NUTRITIVE QUALITY OF DEER BROWSE RELATED TO SOIL FERTILITY IN AN OAK-HICKORY FOREST HABITAT[1/]

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Abstract.--Browse nutritive quality was related to soil fertility in a west-central Tennessee oak-hickory successional forest habitat. Protein and phosphorus determined in a yearlong browse clip sampling and analysis were related to soil phosphorus, soil pH and season across several soil types in different topoedaphic situations. Grouping the sites studied, browse nutritive quality alone was not found satisfactory throughout the entire year to promote deer herd propagation in this habitat. Consumption in addition to browse seems necessary. The study area now supports a sustaining white-tailed deer population.

Keywords: Browse nutritive quality, soil fertility, deer, oak-hickory habitat, topoedaphic situations.

INTRODUCTION

Soils in the Southeast generally are nutrient poor and low in phosphorus (Campbell et al., 1954; Lay, 1957; Short et al., 1973). These highly leached soils are moderately to strongly acid and have high aluminum and iron oxide contents with a low reserve of organic matter and soil nutrients available to plants.

Browse, the current year's growth of woody twigs or stems with leaves, can compose a portion of, or the bulk of, the diet of deer throughout the year. Browse use measurements serve as indicators of the degree of feeding pressure (Lay, 1964).

Natural maturing reduces the nutrient content of browse (Oelberg, 1956). Green leaves of woody plants are 64 to 67 percent digestible, while dead leaves after nutrients leach out are only 39 percent digestible due to indigestible lignin content (Van Soest and Mertens, 1974; see also Harlow, 1985). Viable twigs become less digestible as lignin accumulates with maturity (Short, 1973).

Protein and phosphorus both accumulate in the active meristematic tissues of plants during spring and early summer. Even in the spring, however, range animals can be affected adversely by the consumption of excessive quantities of green forage with reduced protein concentrations due to the high water composition (Bissel et al., 1955; Dietz, 1969).

Sustenance of White-Tailed Deer Populations

The term crude protein represents both protein and nonprotein nitrogen. McEwen et al. (1957) state that the protein requirement found optimal for growth in deer is 16 percent by weight of the forage intake per day. Harlow (1985) cites moisture-free crude protein maintenance needs for yearling deer at around 5.8 percent up to 18 percent for optimum weight gain for older deer.

Phosphorus is an essential mineral, vital to many metabolic processes. McEwen et al. (1957) found minimal phosphorus standards for deer to be 0.25 percent of the dry forage intake to maintain body weight. The ingestion of quality forage with adequate levels of protein and essential minerals such as phosphorus are mandatory for maintenance as well as growth. Murphy and Coates (1966) list the dietary requirements of deer as

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13 to 14 percent crude protein and 0.40 percent phosphorus.

In spring, deer require nutritional gains to recover from winter weight loss. Antler development, growth, gestation, and lactation also require adequate spring nutrition. In late summer and autumn, demands above ordinary individual requirements have lessened, allowing fat deposition for the winter months. During winter, deer populations are often affected by decreased nutritional food quality.

On southern ranges during most of the year, protein content of and phosphorus concentrations in browse are often below acceptable standard levels suggested for herbivore success (Crawford et al., 1975). Even though grasses, forbs, and browse achieve high nutritional levels in the spring and summer months, it appears from some studies that deer are existing on ranges where the major yearly food sources analyzed rank below the recommended nutritional standards (Campbell et al., 1954; Halls, 1969).

Relationship of Soil and Browse Nutrients

Several studies have shown direct relationships between soil nutrient availability and forage/browse nutrient quality. Murphy and Porath (1968) showed direct relationships between fawn body weights and soil fertility levels in Missouri. Hundley (1959), working with different soils in Virginia, determined seasonal relationships in browse nutrient quality as related to soil chemistry during different seasons. Thorsland (1966) found a direct relationship between phosphorus contents in browse and supporting soils in South Carolina. Krueger and Donart (1974) found positive correlations between forage nutrient quality and soil fertility in a mule deer study in California.

Objectives

The objectives of this study were to ascertain relationships between soil fertility, as related to pH and phosphorus availability, and the nutritive quality of deer browse based on phosphorus content, plant moisture and crude protein. Soils and browse were collected from selected topoedaphically discreet sites during the period June 1977 through May 1978 in Nathan Bedford Forrest State Park, Benton County, Tennessee.

Analyses were intended to indicate, among times of year:

(1) Differences in protein and phosphorus levels in preferred browse species growing on different soils.

(2) Variations in soil nutrient status reflected in browse nutrient differences.

(3) Seasonal variations in browse nutrient quality and moisture content.

(4) The variations in soil fertility occurring between July and December.

(5) General relationships between topoedaphic positions, corresponding seral hierarchy and browse quality.

METHODS AND MATERIALS

The Study Site

Nathan Bedford Forrest State Park is a nominal oak-hickory forest tract of some 1600 hectares on both sides of the Tennessee River. The river was impounded in 1944 some 120 km downstream to form Kentucky Lake.

This study was accomplished on the western side of the flooded valley in eastern Benton County which is imposed on the Western Highland Rim. Study sites ranged in topographic position from an emergent near shore island (110 m msl) upslope 1.5 to 1.8 km to the hydrologic ridge crest to the northwest (200 m msl).

The dominant cover of dissected eastern Benton County is an unthrifty, and in places empirically stable, forest of mostly mixed oaks and hickories. White oak is often predominant in such stands of the "climax" oak-hickory forest type (TVA, 1965). Within the present park, along the convex terrain from river to ridge crest where local topography allowed, the forest was once cleared for small plowed fields and pastures. The steepest slopes were cutover repeatedly. The present most stable forest stands on slopes and ridges contain little marketable timber and only salvage cutting is allowed in the park. In the park and elsewhere in the general area, plow and pasture clearings have mostly been abandoned and are slowly reverting towards stable forest cover on generally depleted soils (SCS, 1953).

The nearly level bedrock parent material is primarily of the Fort Payne formation (Mississippian), mostly a cherty limestone with some dolomites and black shales. A thin loess mantles some moderate terrain.

Climate

The climate of Benton County is of the humid continental type, with mild winters and hot summers. The average frost-free period is 192 days and the annual rainfall of 132 centimeters is fairly well distributed throughout the year with the least precipitation occurring in the summer. Droughts are not very common, but lack of rain can produce drought conditions on certain soil types (SCS, 1953; Climatological Data, TN, 1977-78).

Site Characteristics

Ten sample sites, each two hectares in size, were selected. Sites 1 and 2 were located on old fields; sites 3, 4, 5 and 6 on 50-60 percent forested slopes; 7 and 8 on alluvial bottomland areas; 9 on a near-shore island in Kentucky Lake, and 10 in an upland hollow. Sites 3, 4, 5 and 6 were respectively on N, W, E and S aspects and considered stable forest. All other sites evidenced successional status.

Soils

Soils information is available from the Benton County Soil Survey (SCS, 1953) updated in part by Springer and Elder (1980). Soils were collected and examined by the authors in situ and by laboratory analyses. The following soils corresponded with browse sample sites: Mountview Series, site 1; Ennis Series, site 2; Bodine Series, sites 1, 3, 4, 5 and 6; Robertsville Series, sites 7 and 10; Greendale Series, site 8; Lindside Series, site 9 (the island); and, Humphrey Series, site 10. The Bodine Series dominates the park landscape.

Soil Collection and Analysis

Soil samples were bucket-augered from each site twice during the year. The samples were taken in July and December of 1977. Three topsoil samples per core representing 0 to 12 centimeters were taken on all sites and three subsoil samples representing 30 to 42 centimeters were taken on six sites. Seven soil cores per site were made on each date. The samples were taken at random over the site areas.

Soils were analyzed for phosphorus and pH by the Soils Testing Lab, The University of Tennessee, Knoxville, and the Agricultural Extension Service in Nashville, Tennessee. Soil pH was not field tested.

Browse

The browse species treated in the present study were: *Smilax* sp. L. (all sites, all seasons), *Lonicera japonica* Thumb. (honeysuckle), *Acer rubrum* L. (red maple), *Cornus florida* L. (dogwood), *Vitas* sp. Michx. (grape), *Sassafras albidum* Nees, *Rubus* sp. L. (blackberry), *Cephalanthus occidentalis* L. (buttonbush), and *Vaccinium arboreum* Marsh. (farkleberry).

Collection Procedure

Ten rectangular two hectare sites were flagged. Following Aldous (1944) and Devos and Mosby (1969) haphazardly chosen circular collection plots (radius 3.57 m) were used within each of the 10 sites each month. Plots once sampled were not harvested again.

Monthly browse collection was based on the (Browse Clip and Weigh) method used by Schwan and Swift (1941). For deciduous browse species, 15 centimeters of the annual growth were clipped. For vine samples, 26 centimeters of the annual growth were clipped. Samples were within 1.5 m of the ground. A routine collection route was followed to insure plant specimens were collected at approximately the same time of the day each month (Short, 1968).

Browse Analyses

Plants collected during the spring and summer months included leaf and stem tissues. Analysis on material from the fall and winter months was conducted on stem tissue only.

Plant samples were analyzed for total nitrogen which then was converted into a crude protein value by multiplying by 6.25 (Dietz, 1965). Analyses also included evaluation of phosphorus and percent moisture.

Nitrogen and phosphorus were determined on the basis of spectrophotometric analyses. Nutrient analysis procedures also were conducted on standard reference orchard leaves (Standard Reference Material 1571, U.S. National Bureau of Standards, Washington, DC 20234).

Statistics

Data were analyzed using analysis of variance, Duncan's multiple range test (DMRT), and simple correlation, using the statistical analysis subroutine (SAS, 1979).

RESULTS

The ten permanent sites were grouped into four classes reflecting similarities in topoedaphic position and history, soil characteristics, cover and browse quality. The four forested ridge sites, 3, 4, 5 and 6 composed the Xeric classification. Two old field sites, 1 and 2, were classified as Sub-xeric. Three sites with various alluvial soils, 7, 8 and 10, were included under the Mesic classification. The Island, site 9, was placed in a separate category since it was distinguished from all other sites by position, soil type, plant species, and periodic inundation. Table 1 lists sites by classes and details soil pH and phosphorus determinations by site from July and December soil samples.

Soils Data

Xeric sites, 3, 4, 5 and 6 (ridges) were topoedaphically very similar except for aspect. All four were dominated by oak-hickory. Soil pH (four sites) was higher in December than in July considering both topsoil and subsoil samples.

Soil phosphorus (same eight collections) declined markedly in winter (Table 1).

Table 1.--Soil pH and soil phosphorus by sites. Sites separated by topoedaphic classes. a samples at 0-12 cm depth, b at 30-42 cm depth.

		pH		PHOSPHORUS (PPM.)	
SITE		Jul	Dec	Jul	Dec
Subxeric	1a	5.2	5.1	1.3	1.0
	b	5.5	5.2	1.2	1.0
	2a	5.3	5.4	4.5	1.0
	b	5.2	5.4	1.0	1.0
Xeric	3a	5.2	5.5	5.6	1.0
	b	4.9	5.3	4.5	1.0
	4a	4.3	5.8	3.0	1.0
	b	4.6	4.8	2.2	1.5
	5a	4.7	5.9	5.3	1.0
	b	4.7	5.0	3.2	1.0
	6a	4.3	5.8	5.5	1.0
	b	4.7	4.8	5.5	1.0
Mesic	7a	4.7	4.9	5.0	2.5
	b	X	X	X	X
	8a	4.5	4.8	2.3	1.0
	b	X	X	X	X
	10a	4.6	4.8	3.7	1.0
	b	X	X	X	X
Island	9a	5.3	Y	8.8	Y
	b	X	Y	X	Y

Each listed value reflects the average of 21 determinations. X, samples not taken; Y, samples not obtainable.

Pearson produce-number correlations (SAS, 1979) showed a significant negative correlation for Xeric sites between soil pH and soil phosphorus:

Correlated Pair (XERIC)	Corr. Coef.	Sign. Level
Soil pH x Soil Phos.	-0.31993	*0.0266

*Significance probability of the correlation.

Using Duncan's multiple range test (DMRT), July and December topsoil pH's were significantly different (at .05) between sites 3 and 4 as was July phosphorus. On this basis, site 3 (north slope) had the highest topsoil fertility of the Xeric sites, site 4 (west) the lowest, during the summer (Table 1).

Sub-xeric sites 1 and 2 (old fields) did not evidence much variation in soil column pH between sites or between July-December. Soil phosphorus was different between sites with site 2 showing higher topsoil phosphorus in July. The high phosphorus level in site 2, July, did not correspond to a pH difference (Table 1).

Mesic sites 7, 8 and 10 (bottoms) were topoedaphically distinct with transported soils. Site 8 had a slightly lower topsoil pH than the others. Site 7 had significantly higher topsoil phosphorus.

Island site 9 had comparatively low acid topsoils and three to eight times more phosphorus than all other sites.

Soil phosphorus varies with date, sample depth and site. Sites 9, 3 and 2 show higher pH values and higher July phosphorus. Sites 5, 6 and 7 belie this pattern, however, based on our soil measurements. Sites 1, 4 and 10 have relatively low pH values and comparatively low soil phosphorus.

Plant Data

Plant results were subjected to the same topoedaphic site classification, to determine if common site factors have predictive value for browse quality. Season was the only significant variable for protein and for phosphorus in Smilax which was collected as a common denominator across sites (Table 2). Smilax analyzed from the island had the highest phosphorus levels (significant at .05 DMRT), Table 3, numerically higher protein content and showed relatively low moisture content for the year. Site 2 yearly average smilax protein was relatively high, influenced by a 17.6 percent protein measurement for April (highest in this study). The samples highest in plant tissue moisture, from sites 6 and 3, showed low phosphorus measurements and were low in protein as well, Table 3.

For all browse species collected and analyzed, a positive correlation with an "r" value of .82 occurs between plant protein and plant phosphorus. Comparatively, Island site 9 ranked highest in both. Mesic sites (7, 8, 10) showed medium to high protein and phosphorus. Sub-xeric site (1, 2) samples were low in plant phosphorus. Xeric sites (3, 4, 5, 6) were low to medium in both nutrients.

Plant and Soils Data Relationships

Measurements from the topsoil (0-12 cm) were considered within a soil-smilax data set. Both smilax protein and phosphorus were correlated with soil phosphorus (Table 4).

Correlation procedures were also performed for a soils--all plants combined data set (Table 5). All plant phosphorus versus soil phosphorus had a higher correlation than for smilax alone versus soil phosphorus. Both all plant nutrients correlated with plant moisture, perhaps reflecting more consistent nutrient levels at favorable moisture levels.

Table 2.--Seasonal Means of Smilax Phosphorus, Protein, and Moisture.

SEASON PERIOD	% PHOSPHORUS**	% PROTEIN	% MOISTURE
-1/Spring-Growth	0.21[a]	12.7[a]	59.1[a]
-2/Summer-Maintenance	0.14[b]	11.8[b]	60.7[a]
-3/Winter-Senescence	0.13[b]	11.3[b]	39.6[b]

-For purposes of comparison, Spring includes March-June; Summer includes July-October; Winter includes November-February.

**Significant seasonal effects at the 0.10 level, protein and moisture significant at the 0.05 level (analysis of variance).

Different superscripts indicate the means are significantly different at the 0.05 level (Duncan's multiple range test).

Table 3.--Yearly Mean Percentages for Smilax Phosphorus, Protein, and Moisture by Site and Class.

SITE	CLASS	% PHOSPHORUS	% PROTEIN	% MOISTURE
3	Xeric	0.12	11.0	60.0
4	Xeric	0.17	12.5	59.1
5	Xeric	0.16	11.5	44.0
6	Xeric	0.12	11.6	62.8
1	Sub-Xeric	0.12	11.7	52.2
2	Sub-Xeric	0.15	12.8	59.9
7	Mesic	0.17	12.9	50.0
8	Mesic	0.17	12.0	58.8
10	Mesic	0.16	11.7	50.0
9	Island	0.26	13.1	49.8

Table 4.--Correlations for Topsoils and Smilax Data.

CORRELATED PAIR	CORR. COEF.[r]	SIGN. LEVEL
Smilax Protein x Smilax Phos.	0.57527	0.0157
Smilax Protein x Soil Phos.	0.60071	0.0108
Smilax Phos. x Soil Phos.	0.41228	0.0794

Table 5.--Correlations between Soils Data and All Plant Species.

CORRELATED PAIR	CORR. COEF.[r]	SIGN. LEVEL
Plant Protein x Plant Phos.	0.73	0.0002
Plant Protein x Plant Moist.	0.70	0.0004
Plant Protein x Soil Phos.	0.55	0.0127
Plant Phos. x Soil Phos.	0.73	0.0003
Plant Phos. x Plant Moist.	0.59	0.0058

When the spring and summer seasons were pooled, deleting winter, using Smilax data only, the number of significant correlations increased from one to three. The correlation between plant phosphorus and soil phosphorus increased from r=.41 to r=.71 and was significant at the .05 level instead of the .10 level, the level of significance when winter values were included.

When the entire plant data set was run with a deletion of the winter season, a similar change in correlations and improvement in the level of significance in the soil phosphorus--plant phosphorus relationship was noted.

When the spring season only was analyzed for soil phosphorus versus plant phosphorus, the correlation diminished when compared to that for all plants, all seasons (r=.73 versus r=.87). These relationships indicate the correlation between plant phosphorus and soil phosphorus was not entirely attributable to seasonal variation, but also indicated possible site differences appropriate to the topoedaphic classifications and consistent agricultural disturbances considered.

DISCUSSION AND CONCLUSIONS

This study showed soil pH was higher in the winter months than in the summer months and soil phosphorus dropped significantly in the winter months. Many of the study area soils were derived from Mississippian limestone parent materials. The weathering of limestone by carbonation and organic acid formation by organisms as well as leaching of soil nutrients can accentuate soil acidity. There was a general increase in soil pH from the July to December sampling date which may have resulted from the rapid mobilization of inorganic nutrients from senescent leaves and recently fallen litter (Witkamp, 1971).

Seasonal variation of soil nutrient content and pH is controlled by a combination of factors. Many potential decomposer organisms are less

active when soil pH is less than 5.0 and litter is base-poor (Ovington and Madgwick, 1957). Nutrients from litter are not recycled as quickly into the soil under these conditions (Williams and Gray, 1974). Reduced microbial activity in the winter months also reduces the amount of organic acids in the soil (Brady, 1974).

Phosphorus values here were much higher in the summer months than the winter. Harrison (1979) found this same pattern occurring in woodland sites in England. Available (detectable) phosphorus was not released to the soil until warmer soil microbial activity was sufficient. This warming occurs sooner under sparser cover and lesser litter accumulations.

Soil phosphorus concentrations here are probably limiting for optimum plant growth and nutritive quality. Soil phosphorus values averaged five parts per million in all sites (except the Island) which is considered too low for optimum plant growth (Francis and Loftus, 1977). Most phosphorus in soils is available for plant uptake only within a pH range of 6.0 to 7.0 (Brady, 1974). Because all pH values were less than this range, and iron and aluminum oxide levels could therefore be important, real phosphorus limitations might be even more severe. In an Alabama study by Hill (1972), pH was the most definitive variable found affecting rabbit productivity.

A more subtle factor affecting soil fertility and plant nutrient quality in this once agriculturally exploited area is characteristic topoedaphic position. The difference between the Xeric classification and Mesic classification is basically the difference between ridges and steep slopes versus alluvial lowlands; or the disparity between unworkable and usable acreages for small-scale farming. Differences in soil fertility generally occurred between the grouped sites. Soil drainage, moisture supplying capacity of the soil, plant cover and plant response are all affected by topoedaphic use history considerations.

Empirical phenological changes accounted for much of the variation in plant nutrient concentrations. Season was the only significant variable affecting plant protein. The growing season showed the highest plant protein and plant phosphorus concentrations. The maintenance season (summer) showed a gradual decrease in plant protein and a definite decrease in plant phosphorus.

The positive correlation between plant protein and plant phosphorus was due in part to the plant nutrient relationship with season. Positive correlations between the plant nutrients and soil phosphorus demonstrate site differences were also affecting the variation. Topoedaphic site characteristics were rather consistent throughout the year in this temperate, only moderately windy, humid continental area.

As the consequence of relationships not revealed in this study, smilax analyzed from two of the Xeric sites had the consistently highest plant moisture values. If nutrient presumptions had been based only on the apparent succulence of browse, it would have been misleading. Higher plant moisture did not indicate high protein and phosphorus content. No evaluation of physical and physiological water relationships was attempted in this study.

According to figures available from the Tennessee Wildlife Resources Agency (TWRA, Wildlife Research Report 1984-85 and telephone conversation with TWRA scientist Larry Marcum, June 1986) the Benton County deer herd had a prehunt population of 7300 in 1985 and a predicted prehunt population of 8300 in 1986. Most of the white-tailed deer in Benton County are in the eastern portion of the county which includes the Nathan Bedford Forrest State Park.

Since the year of this study (1977-78) the deer kill in Benton County has been reported as 667, 615, 786, 666, 591, 572, 696 and 742 (1977-84 inclusive). This is a moderate harvest when compared to other Tennessee counties and reflects a rather low habitat production (deer per acre) based on current habitat assessment practices.

The protein quality of browse in Nathan Bedford Forrest Park probably is adequate except for the winter months although precise nutrient requirement levels are not known. Browse protein levels obtained, especially from the alluvial Mesic and Island areas, meet minimum standards established by Lay (1956) and Murphy and Coates (1966). According to these same sources the browse phosphorus levels overall do not meet adquate nutritional levels. Only one site, the Island, met the established minimal phosphorus requirement for deer.

The steep terrain over most of the study area, dominated by low nutrient Bodine Series soils, can be expected to support a closed oak-hickory forest if management of the parklands precludes all logging, promotes fire suppression and does not include canopy reduction measures such as farming once accomplished. Forest site samples here indicate understory browse quality is already low and that soil nutrient capability is not promising. An uninterrupted forest recovery occurs on the old fields and bottoms which presently are still close to producing nutritious browse on soils with somewhat better potential. The browse on these relatively few topoedaphic sites will diminish in quality and presence along with an eventual diminution of soil potential with forest succession. Seasonal shading, slower soil warming after leaf out and accumulations of base-poor litter will at least restrict phosphate uptake. Simple spacial density competition will limit intolerant site browse reproduction and productivity on these now more open sites with closure.

Even if the topographic expressions which lent themselves to pioneer disturbance for subsistence farming were somehow successionally arrested, and browse stands maintained, continuing deer population success here must depend on other food sources.

Non-woody plant foods provide seasonal forage for deer. Crawford et al. (1975) detail mid-August foods taken by three leashed deer (one fistulated) in a Virginia Oak-Pine Forest. Fruit, leaves, stems and flowers were eaten and tallied for clear-cut and selective-cut areas. Green leaves of forbs and graminoids and deciduous hardwood fruits were found to be important in addition to browse. Flowers were a limited part of the consumption measured. Harlow (1985) also evaluated deer food consumption in midsummer in North Georgia and western North Carolina. In thinned hardwood stands, the study evaluated Christmas fern (Polystichum acrostichoides Schott) and non-fleshy fungi in addition to five browse species. The non-woody species yielded slightly less crude protein than the browse sampled, but soft tissues of all collections showed nearly optimum crude protein levels. There was little quality difference within species between sites.

Canopy development and increased acid litter accumulation will also restrict forb and graminoid presence and distribution. Some pteridophytes and fungi may flourish on the forest floor, but their density will not be high and such forage utilization will be seasonal, as will any mast production and consumption.

Along the fluctuating reservoir pool shoreline, a disturbance zone will continue to allow browse, forb and graminoid development. The small offshore islets will also continue to provide herbivore feeding habitat. The areal extent of these water-level habitats is not great in terms of the acreage of the conserved park or the deer population currently resident.

In many regions, wild land deer subsist to some degree by feeding sorties into nearby agricultural fields. In general projections of white-tailed deer range estimates, there are not extensive croplands available to the Nathan Bedford Forrest Park population. The topography of the park is not uncommon for governmentally protected lands in Tennessee, in effect, rough "climax" forest landscape, unsuitable for persistent industrial-commercial or agricultural development, in such a location that urban or suburban prospects are not likely.

Landscape remodeling to promote favorable browse habitats is absurd. Active forest management to allow extant habitats, such as the disturbed sites sampled, which are conducive to seres for browse and forage development and persistence must be a part of the future plans for sustenance of a desirable deer population in this study area and others of similar ecological characteristics. It is clear from this study that browse alone is not likely to provide a complete nutritional source for any sizeable population no matter how selective individual deer are as feeders. The soil nutrient status is such, over most of the area, that browse yields less than an optimal diet on a year around basis. The consumption of other suitable foods (particularly forbs, graminoids, shrub fruits) must be possible or the deer population will drop as the forest progresses in succession. To maintain or increase the carrying capacity, active management practices must intervene to interfere with forest closure.

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