

GAME SESSION

FORAGES EATEN BY DEER IN THE SOUTHEAST

By RICHARD F. HARLOW and ROBERT G. HOOPER
*Wildlife Habitat Research, Southeastern Forest Experiment Station,
Forest Service, U. S. Department of Agriculture
Blacksburg, Virginia*

ABSTRACT

An analysis was made of 956 rumen samples collected from white-tailed deer in the Appalachian Mountain, Piedmont, and Coastal Plain provinces in the Southeast during the four seasons. The study indicated that deer select the same type of diet seasonally although foraging in ecologically different areas. Hardened woody twigs had the lowest frequency of occurrence and lowest volume of all food categories. Green leaves of woody plants ranked highest in frequency of occurrence and volume. Mushrooms ranked third in frequency of occurrence and fifth in total volume. The annual contribution of forbs, grasses and sedges, fungi (mushrooms), and dry leaves totaled 35.9 percent by volume, equaling the amount provided by green leaves of woody plants.

INTRODUCTION

White-tailed deer (*Odocoileus virginianus*) habitat in the Southeast in the past has been evaluated on woody browse surveys. Such range surveys have emphasized the contribution of woody vegetation, while such items as forbs, grasses, mushrooms, fallen leaves, and fruits have received relatively little attention. This disregard has resulted in part from a lack of understanding of the seasonal food habits of deer and in part from the difficulty of measuring utilization by deer of these less-persistent food items. An alternative to range surveys for determining foods taken by deer appears to be rumen analysis. To establish the comparative value of all food types on a seasonal basis, we collected rumen samples from three major Southeastern provinces—Southern Appalachians, Piedmont, and Coastal Plain—during each of the four seasons.

The use of rumen contents to investigate the food habits of white-tailed deer was first reported by Ruff.¹ He collected stomachs from the Pisgah National Forest of North Carolina. Leaves from trees and shrubs totaled 58 percent by volume from 35 stomachs collected during the winter months; succulent woody twigs totaled 41 percent from four stomachs during the spring and summer; fruit (mainly acorns) totaled 77 percent by volume from nine stomachs during the fall.

Pearson and Burnett (1940) reported on the contents of 19 stomach samples collected during early winter from deer in the Black Warrior National Forest of Alabama. Food items present in greatest quantities included acorns, greenbrier² leaves, and sumac fruits. A great variety but small quantity of forbs was present in all the samples.

Pearson (1943) reported on the food habits of white-tailed deer when 195 stomach samples were collected in December from the western part of Alabama. Acorns amounted to 48 percent by volume of all food items found in the stomachs. Other important foods included greenbrier leaves, sumac fruits, dogwood leaves and fruit, pine needles, yellow-jessamine leaves, and blueberry leaves.

Adams (1959) analyzed 39 deer stomach samples collected during the fall, eight during the winter, and 11 during the spring from the Talladega National Forest in Alabama. He found the fall samples contained acorns, greenbrier leaves, blueberry leaves, and fungi. The winter sam-

¹ Ruff, F. J. The White-Tailed Deer of the Pisgah National Game Preserve, N. C., U.S.D.A. Forest Service, unpublished report of research covering 6 years of intensive investigation, 249 pp. 1938.

² Scientific names appear in Appendix.

ples contained large quantities of grasses, forbs, low bush blueberry leaves, and mountain laurel leaves. The spring samples were filled mainly with grasses, forbs, blueberry leaves, and fungi.

Harlow (1961) analyzed rumen contents of white-tailed deer in Florida. He collected 423 samples during November and December and found that 21 plant species made up 84 percent, by volume, of the 193 different food items identified. Acorns and palmetto berries totaled 41 percent, woody plants (mainly evergreen leaves) 38 percent, forbs 11 percent, fungi 9 percent, and grasses totaled 1 percent.

Cushwa *et al.* (1970) analyzed 440 samples of deer rumina obtained from the major provinces of the Southeast during the four seasons. He reported that hardened woody twigs amounted to about 1 percent by volume and occurred in only 13 percent of the samples. Most of the browsing on woody twigs occurred during the spring and summer.

In these examples of deer stomach analysis from the Southeast, the major food categories consisted of leafy browse from evergreen and deciduous woody plants, fruits (particularly oak mast), and herbaceous vegetation. The manner in which much of these data were presented—lumping all plant parts together under a species heading—has led many biologists in the Southeast to equate only woody twig production with the amount of deer food available. Also, wildlife professionals who were educated in the North, where white-tailed deer are compelled to feed on woody twigs (browse) during severe winters, consider the deer as primarily a browser. The idea seems to have migrated southward.

STUDY AREAS

The Southern Appalachian Mountains (Fig. 1) cover 47,500 square miles. The general topography is irregular with steep ridges. Soils are shallow, of low fertility, and exhibit little structure, except that soils in lower valleys may be rich and site index high. A great variety of flowering plants occurs; the major forest types are oak-hickory and oak-pine. The oak-hickory forests are 50 percent or more upland oak and hickory, singly or in combination, and less than 25 percent southern pines. Common associates include gum, yellow-poplar, and maple. Oak-pine forests are 50 percent or more hardwood, usually upland oak, and southern pines make up 25-49 percent. Common associates include gum and hickory. Precipitation ranges from 43 to 60 inches per year in the lower valleys to over 80 inches in the higher elevations (USDA 1941). The freeze-free³ period ranges from 150 to 210 days. Normal daily temperature ranges from 25 to 50°F in January, averaging 37 and ranges from 60 to 85 in July, averaging 72 (USDA Forest Service 1969).

The Piedmont province (Fig. 1) includes 59,000 square miles, approximately 3/5 of which is in forest. Topography is gentle to rolling; stream valleys are narrow. Soils are usually moist, relatively low in organic matter, and are used for general farming, woodland, and pasture. Major forest types are loblolly-shortleaf pine, longleaf-slash pine, and oak-hickory. Loblolly-shortleaf pine forests are 50 percent or more loblolly, shortleaf, and other southern pines, except longleaf or slash, singly or in combination. Common associates include oak, hickory, and gum. Longleaf-slash pine forests are 50 percent or more bayleaf and slash pine, singly or in combination. Common associates include other southern pines, oak, and gum. Mean annual precipitation ranges from 40 to 50 inches, with little or no dry season. The freeze-free period averages 240 days. The normal daily January temperature ranges from 35 to 55, averaging 45. The normal daily July temperature ranges from 70 to 90, averaging 80 (USDA Forest Service 1969).

The Coastal Plain (Fig. 1) is dominated by evergreen trees and shrubs, both broad- and needle-leaved. It is a floristically distinct area from the other forest regions in the Southeast (Braun 1967). The Gulf Coast flatwoods (10,500 square miles) are 9/10 forested, and parts of these forests are grazed by livestock. Soils have a thick horizon of clay

³ Days between last 32°F temperature in spring and first 32°F in autumn.

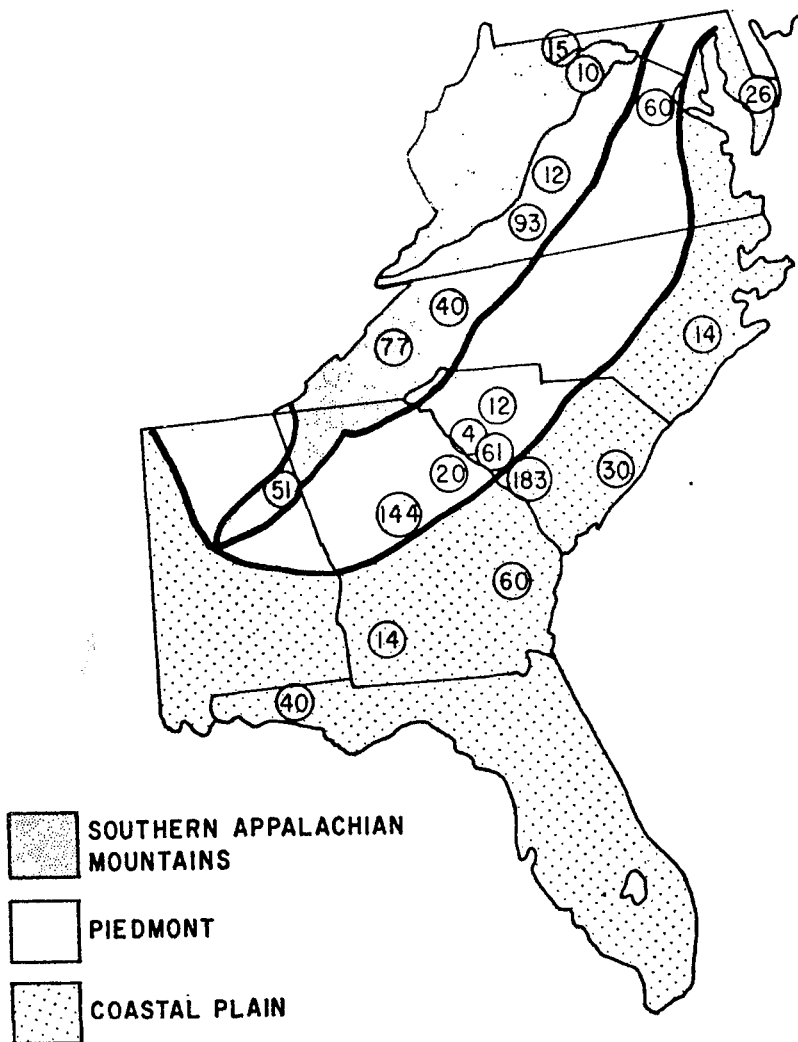


FIGURE 1. Southeastern United States, showing physical provinces and number of rumen samples collected in 20 areas representing 32 locations.

accumulation without much weatherable materials. Major forest types include oak-hickory and longleaf-slash pine. Range of mean annual precipitation is from 45 to 60 inches. The freeze-free period lasts from 270 to 300 days. The normal daily temperature ranges from 45 to 65 in January averaging 55 and in July ranges from 75 to 90, averaging 82 (USDA Forest Service 1969). The Atlantic Coast flatwoods (42,800 square miles) are 2/3 in forest, partly farm-woodland. Soils are seasonally wet and are used to a limited extent for pasture and woodland, and, where drained, for hay, cotton, corn, and truck crops. Predominant forest types include loblolly-shortleaf pine and longleaf-slash pine. Mean annual total precipitation ranges from 45 to 60 inches. The freeze-free period averages 270 days. The normal daily January temperature

ranges from 40 to 65, averaging 55 and in July ranges from 70 to 90, averaging 80 (USDA Forest Service 1969).

TECHNIQUE EVALUATION AND USE

Preliminary to this study we determined what sieve mesh size would come closest to giving "true occurrence" for the food items in the rumen contents and not be too time-consuming. To do this we collected 23 deer rumina during 1 year at the Atomic Energy Commission's Savannah River Project in South Carolina. One-quart rumen samples were segregated according to particle size by washing each through a gang of sieves with 9.51 mm, 6.35 mm, 5.66 mm, and 3.36 mm mesh. Contents of each sieve were identified macroscopically and their volumes measured by water displacement. Percentage composition by volume for each sieve size was calculated by the aggregate percent method (Martin, Gensch, and Brown 1946). Any food item less than 0.1 percent by volume was recorded as a trace.

The greatest difference in the aggregate percentage composition was found between the largest mesh (9.51 mm) and the other three sizes (Table 1). Apparently the larger food fragments were not present in the same proportion as the smaller ones.

The mesh size at which any given food item reaches its maximum frequency of occurrence is the logical point to end the analysis for occurrence. This "leveling-off point" was reached for 57 percent of the food items when the 9.51 mm mesh sieve was used (Table 1); 27 percent of the food items were not recorded with this sieve. With the 6.35 mm sieve, 80 percent of the food items reached the leveling-off point and 10 percent were not recorded. The addition of the 5.66 mm sieve increased the food items reaching the leveling-off point to 93 percent, while 3 percent remained to be recorded in the 3.36 mm sieve.

It was apparent that most of the food items not recorded by the larger sieve sizes occurred in trace amounts. By excluding these, we found that 89 percent of the food items reached the leveling-off point when the 6.35 mm mesh was used. The 9.51 mm mesh size gave the true occurrence for 68 percent of the food items and the 5.66 mm mesh gave the true occurrence for 95 percent of the food items.

Since we determined it was important to obtain a good estimate of both frequency and composition, sieves 9.51 mm, 5.66 mm, and 0.3 mm in size were used for this study. The 9.51 mm size was used because it separated out the largest food items immediately, decreasing the amount of time it would take to complete a sample if these parts had to be separated out by hand. Using the 3.36 mm sieve was not worth the increase in time—15 to 20 one-quart samples can be analyzed per day by a 2-man crew if the 5.66 mm mesh is used, but only four to five samples can be examined when the 3.36 mm mesh is added. Also, in view of the possible influence of differential digestion reported by Norris (1943), it is doubtful if the increase in accuracy using the smaller mesh size is justifiable. This differential rate of digestion may be compensated for increasing the number of rumen in the sample.

Rumen samples were taken from 956 deer collected at 32 locations in 20 areas of the Southeast from 1967 to 1970 (Fig. 1). The Southern Appalachians contributed 27 spring samples, 26 summer samples, 155 fall samples, and 80 winter samples. Piedmont locations contributed 32 spring, 31 summer, 192 fall, and 46 winter samples. Coastal Plain locations contributed 38 spring, 31 summer, 265 fall, and 33 winter samples.

Most of the spring and summer samples were from deer killed in Alabama, Georgia, North Carolina, South Carolina, and Virginia.⁴ During the fall and early winter hunting season, rumen samples were collected by many cooperators including employees of the Forest Service and Fish and Wildlife Service, wildlife students, state game commission employees, and personnel of the Southeastern Cooperative Wildlife Disease Study.

⁴ These deer were collected under the direction of and rumen samples made available by Dr. Frank Hayes, Director, Southeastern Cooperative Wildlife Disease Study, School of Veterinary Medicine, University of Georgia, Athens.

TABLE 1. Percentage composition, by volume and occurrence, of the rumen contents of 23 white-tailed deer as determined by four different mesh sizes

Plant material	Aggregate percentage of total identified material				Occurrence			
	9.51	6.45	5.66	3.36	9.51	6.45	5.66	3.36
<i>Fruit, Seeds and Flowers</i>								
Apple (fruit)	28.0	24.3	23.9	23.5	4	4	4	4
Grape (fruit)	1.7	2.0	2.1	2.0	2	2	2	2
Flatwoods (fruit)	1.9	1.4	1.3	1.3	1	1	1	1
Black cherry (fruit)	1.5	1.3	1.2	1.1	1	2	2	2
Pea (pod and seed)	1.0	1.1	1.3	1.7	1	1	1	1
Wisteria (seed)	.6	.5	.4	.4	1	1	1	1
Compositae (flower)	.4	.3	.3	.3	1	1	1	1
Grape (flower)	0	.2	.1	.1	0	1	1	1
Blackberry (seed)	tr.	tr.	tr.	tr.	1	1	1	1
Pine (flowers)	0	tr.	tr.	tr.	0	1	1	1
Prickly pear (seed)	0	0	0	tr.	0	0	0	1
Greenbrier (seed)	0	tr.	tr.	tr.	0	1	1	2
Hackberry (seed)	0	0	tr.	tr.	0	0	1	1
Pokeweed (fruit)	0	tr.	tr.	tr.	0	1	2	2
Blueberry (fruit)	0	0	tr.	tr.	0	0	1	1
<i>Green Leaves</i>								
Honeysuckle	3.4	5.7	6.1	5.8	6	6	7	7
Blackberry	1.3	1.4	1.3	1.3	1	1	1	1
Holly	0	4.0	4.6	7.5	0	1	1	1
Greenbrier	.4	.3	.3	.3	4	4	4	4
Grape	tr.	tr.	tr.	tr.	1	1	1	1
Cypress	tr.	tr.	tr.	tr.	1	1	1	1
Unidentified	16.8	21.0	22.7	21.5	17	19	19	19

<i>Woody Twigs</i>										
Red maple	1.3	1.3	1	1	1	1	1	1	1	1
Unidentified	3.3	3.0	8	8	8	8	8	8	8	8
<i>Miscellaneous</i>										
Prickly pear	11.2	8.8	4	4	4	4	4	4	4	4
Fibrous plant material	19.0	14.8	12	12	12	12	12	12	12	12
Herbaceous stems	5.3	3.7	2	2	2	2	2	2	2	2
Dead leaf material	tr.	tr.	3	3	3	3	3	3	3	3
Pine needles	tr.	tr.	2	2	2	2	2	2	2	2
Fungi (entire)	2.3	2.8	9	11	4	4	4	4	4	4
Total percentages	99.9	100.0	99.7	100.0	99.7	100.0	99.7	100.0	99.7	100.0

Contents from the two larger sieves were identified macroscopically and their volumes measured by water displacement. Materials washed through onto the bottom sieve (0.3 mm) were measured volumetrically and listed as unidentified finely ground material.

Vegetation was identified to species when possible and separated into the following plant parts: (a) fruit, (b) green leaves, (c) dry leaves, (d) succulent⁵ twigs and buds and (e) hardened⁶ twigs and buds. Items not identified to species were categorized as follows: green herbaceous stems and leaves, dried herbaceous stems and leaves, succulent woody stems, hardened woody stems, green deciduous leaves from woody plants, dried deciduous leaves from woody plants, green conifer needles, dried conifer needles, fruit, vines, evergreen hardwood leaves, grasses, sedges, fungi, ferns, dead woody twigs, bark, and miscellaneous items. Frequency of occurrence and percentage total volume were determined for each plant part. All data were tabulated by province and season.

Winter was defined as that period between the first occurrence of 20°F temperature and the last occurrence of 28°F temperature, and summer was considered to occur during June, July, and August for all provinces. Dates established for the four seasons within each province are listed in Table 2.

Generally, food items listed in the following discussion made up at least 1 percent by volume or occurred in at least 10 percent of the samples.

TABLE 2. Seasonal periods for three Southeastern provinces

Province	Spring	Summer	Fall	Winter*
Southern Appalachian Mountains	March 18- June 1	June 2- Aug. 31	Sept. 1- Dec. 11	Dec. 12- March 17
Piedmont	March 30- June 1	June 2- Aug. 31	Sept. 1- Dec. 3	Nov. 30- April 5
Coastal Plain	March 5- June 1	June 2- Aug. 31	Sept. 1- Dec. 22	Dec. 23- March 4

* That period between first average occurrence of 20°F temperature and last average occurrence of 28°F temperature.

TABLE 3. Confidence limits (95 percent) for the major food items based on percentage frequency of occurrence for the three provinces and four seasons

Season	Number samples	Fruit	Green leaves	Dry leaves	Succulent twigs and buds	Hardened twigs and buds	Fungi
			Southern Appalachian Mountains				
Spring	27	52±20	100±8	15±14	55±20		15±14
Summer	26	42±20	100±8	27±18	31±19	7±11	69±19
Fall	155	66±7	90±1	44±8	16±6	21±6	59±7
Winter	80	41±11	88±3	56±11	17±8	24±9	45±11
			Coastal Plain				
Spring	38	29±15	97±5	8±9	42±16	11±10	18±13
Summer	31	71±16	100±3	16±13	29±16	9±11	77±15
Fall	265	90±4	85±4	35±6	35±6	23±5	62±6
Winter	33	57±17	97±5	27±16	9±10	36±17	57±17
			Piedmont				
Spring	32	13±12	97±6	9±10	44±18	3±6	16±13
Summer	31	71±16	97±6	19±14	52±18	32±17	55±18
Fall	192	65±7	94±3	38±7	64±7	28±6	70±6
Winter	46	33±14	96±6	70±14	9±8	39±14	24±13
			All Areas				
All Seasons	956	64±3	92±1	36±3	35±3	22±3	55±3

⁵ Succulent. Twigs which are soft, flexible, green colored with epidermal layer not hardened. A condition found most often during growth.

⁶ Hardened. Twigs which are hard with epidermal layer turning dark.

RESULTS

Table 3 shows confidence limits (95 percent) for percentage frequency occurrence (Steel and Torrie 1965:353) of the major food types for the three provinces and four seasons. Fall samples in all three provinces had comparatively narrow confidence limits because of large sample sizes. Confidence limits for green leaves, a commonly utilized plant part, were comparatively narrow throughout the year.

SPRING FOODS

SOUTHERN APPALACHIAN MOUNTAINS

Vegetation found in the stomachs in greatest abundance included green deciduous leaves of woody plants, grasses and sedges, succulent green woody stems, and green herbaceous stems and leaves (Table 4). Yellow-poplar fruit and green leaves, acorns, the fruit of apple, and the green leaves of sourwood, honeysuckle, blueberry, blackberry, and legumes were the dominant items.

PIEDMONT

Food categories of importance were green deciduous leaves of woody plants, succulent green woody stems, and green herbaceous stems and leaves. Individual items occurring in greatest volume and frequency included the green leaves of honeysuckle, blackberry, greenbrier, and oak acorns.

COASTAL PLAIN

Important spring food categories were succulent green woody stems, green herbaceous stems and leaves, grasses and sedges, and green deciduous leaves of woody plants. Important plants and their parts included honeysuckle leaves, oak leaves, pine needles, and the green leaves and fruit of gallberry and greenbrier.

Foods appearing in greatest abundance in the stomachs from all three provinces during the spring included green leaves of woody plants, succulent twigs and buds, and forbs (green herbaceous stems and leaves).

TABLE 4. Spring foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)

Southern Appalachian Mountains (27 samples)		Piedmont (32 samples)		Coastal Plain (38 samples)	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
Yellow-poplar—f 3.4(33), gl 8.5(30), ht&bb tr. (4) ¹	11.9	Honeysuckle—gl 13.4(47), dl 0.2(6), st&bb 1.9(13), ht&bb 0.1(3)	15.7	Honeysuckle—gl 13.5(13), st&bb tr. (5)	13.5
Sourwood—gl 3.6(4), st&bb 0.4(4)	4.0	Blackberry—gl 4.5(31), st&bb tr. (3)	4.5	Oak—f tr. (2), gl 4.0(13)	4.0
Honeysuckle—gl 2.7(7), dl 0.4(4), st&bb 0.7(4)	3.9	Oak—f 1.3(12), gl tr. (3)	1.3	Pine—dl tr. (13), st&bb 3.9(3)	3.9
Blueberry—f 0.3(7), gl 2.1(15)	2.4	Greenbrier—gl 0.3(22)	0.3	Gallberry—f tr. (3), gl 2.9(15)	2.9
Oak—f 2.1(15), gl tr. (15)	2.1	Red maple—f tr. (3), gl 0.3(6), st&bb tr. (3)	0.3	Cactus—f 0.4(2), gl 1.7(8), dl tr. (3)	2.1
Black cherry—gl 2.0(4)	2.0	Blueberry—f 0.2(3), gl tr. (6)	0.2	Red maple—gl 1.2(13)	1.2
Apple—f 1.2(4), gl 0.1(4), st&bb tr. (4)	1.4	Pine—dl 0.1(22)	0.1	Hawthorn—f 1.2(3)	1.2
Greenbrier—gl 0.7(19)	0.7	Black cherry—gl tr. (3), ht&bb tr. (3)	tr.	Blackberry—f tr. (2), gl 0.6(13), st&bb 0.2(3)	0.8
Rhododendron—gl 0.3(7), st&bb 0.1(4)	0.4	Elm—gl tr. (6)	tr.	Grape—gl 0.6(8)	0.6
Red maple—gl 0.2(19), ht&bb tr. (4)	0.2	Grape—gl tr. (3)	tr.	Greenbrier—f 0.1(8), gl 0.2(26), st&bb tr. (3)	0.3
Sycamore—gl 0.1(4)	0.1	Yellow-poplar—gl tr. (3)	tr.	Pear—gl 0.3(5)	0.3
Pine—dl tr. (15)	tr.	Sumac—gl	tr.	Flowering dogwood— f tr. (2), gl 0.1(3)	0.1
Blackberry—gl tr. (11)	tr.			Blueberry—gl tr. (5)	tr.

Holly—gl tr. (4)	4	tr.				Willow—gl tr. (3)	3	tr.
Dogwood—gl tr. (4)	4	tr.				Sweet bay—gl tr. (3)	3	tr.
Witch hazel—gl tr. (4)	4	tr.				Sycamore—gl tr. (3)	3	tr.
Hop hornbeam—gl tr. (4)	4	tr.						
Unidentified						Unidentified		
Green deciduous leaves from woody plants	82	35.0				Green deciduous leaves from woody plants	55	21.1
Succulent green woody stems	56	5.2				Succulent green woody stems	45	5.2
Dried deciduous leaves from woody plants	15	0.1				Evergreen hardwood leaves	11	1.9
Dried conifer needles	11	tr.				Hardened woody stems	18	0.8
Hardened woody stems	4	tr.				Dried deciduous leaves from woody plants	13	0.1
						Fruit	11	0.3
						Dried conifer needles	3	tr.
Subtotal		69.2			49.2			60.3
FORBS						FORBS		
Legume family—gl 6.5(19)	19	6.5				Legume family—gl 7.6(10)	10	7.6
Composite family—f tr. (7), gl 0.8(4)	11	0.8				Cinquefoil—f 1.0(3), gl 1.4(5)	8	2.4
Mustard family—gl 0.1(22)	22	0.1				Mustard family—gl 0.3(5)	5	0.3
Galax—gl tr. (7)	7	tr.				Composite family—gl tr. (3)	3	tr.
Columbine—f tr. (4)	4	tr.				Violet—gl tr. (3)	3	tr.
Violet—gl tr. (4)	4	tr.						
Lily family—gl tr. (4)	4	tr.				Unidentified		
Unidentified						Green herbaceous stems and leaves	55	21.1
Green herbaceous stems and leaves	52	19.6				Green herbaceous stems and leaves	55	21.1
Subtotal		27.0			49.9			31.4

1 f = fruit; gl = green leaves; dl = dry leaves; st&bb = succulent twigs and buds; ht&bb = hardened twigs and buds; tr. = trace.

TABLE 4. Spring foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)
(Continued)

Southern Appalachian Mountains (27 samples)		Piedmont (32 samples)		Coastal Plain (38 samples)	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
GRASSES AND SEDGES— gl 1.7 (33)	1.7 33	GRASSES AND SEDGES— gl 0.5 (19)	0.5 19	GRASSES AND SEDGES— gl 7.7 (37)	7.7 37
FUNGI	2.1 30	FUNGI	0.4 16	FUNGI	0.6 24
				FERNS	tr. 8
				MISCELLANEOUS ITEMS	tr. 3
TOTAL	100.0	TOTAL	100.0	TOTAL	100.0

SUMMER FOODS

SOUTHERN APPALACHIAN MOUNTAINS

The most abundant summer foods were green deciduous leaves of woody plants, fungi (mushrooms primarily), and green herbaceous stems and leaves (Table 5). Abundant in the samples were the green leaves of red maple, oak, sourwood, flowering dogwood and honeysuckle, the leaves and stems of legumes, and the fruits of chinaberry.

PIEDMONT

Summer foods occurring in greatest abundance were green deciduous leaves of woody plants, green herbaceous stems and leaves, grasses and sedges, and mushrooms. Items occurring in abundance included the fruit and leaves of blackberry and blueberry, the fruit of grape and apple, and the green leaves of honeysuckle.

COASTAL PLAIN

Foods occurring in greatest quantities included green deciduous leaves of woody plants, green herbaceous stems and leaves, grasses and sedges, succulent green woody stems, and fungi. Individual items occurring in greatest abundance or volume included blueberry fruits, black cherry fruits, and the green leaves of honeysuckle, red maple, greenbrier, and gallberry.

Important foods in the summer samples for all provinces included soft fruits, green leaves of woody plants, forbs (herbaceous plants) and fungi (mainly mushrooms).

FALL

SOUTHERN APPALACHIAN MOUNTAINS

The large number of fall stomach samples resulted in a long list of identifiable plant species (Table 6). Oak mast, as expected, was the most abundant food item; the fruits of apple, persimmon, and grape were abundant. Also found frequently and abundantly were the green leaves of rhododendron and honeysuckle. The most abundant evergreen forbs in the samples were galax and wintergreen. Other important food items in the samples included grasses, sedges, and fungi.

PIEDMONT

Green honeysuckle leaves and acorns dominated fall foods in the Piedmont. Also, the fruits of honey locust, sumac, and corn, and the fruit and green leaves of greenbrier and grape were abundant. Pine needles were found frequently but in small quantities. Dried deciduous leaves of woody plants occurred in greatest volume and frequently among the identifiable species. Hardened woody stems were found frequently but in small quantities. Green deciduous leaves of woody plants, grasses, and mushrooms were also abundant.

COASTAL PLAIN

The fall samples were dominated by acorns, with the fruit and leaves of greenbrier, the green leaves of honeysuckle, and the fruits of sumac and cactus also found commonly. Legumes and gallberry leaves were noticeably present, along with pine needles which occurred frequently but in small amounts. Food categories of greatest importance included dried deciduous leaves of woody plants, green herbaceous stems and leaves, and grasses of high incidence but low volume.

Stomach samples from all three provinces contained great quantities of fruits (particularly acorns). Other items in greatest abundance and frequency included green leaves and dry leaves of woody plants and fungi.

TABLE 5. Summer foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)

Southern Appalachian Mountains (26 samples)		Piedmont (31 samples)		Coastal Plain (31 samples)	
TREES, SHRUBS & VINES		TREES, SHRUBS & VINES		TREES, SHRUBS & VINES	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
Red maple—gl 14.5(58), dl 0.2(4)	14.6 62	Honeysuckle—gl 26.4(58), dl tr. (3), st&b 3.5(26), ht&b 5.1(26)	35.0 100	Blueberry—f 10.0(23)	10.0 23
Oak—f 0.3(8), gl 6.2(35)	6.5 43	Blueberry—f 11.5(23), gl 2.3(19), dl tr. (3), st&b 1.6(23)	15.4 68	Honeysuckle—gl 2.2(10), st&b 1.2(7)	3.4 17
Chinaberry—f 3.1(15)	3.1 15	Oak—f 2.6(7), gl tr. (3), dl 0.2(3)	2.8 13	Black cherry—f 3.0(10)	3.0 10
Flowering dogwood—gl 2.3(4), dl 0.1(4)	2.4 8	Grape—f 2.5(23), gl tr. (7)	2.3 30	Red maple—gl 2.9(7)	2.9 7
Honeysuckle—gl 1.8(8)	1.8 8	Blackberry—f 1.4(16), gl 0.7(10)	2.1 26	Oak—f 0.6(10), gl 0.1(13), dl 0.7(3)	1.4 26
Grape—f 1.4(12), gl tr. (4)	1.4 16	Apple—f 1.8(19)	1.8 19	Hawthorn—f 1.0(3)	1.0 3
Black cherry—f 0.4(8), dl tr. (4)	0.4 12	Greenbrier—f 0.2(3), gl 0.1(16)	0.3 19	Greenbrier—gl 0.8(26), dl tr. (3)	0.8 29
Rhododendron—gl 0.4(12)	0.4 12	Sumac—f 0.2(3)	0.2 3	Gallberry—gl 0.8(26), st&b tr. (3)	0.8 29
Greenbrier—gl 0.1(19)	0.1 19	Pine—dl 0.1(26)	0.1 26	Grape—f 0.2(10), gl 0.6(3)	0.8 13
Yellow-poplar—gl 0.1(12)	0.1 12	Red maple—gl 0.1(7), dl tr. (3)	0.1 10	Hickory—f 0.8(7)	0.8 7
Spice bush—gl 0.2(4)	0.2 4	Chinaberry—f 0.1(3)	0.1 3	Saw palmetto—f 0.6(16)	0.6 16
Sumac—f 0.1(4), gl tr. (4)	0.1 8	Sassafras—gl tr. (3)	tr. 3	Sweet bay—f 0.3(3), gl tr. (7)	0.3 10
Pine—dl tr. (12)	tr. 12	Elm—dl tr. (3)	tr. 3	Yellow jessamine—gl 0.3(3)	0.3 3

Blueberry—gl tr. (8)	tr.	8	Flowering dogwood—f tr. (3)	tr.	3	Apple—f 0.2(7)	0.2	7
Mountain laurel—gl tr. (8)	tr.	8	Persimmon—f tr. (3)	tr.	3	Red bay—gl 0.2(3)	0.2	3
Hawthorn—f tr. (4)	tr.	4	American hornbeam	tr.	3	Pine—dl 0.1(7)	0.1	7
Viburnum—gl tr. (4)	tr.	4				Blackberry—f 0.1(3), gl tr. (3)	0.1	6
Sycamore—gl tr. (4)	tr.	4				Sumac—f 0.1(3), gl tr. (3)	0.1	6
						Trumpet vine—f tr. (3)	tr.	3
						Elm—st&b tr. (3)	tr.	3
Unidentified			Unidentified			Green deciduous leaves from woody twigs	12.5	48
Green deciduous leaves from woody plants	21.9	46	Green deciduous leaves from woody plants	7.2	32	Succulent green woody stems from woody plants	1.7	32
Succulent green woody stems	1.9	34	Dried deciduous leaves from woody plants	0.9	19			
Hardened woody stems	0.8	15	Hardened woody stems	0.8	7	Dried deciduous leaves from woody plants	1.0	13
Dried deciduous leaves from woody plants	0.7	35	Succulent green woody stems	0.3	7	Evergreen hardwood leaves	0.3	13
Green conifer needles	0.1	4	Dried conifer needles	tr.	13			
Evergreen hardwood leaves	0.1	4				Fruit	0.3	7
						Hardened woody stems	0.2	19
						Dried conifer needles	tr.	10
FORBS	61.1		FORBS	69.6			44.4	
Subtotal			FORBS			Legume family—f tr. (3), gl 4.0(23)	4.0	23
Legume family—gl 5.8(39), st&b tr. (4)	5.8	43	Legume family—gl 0.3(10)	0.3	10	Pokeweed—f 0.1(3)	0.1	3
Pokeweed—f 0.4(4)	0.4	4	Violet—gl tr. (7)	tr.	7	Deer's tongue—gl tr. (7)	tr.	7
Cinquefoil—gl tr. (12)	tr.	12				Composite family—gl tr. (3)	tr.	3
Wintergreen—gl tr. (4)	tr.	4				Strawberry—gl tr. (3)	tr.	3
Unidentified			Unidentified			Green herbaceous stems and leaves	28.7	77
Green herbaceous stems and leaves	12.6	42	Green herbaceous stems and leaves	5.7	52			
Subtotal	18.8			6.0			31.9	

TABLE 5. Summer foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)
(Continued)

Southern Appalachian Mountains (26 samples)		Piedmont (31 samples)		Coastal Plain (31 samples)	
TREES, SHRUBS & VINES		TREES, SHRUBS & VINES		TREES, SHRUBS & VINES	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
GRASS AND SEDGES— g 0.3 (31)	0.3 31	GRASS AND SEDGES— g 8.0 (42)	8.0 42	GRASSES AND SEDGES— g 7.2 (36)	7.2 36
FUNGI	19.8 89	FUNGI	15.6 68	FUNGI	16.4 81
	100.0	MISCELLANEOUS ITEMS	0.8 10	MISCELLANEOUS ITEMS	0.1 3
TOTAL	100.0		100.0		100.0

TABLE 6. Fall foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)

Southern Appalachian Mountains (155 samples)		Piedmont (192 samples)		Coastal Plain (265 samples)	
TREES, SHRUBS & VINES	Total Vol. Occ. percent	TREES, SHRUBS & VINES	Total Vol. Occ. percent	TREES, SHRUBS & VINES	Total Vol. Occ. percent
Oak—f 42.9 (57), gl 0.4 (5), dl 0.2 (2)	43.5 64	Honeysuckle—f tr. (3), gl 25.7 (73), dl tr. (1), st&b 8.6 (56), ht&b 1.6 (13)	35.9 100	Oak—f 60.9 (76), gl 0.5 (22), dl tr. (8)	61.5 100
Rhododendron—gl 6.0 (24), dl 0.1 (2), st&b 0.1 (2), ht&b 0.1 (2)	6.3 30	Oak—f 19.5 (37), gl 0.1 (10), dl 0.5 (5), ht&b tr. (1)	20.1 53	Honeysuckle—f 0.3 (3), gl 6.7 (54), dl 0.2 (2), st&b 3.4 (35), ht&b 0.3 (4)	10.9 98
Honeysuckle—f tr. (1), gl 3.7 (15), st&b 0.9 (5), ht&b 0.2 (3)	4.8 24	Greenbrier—f 0.3 (12), gl 3.0 (28), dl 0.1 (3), st&b tr. (2)	3.4 45	Gallberry—f 0.7 (6), gl 1.7 (19), dl 0.1 (3)	2.5 28
Persimmon—f 2.7 (10), ht&b 0.1 (1)	2.8 11	Honey locust—f 3.3 (10)	3.3 10	Sumac—f 1.6 (19), gl 0.2 (2), st&b tr. (1), ht&b tr. (1)	1.8 23
Apple—f 2.8 (7), gl tr. (1), dl tr. (1), ht&b tr. (1)	2.8 10	Sumac—f 2.3 (20), gl tr. (3), dl tr. (1), ht&b tr. (1)	2.3 25	Greenbrier—f 0.2 (6), gl 1.3 (32), dl tr. (2), st&b tr. (2), ht&b tr. (1)	1.5 43
Grape—f 0.9 (11), gl 0.2 (4), dl tr. (1), st&b tr. (1)	1.1 17	Grape—f 0.1 (3), gl 0.9 (14), dl tr. (1), st&b tr. (1)	1.1 19	Cactus—f 1.3 (11), gl 0.1 (1)	1.4 12
Mountain laurel—gl 0.9 (12), dl tr. (1), st&b 0.1 (1)	1.0 14	Yellow jessamine—gl 0.9 (3), ht&b 0.2 (1)	1.1 4	Saw palmetto—f 1.2 (4)	1.2 4
Greenbrier—f tr. (1), gl 0.7 (33), dl 0.2 (4), st&b tr. (1)	0.9 39	Pine—gl tr. (1), dl 0.9 (48), ht&b tr. (1)	0.9 50	Hawthorn—f 0.7 (7), gl tr. (2), dl tr. (2), ht&b tr. (1)	0.7 12
Black cherry—f 0.6 (5), gl tr. (2), dl tr. (2)	0.6 9	Azalea—gl 0.7 (1)	0.7 1	Titi—gl 0.6 (5), dl 0.1 (3), ht&b tr. (3)	0.7 11
Pear—f 0.3 (1), gl 0.3 (1)	0.6 2	Apple—f 0.6 (1)	0.6 1	Sassafras—f 0.5 (2), gl tr. (1)	0.5 3

TABLE 6. Fall foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)
(Continued)

Southern Appalachian Mountains (155 samples)		Piedmont (192 samples)		Coastal Plain (265 samples)	
TREES, SHRUBS & VINES	TREES, SHRUBS & VINES	TREES, SHRUBS & VINES	TREES, SHRUBS & VINES	TREES, SHRUBS & VINES	TREES, SHRUBS & VINES
Species	Species	Species	Species	Species	Species
Total Vol. Occ. percent	Total Vol. Occ. percent	Total Vol. Occ. percent	Total Vol. Occ. percent	Total Vol. Occ. percent	Total Vol. Occ. percent
Hawthorn—f 0.5(2), gl tr. (1)	Red cedar—gl 0.4(4)	Blueberry—f tr. (1), gl 0.4(7), dl tr. (1), ht&b tr. (2)	Flowering dogwood—f 0.3(8), gl tr. (1), dl tr. (1), ht&b tr. (1)	Red bay—f 0.2(3), gl 0.1(1)	Apple—f 0.3(3)
Sumac—f 0.3(4), gl tr. (1), st&b 0.1(1)	Flowering dogwood—f 0.3(10), gl tr. (1)	Blueberry—f tr. (1), gl 0.1(2), dl tr. (1)	American holly—f tr. (1), gl 0.1(2)		Flowering dogwood— f 0.3(2), gl tr. (1)
Blueberry—f 0.3(5), gl tr. (1), dl tr. (1)	Persimmon—f 0.3(10), gl tr. (1)		Black gum—f 0.1(3)		Blackberry—gl 0.2(6), dl tr. (1), ht&b tr. (2)
Red maple—f tr. (1), gl 0.1(3), st&b tr. (1), ht&b tr. (1)	Blueberry—f tr. (1), gl 0.1(2), dl tr. (1)		Red maple—gl 0.1(1)		Viburnum—gl 0.1(2), st&b tr. (1), ht&b 0.1(2)
Wisteria—f 0.1(3)			Magnolia—gl 0.1(1)		Pine—f tr. (1), gl tr. (2), dl 0.1(20)
Pine—gl tr. (2), dl tr. (8)			Elm—gl tr. (1), dl tr. (8)		Persimmon—f 0.1(1), dl tr. (1), ht&b tr. (1)
Flowering dogwood—f tr. (3), gl tr. (1), dl tr. (1)			Blackberry—f tr. (2), gl tr. (5), dl tr. (1)		Basswood—gl 0.1(1)
Blackberry—gl tr. (3), st&b tr. (1)					Plum—f tr. (1), gl tr. (1), dl tr. (1), st&b tr. (1), ht&b tr. (2)
Viburnum—f tr. (1), gl tr. (1), dl tr. (1)					
Leucothoe—gl tr. (3)					

Black gum—f tr. (1), dl tr. (1)	tr.	2	Hawthorn—f tr. (1), gl tr. (1), dl tr. (2), ht&b tr. (1)	tr.	5	Grape—f tr. (4), gl tr. (3), st&b tr. (1)	tr.	8
Sassafras—gl tr. (1)	tr.	1	Black cherry—f tr. (1)	tr.	1	Wisteria—f tr. (7)	tr.	7
Willow—gl tr. (1)	tr.	1	Trumpet vine—dl tr. (1)	tr.	1	Pepper-vine—gl tr. (4), st&b tr. (1)	tr.	5
Yellow-poplar—gl tr. (1)	tr.	1	Wisteria—f tr. (1)	tr.	1	Yellow jessamine— gl tr. (3), ht&b tr. (1)	tr.	4
Red cedar—gl tr. (1)	tr.	1	Willow—gl tr. (1)	tr.	1	Black gum—f tr. (2), gl tr. (1)	tr.	3
American holly—gl tr. (1)	tr.	1	St. John's wort—f tr. (1)	tr.	1	Privet—f tr. (1), gl tr. (1)	tr.	2
Pepper-vine—gl tr. (1)	tr.	1	Yellow-poplar—dl tr. (1)	tr.	1	Sweet gum—f tr. (1), dl tr. (1)	tr.	2
Beech—gl tr. (1)	tr.	1	Viburnum—ht&b tr. (1)	tr.	1	Trumpet vine—gl tr. (1)	tr.	1
American hornbeam— dl tr. (1)	tr.	1	Spice bush—f tr. (1)	tr.	1	Ivy—gl tr. (1)	tr.	1
Sourwood—gl tr. (1)	tr.	1	Basswood—gl tr. (1)	tr.	1	Hickory—f tr. (1)	tr.	1
			Sweet gum—dl tr. (1)	tr.	1	Willow—gl tr. (1)	tr.	1
			Witch hazel—gl tr. (1)	tr.	1	Azalea—gl tr. (1)	tr.	1
						Elm—gl tr. (1)	tr.	1
						Cedar—gl tr. (1)	tr.	1
						Myrtle—gl tr. (1)	tr.	1
						Water tupelo—f tr. (1)	tr.	1
						Cypress—dl tr. (1)	tr.	1
						Hackberry—dl tr. (1)	tr.	1
						Loblolly bay—gl tr. (1)	tr.	1
Unidentified			Unidentified			Unidentified		
Dried deciduous leaves from woody plants	3.7	48	Dried deciduous leaves from woody plants	4.0	42	Dried deciduous leaves from woody plants	1.8	31
Green deciduous leaves from woody plants	2.2	23	Green deciduous leaves from woody plants	2.0	20	Hardened woody stems	1.3	18
Hardened woody stems	0.9	19	Hardened woody stems	1.1	17	Green deciduous leaves from woody plants	1.0	15
Evergreen hardwood leaves	0.8	10	Vines	0.9	2	Evergreen hardwood leaves	1.0	6
Succulent green woody stems	0.3	9	Dried conifer needles	0.2	11	Dried conifer needles	0.1	8

TABLE 6. Fall foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses) (Continued)

Southern Appalachian Mountains (155 samples)		Piedmont (192 samples)		Coastal Plain (265 samples)	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
Fruit	0.3	Evergreen hardwood leaves	0.2	Succulent green woody stems tr.	3
Green conifer needles	0.2	Succulent green woody stems	0.2	Green conifer needles	1
Dried conifer needles	tr.	Fruit	tr.	Vines	1
		Green conifer needles	tr.	Fruit	1
Subtotal	74.1		79.5		89.8
FORBS		FORBS		FORBS	
Wintergreen—gl 2.2(23)	2.2	Plantain—gl 0.1(1)	0.1	Legume family—f 0.8(8), gl tr. (4), dl 0.2(1), st&b 0.1(1)	1.1
Galax—gl 1.7(28)	1.7	Legume family—f tr. (3), gl tr. (12)	tr.	Kudzu—gl 0.4(5), st&b tr. (1)	0.4
Legume family—f tr. (3), gl 1.2(9), st&b 0.2(3)	1.4	Strawberry—gl tr. (3), dl tr. (1)	tr.	Poison ivy—f tr. (1), gl tr. (1)	tr.
Trailing arbutus— gl 0.7(9), st&b 0.1(1)	0.8	Composite—gl tr. (1), dl tr. (1)	tr.	Pipsissewa—gl tr. (1)	tr.
Composite family— f tr. (1), gl 0.3(4)	0.3	Pokeweed—f tr. (2)	tr.	Composite family—f tr. (1) tr.	1
Plantain—gl 0.1(2)	0.1	Pipsissewa—gl tr. (2)	tr.		
Kudzu—gl 0.1(1)	0.1	Partridge berry—gy tr. (1)	tr.		
Cinquefoil—gl tr. (3)	tr.				
Partridge berry—gl tr. (1)	tr.				

Unidentified						
Dried herbaceous stems and leaves	2.0	1				14
Green herbaceous stems and leaves	1.6	15				2
Subtotal	10.2
GRASSES AND SEDGES—						
gl 4.7 (42)	4.7	42				32
Corn—f 2.4 (5)	2.4	5				3
FUNGI	8.4	70				72
FERNS—gl 0.1 (5)	0.1	5				1
MISCELLANEOUS ITEMS	0.1	6				2
TOTAL	100.0
Unidentified						
Dried herbaceous stems and leaves	1.3	4				1.1
Green herbaceous stems and leaves	0.6	8				tr.
Subtotal	2.0	..				2.6
GRASSES AND SEDGES—						
gl 1.0 (32)	4.0	26				1.0
Corn—f 1.2 (3)	5.9	4				1.2
FUNGI	8.6	74				5.4
FERNS—gl tr. (1)	tr.	2				tr.
MISCELLANEOUS ITEMS	tr.	4				tr.
TOTAL	100.0	..				100.0

WINTER FOODS

SOUTHERN APPALACHIAN MOUNTAINS

Acorns were an abundant food item in the winter samples (Table 7). Major food categories found most abundantly included dried deciduous leaves of woody plants, green herbaceous stems and leaves, grasses and sedges, hardened woody stems which occurred frequently but in small amounts, and mushrooms. Individual items included rhododendron, dry leaves of oak and green leaves of mountain laurel, honeysuckle, and galax.

PIEDMONT

Winter food categories found in greatest quantities were dried deciduous leaves of woody plants, green herbaceous stems and leaves, grasses and sedges, and fungi. Foods of importance included oak acorns, green leaves of greenbrier, honeysuckle, yellow-jessamine, sumac fruits, and pine needles.

COASTAL PLAIN

Unidentifiable winter foods abundant in the stomach samples included evergreen hardwood leaves, dried deciduous leaves of woody plants, grasses and sedges, hardened woody stems (which occurred fairly frequently but low in volume), and fungi. Identifiable foods of greatest importance included acorns, green leaves of honeysuckle, gallberry, and deer's tongue (a forb), and pine needles which occurred frequently but in small amounts.

Fruits, dry leaves, green leaves of woody plants, and grasses and sedges were abundant. Hardened woody twigs occurred in greater abundance during winter than during other seasons, but could not be classed as a major food item.

TABLE 7. Winter foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)

Southern Appalachian Mountains (80 samples)		Piedmont (46 samples)		Coastal Plain (33 samples)	
TREES, SHRUBS & VINES		TREES, SHRUBS & VINES		TREES, SHRUBS & VINES	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
Rhododendron—gl 21.5(66), dl 1.3(5), st&b 0.5(6), ht&b 0.4(2)	23.7	Honeysuckle—f 0.9(2), gl 18.4(52), dl 2.8(17), st&b 0.1(2), ht&b 4.1(26)	26.3	Honeysuckle—gl 37.9(33), st&b 0.1(9), ht&b tr. (3)	38.0
Oak—f 13.9(38), gl tr. (2), dl 1.3(15)	15.2	Sumac—f 6.8(11)	6.8	Oak—f 20.6(36), gl 1.0(45)	21.6
Honeysuckle—gl 5.7(12), dl 1.6(3), st&b 1.4(5), ht&b 0.7(5)	9.4	Pine—gl 3.4(17), dl 0.6(33)	4.0	Gallberry—f 0.3(6), gl 1.8(27)	2.1
Mountain laurel—gl 2.6(9), dl 0.3(1), ht&b tr. (1)	2.9	Greenbrier—f tr. (9), gl 1.5(22), dl 1.8(2)	3.3	Black titi—gl 1.1(3)	1.1
Flowering dogwood— dl 0.8(3)	0.8	Yellow jessamine— gl 2.9(11)	2.9	Greenbrier—f tr. (15), gl 1.0(33), dl tr. (3)	1.0
Leucothoe—f 0.1(4), gl 0.6(9)	0.7	Oak—f 1.6(15), gl 0.1(11)	1.7	Sumac—f 0.7(15)	0.7
Greenbrier—gl 0.5(11), tr. (1), ht&b tr. (1)	0.5	Blackberry—gl tr. (7), dl 0.9(4)	0.9	Sweet bay—gl 0.7(9)	0.7
Grape—gl 0.4(3)	0.4	Grape—gl 0.6(7)	0.6	Cactus—gl 0.6(3)	0.6
American holly—gl 0.2(4)	0.2	Honey locust—f 0.5(2)	0.5	Willow—gl 0.4(3)	0.4
Black cherry— ht&b 0.2(1)	0.2	Mountain laurel—gl 0.2(4)	0.2	Blackberry—f tr. (3), gl 0.3(15)	0.3
Hawthorn—f 0.2(1)	0.2	Apple—f 0.2(2)	0.2	Blueberry—f tr. (3), gl 0.2(12), ht&b 0.1(3)	0.3
Blackberry— gl 0.1(4), dl tr. (1)	0.1	Willow—gl 0.2(4)	0.2	Pine—f 0.2(3), gl tr. (3), dl tr. (9), st&b tr. (3), ht&b tr. (3)	0.2

TABLE 7. Winter foods of white-tailed deer, by province, in percentage volume and percentage occurrence (in parentheses)
(Continued)

Southern Appalachian Mountains (80 samples)		Piedmont (46 samples)		Coastal Plain (33 samples)	
TREES, SHRUBS & VINES		TREES, SHRUBS & VINES		TREES, SHRUBS & VINES	
Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent	Species	Total Vol. Occ. percent
Red maple—gl 0.1(1)	0.1	American holly—gl 0.1(7)	0.1	Saw palmetto—f 0.2(9)	0.2
Pine—gl tr. (3), dl tr. (4)	7	Flowering dogwood— f 0.1(2), gl tr. (1)	0.1	Sassafras—f 0.1(3)	0.1
Wisteria—f tr. (3)	3	Red cedar—gl tr. (9)	tr.	Hawthorn—gl tr. (9)	tr.
Apple—f tr. (1)	1	Blueberry—gl tr. (4)	tr.	Red maple—gl tr. (3)	tr.
Yellow-poplar—gl tr. (1)	1	Persimmon—f tr. (2), gl tr. (2)	4	Palmetto—f tr. (3)	tr.
Sumac—f tr. (1)	1	Trumpet vine—gl tr. (2)	tr.		
Persimmon—f tr. (1)	1	Wisteria—f tr. (2)	2		
Strawberry bush—gl tr. (1)	1	St. John's wort—f tr. (1)	1		
Unidentified		Black gum—f tr. (1)	1		
Dried deciduous leaves from woody plants	2.6	Unidentified		Unidentified	
Hardened woody stems	1.1	Dried deciduous leaves from woody plants	4.8	Hardened woody stems	4.7
Succulent green woody stems	0.6	Evergreen hardwood leaves	1.0	Evergreen hardwood leaves	3.4
Evergreen hardwood leaves	0.5	Hardened woody stems	0.6	Dried conifer needles	2.8
Green conifer needles	0.2	Succulent green woody stems	0.4	Dried deciduous leaves from woody plants	1.1
		Green deciduous leaves from woody plants	0.3	Green deciduous leaves from woody plants	0.7
			11		9

Dried conifer needles Green deciduous leaves from woody plants	tr.	5	Dried conifer needles	tr.	9	Fruit	tr.	3
Subtotal	59.4	4	FORBS	55.1	..	FORBS	79.8	..
Galax—gl 5.6(50), dl tr. (1), st&b tr. (1)	5.6	52	Legume family—f tr. (4), gl 0.1(4)	0.1	8	Deer's tongue—gl 3.6(3)	3.6	3
Wintergreen— gl 1.3(5), dl tr. (1)	1.3	6	Pipsissewa—gl 0.1(2)	0.1	2	Composite family— gl 1.3(9)	1.3	9
Legume family—gl 0.3(4)	0.3	4	Ground cherry—gl tr. (2)	tr.	2	Legume family— f tr. (3), gl tr. (3)	tr.	6
Trailing arbutus—gl 0.2(1)	0.2	1	Unidentified			Cinquefoil—gl tr. (3)	tr.	3
Cinquefoil—gl 0.1(1)	0.1	1	Green herbaceous stems and leaves			Unidentified		
Partridge berry—tr. (3)	tr.	3	Green herbaceous stems and leaves	7.4	30	Green herbaceous stems and leaves	0.8	12
Green herbaceous stems and leaves	4.5	29	Dried herbaceous stems and leaves	tr.	4	Dried herbaceous stems and leaves	0.8	3
Dried herbaceous stems and leaves	0.2	6	Unidentified			Unidentified		
Subtotal	12.2	..	Green herbaceous stems and leaves	7.6	..	GRASSES AND SEDGES— gl 10.5(42)	6.5	..
GRASSES AND SEDGES— gl 19.6(52)	19.6	52	GRASSES AND SEDGES— gl 32.3(50)	32.3	50	GRASSES AND SEDGES— gl 10.5(42)	10.5	42
Corn—f 0.5(1)	0.5	1	FUNGI	4.9	28	FUNGI	3.2	58
FUNGI	6.2	59	FUNGI	0.1	2			
FERNS—gl 0.5(23)	0.5	23	FERNS—gl 0.1(2)	tr.	2			
MISCELLANEOUS ITEMS	1.7	10	MISCELLANEOUS ITEMS					
Subtotal	100.0	..	TOTAL	100.0	..	TOTAL	100.0	..

The frequency of occurrence and percentage volume of the major food categories for all provinces and seasons were compiled with the following results:

<i>Food Categories</i>	<i>Volume</i>	<i>Frequency of</i>
		<i>Occurrence</i>
		<i>percent</i>
Fruit	21.5	64
Green Leaves	35.7	92
Dry Leaves	3.7	36
Succulent Twigs and Buds	4.3	35
Hardened Twigs and Buds	2.3	22
Forbs	16.5	44
Grasses and Sedges	8.1	33
Fungi	7.6	55

Note that hardened woody twigs had the lowest frequency of occurrence as well as the lowest volume. Green leaves of woody plants ranked highest in both frequency of occurrence and percentage volume. Mushrooms ranked third behind fruit in frequency of occurrence and fifth in total volume above hardened twigs and buds, dry leaves, and succulent twigs and buds of woody plants.

The annual contribution of forbs, grasses and sedges, fungi, and dry leaves in the diet of deer in the Southeast totaled 35.9 percent by volume, equalling the amount provided by the green leaves of woody plants.

DISCUSSION

Analyzing rumen contents to determine the food habits of herbivores has certain weaknesses. For example, Norris (1943) noticed there were differences in the digestibility of foods and that many items found in the rumen of range sheep were too fragmentary for separation and identification by macroscopic analysis. Hosley (1956) reported that stomach analyses were seldom correlated with the availability of plants on range where the samples were collected.

On the other hand, there are certain disadvantages to rumen analysis. Where several herbivores occupy the same habitat, range surveys will not reveal which species take fruits, mushrooms, forbs, grasses, fallen leaves, and acorns. Rumen analysis reveals what was taken, when it was taken (season of the year), and what animals took it. Rumen analysis allows qualitative comparison of food items, provided samples are taken soon after the deer has fed. Dzieciolowski (1970:103) stated:

The botanical method of rumen content analysis gives a reliable qualitative characteristic of food consumption, and provides data for a listing of species consumed. This is especially important in the case of tiny plants which are often overlooked in other techniques of sampling such as animal observation.

This study demonstrates the comparatively small contribution made by hardened woody twigs to the diet of white-tailed deer in the Southeast. Woody twigs are readily available throughout deer ranges, yet they failed to show up in the stomach samples at a frequency approaching their availability. Undoubtedly much of this knowledge was available from the several earlier studies mentioned, but the message was not clear because of lack of specificity in the terminology and because of failure of biologists working with deer habitat in the South to make a thorough search of the literature. Past reports which listed woody plant species by name only and failed to specify what portion of the plant was eaten have helped to establish and perpetuate the belief that woody browse (twigs) is the most important source of food for deer during the winter. If "browse" is to be used, it should be prefixed by "leafy" or "woody" when referring to specific woody plants. If woody twigs are

TABLE 8. Percentage comparisons of deer food categories between regions and seasons.

Season	Number samples	Woody Plants							Fungi	Other		
		Fruit	Green leaves	Dry leaves		Succulent twigs and buds		Hardened twigs and buds			Forbs	Grasses and sedges
				Dry leaves	Succulent twigs and buds	Succulent twigs and buds	Hardened twigs and buds					
Southern Appalachian Mountains												
Spring	27	7.0	55.3	0.5	6.4			0.8	27.0	1.7	2.1	..
Summer	26	5.7	52.1	1.0	1.9			0.8	18.4	0.3	19.8	..
Fall	155	54.1	15.6	6.2	1.8			1.3	7.9	4.7	8.4	..
Winter	80	14.7	32.9	8.1	2.5			2.4	12.0	19.6	6.2	1.6
Coastal Plain												
Spring	38	3.0	48.1	0.1	9.3			0.8	30.4	7.7	0.6	..
Summer	31	17.3	21.8	1.8	3.4			0.2	31.8	7.2	16.4	0.1
Fall	265	70.3	14.0	2.6	3.5			1.7	1.5	1.0	5.4	..
Winter	33	22.1	48.9	4.7	0.1			4.8	5.7	10.5	3.2	..
Piedmont												
Spring	32	1.5	39.7	0.5	7.4			0.1	49.9	0.5	0.4	..
Summer	31	20.3	36.8	1.2	5.4			5.9	6.0	8.0	15.6	0.8
Fall	192	32.7	34.3	7.1	9.7			2.9	0.7	4.0	8.6	..
Winter	46	10.1	29.0	10.9	0.5			4.7	7.6	32.3	4.9	..

found in the diet, they should be appropriately labeled as hardened or succulent.

It is, of course, desirable to list deer foods by species to alert managers to individual plants of proven value. However, some plants are difficult to propagate and an alternative should be sought. Reports listing types of foods better equip the manager to select similar foods which may be better adapted. For example, deer obviously prefer green material during winter. Managing for easily cultivated, winter-hardy green foods in the lower South, such as rye grass, honeysuckle, crimson clover, and hairy vetch, would be desirable and practical. Deer prefer fruits any time they are available; corn would be an excellent alternative to acorns. A summary of types of foods (Table 8) illustrates that deer select the same type of diet seasonally although foraging in different physiographic regions. For example, fruits were found in greatest quantities in the rumen samples of deer in all regions during the fall; dry leaves occurred most abundantly during the winter, forbs were found in greatest amounts during the spring and summer.

This report intentionally emphasizes the importance of food items such as mushrooms, forbs, grasses, and dry deciduous leaves that have seldom been measured in range surveys. These items are so important that their consideration in future range surveys is essential. We recommend that future range surveys include foods which are most important to the deer, not just those easiest to measure.

LITERATURE CITED

- Adams, W. H. 1959. Choccolocco deer range analysis and management implications. Southeast. Assoc. Game & Fish Comm. Annu. Conf. Proc. 13:21-24.
- Braun, E. Lucy. 1967. Deciduous forests of eastern North America. Hafner Publ. Co., New York, London. 595 pp.
- Cushwa, C. T., R. L. Downing, R. F. Harlow, D. F. Urbston. 1970. The importance of woody twig ends to deer in the Southeast. Southeast. Forest Exp. Sta., USDA Forest Serv. Res. Pap. SE-67, 12 pp.
- Dzieciolowski, R. 1970. Foods of the red deer as determined by rumen content analysis. *Acta Theriologica* 15(6):89-110.
- Harlow, R. F. 1961. Fall and winter foods of Florida white-tailed deer. *Quart. J. Fla. Acad. Sci.* 24(1):19-38.
- Hosley, N. W. 1956. Management of the white-tailed deer in its environment, p. 187-331. *In* Deer of North America. Stackpole Co., Harrisburg, Pa. and Wildl. Manage. Inst., Washington, D. C.
- Martin, A. C., R. H. Gensch, C. P. Brown. 1946. Alternative methods in upland gamebird food analysis. *J. Wildl. Manage.* 10(1):8-12.
- Norris, J. J. 1943. Botanical analysis of stomach contents as a method of determining forage consumption of range sheep. *Ecology* 24:244.
- Pearson, A. M. 1943. White-tails like acorns. *Ala. Conserv.* Dec. 8, 9, 12.
- and C. C. Burnett. 1940. Deer food in the Black Warrior National Forest. *Ala. Game & Fish News.* Feb.: 3-4.
- Steel, R. G. D. and J. H. Torrie. 1960 *Principles and procedures of statistics.* McGraw-Hill Book Co., New York. 481 pp.
- U. S. Dept. Agr. 1941. Climate and weather data for the United States, pp. 685-747. *In* Climate and man. Yearbook of Agriculture. U. S. Govt. Print. Off., Washington, D. C. 1,248 pp.
- . 1969. A forest atlas of the South. USDA Forest Serv. Southern and Southeast. Forest Exp. Stations, 27 pp.

APPENDIX

The common and scientific names of plants mentioned in the text.

TREES, SHRUBS, AND VINES

<i>Common</i>	<i>Scientific</i>
American beech	<i>Fagus grandifolia</i> Ehrhart.
American elm	<i>Ulmus americana</i> L.
American holly	<i>Ilex opaca</i> Aiton
American hornbeam (ironwood)	<i>Carpinus caroliniana</i> Walter.
Apple	<i>Malus</i> sp.
Aspen	<i>Populus</i> sp.
Azalea	<i>Rhododendron</i> sp.
Balsam fir	<i>Abies balsamea</i> (L.) Mill.
Basswood (linden)	<i>Tilia</i> sp.
Bigleaf gallberry	<i>Ilex coriacea</i> (Pursh) Chapman
Blackberry	<i>Rubus</i> spp.
Black cherry	<i>Prunus serotina</i> Ehrhart.
Black gum	<i>Nyssa sylvatica</i> Marsh.
Black titi	<i>Cliftonia monophylla</i> (Lam.) Britt.
Blueberry	<i>Vaccinium</i> spp.
Cactus (prickly pear)	<i>Opuntia</i> sp.
Chinaberry	<i>Melida azedarach</i> L.
Cypress	<i>Taxodium</i> sp.
Flowering dogwood	<i>Cornus florida</i> L.
Flatwoods plum	<i>Prunus umbellata</i> Ell.
Gallberry	<i>Ilex glabra</i> (L.) Gray
Grape	<i>Vitis</i> spp.
Greenbrier	<i>Smilax</i> spp.
Ground cherry	<i>Physalis</i> sp.
Hackberry	<i>Celtis</i> sp.
Hawthorn	<i>Crataegus</i> spp.
Hemlock	<i>Tsuga canadensis</i> (L.) Carr.
Hickory	<i>Carya</i> sp.
Holly	<i>Ilex</i> spp.
Honey locust	<i>Gleditsia triacanthos</i> L.
Honeysuckle	<i>Lonicera</i> spp.
Hop hornbeam	<i>Ostrya virginiana</i> (Miller) K. Koch
Ivy	<i>Hedera helix</i> L.
Japanese honeysuckle	<i>Lonicera japonica</i> Thunberg
Leucothoe	<i>Leucothoe axillaris</i> (Lam.) D. Don
Loblolly bay	<i>Gordonia lasianthus</i> (L.) Ellis
Loblolly pine	<i>Pinus taeda</i> L.
Longleaf pine	<i>Pinus palustris</i> Miller
Magnolia	<i>Magnolia</i> spp.
Maple	<i>Acer</i> sp.
Mountain laurel	<i>Kalmia latifolia</i> L.
Oak	<i>Quercus</i> spp.
Pear	<i>Pyrus</i> sp.
Pepper-vine	<i>Ampelopsis arborea</i> (L.) Koehne
Persimmon	<i>Diospyros virginiana</i> L.
Pine	<i>Pinus</i> spp.
Poison ivy	<i>Rhus radicans</i> L.
Privet	<i>Ligustrum vulgare</i> L.
Red bay	<i>Persea borbonia</i> (L.) Sprengel
Red cedar	<i>Juniperus virginiana</i> L.
Red maple	<i>Acer rubrum</i> L.
Rhododendron	<i>Rhododendron maximum</i> L.
Sassafras	<i>Sassafras albidum</i> (Nutt.) Nees
Saw palmetto	<i>Serenoa repens</i> (Bartram) Small
Shortleaf pine	<i>Pinus echinata</i> Miller
Slash pine	<i>Pinus elliotii</i> Engelm.
Sourwood	<i>Oxydendrum arboreum</i> (L.) DC.
Spice bush	<i>Lindera benzoin</i> L.

Common
St. John's wort
Strawberry bush
Sumac

Sweet bay
Sweet gum
Sycamore
Trumpet vine
Viburnum
Water tupelo
Wax myrtle
White cedar
White pine
White titi
Willow
Wisteria
Witch hazel
Yellow-jessamine
Yellow-poplar

Scientific
Hypericum sp.
Euonymus sp.
Rhus sp.

Magnolia virginiana L.
Liquidambar styraciflua L.
Platanus occidentalis L.
Bignonia radicans L.
Viburnum sp.
Nyssa aquatica L.
Myrica cerifera L.
Thuja occidentalis L.
Pinus strobus L.
Cyrilla racemiflora L.
Salix sp.
Wisteria frutescens (L.) Poiret
Hamamelis virginiana L.
Gelsemium sempervirens (L.) Aiton
Liriodendron tulipifera L.

HERBACEOUS PLANTS INCLUDING EVERGREEN FORBS

Alfalfa hay
Cinquefoil
Columbine
Composite family
Corn
Crimson clover
Deer's tongue

Galax
Geranium
Kudzu
Legume family
Lily family
Mustard family
Partridge berry
Pea
Pipsissewa
Plantain
Pokeweed
Rye grass
Salal
Soybean
Strawberry
Trailing arbutus
Vetch
Violet
Wintergreen

Medicago sp.
Potentilla sp.
Aquilegia sp.
Compositae
Zea mays L.
Trifolium incarnatum L.
Trifolia odoratissima
(Walter ex J. F. Gmelin) Gassin
Galax aphylla L.
Geranium sp.
Pueraria lobata (Willd.) Ohwi
Leguminosae
Liliaceae
Cruciferae
Mitchella repens L.
Vigna luteola (Jacquin) Bentham
Chimaphila sp.
Plantago sp.
Phytolacca americana L.
Lolium sp.
Gaultheria shallon Pursh
Glycine sp.
Fragaria sp.
Epigaea repens L.
Vicia sp.
Viola spp.
Gaultheria procumbens L.

AUTHORITIES

Manual of the Vascular Flora of the Carolinas by Albert E. Radford, Harry E. Ahles, and C. Ritchie Bell, 1968. Univ. North Carolina Press, Chapel Hill. 1,183 pp.; *Check List of Native and Naturalized Trees of the United States* by Elbert L. Little, 1953. Agricultural Handbook 41, Forest Service, U. S. Dept. Agr. 472 pp.

QUANTITY AND QUALITY OF JAPANESE HONEYSUCKLE ON ARKANSAS OZARK FOOD PLOTS¹

By CHARLES A. SEGELQUIST

Wildlife Habitat and Silviculture Laboratory, Southern Forest Experiment Station USDA Forest Service, Nacogdoches, Texas

and

MITCH ROGERS

Arkansas Game and Fish Commission, Calico Rock, Arkansas

and

FRED D. WARD

Arkansas Game and Fish Commission, Little Rock, Arkansas

ABSTRACT

In the spring of 1968 Japanese honeysuckle was planted on four wild-life food plots in the Arkansas Ozarks. Two years later, with moderate fertilization and occasional mowing, this evergreen species produced 239 oven-dry pounds of winter forage per acre, 12 times more than the surrounding forest. The nutrient quality of leaves was consistently high throughout the year. Leaves retained through the winter contained about 14 percent crude protein, more than eastern redcedar, flowering dogwood twigs, panic grasses, and pussytoes, the most common native forages eaten by deer during the winter. Honeysuckle leaves were more digestible than any native forage. Since honeysuckle was not browsed heavily by deer until mid-winter, most current annual growth was available after mast had been eaten and when green forage was scarce.

This paper reports yield and nutritive quality of Japanese honeysuckle (*Lonicera japonica*) grown on wildlife food plots in the Arkansas Ozarks; it compares productivity on food plots to that of native vegetation in the surrounding forest. It also shows how the nutritional quality of honeysuckle varied by seasons and to what extent honeysuckle was browsed by white-tailed deer (*Odocoileus virginianus*).

The Sylamore Experimental Forest, where the study was conducted, contains four major habitat types; upland hardwood, upland pine-hardwood, cedar glade, and stream-bottom hardwood. While average summer vegetation yields range from 90 to 210 oven-dry pounds per acre for the four types (Segelquist and Green 1968), winter yields are low—averaging about 15 pounds per acre, of which only 2 pounds are green vegetation of preferred species. When mast (primarily acorn) yields are high, sufficient winter food is available for deer, but when mast yields are low, as they frequently are, winter foods are scarce, and the deer population declines (Segelquist et al. 1969).

Honeysuckle was planted on food plots in the spring of 1968 to provide supplemental green winter forage for deer. Food plots were located along narrow ridge tops and stream bottoms, the only areas level enough for mechanical cultivation. Plots were confined to three of the four major habitat types; upland hardwood, upland pine-hardwood, and stream-bottom hardwood. Upland hardwoods occupy north and east slopes, while the pine-hardwood type occurs on the drier south and west exposures. The stream-bottom type occupies the moist fertile zone along the narrow stream valleys. The cedar glades are relatively open, but their shallow rocky soils with dry south and west exposures are not suited for cultivation.

¹ Work done with cooperation of Federal Aid in Fish and Wildlife Restoration funds under Arkansas Project W-53-R.