Black Jack (*Quercus marylandica*)
Red Oak (*Quercus rubra*)
Sumac (*Rhus copallina*)
Dwarf Greenbrier (*Smilax pumila*)
Buckeye (*Ungnadia speciosa*)
Tree Huckleberry (*Vaccinium arboreum*)

The ratios of utilization by palatability groups appear to give a handy measure of the relative condition of the three ranges. The desirable-intermediate-undesirable utilization for the overstocked pen was 65-48-20, the ratio for the fully-stocked pen was 45-33-4. The ratio for the understocked pen was 28-5-1.

The utilization of common undesirable species is just as important an indicator of range condition as the utilization of more palatable species. The "key species" concept (Mitchell, 1941), places the entire weight on the desirable species. This may be practicable under some conditions but there seems little point in ignoring the evidence available in less palatable species. Utilization of pine, for instance, may prove to be one of the best indicators that the food supply is overtaxed.

## CONCLUSIONS

Analysis of range condition is necessary for recognition of problem areas. This must include the development of local palatability ratings on areas lightly stocked. Heavy use of unpalatable species is just as much evidence of trouble as a die-off, and the die-off is more difficult to find and evaluate. Hedging of common palatable species is an excellent sign of past history of utilization. Mortality of plants caused by extreme use is difficult to detect because of rapid deterioration.

The quality of browse is lowest in winter. Protein is deficient in winter, although some species of evergreens provide adequate amounts. Phosphorus is deficient all year, except in spring, and this is the most critical aspect of the diet.

Since quality is more limited than quantity and many species are unpalatable, special efforts will be needed to demonstrate that ranges are fully utilized before a general browse line is in evidence. No more than about one-third of the available browse may be considered usable deer food. Recognition of the palatable and nutritious winter foods on a range is the first step in demonstrating the limitations and problems.

Acorns have a critical bearing on the range carrying capacity because they are available in fall and winter when browse supplies are most limited. With the general decline of oaks in the pine forest, it is becoming more important to balance the deer herd with the winter browse supply.

An important question is what can be done about the phosphorus and protein deficiencies. Fertilization of browse plants probably would improve their quality, but costs would be high. Prescribed burning under proper conditions improves quality for a year or two, Lay (1955, 1956). Removal of overstory through timber harvest increases the browse and herb supply, and the resultant succulent growth is of higher quality.

The attraction of deer to improved pastures of winter legumes and grasses points to the use of fertilized food patches. Two-to-five-acre patches of oats and vetch have proved effective in East Texas.

Adjustment of timber stand improvement practices might make more permanent improvements in the quality of a deer range. The best browse species could be released from competition without seriously reducing pine production because most of them are understory species. All possible oaks of acorn bearing size would be protected.

Removal of hogs and cattle would increase deer carrying capacity on many ranges. Exclusion of livestock in fall and winter would be sufficient if summer stockings were moderate.

When deer food patches are justifiable, it would be well to consider the possible use of perennial plantings such as Japanese honeysuckle, yaupon, or an evergreen species of Smilax. The cost per year might be less than that of annuals.

Supplementary feeding of deer, as is practiced with livestock, is sound nutritionally but merely postpones the problem of herd reduction. Workers in states that have tried it seem to be universally opposed.

Although herd management is not the subject of this paper, it is an integral part of any deer management discussion. In East Texas we have two problems. One is the understocked range where the deer are held down by illegal hunting. Wherever this has been solved, we have the far greater problem of fully-stocked or overstocked range. Under harvest is permanently damaging some ranges by causing complete elimination of some of the best food species. Some bottom lands are being converted to savannahs with no tree or shrub reproduction. The adjacent uplands appear to offer an abundance of browse but it is largely

sweetgum, wax myrtle, persimmon, and other unpalatable species. The yaupon, blackgum, ash, greenbrier, and rattan is dead or dying. Weights are down to 75 pounds, whereas, better ranges in East Texas produce bucks which average 105 pounds. The fawn crop has also been reduced.

Herd reduction is needed more than we realize because the quality of the food supply is lower than casual inspection might indicate.

## SUMMARY

1. Winter is the most critical period for deer because the quantity and quality of the food supply is lowest at that time.

2. Winter browse contains about 6 per cent protein and 0.16 per cent phosphoric acid. The minimum adequate level appears to be about 7 per cent protein and 0.35 per cent phosphoric acid. Fifteen evergreen species averaged 7.56 per cent protein and 0.16 phosphoric acid. Ten deciduous species averaged 4.06 per cent protein and 0.14 phosphoric acid.

3. A division of the available herbage into three categories of palatability, with utilization of half of the season's growth of desirable species, shows that only one-third of the available herbage may be used by deer and/or cattle. A general browse line will not be present when carrying capacity is reached.

4. Carrying capacity for deer can be increased with plantings of winter greens, fertilization or release of common desirable species, prescribed burning, timber removal, increasing the acorn supply, removal of hogs and cattle, or with plantings of palatable evergreens. Herd control is necessary, regardless of the carrying capacity.

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