White-tailed Deer, *Odocoileus virginianus*, Fecal Groups Relative to Vegetation Biomass and Quality in Maine

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Relationships between the location of White-tailed Deer, *Odocoileus virginianus*, fecal groups and the biomass and quality of adjacent vegetation were studied in a hay field near Unity, Maine, in November 1984. Dry weight biomass of vegetation (primarily *Phleum pratense* and *Trifolium* sp.) clipped from 0.25-m^2 plots adjacent to deer fecal groups ($\bar{x}$ = 5.1 g, SD = 1.6 g) was significantly higher than for random plots ($\bar{x}$ = 2.6 g, SD = 1.1 g). Crude protein content of vegetation near fecal groups ($\bar{x}$ = 20.9%, SD = 8.0%), however, was similar to vegetation at random locations ($\bar{x}$ = 20.6%, SD = 4.9%). Distance from the forest edge did not significantly affect biomass or protein content of vegetation. Location of White-tailed Deer fecal groups was a reliable indicator of greater forage biomass, and was likely related to the feeding activities of this ungulate.

Key Words: White-tailed Deer, *Odocoileus virginianus*, fecal groups, vegetation biomass, vegetation quality, Maine.

Although pellet group counts have been employed to estimate habitat use and population size for ungulates (Julander et al. 1963), reliability of such techniques continues to be debated. Strong relationships were reported between location of Mule Deer (*Odocoileus hemionus*) feces and occurrence and use of preferred foods (Anderson et al. 1972; Bowyer 1984; McCullough 1969). Nonetheless, others have cautioned against inferring habitat use by counting pellet groups (Collins and Urness 1981; Neff 1968). Collins and Urness (1979) reported significant differences between locations of pellet groups and distributions and activities of tame Wapiti (*Cervus elaphus*). Leopold et al. (1984), however, noted that problems with pellet group counts arose only in comparisons of absolute densities and habitat use, and suggested that relative magnitude of deer densities determined from pellet group transects provided reliable indices of use.

Murphy et al. (1985) documented the importance of agricultural lands and grasslands in the ecology of White-tailed Deer (*O. virginianus*) in Wisconsin, and Crawford (1982) pointed out the prominence of herbaceous species in the diet of these deer in Maine. Because of the value of agricultural areas to northern populations of deer, this habitat was selected to study relationships between fecal groups and deer forage. We hypothesized that if the location of fecal groups served as an index to foraging activities as reported for Mule Deer, vegetation biomass or quality would be greater adjacent to fecal groups of White-tailed Deer than for random samples.

Study Area

Research was conducted in a 3-ha hay field near Unity, Waldo County, Maine (44° 36′ N; 69° 23′ W) at an elevation of 76 m. The field adjoined a deer wintering area that encompassed 3 km^2 of boreal forest. Topography of this area is low, rolling hills. The forest overstory is dominated by conifers including Balsam Fir (*Abies balsamea*), White Pine (*Pinus strobus*), and Northern White Cedar (*Thuja occidentalis*); northern hardwoods are scattered throughout the forest. Hay-field vegetation is dominated by Timothy Grass (*Phleum pratense*) and Clover (*Trifolium* sp.), generally $<$ 15 cm tall. The population of deer was not estimated, but $>$ 65 deer were observed in the hay field at one time. This population has increased in recent years because of a change in hunting regulations that substantially reduced the kill (Hodgman and Bowyer 1986). A more complete description of this area was provided by Hodgman and Bowyer (1985).

Methods

Data were collected weekly in November 1984 by clipping vegetation in 50 random 0.25-m^2 plots. Fresh fecal groups were located by walking along randomly placed 1-m wide transects that distributed sampling effort across four sections of the field, each 25 by 300 m. An additional 50 vegetation sample plots adjacent to these fresh fecal groups also were clipped. Four 0.0625-m^2 plots were located 1.2 m from the center of a fecal group at the four cardinal compass points; all four plots were combined into a single sample (0.25 m^2) that represented the vegetation surrounding each fecal group. Adequate sample sizes for random samples and those near fecal groups were assured by examining reduction of the variation in the mean as sample size increased (Kershaw 1964: 29). One random sample was lost during transportation from the field to the laboratory. Distance of each sample from the forest edge was measured and categorized as 0–25 m, 26–50 m, 51–75 m, or 76–110 m from cover. Vegetation samples were separated to remove dead or inorganic material, were oven dried at 50° C for 24 h and weighed to the nearest 0.01 g to obtain dry weight biomass.

Because the field was mowed in September, feeding site inspections such as those used by Mackie (1970) and Bowyer and Bleich (1984) to determine deer use of vegetation were not possible. Deer were observed feeding and defecating in the field, but because the population was hunted and extremely wary, attempts to quantify these parameters were unsuccessful. Deer were not observed bedding in the field, but evidence of beds was found in the forest around its periphery.

Crude protein content of vegetation was used as a measure of quality and determined from standard micro-Kjeldhal procedures (Horwitz 1975). Statistical analyses included the Kruskal-Wallis and Mann-Whitney *U*-tests (Siegel 1956).

Results

The Kruskal-Wallis test indicated no significant effects of distance from the forest edge on biomass of random samples ($P = 0.13$), biomass of samples adjacent to fecal groups ($P = 0.14$), crude protein content of random samples ($P = 0.40$), or crude protein content of samples adjacent to fecal groups ($P = 0.33$) [Table 1]. Consequently, samples from various distance categories were pooled for further analyses. The Mann-Whitney *U*-test showed a highly significant difference ($P < 0.001$) in dry weight biomass of vegetation between random samples and those near fecal groups, but no difference ($P = 0.17$) occurred between these same variables for crude protein content (Table 1).

Discussion

Maxima for dry weight biomass of vegetation samples adjacent to fecal groups were considerably larger than for random samples (Table 1). This pattern may have occurred because deer sought out rare and widely distributed areas of high vegetative biomass. Coefficients of variation for dry weight biomass of vegetation were larger for random samples (42%) than those near fecal groups (31%); this also would be expected if deer selected microhabitats with more vegetation.

Biomass of vegetation adjacent to White-tailed Deer fecal groups was nearly twice that of random samples (Table 1). Our results agree with those of McCullough (1969), and Anderson et al. (1972) for locations of Mule Deer feces relative to use and biomass of preferred forages. Differences in crude protein between random samples and those near fecal groups, however, were slight (Table 1) and

TABLE 1. Dry weight biomass and crude protein content of vegetation clipped from random plots and plots adjacent to White-tailed Deer fecal groups in a 3-ha hay field near Unity, Maine, November 1984.

Distance from Forest Edge (m)	N	Biomass (g/0.25 m^2) $\bar{x}$	SD	Range	% Crude Protein $\bar{x}$	SD	Range
RANDOM SAMPLES							
0-25	21	2.7	1.1	0.6-4.9	19.6	4.7	10.8-30.0
26-50	15	2.2	1.3	0.5-5.3	22.4	6.2	13.5-38.5
51-75	10	3.0	0.7	1.9-4.3	20.3	3.6	16.6-28.3
76-110	3	3.1	0.8	2.2-3.7	20.5	0.9	19.9-21.5
0-110	49	2.6	1.1	0.5-5.3	20.6	4.9	10.8-38.5
SAMPLES ADJACENT TO FECAL GROUPS							
0-25	21	5.2	1.8	2.0-8.0	22.4	9.5	14.8-54.5
26-50	16	5.2	1.3	2.9-8.2	21.5	8.8	15.9-51.7
51-75	10	5.4	1.3	3.5-7.4	18.3	1.6	15.1-20.2
76-110	3	2.9	0.9	2.0-3.7	16.6	1.5	15.3-18.3
0-110	50	5.1	1.6	2.0-8.2	20.9	8.0	14.8-54.5

may have resulted from relatively low variation in this parameter in the mowed hay field. The coefficient of variation for random samples of crude protein was only 24%. Additionally, deer probably selected the hay field as a desirable place in which to feed because of the uniformly high crude protein content of forbs and grasses that occurred there. Thus, crude protein of vegetation also may affect selection of foraging sites in other areas where this parameter is more variable.

White-tailed Deer defecated and presumably fed in areas of greater vegetation biomass within a single vegetative type. Direct measurements of feeding activities could not be made, but we suggest they may be inferred from our data on vegetation biomass. Thus, fecal groups were a reliable index to the occurrence of deer at sites with more forage in a Maine hay field.

Our results do not conform to the prediction by Collins and Urness (1979, 1981) that locations of fecal groups are unrelated to grazing activities of cervids. Our results may differ for two reasons. First, we sampled small areas around pellet groups within a single vegetative type, whereas they collected data on grazing activities in many different plant communities. The scale on which they sampled would not detect changes in grazing activities relative to the localized differences in vegetative biomass that we observed. Second, both their studies (Collins and Urness 1979, 1981) used a small number of tame animals. Whether these tame cervids fed and defecated in a manner representative of their wild counterparts is unknown. For instance, Bartmann and Alldredge (1982) reported that tame Mule Deer foraged differently from wild ones.

Williamson and Hirth (1985) reported variation in the selectivity of foraging by free-ranging deer as they ventured farther from escape cover, and Bowyer (1986) noted a decline in deer use of areas far from cover. Although not significant, we noted a decrease in biomass and crude protein content in vegetation adjacent to fecal groups farthest from the forest edge, a pattern not evident in random samples (Table 1). These results raise the possibility that fecal groups far from the edge of the field may be a poor indicator of sites with high biomass or protein content. Our sample sizes were too small to test for such a relationship, but this possibility warrants further investigation.

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