NUTRIENT ANALYSIS OF SELECTED FORBS ON CLEARCUT AREAS IN SOUTHEASTERN OKLAHOMA

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Abstract: Select forbs, chosen on the basis of their suspected importance in white-tailed deer (*Odocoileus virginianus*) diets, were collected in the geologic Ouachita Highlands and Coastal Plain provinces in southeastern Oklahoma to determine nutrient content and dry matter digestibility. Sampling was conducted from May to September, 1977, on 5-year-old clearcuts. Field dry matter, crude protein, calcium, phosphorus, ash, and *in vitro* dry matter digestibility were determined. Crude protein content (9.2 to 16.8%) was generally low for all species. Calcium and phosphorus concentrations (0.75 to 1.57% Ca and 0.19 to 0.37% P) appeared adequate to meet estimated daily maintenance requirements for white-tailed deer. Dry matter digestibility ranged from 31.4 to 46.7% and averaged 40.8%. Differences ($P<.05$) in nutrient content and dry matter digestibility were not evident between the Ouachita Highlands and the Coastal Plain geologic provinces in this study except for ash content.

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Prior to 1969, pine-hardwood forests in southeastern Oklahoma were harvested by cutting individual trees or selected groups of trees. In 1969, Weyerhaeuser Company purchased approximately 323,890 ha of pine-hardwood forests and initiated a high-yield practice of intensive timber management. Large blocks of timber were clearcut, and undesirable hardwoods were cleared or chemically sprayed. The large openings were planted with loblolly pine (*Pinus taeda*).

Vegetative production and timber stand density are inversely related (Della-Bianca and Johnson 1965, Moore and Downing 1966, Blair 1967, Schuster and Halls 1973, Wolters 1973). Many plants responded to the openings created by these clearcuts. Nutrient content of forbs responding to these openings has not been studied in southeastern Oklahoma to date. For this reason 6 forbs (Table 1), assumed to be highly

TABLE 1. Plants collected in southeastern Oklahoma for analyses of nutrient contents and dry matter digestibilities.

Scientific name	Common name
Aster patens	Late purple aster
Aster lateriflorus	(None)
Helianthus hirsutus	Stiff-haired sunflower
Helianthus silphoides	(None)
Bidens polylepis	(None)
Lactucca canadensis	Wild lettuce

preferred by white-tailed deer, were sampled from clearcut areas. Analyses were conducted to determine nutrient content and dry matter digestibility. Species were chosen on the basis of observations made over a 5-year period, from 1973 to 1977. Relative abundance to other species and high occurrence of browsing were the reasons these species were chosen (Silker, unpublished).

Nutrient content of a few select forbs cannot be used to estimate total nutrient value of deer range. Yet, if preferred foods are deficient in essential nutrients or exhibit low dry matter digestibility, then less preferred forages may also exhibit similar deficiencies. Deer have been reported to consume the most palatable plants and plant parts available and these are often the most nutritious (Swift 1948, Klein 1962, Longhurst et al. 1968).

METHODS AND MATERIALS

Study locations were established on 5-year-old clearcut of Weyerhaeuser Company in McCurtain County, southeastern Oklahoma (Fig. 1). Three locations were in the geologic Ouachita Highlands (Fig. 2), and 3 were in the geologic Coastal Plain (Fig. 3). Study areas in the Ouachita Highlands were located about 16 km southwest of Smithville, OK. Locations in the Coastal Plain were about 8 km southeast of Eagletown, OK. The harvested locations ranged in size from 131 to 267 ha.

Climate in McCurtain County is hot and humid in summer. Winters are generally mild with a mean frost-free season for the Ouachita Highlands of 190 days and for the Coastal Plain of 220 days. Average annual precipitation is 137 cm and 119 cm respectively (Reasoner 1974).

The terrain of the Ouachita Highlands is rugged and mountainous with elevations varying from about 91 m on the lowest valley floors to about 823 m on mountain peaks. The soils developed from shales and sandstones. The terrain of the Coastal Plain is gently rolling and elevation varies from about 107 m to 200 m. The soils developed from clayey and loamy sediments (Gray and Galloway 1959).

Four plots were randomly chosen from 24 0.101 ha cattle exclosures built in 1973 on each of the 6 clearcuts. Enough plant biomass was collected from the 4 plots at each location to conduct laboratory analyses. Samples from plots within a location were composited to represent that location and respective province (Table 2). *Aster lateriflorus* was not sampled in the Coastal Plain. *Helianthus silphoides* was not sampled in the Ouachita Highlands (Table 2). The 2 species were not present in these respective provinces. Bidens were available in low, moist areas in both provinces and were collected as near to established plots as possible. Late purple aster, stiff-haired sunflower, and wild lettuce appeared about 1-2 weeks farther along in development in the Coastal Plain and were collected accordingly. Species were sampled during the season or seasons in which they appeared to be mostly browsed. Only those plant parts that are browsed were sampled.

Vegetative parts of plants, including leaves and stems, were clipped to an approximate 0.3 cm diameter. Flowering stalks of wild lettuce were clipped to an approximate 0.6 cm diameter. Heads from sunflowers were sampled by severing stems just below the heads.

Dried plant tissues were ground through a 2 mm screen in a Wiley mill and analyzed for percentage content of crude protein, phosphorus, calcium, and ash by methods of the Association of Official Agricultural Chemists (1960).

In vitro dry-matter digestibility was determined by the 2-stage Tilley and Terry (1963) technique using a ruminally fistulated white-tailed deer. Values reported were an average of duplicate samples.

Analysis of variance was used to test for differences at the 5 percent level of rejection (Barr et al. 1976).

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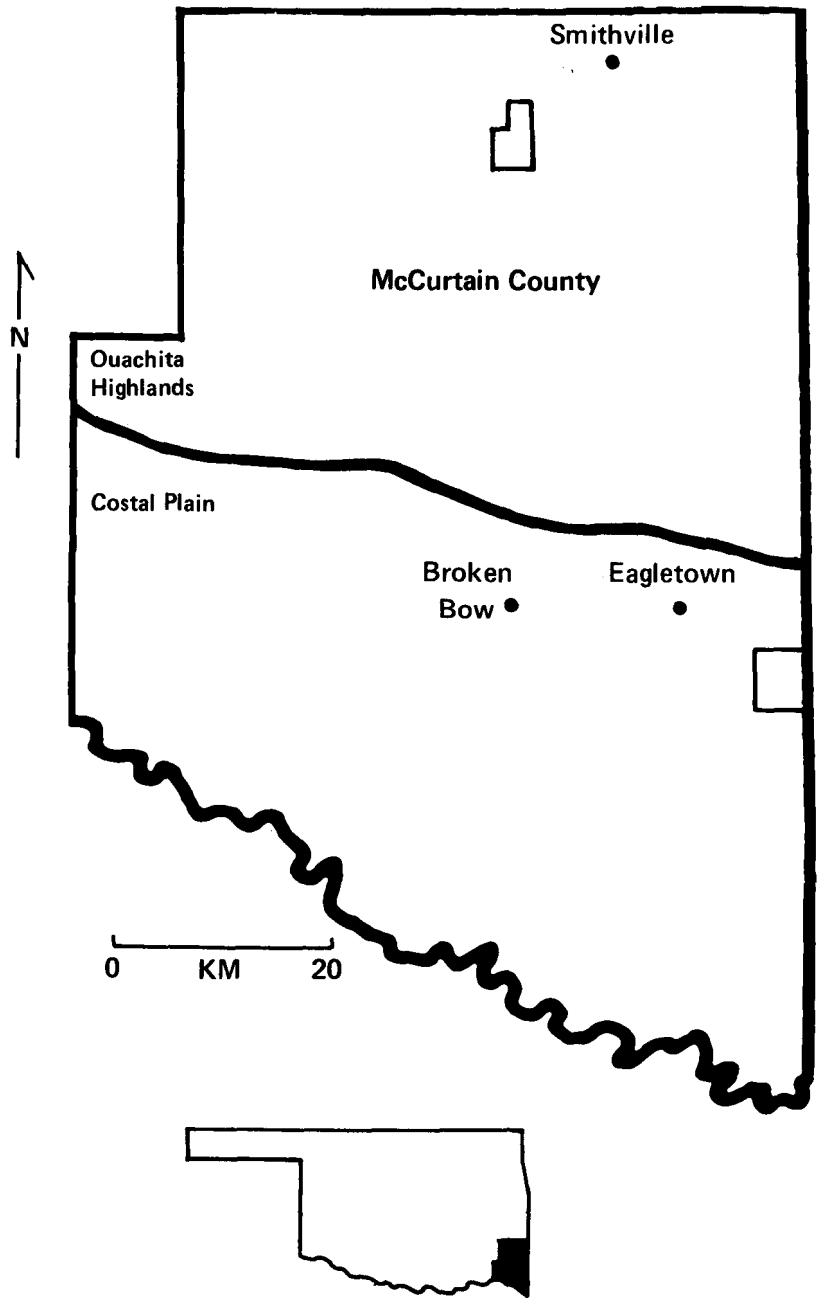

Fig. 1. Location of clearcuts in Ouachita Highlands and Coastal Plain provinces in southeastern Oklahoma where forb samples were collected from May to September, 1977. Blocks show general area where clearcuts were located.

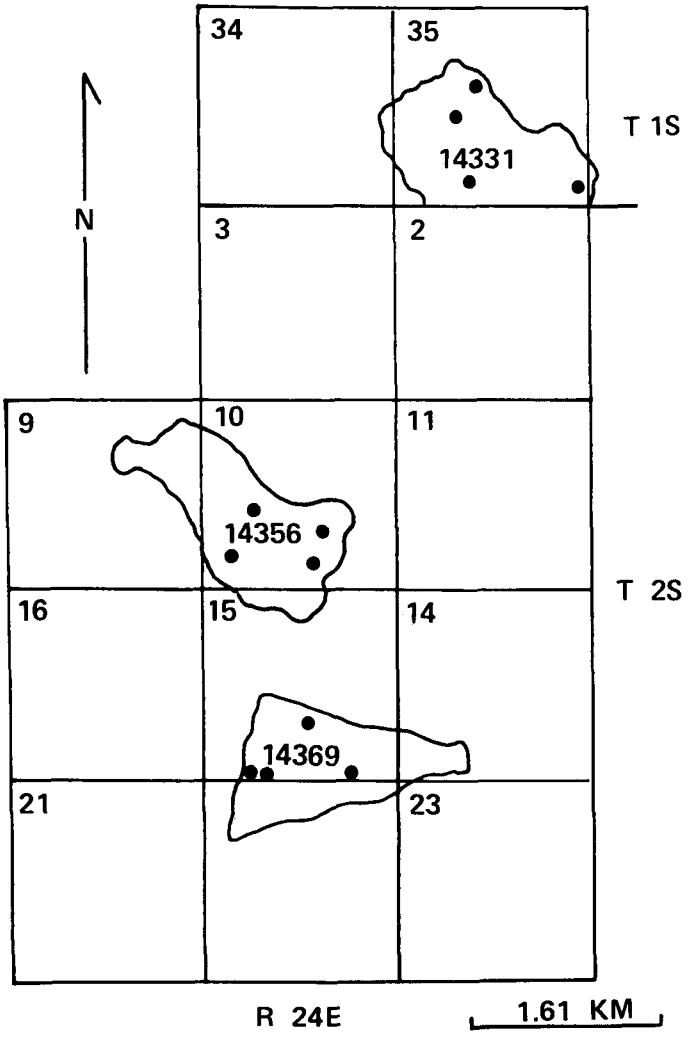

Fig. 2. Five-year-old clearcuts in the geologic Ouachita Highlands in McCurtain County, Oklahoma where forb samples were collected from May to September, 1977.

Agricultural Experiment Station. Thanks are due A.A. Kocan of the College of Veterinary Medicine for the use of a white-tailed deer, R.D. Morrison of the Statistics Department and R.J. Tyrl of the Biological Science Department, and to personnel at the Nutrition Laboratory, Department of Animal Sciences and Industry for use of their facilities at Oklahoma State University.

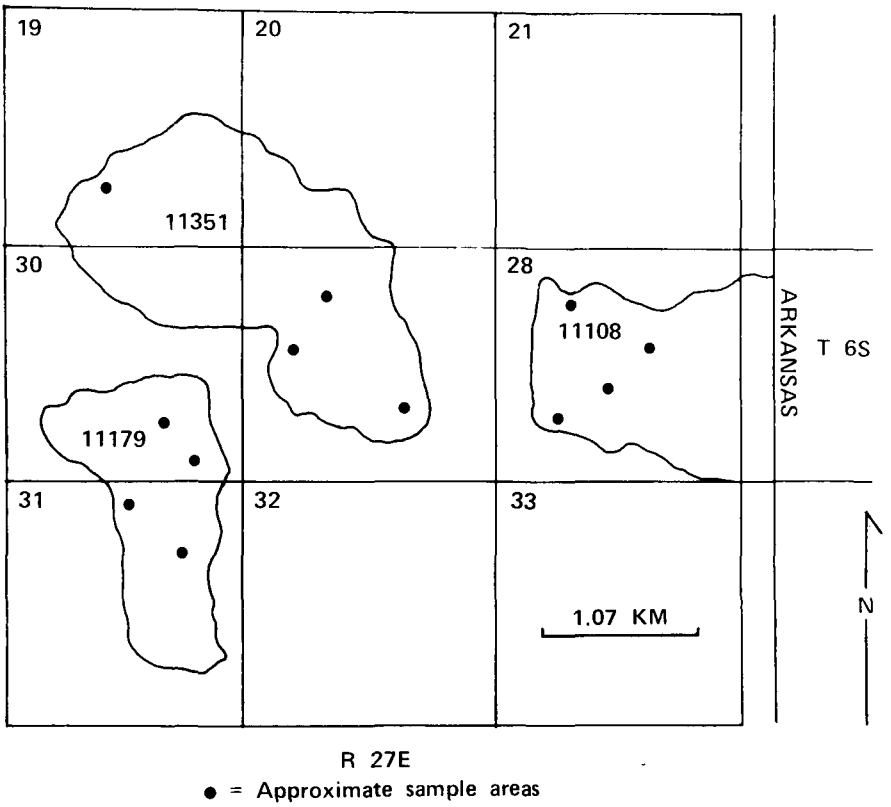

Fig. 3. Five-year-old clearcuts in the geologic Coastal Plain in McCurtain County, Oklahoma where forb samples were collected from May to September, 1977.

TABLE 2. Dates of composite sampling of forbs in Ouachita Highlands and Coastal Plain provinces in 1977 on clearcuts in southeastern Oklahoma.

Province and Location	Species and Plant Parts Sampled							
	Aster paeny	*Aster laeriflorus*	*Helianthus hirsutus*		*Helianthus silphioides*	*Bidens polylepis*	*Lactuca canadensis*	
	Vegetative	Vegetative	Vegetative	Head	Head	Vegetative	Vegetative	Flowering stalk
Ouachita Highlands								
14331	May 19	May 19	May 19	August 4	---[a]	---	May 19	July 8
14356	May 20	May 20	May 20	August 4	---	---	May 20	July 8
14369	May 20	May 20	May 20	August 4	---	---	May 20	July 8
						July 8[b]		
Coastal Plain								
11108	May 10	---	May 10	August 3	September 18	---	May 10	July 8
11151	May 10	---	May 10	August 3	September 18	---	May 10	July 8
11179	May 10	---	May 10	August 3	September 18	---	May 10	July 8
						July 8		

[a] No samples collected.
[b] Not sampled in established plots

RESULTS AND DISCUSSION

Within species differences ($P<.05$) across provinces were not evident except for ash contents in flowering stalks of wild lettuce and heads of stiff-haried sunflowers, dry matter in flowering stalks, and Ca contents in vegetative parts of stiff-haired sunflower. For all species, only ash content differed ($P<.05$) between provinces (Table 3). Province differences were expected because of physiographic, edaphic and climatic differences between the 2 provinces. The reason few differences were found is not known.

TABLE 3. Percentage means, by province, of nutrient contents for forbs collected from May to September, 1977 in Ouachita Highlands and Coastal Plain provinces in southeastern Oklahoma.

Province	Species and Part	Nutrient						
		Field Dry Matter (DM)	Crude Protein % of DM	Calcium, % of DM	Phosphorus, % of DM	Ca:P Ratio	Ash, % of DM	IVDMD, % of DM
Ouachita Highlands	*Aster patens*, vegetative	29.5+	10.3	0.79	0.19	4.3:1	9.7	42.0
	Helianthus hirsutus, vegetative	24.9	12.6	1.78[c]	0.24	7.7:1	13.3	41.7
	Helianthus hirsutus, head	31.7	8.8	1.14	0.21	5.5:1	8.9[c]	33.7
	Lactucca canadensis, vegetative	15.6	16.8	0.99	0.31	3.3:1	13.6	44.7
	Lactucca canadensis, flowering stalk	16.8[c]	13.5	0.77	0.34	2.3:1	10.8[c]	35.4
Province mean		23.7	12.4	1.09	0.26	4.6:1	11.3[a]	39.4
Coastal Plain	*Aster patens*, vegetative	28.1	9.0	0.77	0.18	4.5:1	9.4	41.1
	Helianthus hirsutus, vegetative	22.4	12.8	1.35[d]	0.22	6.0:1	11.1	46.4
	Helianthus hirsutus, head	33.9	9.6	1.13	0.24	4.7:1	10.3[d]	29.1
	Lactucca canadensis, vegetative	14.6	15.5	0.91	0.38	2.5:1	12.4	48.6
	Lactucca canadensis, flowering stalk	20.7[d]	13.7	0.72	0.39	1.8:1	9.3[d]	38.3
Province mean		23.9	12.1	0.98	0.28	3.9:1	10.5[b]	40.7
Least-significant differences (.05 level)								
Location (Province); Error A		2.74	1.57	0.228	0.066	1.29	0.67	2.91
Location * species (Province); Error B		1.55	1.11	0.147	0.040	0.93	0.86	3.47
Species * location (Province)		2.20	1.58	0.208	0.057	1.32	1.22	4.91
Between 2 provinces for same species		3.34	2.09	0.291	0.080	1.73	1.27	5.23

+ Values in Table represent a mean of 3 composited samples; 1 composited sample from each clearcut (location) within a province.
ab Means in a column for provinces with different superscripts differ statistically ($P<.05$) across provinces.
cd Means in a column for species with different superscripts differ statistically ($P<.05$) across provinces.

Nutrient contents of individual species and parts, averaged across provinces, are presented in Table 4. Field dry matter differed markedly with species ($P<.05$) and ranged from 15.1% in vegetative parts of wild lettuce to 32.8% in stiff-haired sunflower heads. Leaves and stems collected had lower ($P<.05$) field dry matter than heads and flowering stalks. In very succulent plants, water dilutes nutrients, and due to bulkiness may reduce dry matter intake (Amman et al. 1973). This in turn reduces the amount of all nutrients consumed by deer (Dietz 1965). Low dry matter intake, and the associated deficiencies in nutrients and energy may be a problem for deer in the study areas.

Dry matter digestibility differed ($P<.05$) among species ranging from 31.4 to 46.7%. Because of bacterial adaptation, true digestion values of these plants for deer from the study areas may be higher than those reported herein. The white-tailed deer used in this study was maintained on a balanced commercial ration and alfalfa hay. Microorganism numbers and strains vary with the type of food consumed and adjust over time to new feeds (Lay 1969). Deer in the study areas that eat native forages may be better adapted for digesting plant parts. Vegetative parts were higher in dry matter digestibility than other parts sampled. The leaves in these samples presumably contained less undigestible fiber than heads or flowering stalks. Whether these values reflect true digestion or lower than

TABLE 4. Percentage means, average across provinces, of nutrient contents for forbs collected from May to September, 1977 in Ouachita Highlands and Coastal Plain provinces in southeastern Oklahoma.

Species and Part	Nutrient						
	Field Dry Matter (DM)	Crude Protein % of DM	Calcium, % of DM	Phosphorus, % of DM	Ca:P Ratio	Ash, % of DM	IVDMD, % of DM
Aster patens, vegetative	28.8[a]	9.7[c]	0.78[d]	0.19[e]	4.4[b]	9.5[a]	41.5[c]
Helianthus hirsutus, vegetative	23.7[b]	12.7[b]	1.57[c]	0.23[b]	6.9[c]	12.2[b]	44.1[cd]
Helianthus hirsutus, head	32.8[c]	9.2[c]	1.13[b]	0.23[b]	5.5[b]	9.6[a]	31.4[a]
Lactucca canadensis, vegetative	15.1[d]	16.1[c]	0.95[b]	0.35[c]	2.9[a]	13.0[b]	46.7[d]
Lactucca canadensis, flowering stalk	18.7[e]	13.6[b]	0.75[c]	0.37[c]	2.1[a]	10.1[a]	36.9[b]
**Aster lateriflorus*, vegetative	23.6	11.3	0.87	0.26	3.3	10.2	46.5
**Helianthus silphoides*, head	23.8	12.0	0.96	0.25	3.8	9.4	36.2
***Bidens polylepis*, vegetative	19.1	16.8	0.91	0.26	3.7	8.5	43.6

*Sampled in 1 province-No tests conducted.
**Means not available-No tests conducted.
[a]Means in columns with different superscripts differ statistically ($P<.05$).

true digestion, digestibility does not appear to be a severe problem for deer consuming these forages.

Species differed ($P<.05$) in crude protein content. Vegetative parts from bidens (16.8%) and wild lettuce (16.1%) contained sufficient amounts of crude protein. All other species were low in crude protein content. The percentage of crude protein required for maximum growth of deer, including growing fawns and lactating does, has been reported to be 16 to 17% of their diets (McEwen et al. 1957, Verme and Ullrey 1972). White-tailed deer collected from McCurtain County in September, 1977, and in March and September, 1978, had markedly depleted fat reserves possibly due to low energy and / or protein intake which was especially evident in the winter and spring seasons (Kocan 1978).

Species and plant parts ranged from 0.75 to 1.57% Ca and exceeded 0.40% Ca reported to be the desirable dietary level (Ullrey et al. 1973). Late purple aster was lowest in P content (0.19%). All other species and plant parts approached or exceeded the 0.27% recommended for optimum development of weaned male and female fawns (Ullrey at al. 1975). Although P content is usually expected to be low on southern deer ranges because of leaching (Lytle 1960), it was higher than that reported from other areas in the south (Lay 1969, Blair and Brunett 1977).

All species and parts exceeded the recommended Ca:P ratio of 1.5:1 for white-tailed deer (Ullrey et al. 1973). The unfavorable imbalance of Ca to P in this study was a result of an excessive Ca percentage rather than a deficient P percentage.

Ability of deer to obtain sufficient amounts of dry matter and nitrogen (crude protein = N X 6.25) appears to be the critical nutritional problem of white-tailed deer in the study areas. This work is supported by histological analysis of tissues and selected blood chemistry analysis from deer collected in 1977 and 1978 (Kocan 1978).

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