QUALITY OF DEER FORAGES FROM EASTERN WEST VIRGINIA[1]

by

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ABSTRACT

During the period January through March 1973, white-tailed deer *(Odcoileus virginianus)* forage was analyzed for availability mineral content crude protein, and digestibility on Short Mountain Public Hunting Area, West Virginia. Carrying capacity was estimated uusing both quantitative and qualitative aspects of the available forage. On the basis of available dry matter 20.99 deer days per acre could be supported. This compares to 16.91 deer days per acre for digestible dry matter and 20.30 deer days per acre for curde protein. Phosphorus, supporting 12.11 deer days per acre and potassium, supporting 16.67 deer days per acre, could also limit deer numbers. Carrying capacity may be over-estimated when using available dry matter and the effect of forage quality on health and productivity of the deer heard must be considered.

INTRODUCTION

When deer range carrying capacity is mentioned, the first component that usually comes to mind is the amount of available food. This fact, and the relative ease of obtaining ddata on available forage may account for the abundance of studies which determined forage availability. Studies by Dunkeson (1955), Moore et al. (1960), Moore and Strode (1966), Shaw and Ripley (1966), Moore (1967), and Segelquist and Green (1968) are examples which stressed the availability of forages to deer.

Lay (1956), Swank (1956), Verme (1963 and 1967), Dietz (1965), Murphy and Coates (1966), Short (1969) and others, have cautioned against basing carrying capacity estimates solely on available forage. To do so is to overlook limiting factors such as digestible energy, protein, and minerals. This paper deals with the effect that minerals can exert on carrying capacity estimates.

METHODS

The study was conducted at the 8,020-acre Short Mountain Public Hunting Area, in Hampshire County, West Virginia. The elevation varies from 1,200 feet on the southern end to 2,615 feet on the northern end. Berks, Lehew, Laidig, and Dekalb are the primary soil types. All soils on the area are acid and considered poor (Jencks 1969) and with the exception of Laidig, all are excessively drained. A mixed oak-pine forest association accounts for approximately 92 percent of the forest acreage with the remainder in other forest types.

A ranked set sampling procedure was used to determine forage availability during January through March 1973 (McIntyre 1952 and Halls and Dell 1966). A circular quadrat 42 inches in diameter, was used to define the areas to be ranked (Campbell and Cassady 1955). All annual growth of any species located in the imaginary cylinder formed by the quadrat to a height of 5 feet was clipped and later dried in a forced draft oven at 65° C for 24 hours. Efforts were made to collect any vegetative matter located in

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the quadrats. During the winter priod collected material was mainly woody twigs, evergreen leaves and twigs, and rosettes of grasses (Gramineae) and sedges (Cyperaceae). Three hundred quadrat sets were located by a random start systematic sampling procedure (Bourdeau 1953).

Forage samples collected were ground in a Wiley mill using a lmm stainless steel mesh, and individual samples pooled by location and species. Pooled samples were then analyzed for crude protein and *in vitro* digestibility by the senior author. Samples were also sent to the Forage Testing Service, located at the University of Georgia, for mineral analysis. Deer days per acre were calculated using the requirements for white-tailed deer or sheep as published by McEwen et al. (1957), Telle et al. (1964), National Research Council (1968), and Dietz (1972).

RESULTS

Mineral composition of all species found on Short Mountain that contributed at least 0.1 pound per acre are presented in Table 1. As can be seen, no significant amounts of mast and fungi were found during the sampling period. The range in mineral content is extremely wide between species. An example is potassium, which varies from 0.00 percent in dead leaves to 1.72 percent in sedges. Manganese, however, is relatively constant at 897 parts per million as in dewberry *(Rubus* sp.), with only grasses, sassafras *(Sassafras albidum),* flowering dogwood *(Cornus florida),* rapberry *(Rubus* sp.), and greenbrier *(Smilax* sp.) showing much variation from this amount.

Table 1. Mineral content of forage species from Short Mountain, West Virginia.

Species	P	K	Ca	Mg	Cu	Mo	Zn	Mn	Fe
	Percent of Dry Matter (by weight)				Parts Per Million				
Dead Leaves	0.12	0.0	1.21	0.14	4	3.4	32	897	162
Laurel	0.14	0.37	0.90	0.13	4	2.6	22	897	53
Teaberry	0.15	0.69	1.16	0.15	1	3.5	16	897	59
Greenbrier	0.12	0.85	0.26	0.02	6	1.6	31	400	84
Red Oaks	0.15	0.21	0.45	0.03	7	2.4	22	897	52
Chestnut Oak	0.16	0.35	0.94	0.09	9	3.2	27	897	57
Vaccinium[1]	0.15	0.33	0.97	0.03	14	2.9	28	897	70
Azalea	0.21	0.32	0.36	0.01	10	4.9	27	897	70
Scrub Oak	0.16	0.27	0.71	0.03	10	3.5	29	897	66
Grasses	0.17	0.68	0.21	0.03	6	2.4	46	574	243
Red Maple	0.19	0.50	1.25	0.04	13	3.0	61	897	56
Sassafras	0.15	0.41	0.62	0.03	10	1.8	71	697	53
Flowering Dogwood	0.16	0.96	2.16	0.36	7	4.3	49	175	69
Dewberry	0.17	0.59	0.50	0.14	10	2.9	65	897	84
Witch Hazel	0.17	1.11	1.45	0.15	8	2.0	38	889	68
Rasberry	0.18	0.60	0.63	0.15	12	1.4	38	744	56
Black Gum	0.17	0.28	1.07	0.14	12	3.5	46	897	63
Pitch Pine	0.17	0.48	0.20	0.02	5	5.7	40	897	156
Sedges	0.20	1.72	0.16	0.04	13	2.2	79	897	91

[1]Small amounts of *Gaylussacia baccata* are included.

Table 2 presents deer days per acre carrying capacity estimates for the macro-elements (P, K, Ca, and Mg). For comparison, deer days per acre for dry matter production, digestible dry matter, and crude protein are also included in Table 2.

Values for phosphorus all fall below the 0.25 percent level reported by McEwen et al. (1957) as minimum requirements for white-tailed deer. Azalea *(Rhododendron roseum)* contained the highest level of phosphorus. However, most species exceed the 0.03 percent calcium content recommended by McEwen and his co-workers. Sedges, pitch pine *(Pinus rigida)*, grasses and greenbrier all contained less than the 0.30 percent calcium. Only flowering dogwood (13.5:1), dead leaves (10.1:1), witch hazel *(Mamamelis virginiana)*, (8.5:1), and teaberry *(Gaultheria procumbens)* (7.7:1) exceed the 7:1 calcium phosphorus ratio reported by Wise et al. (1963) as marking the point at which a loss in feed efficiency can be expected. Only in sedges was the Ca-P ratio below 1:1. Laurel *(Kalmia latifolia)*, red oak *(Quercus* sp.), chestnut oak *(Q. montana)*, vaccinium *(Vaccinium* sp.), azalea, scrub oak *(Q. ilicifolia)*, red maple *(Acer rubrum)*, sassafras, blackgum *(Nyssa sylvatica)*, and pitch pine fall below the 0.55 percent level of potassium recommended by Telle et al. (1964) for lambs. Ten of 19 species contained less than 0.06 percent magnesium as recommended for pregnant ewes by the National Research Council (1968).

Except in rather rare exceptions iron deficiencies are not a problem in ruminants. All forage species contained well over the 40 ppm recommended by Lawlor et al. (1965) for older lambs. Underwood and Somers (1969) recommended a level of 32 ppm zinc in the diet of rams for normal testicular development. Data for manganese requirements indicate that the requirement for ruminants is about 20 ppm, as suggested by Bentley and Phillips (1951). This minimum level is exceeded by all species studies.

Copper and molybdenum are considered together because of interactions between these two minerals. Beck (1962) reported that pastures containing less than 7 ppm copper resulted in deficiency symptoms in some sheep breeds. Beck (1962) reported that molybdenum levels were between 1 and 4 ppm with the majority less than 1 ppm. Sulphate which also interferes with copper metabolism, ranged from 0.1 to 0.9 percent with most values in the range of 0.2 to 0.4 percent. Underwood (1966) suggested that in any area where molybdenum levels are in the range of 2 to 5 ppm and sulphate levels are normal to high, minimum copper requirements of sheep or cattle would need to be raised to 10 ppm. Increased copper requirements are indicated by the molybdenum levels and the relatively low content of the forages collected from Short Mountain.

DISCUSSION

The role that each essential element plays in the body can be characterized as either physical, chemical or biological depending on its form or combination and its location in the body (Underwood 1966). Numerous factors can influence animal requirements and plant content. Many animals consume diets that do not meet the requirements established for optimum health. Deviations to either side of established requirements can result in toxicity of deficiency. More often, however, the discrepency between intake and requirements results in unsatisfactory growth and production or an ill-defined uthriftyness (Underwood 1966). The possibility of confusing lack of growth, poor production, or poor appearance with lack of energy intake, protein deficiencey, or parasitism makes mineral deficiencies important (Underwood 1966).

Table 2. Deer days per acre carrying estimates for major forage species from Short Mountain (Figures represent total production and must be reduced by appropriate utilization figures, i.e. 50%).

Species	Ca	P	Mg	K	Dry Matter	Digestible Dry Matter	Crude Protein
Laurel	38.67	7.22	33.52	8.67	12.89	11.79	12.95
Vaccinium[1]	6.80	1.29	1.29	1.33	2.15	1.00	1.73
Teaberry	11.42	1.77	8.86	2.71	2.95	2.71	3.02
Azalea	0.38	0.27	0.06	0.19	0.32	0.18	0.29
Red Oaks	0.77	0.31	0.31	0.20	0.51	0.31	0.35
Chestnut Oak	1.43	0.29	0.82	0.29	0.46	0.30	0.35
Scrub Oak	0.56	0.15	0.14	0.12	0.24	0.10	0.18
Grasses	0.14	0.13	0.12	0.24	0.20	0.17	0.34
Greenbrier	0.61	0.33	0.28	0.09	0.71	0.38	0.56
Flowering Dogwood	0.53	0.05	0.53	0.13	0.07	0.07	0.08
Sedges	0.03	0.04	0.04	0.16	0.05	0.05	0.09
Red Maple	0.24	0.04	0.05	0.04	0.06	0.06	0.05
Sassafras	0.18	0.05	0.05	0.05	0.07	0.07	0.08
Witch Hazel	0.29	0.04	0.18	0.12	0.06	0.05	0.06
Black Gum	0.12	0.02	0.09	0.02	0.03	0.02	0.03
Raspberry	0.12	0.04	0.18	0.06	0.06	0.05	0.05
Dewberry	0.10	0.04	0.16	0.06	0.06	0.06	0.07
Pitch Pine	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sub Total	62.41	12.11	46.70	16.67	20.99	16.91	20.30
Dead Leaves	632.73	75.30	732.08	0	156.88	86.12	149.48
Total	695.14	87.41	788.78	16.67	177.87	103.03	169.78

[1]Small amounts of *Gaylussacia baccata* are included.

The subtotals in Table 2 point out that a simple knowledge of dry matter production on an area is insufficient to correctly estimate carrying capacities. Carrying capacity is determined by a multiplicity of factors, the most limiting of which determines the current carrying capacity. Phosphorus, supporting 12.11 deer days per acre, is a limiting facotr on deer numbers on Short Mountain, more limiting in fact than available dry matter. Reid et al. (1970) suggested that domestic ruminants in West Virginia, maintained on pasture or hay without mineral supplements, would be receiving sub-optimal levels of certain minerals (P, Ca, Mg and Na) for parts of the year. Carl Defazio (personal communication, 1973) also stated that soils in Hampshire County are generally deficient in phosphorus. Authors from other parts of the country have also reported that phosphorus was probably acting to limit deer numbers (Swank 1956 and Dietz 1965). Underwood (1966) pointed out that phosphorus deficiency is the most wide-spread and economically important mineral deficiency affecting grazing livestock.

Other marginal limiting factors are potassium, 16.67 deer days per acre, and digestible dry matter, 16.91 deer days per acre. The addition of available nutrients from dead leaves increases the possible deer days per acre for all categories except potassium (Table 2). This is accounted for by the lack of potassium in leaves (Table 1), which may be due to the leaching of potassium after leaf fall. With the addition of dead leaves, the order of the limiting facotrs are shifted considerably. Potassium becomes severely limiting when dead leaves are considered. It should be pointed out that data used in calculating availability of dead leaves are from a limited sample and may not reflect the true availability of dead leaves. It is known that dead leaves are found in the rumens of deer (Harlow and Hooper 1971), however, the role dead leaves play in winter nutrition is not known at this time. For this reason the data on dead leaves have been included as a subtotal. It is important to consider the potential affects these materials can have if they are included in the total.

As noted earlier there is a possibility of a copper molybdenum interaction. An increase in cooper requirements due to high levels of molybdenum contained in the forages is very probable. This could very likely result in a deficiency of copper during the winter months. The manifestation of a copper deficiency, or for that matter any nutritional deficiency, depends on the species of animal, its age, sex, severity of the deficiency, and duration of the deficiency. Simple copper deficiency in sheep results in a number of well-defined symptoms but these depend on a number of factors, many of which are unknown. Gross symptoms in sheep can include inadequate keratinization of the wool swayback or neonatal ataxia, and perhaps reduced fertility (Underwood 1966). Actual affects in white-tailed deer are unknown. However, it is known that white-tailed deer from the eastern region of West Virginia are smaller physically, have smaller antlers, and lower productivity than do deer from other regions (Gill 1956). Whether this is attributable to mineral deficiencies or some other factor is not known.

It is unfortunate that more is not known of the mineral requirements of white-tailed deer. Often the requirements for domestic animals are used as they have been in this paper. How these reflect the needs of deer is not precisely known. Deer apparently have the ability to step up the nutritive value of their diet by selective foraging (Swift 1948 and Klein 1962). The effect this has on the mineral intake is not well known. Quite possibly, deer on Short Mountain are able to obtain adequate potassium and zinc intakes in this manner. It should be pointed out that data presented are for the winter period only. Many authors have reported the importance of summer range in maintaining deer through the winter period. To what extent reserves of minerals built up during the summer help support deer during the winter is not understood.

The gross symptoms of deficiency are known. Many authors report the reduced body size, reduced antler size, and lowered productivity resulting from inadequate nutrition. As Dietz (1965) reported, energy, protein, and phosphorus are probably the most common nutritional deficiencies of deer in North America. However, the interplay between energy, protein, and minerals presents an extremely complex picture. The resulting vague unthriftyness, poor production, and poor growth mentioned by Underwood (1966) are often the only indication that something is amiss. Therein lies the need for more intensive investigations of carrying capacity and consideration of all factors that contribute or diminish its value. The increasing demand for natural resources from smaller and smaller tracts of land makes accurate assessment of carrying capacity imperative.

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