Seasonal Use of Clearcuts and Food Plots by White-tailed Deer in the Southern Appalachians

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Abstract: We sampled forage and browse and made spotlight counts to study seasonal use of clearcuts and food plots by white-tailed deer (*Odocoileus virginianus*) in the Southern Appalachians. Browse production was greater in clearcuts than in adjacent forest. Deer used clearcuts most intensively during the summer when green leaves and herbs were abundant. Use of clearcuts was very low in winter. Browsing intensity was higher in clearcuts than in the forest in summer but not in winter. However, less than 4% of all twigs were browsed even in clearcuts in summer. Food plots, especially those containing clover-grass mixtures, were used most intensively in early spring when plant growth was rapid. They also appeared to be an important source of nutritious forage in winter, especially when acorns were in short supply. However, forage biomass in food plots was reduced significantly by unfavorable weather conditions, including extreme cold and drought.

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Two techniques used extensively in the Southern Appalachians to improve forage conditions for deer are cultivating agricultural crops in small openings (food plots) and harvesting timber, especially clearcutting. However, there are few studies evaluating the effectiveness of these techniques. The purpose of this study was to determine the seasonal use of food plots and clearcuts by deer in the Southern Appalachians.

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Methods

The study was conducted on national forest lands in the Southern Appalachians. Specific study areas were the Blue Ridge Wildlife Management Area in northern Georgia, the Tellico unit of the Cherokee Wildlife Management Area in eastern Tennessee, and the Pisgah Game Land in Haywood, Henderson, and Transylvania counties, North Carolina. Deer densities on these areas were estimated to range from 6–8 deer/km^2. The study region lies within the Blue Ridge physiographic province and is characterized by mountains with steep slopes and sharp crests, dissected by narrow valleys. Major forest types include oak-hickory (*Quercus* spp.-*Carya* spp.), oak-pine (*Quercus* spp.-*Pinus* spp.), and loblolly-shortleaf pine (*P. taeda-P. echinata*). Clearcuts, 0–5 years of age, comprised $< 5\%$ of the study areas. Habitat characteristics of the region are described more fully by Wentworth et al. (1990). Scientific names of plants are from Radford et al. (1968). Common names of plants are according to local use.

We measured availability and deer use of browse in young clearcuts on 7 upland oak-hickory sites on the 3 study areas. Criteria for selection of clearcuts were moderate site quality (site index 21–24 m) that was characteristic of most of the region and an age of 2 or 3 years. Clearcuts ranged in size from 10 to 16 ha. Summer sampling was conducted between 16 June and 17 July; winter sampling was conducted between 13 January and 27 February. Three sites were sampled in the summer of 1985 and the following winter (1985–86). Four different sites were sampled in the summer of 1986, but because of weather and scheduling problems, only 2 of these sites were sampled in the next winter (1986–87). The other 2 sites were sampled in late March, after spring growth had begun, and were analyzed separately. Browse abundance and use at each clearcut were measured in 30 sets of sample plots. Each set consisted of 3 plots located on a line perpendicular to the boundary of the clearcut: 1 at the edge, 1 25 m inside the clearcut, and 1 50 m into the adjacent uncut stand. The location of the first set of plots was determined randomly, with the remaining sets spaced at 50-m intervals around the perimeter of the clearcut.

The sample plots were 2 m $\times$ 0.5 m in size. In each plot, all herbaceous and woody browse within 1.5 m of the ground was examined for evidence of use. For woody plants, the total number of twig tips and the number browsed during the

current season were recorded for each species. For herbaceous plants, the percent of the plot covered and the percent of the available forage used were visually estimated by species.

Seasonal use also was examined with exclosures in food plots, and spotlight counts in clearcuts and food plots on the Blue Ridge Wildlife Management Area. Because of logistical considerations, these measurements were not duplicated on the other 2 study areas. Monthly production and use of forage in food plots was examined between December 1984 and May 1986 by clipping and weighing forage from paired sample plots inside and outside movable exclosures. Approximately 0.2% of the Blue Ridge Wildlife Management Area was maintained in food plots which ranged in size from 0.1 to 1.6 ha. Each of those sampled was at least 0.4 ha. Two types of food plots were examined; those planted to tall fescue and those containing various combinations of ladino clover, orchard grass, and annual ryegrass (clover-grass mixtures). Food plots were fertilized each September according to soil test results. Exclosures were approximately 1 m in diameter and 1.2 m tall, constructed from 5-cm × 10-cm mesh welded wire fencing with a top of 2.5-cm mesh poultry netting.

In December 1984, 1 exclosure was installed in each of 6 food plots. Exclosures were installed in 6 additional food plots in January 1985. Sampling commenced 1 month after exclosure installation and continued through May 1985. Between June and August 1985, exclosures were removed to permit scheduled mowing of the fields. Exclosures were reestablished in September 1985, and sampling was conducted from October 1985 through June 1986. During this second sampling period, 5 exclosures were established in each of 10 food plots. Initial exclosure placement was determined randomly.

Within each period, food plots were sampled at approximately 1-month intervals. All above-ground forage was removed from a 0.5-m^2 circular plot in the center of the exclosure and from a similar 0.5-m^2 plot, 1 m from the outside edge of the exclosure. The exclosures were then moved 5 m along a line perpendicular to the long axis of the field and reestablished for the next month's sampling.

All clipped samples were placed in labeled bags and stored on ice. They were then returned to the laboratory, and dried in an oven at 80 C. The weight of forage inside the exclosure was used to estimate the quantity of forage available to deer during the previous month. Use was estimated by subtracting the quantity of forage outside the exclosure from the quantity inside the exclosure. Use by other species was assumed to be negligible.

Deer were counted by spotlight in clearcuts and food plots on the Blue Ridge Wildlife Management Area between January 1986 and May 1987 to obtain an index of seasonal use of each. Because of differences in size and visibility, valid comparisons between numbers of deer seen in clearcuts and food plots were not possible. A route passing through 5 clearcuts and 8 food plots was traversed 3 times each month. Counts began 2 hours after official sunset and lasted approximately 2 hours. Counts were not conducted on nights with rain, dense fog, or high winds.

In clearcuts and adjacent forest seasonal differences in abundance and use of twigs and herbaceous forage were examined with *t*-tests. Chi-square and Bonferroni

z statistics were used to examine avoidance or preference of plot position (i.e. edge, clearcut, or forest), and of individual species (Neu et al. 1974); data for summer and winter were analyzed separately. Monthly availability and use data from food plots were pooled by season: fall (Oct–Dec), winter (Jan–Mar), and spring (Apr–Jun). Seasonal differences in availability and use of each forage type were examined with 1-way analysis of variance and Tukey's Studentized range tests (Steel and Torrie 1980). Differences between forage types and between years were examined with t-tests. All analyses were made with the Statistical Analysis System (Ray 1982). Statistical significance was indicated at $P \leq 0.05$.

Results

Browse was more abundant in clearcuts than in forests and intermediate in the edge. Mean numbers of twigs/ha were 1,196,000; 816,000; and 957,000; respectively.

Deer use of twigs was significantly greater in summer than winter in the edge and clearcut plots, but not in forest plots ($P = 0.08$) (Table 1). Approximately 3% of the available twigs were browsed in summer, whereas < 1% showed evidence of use in winter. Among sites, use ranged from 1.1% to 6.0% in summer, and 0.4% to 1.5% in winter. Browse use on the 2 sites examined in early spring averaged about 5% of the available twigs. Although sample sizes were too small to draw firm conclusions, it appeared that spring was the period of greatest use.

In summer, there were significant differences in browse use among plot positions. Edge and clearcut plots received greater use than expected in proportion to availability, whereas forest plots were used less than expected. In winter, there were no differences in browse use among plot positions ($P = 0.41$).

In summer, distinct species preferences were apparent. Blackgum (*Nyssa sylvatica*), greenbriers (*Smilax* spp.), grapes (*Vitis* spp.), sourwood (*Oxydendrum arboreum*), chestnut oak (*Quercus prinus*), sassafras (*Sassafras albidum*), and yellow poplar (*Liriodendron tulipifera*) all received greater use than expected. Twigs of blueberries (*Vaccinium* spp.) accounted for 18% of total twig use, but because they

Table 1. Seasonal browse use by deer (% of available twigs browsed) in the Southern Appalachians, 1985–87.

Position[a]	Winter	Spring	Summer
Forest	0.61	3.37	1.16
Edge	0.91	5.84	3.28[b]
Clearcut	0.95	6.15	3.60[b]

[a] Sample sizes for each position were 5 for winter, 2 for spring, and 7 for summer.

[b] Twigs/ha browsed significantly greater than in winter ($P \leq 0.05$). Sample size in spring was too small for statistical comparison.

were so abundant (approximately ⅓ of available twigs), they were used less than expected in proportion to availability. In winter, when there was little use of twigs, most species were used in proportion to their availability. Only red maple (*Acer rubrum*) and grapes received greater than expected use. Maximum browsing on any species in any season (blackgum in summer) was 14% of available twigs.

In summer, forbs were the dominant herbaceous forage in clearcuts (Table 2). Important species included cinquefoil (*Potentilla canadensis*), fireweed (*Erechtites hieracifolia*), pokeweed (*Phytolacca americana*), and violets (*Viola* spp.). Grasses and forbs were of nearly equal importance on the clearcut edge. Availability of all herbaceous forages was low in the forest. The availability of herbaceous forage declined significantly from summer to winter. There was about a 10-fold difference in forage availability between seasons.

Observed use of herbaceous forage was low in both summer and winter. Approximately 2% of the available forage showed evidence of use in summer, and <1% was browsed in winter. Species receiving greatest use in summer included violets, large summer bluet (*Houstonia purpurea*), thin-leaved mountain-mint (*Pycnanthemum montanum*), Christmas fern (*Polystichum acrostichoides*), pokeweed, and members of the Compositae family. In winter, Christmas fern, panic grasses (*Panicum* spp.), and composites received the greatest use.

Generally, forage availability in food plots was highest in fall, lowest in winter, and intermediate in spring (Table 3). In both years of the study, availability dropped sharply in early winter following severe freezes, and little forage was available in mid-winter. It rebounded in spring, during green-up. Seasonal differences in use were less apparent. Use of fescue tended to be highest in winter, and use of the clover-grass mixtures appeared to be highest in spring. However, the only significant seasonal difference was during the first year of the study when use of the clover-grass mixtures was greater in spring than winter. Both forage types were used little in the fall, and in fact, because of low use and high variability within food plots, the calculated value for use of fescue in fall 1985 was < 0.

In both fall and winter, food plots planted to fescue provided a greater quantity of forage than those containing clover-grass mixtures. Forage availability in spring was similar for both forage types. There were no significant differences in the quantity of forage used between forage types in any season, although percent use was generally higher for the clover-grass mixture. Forage availability and use also differed between the 2 years of the study. Availability of the clover-grass mixtures in spring, and the availability of fescue in both winter and spring was significantly higher the first year. Use of the clover-grass mixtures was significantly higher than fescue in both winter and spring of the first year.

Counts of deer in clearcuts and food plots generally supported the results of the browse and forage sampling (Fig. 1). Observed use of clearcuts was low in the winter, at a time when visibility was at its maximum. During 1986, use peaked in April and May as succulent plant growth and herbaceous forages became available. Use during the winter and spring of 1987 was more erratic, and increased spring use was not observed. Use of food plots was low throughout the winter of 1986, when

Table 2. Seasonal availability and use by deer of herbaceous forage from clearcuts and adjacent uncut stands in the Southern Appalachians, 1985–87.

		Forbs				Ferns				Grasses			
		% Cover		% Used		% Cover		% Used		% Cover		% Used	
Position	Season	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE	$\bar{x}$	SE
Forest	Summer	1.43	0.31[a]	1.40	0.85	1.81	0.67[a]	1.80	1.42	1.13	0.53	0	
	Winter	0.10	0.02	0		0.22	0.06	0.42	0.42	0.09	0.04	0	
Edge	Summer	5.01	1.28[a]	4.21	0.92[b]	0.63	0.33	0		5.07	1.21[a]	0.07	0.07
	Winter	0.30	0.14	0.55	0.55	0.17	0.10	0		0.70	0.28	0.72	0.72
Clearcut	Summer	17.46	1.77[a]	3.43	0.60[b]	3.43	1.18[a]	0.70	0.69	8.00	1.84[a]	0.11	0.10
	Winter	0.48	0.21	0.31	0.24	0.23	0.14	0.88	0.88	1.56	0.58	0.06	0.05

[a] Availability significantly greater in summer ($P \leq 0.05$).
[b] Use significantly greater in summer ($P \leq 0.05$).

Table 3. Forage availability and use (kg/ha/month) in food plots on the Blue Ridge Wildlife Management Area, Georgia, 1984–86.

Forage type and season	1984–85					1985–86				
		Available		Used			Available		Used	
	N	$\bar{x}$	SE	$\bar{x}$	SE	*N*	$\bar{x}$	SE	$\bar{x}$	SE
Fescue										
Fall						15	2,037	139	−67	95
Winter[a]	10	902	160	200	108	15	453	97	113	48
Spring[a]	7	1,451	163	137	152	15	874	136	49	55
Clover-grass mixtures										
Fall						15	1,596	101	64	110
Winter[b]	20	365	82	162	53	15	236	23	30	23
Spring[a,b]	16	1,154	150	425	101	15	764	81	112	34

[a] Availability significantly greater in 1984–85 ($P \leq 0.05$).
[b] Use significantly greater in 1984–85 ($P \leq 0.05$).

forage availability was low following a severe freeze in January. Green-up was delayed that spring, and consequently use did not increase until June when forages were growing rapidly. In the following year, use peaked during late winter-early spring.

Discussion

Clearcuts appeared to contribute little to the winter diet of deer in the Southern Appalachians. In winter, use of both woody and herbaceous plants in clearcuts was low (Tables 1, 2). Browsing intensity was similar in the forest, edge, and clearcut plots, indicating that deer did not exhibit a preference for cut versus uncut stands during the dormant season. Spotlight counts likewise indicated that deer use of clearcuts was low in winter. Numerous studies have shown that clearcutting increases the supply of deer browse (e.g., Harlow and Downing 1969), but most of the forage in clearcuts during winter is twigs. Twigs are highly lignified and of low nutritional value at that time (Short 1969), and they are a minor component of the fall and winter diet in the region (Harlow and Hooper 1971, Wentworth et al. 1990). When available, acorns are the dominant fall and winter food. In years of low acorn abundance deer rely on leaves of broadleaf evergreen species such as rosebay rhododendron (*Rhododendron maximum*) and mountain laurel (*Kalmia latifolia*). Both species are usually available in large quantities, even in uncut stands, but are of relatively low nutritional value (Wentworth et al. 1990).

The major contribution of clearcuts to deer was during the summer. Use of both twigs and forbs was significantly greater in summer than winter (Tables 1, 2), and browsing intensity during the growing season was significantly higher in the clearcut and edge plots than in plots in the adjacent uncut stands. Deer use of clearcuts during the summer is likely greater than indicated by our study because

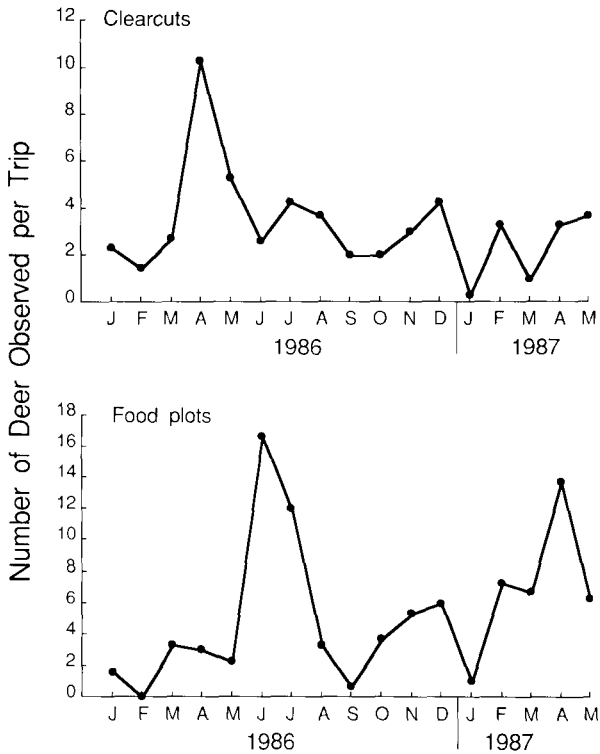

Figure 1. Trends in spotlight counts for clearcuts and food plots, Blue Ridge Wildlife Management Area, Georgia, 1986–87. Numbers of deer observed are not directly comparable between clearcuts and food plots because visibility and acreage sampled differed greatly.

many important summer foods (e.g. green leaves, herbaceous plants, fruits) may be completely removed when eaten (Healy 1971), making it difficult to detect use.

The seasonal pattern of forage availability and use in food plots differed greatly between the 2 years of the study (Table 3). Availability appeared to be strongly influenced by winter rainfall. Total precipitation between January and April (measured in Dahlonega, Ga., approximately 20 km from the study sites) was nearly 2 times greater in 1985 than 1986 (Natl. Oceanogr. and Atmos. Admin. 1985, 1986). Consequently, late winter and spring growth after the severe freeze in January was significantly less in 1986, as reflected in the lower availability estimates.

Use of the clover-grass mixtures also was significantly lower in the winter and spring of 1986 than during the same period in 1985. Although the lower use in 1986 was undoubtedly related to the lower availability of forages, it also appeared to be related to acorn availability. Acorn production was very poor in fall 1984, and food habits analysis indicated that acorns were depleted by the end of November, 2 months before we began sampling in January 1985 (Wentworth et al. 1990). In the

fall of 1985, acorns were abundant, and they still made up > 40% of the diet in March 1986. Thus, the use of food plots appeared to be influenced by the availability of alternative native foods. Use of food plots was highest when acorns were in short supply. Although there were no significant differences in the quantity of forage used between forage types (Table 3), the clover-grass mixtures appeared to be preferred over fescue. Nearly 20% of the available forage in food plots planted with the clover-grass mixtures was used by deer, whereas < 8% of the fescue available was used. Although fescue is generally considered to be less palatable than most improved forage crops, food plots containing fescue did receive significant use in our study, especially in winter.

Results of our study indicate that the contributions of food plots and clearcuts to deer habitat in the Southern Appalachians are complementary. Clearcuts are used most by deer in summer, when they provide large quantities of forage. Deer feed in clearcuts relatively little in winter, whereas food plots are used most in winter and early spring, especially when acorns are scarce. Browsing intensity in clearcuts indicated that levels of timber harvest and the size and distribution of clearcuts in the region were adequate to sustain the deer densities at the time of the study without significantly affecting forest regeneration. Forage crops planted in food plots should be selected with consideration for cold-hardiness and drought tolerance as well as forage quality and cultural requirements.

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