

## FOODS OF RUFFED GROUSE FROM THREE LOCATIONS IN THE SOUTHERN APPALACHIAN MOUNTAINS

MONTE E. SEEHORN, USDA Forest Service, 1720 Peachtree Road, NW, Atlanta, GA 30309

RICHARD F. HARLOW, USDA Forest Service, Southeastern Forest Experiment Station, Department of Forestry, Clemson University, Clemson, SC 29631

MICHAEL T. MENGAK, The Belle W. Baruch Forest Science Institute of Clemson University, Georgetown, SC 29440.

*Abstract:* An analysis was made of 574 ruffed grouse (*Bonasa umbellus*) crops and 157 gizzards collected during fall and winter from 3 locations in the Southern Appalachian Mountains. Grouse crops from the northernmost localities contained more woody twigs and attached buds than grouse crops from locations farther south, and crops from southernmost localities contained more leaves of woody plants than crops from more northern areas. Plants common in grouse diets from all localities included leaves and fruits of greenbrier (*Smilax* spp.), the leaves of mountain-laurel (*Kalmia latifolia*), the fruits of grapes (*Vitis* spp.) and oaks (*Quercus* spp.), and the herbaceous plant, Christmas fern (*Polystichum acrostichoides*). The major portion of the diets consisted of green leaves (64.5%), fruits (28.9%), twigs and buds (5.4%), and animal matter (1.2%).

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Foods of ruffed grouse in Southern Appalachian Mountains have been identified by Nelson et al. (1938), Stewart (1956), Harlow and Guthrie (1972), Smith (1977), and Stafford and Dimmick (1979). Although these studies covered much of the same region as ours, comparison are difficult because the seasonal distribution of samples was different and the other studies were done in different years.

Stafford and Dimmick (1979) reported that winter diets of grouse from the mountainous regions of Tennessee consisted of greater quantities of green leafy material and less buds, attached twigs, and catkins than diets of grouse from upper midwestern and northern forests. They attributed this difference, in part, to the comparative absence of deep snow which allows grouse to feed on herbaceous plants almost continuously throughout the winter. Although winter dietary differences are obvious when comparing foods of grouse from the snow-belt regions of the North with those from southern habitats, no grouse diets have been compared between widespread localities within the Southern Appalachian range. Evidence indicates that diet may differ by locality. Nelson et al. (1938) noted that 27% by volume of the winter diet of grouse from northwestern Virginia consisted of buds and catkins, whereas Stafford and Dimmick (1979) reported that only 8% of the diet of grouse from Tennessee contained these items.

Our study compared food items eaten by ruffed grouse during the fall and winter months from 3 locations over the length of the Southern Appalachian range.

## METHODS

The study included mountainous locations from western Virginia to northeastern Georgia (Fig. 1), a distance of approximately 515 km. In Virginia, collection locations averaged 466 m above sea level in elevation, ranging from 366 to 747 m; North Carolina elevations averaged 1,041 m, ranging from 488 to 1,707 m; Georgia elevations averaged 721 m, ranging from 366 to 1067 m. The study was generally situated in the Appalachian oak forest section of the eastern deciduous forest province (Bailey and Cushwa 1977). From 4 to 8 months of the year the average temperature is over 10 C with the coolest month below 0 C. The summers are hot with the warmest month over 22 C (Bailey and Cushwa 1977). There is no marked dry season. Annual precipitation, mostly rain, averages between 178 to 203 cm in the extreme southern portion of the study area and between 114 to 127 cm in the remaining portions of the study area (USDA 1941). The average annual snow fall is from 13 to 25 cm in the extreme southern portion of the study area (northeastern Georgia) and between 51 to 76 cm in the remaining portions (USDA 1941). The topography, soils, and vegetation of the 2 major provinces (Ridge-Valley and Mountain) of this ecoregion have been described in detail by Braun (195), Korstian (1962), and Hodgkins (1965).

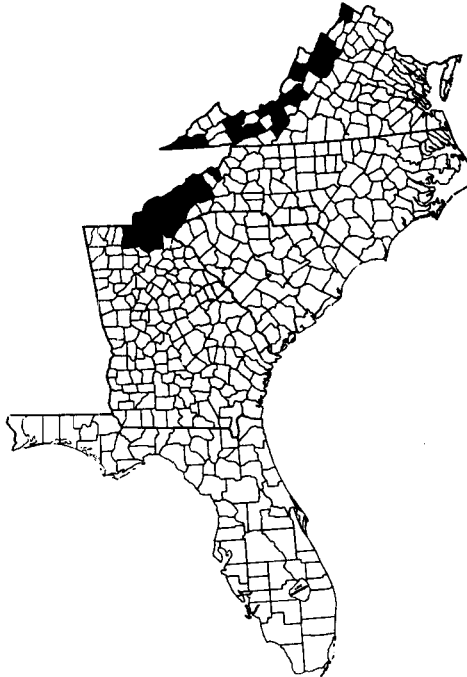


Fig. 1. States and counties in the Southern Appalachian Mountains from which ruffed grouse crops and gizzards were collected during the months of October through February 1971 - 1979.

Crops from 574 grouse and gizzards from 157 grouse were collected from hunters over a period of 9 years (1971 - 1979), principally during the months of October through February. For purposes of comparison, collection period and study area were divided as follows: Subregions: (1) northernmost portion of the Southern Appalachians (western Virginia) — 123 crops, 6 gizzards; (2) central portion (western North Carolina) — 264 crops, 88 gizzards; and (3) southernmost portion (northeastern Georgia — 187 crops, 63 gizzards. Periods: October, 39 crops; November, 101 crops; December, 134 crops; January, 132 crops; and February, 153 crops.

When analysis was delayed for any length of time, fresh crops were frozen. During analysis, food items were separated manually and the volume of each food group determined by volumetric displacement. Percent volume of each food group was derived by the aggregate volume method (Martin et al. 1946). Any volume less than 0.1 ml was considered a trace.

Diet items were separated and recorded by species and by the following categories: (1) leaves of woody plants, (2) woody twig ends and buds, (3) fruits of woody plants and vines (all flowering parts plus fruit and seeds), (4) herbaceous material (forbs, grasses, and sedges), (5) animal matter, and (6) grit.

Homogeneity of variance for volume data was evaluated with an *F* test and comparisons for differences in volumes of specific food categories among locations were made by ANOVA (Sokal and Rohlf 1969). Plant names were taken from Radford et al. (1964).

## RESULTS AND DISCUSSION

### Rangewide Comparison

Leaves of woody plants found in crops contributed 28% of all food consumed (Fig. 2). Twigs and buds were the least abundant food items in crops from all locations, totaling 5.4%. The relative abundance of fruits in crops was approximately the same as woody plant leaves, totaling 29%. Herbaceous plants accounted for the highest percentage volume in crops for all food categories (36.6%) (Fig. 2).

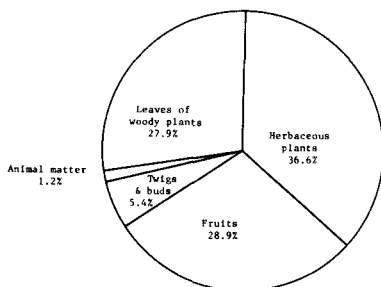


Fig. 2. Percent volume of food types found in 574 grouse crops collected during the months of October through February 1971 - 1979 from the Southern Appalachian Mountains.

A comparison of foods identified in crops and gizzards indicated that gizzards contained greater volumes of fruits (primarily hard-coated seeds) while crops had slightly greater amounts of woody plant leaves and much greater quantities of herbaceous plants (Figs. 2, 3). Twigs and buds, similar to seeds in hardness, were present in nearly equal quantities in both crops and gizzards. Animal matter occurred only in crops, and grit (not a food) only in gizzards.

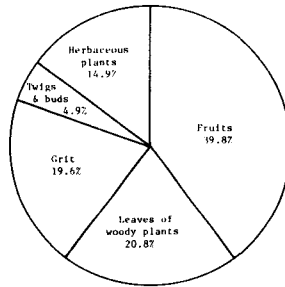


Fig. 3. Percent volume of food types and grit found in 157 grouse gizzards collected during the months of October through February 1971 - 1979 from the Southern Appalachian Mountains.

### Subregional Comparison

*Plant Parts Eaten* — Crops from Georgia contained greater mean volumes (ml) of leaves (primarily from mountain-laurel) than did those from North Carolina and Virginia, which contained nearly the same quantity (Table 1). Twigs and buds are present in greater amounts in crops from Virginia than in those from locations farther south. Fruits were most abundant in crops from Virginia compared with crops from the other 2 subregions. Greater volumes of herbaceous plants were found in crops from North Carolina than in crops from the other 2 subregions (Table 1). However, none of these differences was significant at the 0.05 level.

*Plant Species Eaten* — Foods of particular importance in crops from Virginia included the leaves and fruit of greenbrier, the fruit of grape, the twigs and buds of black cherry (*Prunus serotina*), and the leaves of the herbaceous plants cinquefoil (*Potentilla* spp.) and Christmas fern. These 5 species made up 46.8% by volume of all foods found in the 123 crops examined (Table 2). Plant species found in greatest abundance in crops from North Carolina included the leaves of greenbrier and mountain-laurel, the fruits of grape and oak, the herbaceous plant foam flower (*Tiarella cordifolia*). Together, these species contributed 46.2% by volume of all foods found in 264 crops (Table 2). Species of plants occurring in greatest amounts in the 187 crops collected from Georgia included the leaves of Greenbrier and mountain laurel, the fruits of oak, and the leaves of the herbaceous plants Christmas fern and foam flower. A total of 64.9% by volume of all plant species found in the crops from Georgia consisted of these 5 plants.

Table 1. Average volume (ml) with SE and number of different plant species contributing to the quantities of plant parts found in grouse crops from the 3 subregions of the Southern Appalachian Mountains.

Plant part	VA (123) <sup>a</sup> Volume			NC (264) Volume			GA (187) Volume		
	$\bar{X}$ ml	SE	N <sup>b</sup>	$\bar{X}$ ml	SE	N	$\bar{X}$ ml	SE	N
Leaves of woody plants	20.5	11.9	18	28.0	13.9	32	45.6	27.2	22
Twigs and buds	14.1	6.3	16	6.3	1.7	22	3.4	11.0	19
Fruit	21.1	8.4	39	33.9	13.1	38	25.9	10.2	28
Herbaceous material	9.8	2.9	48	17.9	4.9	80	15.7	6.8	51
<b>Totals</b>			121			172			120

<sup>a</sup> ( ) = Number of crops sampled.

<sup>b</sup> N = Number of different plant species; e.g., in Va., leaves of 18 species were found in 123 crops and these 18 species contributed an average volume of 20.5 ml.

Foods occurring in lesser quantities than those listed above but still important when compared with the smaller volumes of the many plant species found in crops from each of the subregions included: fruits of aromatic wintergreen (*Gaultheria procumbens*), oak species, honeysuckle (*Lonicera japonica*), twigs of blueberry (*Vaccinium* spp.), azalea (*Rhododendron* spp.), birch (*Betula* spp.), leaves of mountain-laurel, herbaceous plants cinquefoil and Christmas fern from Virginia; fruits of hollies (*Ilex* spp.), blackgum (*Nyssa sylvatica*), American Beech (*Fagus grandifolia*), and herbaceous plants Christmas fern, aster (*Aster* spp.) grape-fern (*Botrychium* spp.), strawberry (*Fragaria* spp.), rock-geranium (*Heuchera americana*), violets (*Viola* spp.) from North Carolina; and fruits of grape, American holly (*I. opaca*), hazelnut (*Corylus* spp.), and the herbaceous plant aster from Georgia (Table 2).

Ninety-six plant species were identified in the 123 grouse crops from Virginia, the northernmost part of the Southern Appalachians. Fifty of these were woody species with 15 of them occurring in quantities of 1% or more. Of the 46 herbaceous plants found, only 4 occurred in volumes of 1% or more. Crops of North Carolina and Georgia birds, the central and southernmost portions of the mountains, differed from the crops of Virginia birds in that herbaceous plants outnumbered woody plants. The greatest number of plant species (133) was found in the North Carolina crops. Eleven of the 61 woody plants were present in amounts of 1% or more and 9 of the 72 herbaceous plants attained this level. Of the 84 plant species identified in the Georgia crops, 11 of the 38 woody species occurred in quantities of 1% or more while 6 of the 46 herbaceous plants attained this level of abundance.

Table 2. Plant species that contributed >1% volume of food items found in grouse crops from the 3 subregions, by plant part.

Species	Virginia (N=123)			North Carolina (N=264)			Georgia (N=187)					
	% volume			% volume			% volume					
	Leaves	Fruit	Twigs	%	Leaves	Fruit	Twigs	%	Leaves	Fruit	Twigs	%
Woody plants												
Greenbrier	11.4	16.6		28.0	6.0	1.3		7.3	10.7	1.9		12.6
Grape		5.1		5.1	0.6	12.3		12.9	0.4	3.3		3.7
Black Cherry			4.8	4.8								
Aromatic wintergreen	0.8	3.5		4.3								
Oaks		3.9	0.01	3.9	0.5	2.9		3.4	0.6	1.8	0.01	2.4
Blueberry	0.03	0.8	2.8	3.6	0.3	1.4	0.4	2.1	0.5	0.01	0.5	1.0
Honeysuckle	.02	3.0		3.2	2.2			2.2	0.7	.04		1.1
Mountain laurel	2.8			2.8	10.6			10.6	21.4		0.1	21.5
Azalea		0.4	2.0	2.4								
Birch		1.0	0.7	1.7		1.2	0.4	1.6				
Trailing arbutus ( <i>Epigaea repens</i> )	1.6	0.1		1.7					1.4			1.4
Sumac ( <i>Rhus</i> spp.)		1.3		1.3								
Bittersweet ( <i>Celastrus scandens</i> )		1.2		1.2								
Rose ( <i>Rosa</i> spp.)		1.2		1.2								
Bear oak ( <i>Quercus</i> <i>ilicifolia</i> )		1.0	0.1	1.1								
White oak ( <i>Quercus</i> <i>alba</i> )						5.3	0.01	5.3		10.6		10.6
American beech						2.1	0.1	2.2				
Blackgum						1.3		1.3				
Holly						1.2		1.2				

Table 2. Continued.

Species	Virginia (N=123) % volume			North Carolina (N=264) % volume			Georgia (N=187) % volume					
	Leaves	Fruit	Twigs	%	Leaves	Fruit	Twigs	%	Leaves	Fruit	Twigs	%
American holly						4.6			1.6	4.6	0.01	4.6
<i>Rhododendron</i> sp.												1.6
Hazelnut ( <i>Corylus</i> spp.)									0.06	1.5	0.01	1.5
Scarlet oak ( <i>Quercus coccinea</i> )										1.4		1.4
Other species	8.8			8.8	11.7			11.7	5.9			5.9
Subtotal (%)				75.1				61.8				69.3
Herbaceous plants												
Cinquefoil	4.7			4.7	1.3			1.3				1.3
Christmas fern	4.2			4.2	4.7			4.7	10.4			10.4
White dutch clover ( <i>Trifolium repens</i> )	2.4			2.4	1.1			1.1				
Grape-fern	1.2			1.2	1.6			1.6				1.6
Foam flower					9.1			9.1	8.4			8.4
Aster					2.1			2.1	2.7			2.7
Strawberry					1.5			1.5				
Rock-geranium					1.4			1.4				
Violet					1.3			1.3				
Miterwort ( <i>Mitella diphylla</i> )									1.1			1.1
Other species	12.5			12.5	14.1			14.1	5.1			5.1
Subtotal (%)				25.0				38.2				30.9
Total				100.1				100.0				100.2

The greater volumes of woody twigs and buds found in the diet of grouse in Virginia, compared to grouse farther south, may be due to the often deeper and more prolonged snow cover which tends to reduce the variety of evergreen forbs and woody plant leaves available at ground level, which forces the birds to feed more heavily on arboreal foods. This was previously suggested by Stafford and Dimmick (1979). Acorns, which were absent in the diet of grouse from Tennessee and North Carolina (Stafford and Dimmick 1979), appeared in crops from all 3 study areas. Evidently the geographic area, period of collection, and length of our study coincided with periods of acorn abundance.

When the grouse crop volumes of the food categories from the 3 subregions are combined, their relative percentages are nearly identical to those reported by Stafford and Dimmick (1979).

### Monthly Comparison

*Plant Parts Eaten* — Crops collected during October contained less volume of leaves of woody plants than during later months, with the greatest volumes occurring during December and January (Fig. 4). Twigs and buds were present in crops in greatest amounts during November, December, and January. The greatest volumes of fruits were found in crops collected during October. Herbaceous plants were least abundant in crops during October, gradually increasing in quantity, and attaining their highest volume during February (Fig. 4).

The trends in abundance of leaves of woody plants, twigs and buds, and fruits were the same for gizzards as for crops. However, the abundance of herbaceous material showed no trend for gizzards but tended to fluctuate between months.

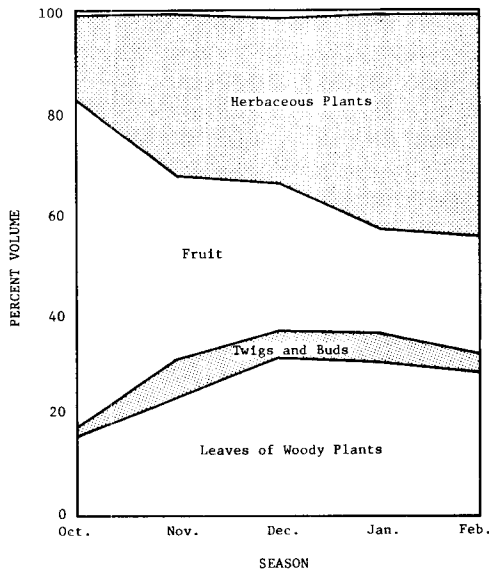


Fig. 4. Monthly comparison of the percentages of total volume of food categories in grouse crops from the Southern Appalachian Mountains, 1971 - 1979.



*Plant Species Eaten.* — Individual plants occurring in crops in sufficient quantities to influence monthly food category differences were leaves of mountain-laurel, leaves and fruit of greenbrier, fruits of oak and grape, and the herbaceous plants foam flower, Christmas fern, cinquefoil, and aster species. The leaves of mountain-laurel and greenbrier were lowest in abundance in crops during October. Greenbrier leaves maintained consistently high levels of abundance in crops over the next 4 months. Mountain-laurel, in contrast, showed a steady increase in volume each month, reaching a peak in February. Plant species contributing the highest quantities of fruits over the 5-month period included greenbrier, which reached its highest volume in crops during January; grape, which contributed most heavily to crop contents during November and December; and oak, which was found in greatest quantities during October, January, and February. The herbaceous plant foam flower was most prevalent in crops during November, with Christmas fern most prevalent during January and February, cinquefoil in December, and aster species in February.

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