Effects of Browse Rejuvenation on White-tailed Deer Diets and Nutrition

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ABSTRACT

We determined the effects of roller chopping (20% of a 1,000-acre area, once per year in separate strips to rejuvenate browse) on white-tailed deer (*Odocoileus virginianus* Raf.) diet composition and nutritional indices in a guajillo (*Acacia berlandieri* Benth.)- and blackbrush acacia (*Acacia rigidula* Benth.)-community in southern Texas. Browse comprised a greater percentage of deer diets in a control area than in the treated area during October 1986, but was similar in deer diets in the control and roller-chopped areas on other sampling dates. Femur marrow fat and kidney fat indices of deer from the roller-chopped and control areas were similar. Rumen crude protein of deer from the control area exceeded that of deer from the roller-chopped area. Based on our results, we suggest that the idea of browse rejuvenation improving deer nutrition should not be accepted as axiomatic without further testing.

KEYWORDS: *Acacia berlandieri*, *Acacia rigidula*, blackbrush acacia, brush management, guajillo, habitat, roller chopping

Browse rejuvenation, or top-growth removal of woody plants to stimulate sprouting, is commonly recommended as a habitat improvement practice to temporarily increase nutritional quality and availability of browse (Scifres, 1980; Vallentine, 1980; Yoakum et al., 1980). This practice has been applied in chaparral in California (Yoakum et al., 1980), bitterbrush [*Purshia tridentata* (Pursh)] (Yoakum et al., 1980) and gambel oak (*Quercus gambelii* Nutt.) stands in the western United States, curlleaf mountain mahogany (*Cercocarpus ledifolius* Nutt. ex. Torr. & Gray) stands in Utah (Vallentine, 1980), and mixed brush in southern Texas (Powell and Box, 1966; Everitt, 1983; Fulbright et al., 1991).

Although browse rejuvenation is a widely accepted management practice, the hypothesis that browse rejuvenation has a positive nutritional impact on large herbivores has not been documented. We tested the hypothesis that stimulating shrub resprouting by top-growth removal would improve the nutritional plane of white-tailed deer (*Odocoileus virginianus* Raf.).

Accepted 22 Dec 1993. Research was supported by the J. F. Welder Heirs, the Houston Livestock Show and Rodeo, the National Rifle Association, Texas A&M University-Kingsville Faculty Sponsored Research, and the Caesar Kleberg Foundation for Wildlife Conservation. *Corresponding author.

Based on increases in browse palatability and nutritional quality following top-growth removal reported by Powell and Box (1966) and Everitt (1983), we predicted that (1) browse would compose a greater percentage of deer diets following top-growth removal by roller chopping than on untreated rangeland and (2) indices of deer nutritional status would be greater on roller-chopped than on untreated rangeland. Our specific objectives were to determine effects of annually roller chopping 20% of a 1000-acre area in separate strips on deer diet composition and nutritional indices in a guajillo- (*Acacia berlandieri* Benth.) and blackbrush-acacia- (*Acacia rigidula* Benth.) community in southern Texas.

Roller chopping was done during the summer because (1) crude protein and digestible energy of deer diets in southern Texas reach the lowest levels during late summer (Meyer et al., 1984) and (2) browse is the primary component of deer diets during summer, fall, and early winter in the Rio Grande Plain of Texas. Forbs are preferred as they become available in late winter and spring (Everitt and Drawe, 1974; Meyer et al., 1984; Varner and Blankenship, 1987) and availability of browse regrowth during summer and fall should have a greater impact on deer nutrition than during portions of the year when forbs are available. New strips of brush were roller chopped each year to provide an annual supply of regrowth.

METHODS

Study Area

The study was conducted on a 12,000-acre ranch in Duval County, Texas. Precipitation is bimodal with peaks in May and September. Mean annual rainfall and temperature in Duval County are 23 inches and 73°F, respectively. Annual rainfall at Freer, Texas, about 10 miles from the study area, was 33 inches in 1985, 26 inches in 1986, 25 inches in 1987, and 19 inches in 1988 (NOAA, 1985-1988).

Predominant soil on the ranch is Olmos Loam (USDA Soil Conservation Service, Benavides, TX, unpubl.), a grassland soil (Mollisol) (Sanders et al., 1974). Vegetation on the ranch is predominantly dense, low-growing brush dominated by guajillo, blackbrush acacia, and honey mesquite (*Prosopis glandulosa* Torr.).

Parallel strips of brush 130 feet wide and 0.75 - 1.1 miles long were roller chopped in a 1,000-acre area with a 20-foot-wide (about 60,000 lb.) roller chopper pulled by a crawler tractor in a pattern of alternating roller-chopped and nontreated strips during the summers of 1985-1988. About 20% of the area was roller chopped each year. This produced a repeating series of sequentially roller-chopped strips, with strips roller chopped each year adjacent to each other and each series adjacent to nontreated brush.

An area of similar size, soil, and plant composition about 1.5 miles distant was selected for a control. Estimated deer density in the roller-chopped area was greater than in the control area during 1985-1987, but estimated densities were similar in the two areas during 1988 (Bozzo et al., 1992). Licht (1987) reported that white-tailed deer on the Edwards Plateau of central Texas rarely travel farther than 1.25 miles from the center of their home range, and home range sizes average only 0.4 miles^2 for does and 1.6 miles^2 for bucks. Ellisor (1969) and Inglis et al. (1986) reported home ranges of deer on the Rio Grande Plains in Dimmit County, Texas, to be 0.9 miles^2 and 0.7 miles^2, respectively. Home range sizes of female deer appear less variable than those of males (Inglis et al., 1986). Thus, samples between sites were assumed to be independent.

Deer Diet Composition and Nutritional Status

Three to eight female white-tailed deer were collected with high-powered rifles in the control area and 4-10 in the roller-chopped area each February 1986-1988 and October 1985-1987. Rumen contents were mixed thoroughly and 0.8-ounce samples were removed. One rumen sample from each deer was rinsed with distilled water, dried at 104°F for 2 days, ground in a Wiley Mill over a 20-mesh screen, and analyzed for % organic matter and crude protein. Crude protein values for rinsed rumen samples are closer to true diet values than are samples that are not rinsed (R. D. Brown, Dep. Wildl. and Fish., Miss. State Univ., pers. commun., 1990). Crude protein was determined by the micro-Kjeldahl procedure (AOAC, 1987) and is reported as a percentage of organic matter. Organic matter was determined by ashing duplicate samples in a muffle furnace at 1,112°F for 6 hours and subtracting ash from 100%.

The second rumen sample was preserved in 100% ethanol. Samples were air dried, ground over a 20-mesh screen and sent to the Composition Analysis Laboratory, Range Science Department, Colorado State University, for microhistological analysis. Three slides sample^{-1} (deer) were prepared and relative density (%) of each plant genus was determined using 20 fields slide^{-1} (Hansen and Lucich, 1978).

Deer were aged by tooth eruption and wear (Severinghaus, 1949), and eviscerated carcass mass, kidney fat index, and femur marrow fat (Riney, 1955; Neiland, 1970) were determined. Fetal counts were made for does collected in February.

Statistical Analyses

Data were analyzed by analysis of variance for a completely randomized design with a factorial arrangement of treatments (6 sampling dates X 2 treatments) (SAS Inst., 1985). Orthogonal contrasts were used to compare treatment means for each date when the sampling date by treatment interaction was significant ($\underline{P} \leq 0.05$) (Snedecor and Cochran, 1967). The experiment was not replicated because of the expense of the treatments. Because the experiment was not replicated, treatment effects were possibly confounded with site effects. Statistical inference is valid when treatments are not replicated, but inferences pertain only to specific sites (Steel and Torrie, 1980; Hurlbert, 1984; Guthery, 1987).

RESULTS

There was a sampling date X treatment interaction ($P = 0.01$) for % browse in deer diets. Browse comprised a greater ($P = 0.001$) percentage of deer diets in the control area than in the treated area during October 1986, but was similar ($P > 0.05$) in deer diets in the control and roller-chopped areas on other sampling dates (Table 1). Major shrubs in deer diets included ceniza [*Leucophyllum frutescens* (Berl.) I. M. Johnston], *Acacia* spp., hog plum [*Colubrina texensis* T. & G. (Gray)],

Table 1. Temporal trends in percent browse, forbs, grass, lichens, and mast and seeds (%) in diets of white-tailed deer collected in a control (Con.) and roller-chopped (Trt.) area during October 1985-1986 and February 1986-1987, Duval County, Texas.

	n	Browse $\bar{x}$	Browse SE	Forbs $\bar{x}$	Forbs SE	Grass $\bar{x}$	Grass SE	Lichens† $\bar{x}$	Lichens† SE	Mast and seeds† $\bar{x}$	Mast and seeds† SE
Oct 1985											
Con.	3	68	6	28	6	4	1	0	0	2	1
Trt.	4	39	12	56	11	3	1	<1	<1	2	1
P-value‡		0.122		0.087		0.902					
Feb 1986											
Con.	5	56	9	24	8	20	5	0	0	0	0
Trt.	6	74	10	15	5	10	5	1	1	0	0
P-value		0.214		0.500		0.002					
Oct. 1986											
Con.	5	61	9	37	10	2	2	0	0	0	0
Trt.	4	7	2	92	2	1	<1	0	0	0	0
P-value		0.001		0.001		0.810					
Feb 1987											
Con.	7	46	8	36	8	18	4	0	0	<1	<1
Trt.	7	57	11	31	9	10	2	2	1	<1	<1
P-value		0.362		0.652		0.001					
Oct 1987											
Con.	6	43	6	27	6	4	3	<1	<1	25	5
Trt.	6	44	14	7	2	1	<1	0	0	47	13
P-value		0.950		0.115		0.797					
Feb 1988											
Con.	8	22	5	65	8	9	3	1	1	2	<1
Trt.	10	30	10	57	11	3	2	3	2	7	4
P-value		0.498		0.413		0.066					

†Treatment main effect and sampling date X treatment interaction not significant ($P > 0.05$).
‡P-value for control versus treatment comparison within a sampling date.

myrtlecroton [(*Bernardia myricaefolia* (Scheele) Wats.], Texas kidneywood (*Eysenhardtia texana* Scheele), honey mesquite, and spanish dagger (*Yucca treculeana* Carr.).

The sampling date X treatment interaction also was significant for % forbs ($P = 0.002$) and for % grasses ($P = 0.04$) in deer diets. Forbs comprised more ($P = 0.001$) of deer diets in the treated area than in the control area during October 1986, whereas the percentage of forbs in diets was similar ($P > 0.05$) in the control area and in the treated area on other sampling dates (Table 1). Major forb genera in deer diets included *Croton* spp., *Zexmenia* spp., ratany (*Krameria* spp.), *Chamaesaracha* spp., and *Lesquerella* spp. Grasses composed more of deer diets in the control area than in the roller-chopped area during February 1986 ($P = 0.002$) and February 1987 ($P = 0.001$) but the percentage of grasses in deer diets was similar ($P > 0.05$) between the two areas on other sampling dates.

There was no sampling date X treatment interaction for % lichens ($P = 0.96$) and percent mast and seeds ($P = 0.13$) in deer diets. The percentage of lichens ($P = 0.24$) and mast and seeds ($P = 0.08$) in deer diets was similar in the control and roller-chopped areas (Table 1).

The sampling date x treatment interaction was not significant ($P > 0.05$) for age, eviscerated carcass mass, femur marrow fat, kidney fat index, rumen crude protein, and number of fetuses per doe. Age, eviscerated carcass mass, femur marrow fat, and kidney fat index of deer from the control area were similar ($P > 0.05$) to those of deer from the treated area (Table 2). Rumen crude protein of deer in the control area was greater ($P = 0.02$) than that of deer in the treated area. The mean number of fetuses per doe for the control (1.1 ± 0.4) ($\bar{x} \pm SE$) and treated (1.6 ± 0.3) areas were similar ($P = 0.18$) for the 3 February collections.

Table 2. Mean age, eviscerated carcass mass (ECM), femur marrow fat (FMF), kidney fat index (KFI), and rumen crude protein (RCP) of white-tailed deer in a control and roller-chopped area averaged across October 1985-1987 and February 1986-1988, Duval County, Texas.

	Control (n=28)		Roller chopped (n=30)		
	$\bar{x}$	SE	$\bar{x}$	SE	P-value
Age (Years)	4.2	0.4	4.1	0.3	0.8328
ECM (lbs)	69.4	1.9	70.3	1.5	0.1463
FMF (%)	57.7	5.3	55.7	4.7	0.7814
KFI (%)	28.7	4.4	22.8	3.5	0.2733
RCP (%)	13.5	0.6	12.2	0.4	0.0231

DISCUSSION

Our predictions that (1) browse would compose a greater percentage of deer diets on roller-chopped than on untreated rangeland and (2) indices of deer nutritional status would be greater on roller-chopped than on untreated rangeland were not supported by our results. We cannot make definite conclusions regarding the effectiveness of rejuvenating browse to improve nutrition of white-tailed deer because the experiment was not replicated (Guthery, 1987), but based on our results we suggest that the idea of browse rejuvenation improving deer nutrition should not be accepted as axiomatic without further testing.

Reasons for the lack of treatment differences in deer nutritional status are unclear. Treatment effects were possibly confounded by greater deer density in the roller-chopped area than in the control area. Greater deer density in the roller-chopped area may have resulted in depletion of high-quality forages, thus masking treatment effects. On the other hand, improved nutritional conditions in the treated area could have resulted in greater deer density in the treated area without resulting in a net increase in nutritional status of individual deer. Shea et al. (1992) reported that reducing density of a Florida pine flatwood white-tailed deer population resulted in no improvement in physiological indices of individual deer. A third possible reason that browse rejuvenation did not result in increased deer nutritional status is that shrub regrowth may be high in secondary compounds, which may obviate the benefit of increased crude protein and other chemical components by reducing digestibility (Hagerman et al., 1992). Reynolds et al. (1992) found that in vitro organic matter digestibility of blackbrush acacia browse was lower than that of browse from nontreated plants 2 months after roller chopping. A final possible reason for the lack of a response to treatment is that laboratory analyses indicating deer forage in southern Texas is of low nutritional quality during late summer and early fall (Varner et al., 1977; Meyer et al., 1984) are possibly misleading because deer select more nutritious plant parts than researchers who sampled the plants (Karn and Hofmann, 1990). Management strategies that increase forage nutritional quality may have little impact on deer nutritional status if the habitat already meets nutritional needs.

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