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I am submitting herewith a thesis written by Steven Kent Stafford entitled "Fall and Winter Foods of Ruffed Grouse in Eastern Tennessee and Western North Carolina." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Wildlife Management.

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FALL AND WINTER FOODS OF RUFFED GROUSE IN EASTERN TENNESSEE AND WESTERN NORTH CAROLINA

A Thesis

Presented for the

Master of Science

Degree

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Steven K. Stafford

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ABSTRACT

The objective of this study was to determine the principal fall and winter dietary patterns of ruffed grouse in eastern Tennessee and western North Carolina.

The study was conducted in the Blue Ridge Region of eastern Tennessee and western North Carolina and the Cumberland Plateau and Great Valley Regions of eastern Tennessee. All three regions are a part of the Southern Appalachians. The oak-hickory and oak-pine forest types are dominant in the area studied.

A total of 294 grouse crops was collected during the fall and winter from October 1972 through February 1974. Seventeen additional crops were collected from December 1969 through February 1970.

Greenbriar was the most important food by volume in the Blue Ridge (20.2 percent) and Valley Regions (33.2 percent). In the Plateau Region, Christmas fern was the most important food (15.5 percent), and greenbriar was second (12.2 percent).

Honeysuckle ranked second only to greenbriar in the Valley (18.0 percent). Mountain laurel leaves and buds ranked second in the Blue Ridge Region (19.6 percent), and fourth in the Plateau Region (10.4 percent). Dogwood was third (11.2 percent) in the Plateau.

The principal foods by volume during the fall for each region were: Blue Ridge--Greenbriar (28.3 percent), grape (8.1 percent), mountain laurel (6.6 percent), dogwood (6.5 percent), black birch (5.9 percent) and partridge berry (5.0 percent). Plateau--dogwood (82.5

percent) and blueberry (9.6 percent) from only two crops collected; Valley--Greenbriar (38.5 percent), Christmas fern (10.0 percent), avens (6.9 percent), honeysuckle (6.3 percent) and cinquefoil (5.2 percent).

The principal foods by volume during the winter for each region were: Blue Ridge--Mountain laurel (28.2 percent), greenbriar (14.9 percent), Christmas fern (12.5 percent) and cinquefoil (5.0 percent). Plateau--Alumroot (14.9 percent), Christmas fern (14.6 percent), greenbriar (11.6 percent), mountain laurel (10.1 percent) and blueberry (4.0 percent). Valley--Greenbriar (30.2 percent), honeysuckle (25.6 percent), Christmas fern (12.7 percent), hawkweed (5.7 percent) and unidentified ferns (5.2 percent).

During periods of snow, grouse from the Blue Ridge and Plateau fed primarily on black birch and mountain laurel. The diet of grouse from the Valley was the same during periods of snow as at other times. Snows were lighter in the Valley as compared to the Blue Ridge and Plateau. Open fields and pastures adjacent to woodlands in all regions appeared to be preferred feeding sites throughout the fall and winter.

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CHAPTER I

INTRODUCTION

The ruffed grouse (Bonasa umbellus) is primarily a bird of the mixed deciduous and coniferous forests of northern North America. Its range in the southeast includes northeast Alabama, north Georgia, western North Carolina, eastern Tennessee, and western Virginia (Figure 1). In recent years ruffed grouse have been successfully reintroduced into Missouri (Lewis et al., 1968). In Georgia efforts are being made to establish grouse populations in suitable habitat south of the present range in that state.

In Tennessee, ruffed grouse occur from the Cumberland Plateau eastward through the Great Valley and Blue Ridge mountains. The highest populations in Tennessee probably occur in the Cumberland Plateau, and in the Blue Ridge Region. The central and southern Valley have relatively low populations. In North Carolina their range extends from the western edge of the Piedmont Region through the Blue Ridge Region adjoining the Tennessee state line. The mountainous Blue Ridge Region has the highest populations. The ruffed grouse population in North Carolina was approximately 400,000 in 1971 (Halls and Stransky, 1971). No figures for Tennessee are available but its population is regarded as stable (Halls and Stransky, 1971). Periodic drastic fluctuations in ruffed grouse populations which occur in northern states have not been reported in these areas. The annual harvest in 1971 was estimated

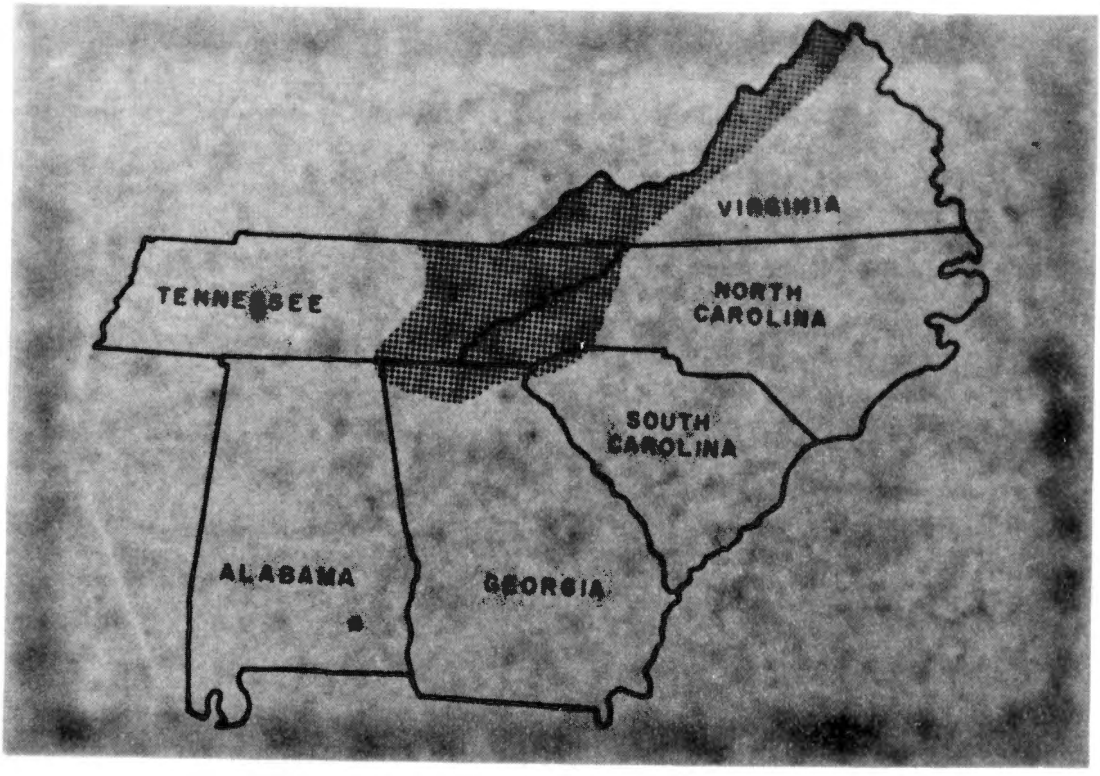


Figure 1. Southern range of ruffed grouse in the southeastern United States.

at 3,000 for North Carolina and 10,000 for Tennessee (Halls and Stransky, 1971). North Carolina's mountains are perhaps the most difficult terrain for hunting in the areas studied.

The objective of this study was to determine the primary foods of ruffed grouse in their southeastern range. There is little information on the ecology of ruffed grouse in the Southern Appalachians south of 40 degrees latitude (Korschgen, 1966). Nelson et al. (1938) collected 184 crops and 107 gizzards from the George Washington National Forest. Treichler et al. (1947) determined nutritional values for foods from the same Virginia forest. Edwards (1957) examined the diet of more than 100 birds collected during the winter in North Carolina but did not detail his findings.

Food studies from other areas in the United States are well documented in the literature. Judd (1905) examined 208 crops from the Northeast; Smyth (1925) reported on New York foods; Johnson (1928) analyzed 26 crops from the Syracuse area of New York; Darrow (1939) in New York reported on seasonal food preferences of adults based on 817 crops; Kuhn (1940) examined 230 fall collected crops from Pennsylvania; Knowlton et al. (1941) examined 102 crops and gizzards from New Hampshire in the fall and summer; Grange (1948) listed important foods for Wisconsin; Gilfillan and Bezdek (1944) examined 42 crops and gizzards from Ohio; Bump et al. (1947) collected 1,093 crops from various sections of New York; Spinner and Bishop (1950) listed nutritional values for important Connecticut foods; Stollberg and Hine (1952) examined 89 crops from Wisconsin; Hungerford (1957) reported on the foods of grouse

broods in Idaho; Korschgen (1966) examined 7,000 droppings from all seasons in Missouri; King (1969) reported on summer and spring foods on Vancouver Island. Gullion (1966, 1972) has done considerable research on grouse food habits in Minnesota. Much of the work in Minnesota has dealt with the importance of aspens (Populus sp.) to grouse (Svoboda and Gullion, 1972; Hill et al., 1968).

The forests in eastern Tennessee and western North Carolina are somewhat different than those further north or in the midwest. Southern pines and the oak-hickory forest type are well represented throughout. Mountain peaks, especially north-facing slopes, exhibit some of the vegetative characteristics of forests in northeastern United States. Winters are generally not severe and snow accumulation only lasts from one to several days.

CHAPTER II

DESCRIPTION OF THE STUDY AREA

Eastern Tennessee and western North Carolina lie within the southern edge of the Appalachian Highlands Region. The topography here ranges from the mountainous Blue Ridge Region in western North Carolina to parallel belts of hills and valleys in the Great Valley of eastern Tennessee. The chief mountain system, the Appalachians, extends through both states. Primary mountain ranges are the Blue Ridge, Cumberland and Great Smokies. The area is composed of three topographic regions--the Blue Ridge, Great Valley and Cumberland Plateau (Figure 2). All three occur in east Tennessee but only the Blue Ridge occurs in western North Carolina. The counties in Tennessee represented are Monroe, Campbell, Claiborne, Carter, Cumberland, Grainger, Johnson, Hancock, Hawkins, Knox, Morgan, Scott, Sevier, and Sullivan. In North Carolina, Macon, Haywood, Jackson, Madison, and Buncombe Counties are represented. Figure 2 illustrates the regional location of each county and region. The general locations where collections were made are listed in the Appendix (Table 18).

I. GEOLOGY AND TOPOGRAPHY

Within the Southern Appalachians two rock belts occur--the southeastern or crystalline belt which includes the Appalachian Mountains and the sedimentary belt which includes the Great Valley and Cumberland

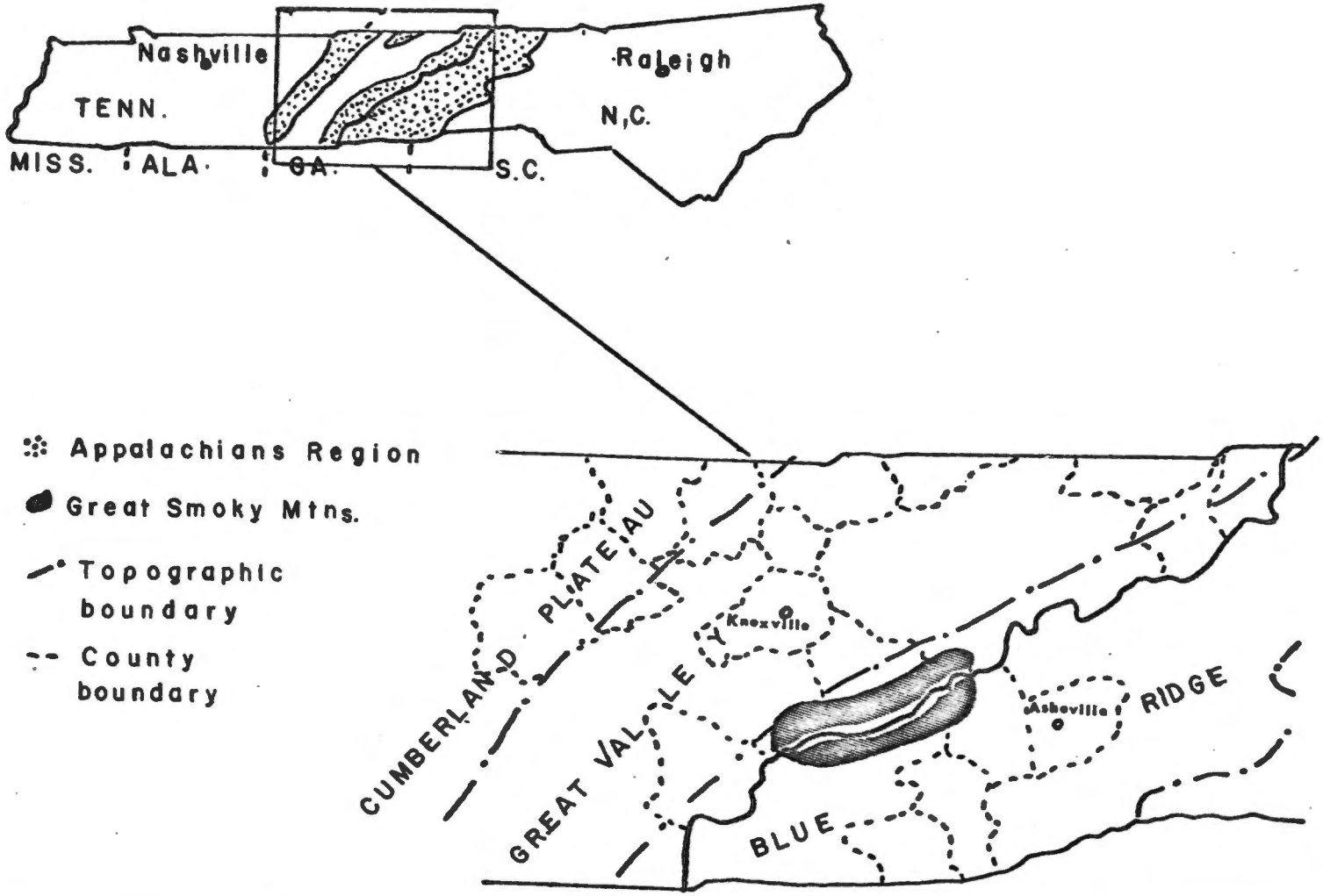


Figure 2. The topographic regions in eastern Tennessee and western North Carolina.

Plateau. Great differences in soil occur over a small area due to differences in physiography, soil parent material and climate (Korstian, 1962). Soils in the Appalachians range from coarse sand, through friable, sandy silt and clay loams to plastic clays.

The Blue Ridge Region skirts the eastern edge of Tennessee and western North Carolina. The highest mountains and steepest relief occur here. The rolling topography of the foothills provides a contrast to the surrounding mountains. Drainage is excellent, but periodic overflow occurs along strips of bottom-land adjacent to streams (Goldston and Gettys, 1956).

Mountain peaks average 5,000 feet elevation. The highest in Tennessee is Clingman's Dome at 6,662 feet. Mount Mitchell in North Carolina is the highest peak east of the Mississippi River at 6,684 feet.

Blue Ridge soils are underlain by sedimentary rock. Much of the area is rich in minerals. During the process of mountain building approximately 200 million years ago, these sedimentary rocks were upheaved into our present mountain ranges. Metamorphism, folding and overthrusting appear to have succeeded each other over a long time. The present form of the mountains and valleys in the Blue Ridge is the result of weathering and stream action (King and Stupka, 1950).

The Great Valley Region, sometimes called the "Hill and Valley Area," is a belt of lowlands lying between the Cumberland Plateau on the northwest and the Great Smoky Mountains on the southeast. The Valley consists of alternate parallel ridges and valleys underlain by

shale and limestone. Soils are quite variable but clay-loams are most common (Morris et al., 1948). Fertile farmlands lie between parallel wooded hills. The highest elevation is 2,100 feet near Bristol, Tennessee; southward the Valley declines to an elevation of 600 feet near Chattanooga, Tennessee. The Valley is not purely a river valley, but one which occurred because it was less resistant to weathering than the surrounding highlands (uplands). Crop collections were made primarily in the northern Valley where elevations are highest.

The Cumberland Plateau is west of the Great Valley in Tennessee. It consists of flattopped mountains and narrow valleys. Most elevations are from 1,500 to 1,800 feet above sea level. Soils here are poorer than those in the other regions. They range from silty to sandy loams and are underlain chiefly by massive sandstone. They produce fair to good forests. Most of Tennessee's coal comes from the Plateau. The Cumberland Mountains occur in the northwest Plateau. These mountains consist of sharp, even-crested sandstone ridges of elevations up to 2,500 feet. They terminate in a steep, rocky escarpment, which forms the northwest rim of the Great Valley (Morris et al., 1948).

II. CLIMATE

Eastern Tennessee and western North Carolina have a temperate climate. Winters are not severe and snow rarely covers the ground for more than a few days at a time. Temperatures in the winter do exhibit sudden changes. Summers are warm by day but are cool at nights in higher elevations. Daytime minimum temperatures of the mountainous

areas in summer average between 65 and 70° F. Average daytime low temperatures in winter are about 36° F. Below freezing temperatures rarely continue more than three to four days in succession. The growing season averages between 140 and 210 days (Goldston and Gettys, 1956).

Precipitation is well distributed throughout all the regions. Average annual precipitation, mostly in the form of rain, is about 50 to 60 inches. Approximately 10 to 20 inches of snow occur annually in eastern Tennessee, whereas in the mountains of northwest North Carolina up to 40 inches occur annually (Morris et., 1948). Tables 1 and 2 present temperature and precipitation data during the period of this study.

For purposes of this study, fall occurs from October through November and winter from December through February. Average monthly differences in temperature and precipitations are given in Table 3. These figures are based on averages of climatological data from representative counties within each land region. It is believed that these data closely approximate the general climate for the respective regions.

It should be noted that late spring and early fall frosts have a more damaging effect on vegetation at lower elevations and in valleys. Late spring freezes can adversely affect mast and fruit production. Retarded spring growth on ridge tops and north-facing slopes prevents some damage in these areas (Leighty, 1956).

III. VEGETATION

The majority of the land in all regions is forested, though the Valley is quite extensively farmed. Upland hardwoods and southern pines

Table 1. Temperature and Precipitation in the Blue Ridge[a] and Plateau[b] Regions of Eastern Tennessee from 1972-74

Month	Temperature--°F.					Precipitation--Inches			
	Average Maximum	Average Minimum	Average	Highest	Lowest	Rain Total	Snow and Sleet Total	Snow and Sleet Max. Depth	Snow and Sleet Date
Blue Ridge									
Oct. 1972	64.7	37.5	51.1	76	15	4.36	0	0	0
Nov.	55.2	29.8	42.5	76	10	3.44	2	0	22
Dec.	54.3	30.7	42.6	70	12	5.21	1	1	27
Jan. 1973	46.3	19.5	32.9	66	-8	2.15	5	5	8
Feb.	46.0	21.6	33.8	65	-3	2.49	Trace	Trace	
Oct.	70.3	38.2	54.3	82	20	5.20	0	0	0
Nov.	60.3	28.4	44.4	74	7	4.13	0	0	0
Dec.	46.3	20.8	33.6	67	-5	5.72	3	6	17
Jan. 1974	55.0	32.8	43.9	70	10	6.16	0	0	0
Plateau									
Oct. 1972	62.8	40.6	51.7	74	25	6.38	0	0	0
Nov.	51.3	34.3	42.8	75	19	1.19	0.7	1	22
Dec.	48.9	31.8	40.4	63	3	-	Trace	Trace	17
Jan. 1973	42.3	22.9	32.6	58	5	4.21	8	7	8
Feb.	44.6	22.7	33.7	60	0	4.05	Trace	0	0
Oct.	71.1	46.5	58.8	80	32	1.86	0	0	0
Nov.	58.7	36.8	47.8	74	18	8.35	0	0	0
Dec.	46.2	25.2	35.7	64	4	6.19	0.2	4	1
Jan. 1974	52.8	34.5	43.7	67	18	10.97	0.0	0	0

[a]Mountain City Weather Station 2, Tennessee. [b]Crossville Weather Station, Tennessee.

Source: U. S. Weather Bureau, 1972, 1973, 1974.

Table 2. Temperature and Precipitation in the Great Valley Region[a] of Tennessee, from 1972-74

Month	Temperature--°F.					Precipitation--Inches			
	Average Maximum	Average Minimum	Average	Highest	Lowest	Rain Total	Snow and Sleet Total	Snow and Sleet Max. Depth	Snow and Sleet Date
Oct. 1972	65.2	40.5	52.9	76	24	5.41	0	0	0
Nov.	53.9	32.5	43.2	72	17	4.39	Trace	Trace	22
Dec.	51.1	32.1	41.6	64	7	7.20	1	Trace	8
Jan. 1973	45.1	21.1	33.1	64	0	2.85	5.3	5	8
Feb.	47.0	20.3	33.7	60	3	2.91	1.1	Trace	18
Oct.	73.1	44.5	58.8	82	28	3.43	0	0	0
Nov.	59.1	32.9	46.0	72	15	9.77	0	0	0
Dec.	47.9	24.0	36.0	66	7	7.14	1.8	1	11
Jan. 1974	53.0	35.8	44.4	68	19	10.28	Trace	0	16

[a]Tazewell Weather Station, Tennessee.

Source: U. S. Weather Bureau, 1972, 1973, 1974.

Table 3. Average Temperature and Precipitation for All Months in Three Land Regions of Eastern Tennessee during 1972

Month	Land Regions									
	Blue Ridge[a]		Plateau[b]				Upper Valley[c]			
	Temp.	Precip.	Temp.	Depart.	Precip.	Depart.	Temp.	Depart.	Precip.	Depart.
January	38.7	5.09	36.3	-0.6	8.68	+2.85	36.7	Not given	8.91	Not given
February	32.3	5.31	34.1	-4.1	5.15	-0.47	33.2	" "	4.84	" "
March	42.8	3.91	43.8	-1.0	5.75	+0.30	42.1	" "	4.51	" "
April	51.4	4.84	55.0	+0.1	5.76	+1.39	52.9	" "	7.59	" "
May	58.7	5.89	60.7	-2.9	3.25	-0.65	60.6	" "	4.40	" "
June	62.8	3.61	65.5	-9.2	4.51	+0.48	65.6	" "	3.72	" "
July	69.5	2.53	70.6	-3.2	5.55	+0.89	72.3	" "	6.12	" "
August	69.2	5.09	70.3	-2.7	1.78	-2.62	72.4	" "	0.76	" "
September	64.7	5.11	67.8	+0.3	5.00	+1.66	68.7	" "	4.24	" "
October	51.1	3.79	51.7	-5.3	6.38	+3.55	52.9	" "	6.12	" "
November	42.5	3.44	42.8	-2.4	5.22	+1.19	43.2	" "	4.39	" "
December	42.5	5.21	40.4	+2.6	9.53	+4.05	41.6	" "	7.20	" "
Annual	52.2	53.82	53.3	-2.0	66.56	+12.56	53.5	" "	62.80	" "

[a]Mountain City Weather Station 2, Tennessee.

[b]Cookeville Experimental Station, Tennessee.

[c]Tazewell Weather Station, Tennessee.

Source: U. S. Weather Bureau, 1972.

are the predominant types. Though these areas are at the southern end of the Appalachian Hardwoods Region, some good quality hardwoods exist. Western North Carolina is composed primarily of the oak (Quercus sp.) and hickory (Carya sp.) forest type, with 50 percent or more of the forest stands in upland oak and hickory. Southern pines (Pinus sp.) make up less than 25 percent. Black gum (Nyssa sylvatica), yellow poplar (Liriodendron tulipifera) and maple (Acer sp.) are common associate trees. Eastern Tennessee is predominantly the oak-pine forest type with 50 percent or more in hardwoods, usually upland oaks, and southern pines make up 25 to 49 percent. Black gum and hickory are common associates (Halls and Stransky, 1971).

Before pioneer settlement, virgin forests existed, but extensive logging in recent times has resulted in second growth forests today. The American chestnut (Castanea dentata) was a dominant timber species in the Applachian Highlands prior to the chestnut blight in the early 1900's.

The Blue Ridge Region has the most contrast in forest composition compared to the other regions. At elevations above 5,000 feet, red spruce (Picea rubens) and Frasier fir (Abeis fraseri) are dominant types. Scattered throughout these zones are treeless areas commonly called grass or heath balds. Other areas known as "laurel slicks" and composed of mountain laurel (Kalmia latifolia) and rhododendron (Rhododendron maximum) occur at highest elevations (King and Stupka, 1950). Most of the spruce and fir types occur in North Carolina. It is thought that a combination of fire, wind and landslides produced the treeless

zones (King and Stupka, 1959). Fire cherry (Prunus pennsylvanicum) is common on burned over mountain forests at high elevations (King and Stupka, 1950).

Beech (Fagus grandifolia), birch (Betula lenta and B. lutea) and red maple (Acer rubrum) occur on moist sites at elevations of 3,000 to 5,000 feet (Korstian, 1962). These same species occur at lower elevations on the Plateau. Scarlet oak (Quercus coccinea), black oak (Q. velutina), and chestnut oak (Q. prinus) are present on good sites on upper mountain slopes. On moist slopes, eastern white pine (Pinus strobus), eastern hemlock (Tsuga canadensis), northern red oak (Q. rubra) and black walnut (Juglans nigra) are scattered throughout (Korstian, 1962). The drier southern slopes are predominantly chestnut oak, hickory, black locust, Virginia pine (Pinus virginiana), and pitch pine (P. rigida). Moist coves consist mainly of yellow poplar, basswood (Tilia americana), maples, hemlock, beech and northern red oak (Korstian, 1962). Abandoned homesteads and cattle pastures are scattered throughout the mountains. Pastures are often overgrown with locust (Robinia pseudoacacia), hawthorne (Crataegus sp.), blackberries (Rubus sp.) and wild rose (Rosa sp.).

Dominant understory vegetation consists mainly of mountain laurel on dry sites and rhododendron on moist northern slopes, flowering dogwood (Cornus florida), tag alder (Alnus serrulata) along streams, sourwood (Oxydendron arboreum), azalea (Rhododendron sp.), and several other members of the family Ericaceae on moist and dry sites (King and Stupka, 1950).

The woodland ridges of the Great Valley consist primarily of the oak-pine forest type. Chestnut oak, scarlet oak and shortleaf pine (P. echinata) occur on the upland soils. Poorer sites are overgrown with Virginia pine in dense stands. On badly eroded soils where limestone is near ground surface, dense stands of red cedar (Juniperus virginianus) occur (Korstian, 1962). Honeysuckle (Lonicera japonica), dogwood, redbud (Cercis canadensis), and sourwood are common understory species. The farmed portion of the Valley is grown to corn (Zea mays), tobacco (Nicotiana tabacum), soybeans (Glycine max) and fescue grasses (Festuca sp.).

The Cumberland Plateau forests are basically similar to those in the Blue Ridge. The Cumberland Plateau is dominated more by Virginia pine and shortleaf pine than the Blue Ridge. Black oak, chestnut oak and hickory are dominant hardwoods.

IV. AGRICULTURAL AND FOREST TRENDS

Forest products are very important to the economy of both Tennessee and North Carolina. Nearly all tree species can be utilized for pulp or sawtimber. Forests occupy 13.1 million acres of the land area of Tennessee. The commercial forest acreage has declined five percent since 1961. Much of this loss was the consequence of farm owners increasing pasture and crop land (Murphy, 1972). The Plateau has experienced more forest conversion than the Blue Ridge.

The Blue Ridge and Plateau Regions have the best pine sites and most acreage, and the trend is toward conversion of hardwoods to

Virginia pine and shortleaf pine. Presently about five million acres are being considered for conversion to pines. The number of small sawmills in Tennessee has declined since 1960 while pulpwood harvest has increased 24 percent (Murphy, 1972).

In western North Carolina hardwood sawtimber predominates. Sawmills are still important to the region. There is less conversion to pines, but where this is the trend, white pines (P. strobus) are planted. Hardwood and softwood pulp mills provide livelihood for many of the mountain people.

In eastern Tennessee corn, wheat and hay are the primary field crops. Corn is grown both for silage and grain. Pasture land for hay and cattle grazing is also important to the economy. Commercial and private apple orchards, tomato fields, and tobacco and strawberries are important farm resources.

To the benefit of grouse, the encroachment on their habitat is not severe yet because extensive forest acreage remains in mountainous areas. Numerous small farms, averaging approximately 70 acres, still possess some woodlands.

CHAPTER III

MATERIALS AND METHODS

I. COLLECTION AND PRESERVATION

Personnel with the Tennessee Wildlife Resources Agency and the North Carolina Wildlife Resources Commission were contacted for assistance in locating potential collectors. Grouse hunters who had participated in other such studies were contacted and asked to provide crops from their kills. Initially it was obvious that collections would not be distributed evenly over the different regions of both states. In order to compare food habits of birds from similar habitat types, some grouping of data from one land region to another was necessary. Consequently, those samples from the northwestern Valley near the Cumberland Mountains were grouped with those from the Cumberland Plateau since the habitat there is characteristic of the Plateau. It is believed that this represents a more realistic interpretation of the results.

Each participant was provided from 20 to 75 collection envelopes each year. The envelopes contained instructions for removing crops, plastic bags, and data cards. Besides the crop, the two central tail feathers and Numbers 9 and 10 primary wing feathers were collected for sexing and aging. The data card contained information on location of kill, date and time of day. Contents of the envelope were frozen. Freezing retained texture and color of vegetable matter.

II. ANALYSIS

Prior to analysis, crops were thawed and allowed to air-dry. In most instances, green material had to be emptied to prevent it from drying to the crop wall. Food items and grit were separated mechanically with forceps and probe. Identification of foods was aided by a reference collection and the following publications: Radford, Ahles and Bell (1964); Martin and Barkley (1961); Harlow (1946); and Justice and Bell (1968). Foods not readily identified were assigned a sample number and placed in sample jars for later identification. A binocular scope and hand lens were used as an aid to identifying small plant parts. Common and scientific names of all foods from this study are listed in the Appendix (Table 19).

The volume of each food group was determined by volumetric water displacement (Martin et al., 1946). Measurements to 0.1 cubic centimeters were possible. Any foods less than this amount were considered as trace (tr.). Percent volume for each food type was derived by the aggregate volume method (Martin et al., 1946). Grit was separated from the food items. Frequency of occurrence and relative frequency were also calculated.

CHAPTER IV

RESULTS AND DISCUSSION

A total of 311 crops was examined for this study (Table 4). A total of 294 crops was collected during October-February of 1972-73 and 1973-74. Seventeen crops collected from December 1969 through February 1970 comprised the remainder. Approximately 50 percent of all crops were from the Blue Ridge Region (156) (Table 4).

Ten crops did not contain food. The volume of food in crops ranged from trace amounts to 102 cubic centimeters.

A total of 59 different plant foods and 5 animal foods were identified. Fifty-two food types were identified in the diet of grouse from the Blue Ridge Region, 35 food items comprised the diet of grouse from the Valley and 39 from the Plateau. The greater variety of plant communities in the Blue Ridge as compared to the other regions probably accounts for the more varied diet of grouse living in that region.

I. REGIONAL COMPARISON OF THE FALL AND WINTER DIET

Principal Foods

Greenbriar (Smilax rotundifolia) was the most important food by volume in the diet of grouse from the Blue Ridge (20.2 percent) and Valley (33.2 percent) Regions (Tables 5 and 6). In the Plateau Region Christmas fern (Polystichum acrostichoides) was the most important food type and comprised 15.5 percent by volume of all foods consumed

Table 4. Number of Grouse Crops Collected by Region, County, and Year in Eastern Tennessee and Western North Carolina, October-February, 1972-1974.

County	1969	1972-1973	1973-1974	Total
NORTH CAROLINA				
Blue Ridge Region				
Buncombe	0	8	0	8
Haywood	0	66	50	116
Jackson	0	8	0	8
Macon	0	3	4	7
Madison	0	2	2	4
Subtotal	0	87	56	143
TENNESSEE				
Blue Ridge Region				
Carter	3	0	0	3
Johnson	0	0	1	1
Monroe	0	0	4	4
Sevier	0	0	5	5
Subtotal	3	0	10	13
Cumberland Plateau and Northwest Valley Region				
Campbell	0	9	9	18
Claiborne	0	5	13	18
Cumberland	0	1	10	11
Grainger	1	0	0	1
Hancock	2	5	0	7
Scott	2	11	3	16
Union	0	0	1	1
Morgan	0	1	5	6
Subtotal	5	32	41	78
Great Valley Region				
Claiborne	1	1	0	2
Grainger	1	0	0	1
Hancock	3	25	31	59

Table 4 (continued)

County	1969	1972-1973	1973-1974	Total
Great Valley Region (continued)				
Hawkins	4	0	1	5
Knox	0	0	2	2
Sevier	0	0	3	3
Sullivan	0	1	0	1
Union	0	0	4	4
Subtotal	9	27	41	77
Grand Totals	17	146	148	311

Table 5. Principal Fall and Winter Foods from Crops of 156 Grouse Collected in the Blue Ridge Region of Eastern Tennessee and Western North Carolina, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol	Times Occur.	% Freq. Occur.	% Rel. Freq.
Greenbriar	267.9	20.2	45	28.9	9.2
Mountain laurel	259.1	19.6	36	23.1	7.3
Christmas fern	108.8	8.2	38	24.2	7.7
Black birch	68.8	5.1	26	16.7	5.3
Cinquefoil	59.1	4.5	37	23.7	7.5
Avens	54.1	4.1	27	17.3	5.5
Unidentified ferns	48.1	3.6	35	22.4	7.1
Grapes	44.0	3.3	11	7.1	2.2
Sheep sorrel	42.7	3.2	10	6.5	2.0
Dogwood	34.3	2.6	9	5.8	1.8
Alumroot	29.2	2.2	19	12.2	3.9
Aster	26.9	2.0	19	12.2	3.9
Unidentified leaves and buds	32.5	2.5	24	15.4	4.9
Hawkweed	18.8	1.4	10	6.5	2.0
Hawthorne	14.4	1.1	6	3.9	1.2
Plantain	13.3	1.0	5	3.2	1.0
Total of all other foods	204.3	15.4	131		27.5

Table 6. Principal Fall and Winter Foods from Crops of 77 Grouse Collected in the Great Valley Region of Eastern Tennessee, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
Greenbriar	95.3	33.2	33	42.9	13.5
Honeysuckle	51.7	18.0	33	42.9	13.5
Christmas fern	33.8	11.8	21	27.3	8.6
Unidentified ferns	13.2	4.6	25	32.5	10.3
Avens	13.1	4.6	20	26.0	8.2
Hawkweed	11.7	4.1	7	9.1	2.9
Cinquefoil	9.2	3.2	12	15.6	4.9
Aster	8.8	3.1	7	9.1	2.9
Sumac	7.1	2.5	5	6.5	2.0
Unidentified leaves and buds	7.7	2.7	17	23.4	7.1
Grape	5.5	1.9	6	7.8	2.5
Partridge berry	4.7	1.6	5	6.5	2.1
Oak	3.0	1.0	1	1.3	0.5
Alumroot	2.8	1.0	4	5.2	1.6
Total of all other foods	21.3	6.7	45	58.4	18.8

(Table 7). Greenbriar comprised 12.2 percent by volume in the Plateau. Greenbriar, unidentified ferns, Christmas fern, cinquefoil, alumroot and aster were important foods in all three regions. Together they comprised 40.7 percent by volume of all foods in the Blue Ridge, 56.9 percent in the Valley, and 40.3 percent in the Plateau.

Other important foods by region in descending order of importance were: (1) Blue Ridge--Mountain laurel, Christmas fern, black birch, cinquefoil (Potentilla canadensis), avens (Geum canadense), unidentified ferns and grape (Vitis sp.); (2) Plateau--Flowering dogwood, mountain laurel, blueberry (Vaccinium sp.), trailing arbutus (Epigaea repens), cinquefoil, alumroot (Heucheria villosa), and mayapple (Podophyllum peltatum); (3) Valley--Honeysuckle, Christmas fern, unidentified ferns, avens, hawkweed (Hieracium sp.), cinquefoil, aster (Aster sp.) and staghorn sumac (Rhus typhina). A more complete tabulation of foods is presented in the Appendix (Tables 20, 21 and 22).

Twenty-nine percent of the Blue Ridge birds, 42.9 percent of the Valley, and 42.3 percent of the Plateau birds had eaten greenbriar.

Greenbriar was the most important fall and winter grouse food in Virginia (Nelson et al., 1938); Ohio (Gilfillan and Bezdek, 1944); and Pennsylvania (Kuhn, 1940). These areas possess habitats similar to those in the Southern Appalachians region.

Greenbriar vines are well distributed in woodlands and overgrown fields and are very productive in open woods. Young thickets generally produce more fruit than the older ones (Nelson et al., 1938). Greenbriar is dioecious and from personal observation of numerous fruitless

Table 7. Principal Fall and Winter Foods from Crops of 78 Grouse Collected in the Cumberland Plateau Region of Eastern Tennessee, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
Christmas fern	78.0	15.5	37	47.4	11.7
Greenbriar	61.4	12.2	33	42.3	10.4
Dogwood	96.3	11.2	10	12.8	3.2
Mountain laurel	52.3	10.4	19	24.4	6.0
Blueberry	26.4	5.2	11	14.1	3.5
Trailing arbutus	19.2	3.8	5	6.4	1.6
Cinquefoil	19.1	3.8	24	30.8	7.6
Alumroot	16.5	3.3	10	12.8	3.2
Mayapple	15.8	3.1	12	15.4	3.8
Aster	13.8	2.8	18	23.1	5.7
Unidentified ferns	13.6	2.7	17	21.8	5.4
Honeysuckle	10.7	2.1	11	14.1	3.5
Blackberry	10.0	2.0	6	7.7	1.9
Wintergreen	8.5	1.7	5	6.4	1.6
Unidentified leaves and buds	12.1	2.5	18	23.1	5.7
Total of all other foods	49.7	17.7	81		25.2

vines in heavily forested mountain areas, it appears likely that male plants dominate older thickets and the later stages of forest succession. The vines are readily accessible to grouse since they commonly grow among shrubs close to the ground. The tardily deciduous leaves are available to grouse throughout the winter. The vines can withstand considerable browsing by deer and cattle and are important in the diet of both animals in some southern woodlands (Halls and Ripley, 1961).

Nine species of ferns were identified in the diet of grouse from all regions. Christmas fern and grapefern (Botrychium dissectum) occurred more frequently and in greater quantities in the diet of grouse than other fern species. Christmas fern ranked third by volume (8.2 percent) and second in occurrence (24.2 percent) in grouse from the Blue Ridge. It was third by volume (11.8 percent) and fourth in occurrence (27.3 percent) in the Valley. In the Plateau, Christmas fern ranked first by volume (15.5 percent) and occurrence (47.4 percent). Other ferns identified in the diet were: blunt-lobed woodfern (Woodsia obtusa), bladder fern (Cystopteris virginianum), beech fern (Thelypteris sp.), rock cap (Polypodium virginianum), lady fern (Athyrium sp.), climbing fern (Lycopodium sp.), and hay-scented fern (Dennstaedtia punctilobula).

The distribution of ferns over a variety of woodland types makes them readily available as a food source. Christmas fern and grapefern occurred over a wider range of vegetation types in the regions studied than other ferns. Since ferns are evergreen, they are available to grouse during the winter when most other low growing vegetation has

died. This is reflected in their greater frequency of use in January and February than in previous months in all regions.

Mountain laurel leaves and buds ranked second (19.6 percent) and fourth (10.4 percent) by volume in the Blue Ridge and Plateau Regions respectively, but only one bird from the Valley had eaten it. Twenty-three percent of the Blue Ridge and 24.4 percent of the Plateau grouse consumed mountain laurel.

Laurel grows best on dry southerly slopes in the woodlands of mountainous areas. It is most abundant in the Blue Ridge and Plateau and occurs only at higher elevations in the Valley (Radford, Ahles, and Bell, 1964). The tough evergreen leaves are available as a food source throughout the winter. Laurel thickets also furnish cover and roosting sites during snow periods.

Another heath, rosebay rhododendron (Rhododendron maximum), is somewhat similar to laurel in growth pattern, except that it more generally occurs on moist northerly slopes and in coves. Rhododendron did not appear in the diet of the grouse examined, but Halls and Ripley (1961) reported that grouse eat the buds and occasionally the leaves and twigs. It is conceivable that during the winter, grouse avoid the colder, wetter sites where rhododendron is most prevalent and thereby do not have access to it as a food. Other heaths, such as azalea, blueberry, trailing arbutus, wintergreen and sourwood, occurred in the diet. These plants are associated with acid soils and occur on generally dry sites.

Basal leaves of cinquefoil were important foods in all regions studied. Cinquefoil was third in occurrence (23.7 percent) in the

Blue Ridge (Table 5, page 22), sixth (15.6 percent) in the Valley (Table 6, page 23) and third (30.8 percent) in the Plateau (Table 7, page 25). Cinquefoil is most prevalent on acid soils of open pastures or farm lands in all regions. Grazing by cattle does not appear to reduce its presence. This plant grows close to the ground and is protected from winter freezes by the leaf litter that covers it.

Black birch was the only tree species constituting an important food source; the leaf buds and staminate catkins were eaten. Birch occurred primarily in the diet of birds from the Blue Ridge and Plateau Regions. In the Blue Ridge, it ranked fourth by volume (5.1 percent) and occurred in 16.7 percent of the grouse. In the Valley it occurred in 10.4 percent of the birds, but was consumed in small volume. In the Plateau it occurred frequently (12.8 percent), but in small amounts.

Birch buds were taken three times more frequently and in larger amounts than birch catkins. Buds are easily taken from seedling trees close to the ground and from stout branches and stems in trees. Feeding on the catkins is accomplished with considerable difficulty since the flowers occur in clusters at the end of slender branches. Svoboda and Gullion (1972) observed grouse feeding on birch and indicated that considerable wing fluttering is necessary for only three bites or less.

Black birch does not occur abundantly in the Valley except at higher elevations. It occurs in extensive stands on the northerly aspects of upper mountain slopes.

Avens was utilized primarily by grouse from the Blue Ridge and Valley Regions; seeds and leaves were eaten (Table 5, page 22). It was

eaten frequently, but usually in small amounts. However, one bird from the Blue Ridge consumed over 2,000 of the small seeds. Grouse in Missouri are reported to feed heavily on the seeds during fall (Korschgen, 1966). The seeds and leaves of avens are readily available to grouse feeding on the ground. The seeds are abundant through the early fall. Basal leaves occur through the winter when they are covered by leaf litter.

Avens is common in ungrazed or overgrown pastures in each region. It occurs on eroded soils of the upper mountainous areas and in lowland fields. Cattle grazing in open woods and overgrown fields may reduce its distribution in these areas.

The leaves and fruits of honeysuckle ranked second by volume (18.0 percent) and occurrence (42.9 percent) in the Valley Region; leaves were utilized much more than fruits. In the Plateau and Blue Ridge Regions, honeysuckle was not significant in the diet.

Honeysuckle vines occur extensively in dense woodlands and open areas in all regions. Honeysuckle is prevalent in the Valley Region and commonly is the dominant ground cover. It is adapted to a variety of soil types and occurs in mountainous as well as lowland forests. The semi-evergreen leaves are available throughout the year but fruits disappear soon after the first fall freeze. The entwining and climbing growth characteristics of honeysuckle make it a good cover as well as a good food for grouse.

Grape was consumed in all regions, but was most important in the diet of birds from the Blue Ridge and Valley Regions.

Flowering doogwood fruits and buds were taken by grouse in all regions, but were significant only in the Plateau Region (11.2 percent by volume).

Dogwood and grape are well distributed in the woodlands of all regions. Production of fruits of both species is good in some years but is not consistent from year to year. The fruits mature in early fall and are eaten by many species of animals. Dogwood flower buds are available from October to early May. Fruit production of grapes was only fair in the fall of 1972, but was good in 1973.

The leaves of alumroot comprised a small part of the diet in all regions. Alumroot plants grow in moist coves and on shaded rock outcroppings near wet areas in the mountainous areas of the Blue Ridge and Plateau Regions primarily. They are usually found on the same sites with Christmas fern. The leaves are available to grouse through the winter.

The leaves of aster also occurred in low but similar amounts in the diet of grouse from all regions. Aster occurs on most land types but is most abundant on open pastures in all regions. Grazing does not appear to reduce its presence. Aster commonly grows in association with cinquefoil, hawkweed and avens.

Hawkweed was utilized primarily by grouse from the Valley where it ranked sixth by volume (4.1 percent) and occurred in 9.1 percent of the grouse. It was relatively unimportant elsewhere. Hawkweed, like aster, occurs on most land types, but is most abundant on open pastures in all regions. Grazing does not appear to reduce its presence. Hawkweed commonly grows in association with cinquefoil and avens.

The berries and evergreen leaves of partridge berry (Mitchella repens) are considered to be important grouse foods in the northern states (Bump et al., 1947). Grange (1948) reported heavy use of the leaves during the fall and winter in Wisconsin. In Virginia, partridge berry ranked tenth by volume among all grouse foods (Nelson et al., 1938). Partridge berry was not as important in the areas represented by this study, contributing less than 2 percent in all areas. Partridge berry grows abundantly in mountain coves and on mountain slopes under rhododendron thickets. It occurs primarily in the Blue Ridge and Plateau Regions. The evergreen leaves are available year round, but the fruits mature in late summer and are not abundant after this time. The fruits are nutritious, being high in nitrogen free extract (Treichler et al., 1947).

The buds and fruits of blueberry were utilized primarily by grouse from the Plateau where they ranked fifth by volume (5.2 percent) and occurred in 14.1 percent of the grouse. Only slight use was recorded in birds from the Valley.

Blueberry occurs in extensive stands on dry woodland sites throughout the Appalachians. Maturation of the fruits occurs in midsummer and the fruits are generally not available in the late fall and winter. Blueberry leaf buds are numerous on individual bushes and are easily reached by grouse feeding from the ground.

The tough leaves of trailing arbutus were eaten by grouse in each region. In the Plateau, arbutus ranked sixth by volume (3.8 percent) and occurred in 6.4 percent of the grouse. The greatest use of arbutus

in the Plateau reflects its abundance in the pine forests in the region. In the Valley and Blue Ridge Regions, it was insignificant. Trailing arbutus, a heath plant, is generally abundant in the groundcover beneath stands of Virginia pine and mountain laurel. It is most prevalent on dry, lower mountain slopes. The tough leaves are available throughout the winter.

Staghorn sumac seeds were important only in the diet of grouse from the Valley Region, ranking ninth by volume (2.5 percent) and occurring in 6.5 percent of the grouse. Sumac seeds were identified in the gizzards of five grouse from the Valley, six from the Blue Ridge, and three from the Plateau. These stony-like seeds may serve as a substitute for rock grit.

Sumac occurs on overgrown fields, along edges of woods and on road-banks in every region. It does not often occur in large stands over extensive areas. The seeds of staghorn sumac are very durable against decay.

Mayapple leaves occurred primarily in the diet of grouse from the Plateau Region where they ranked ninth by volume (3.1 percent) and occurred in 15.4 percent of the grouse. In the Valley they ranked eighteenth by volume (0.5 percent) and occurred in one bird. Mayapple did not occur in grouse from the Blue Ridge.

Mayapple, a fleshy stemmed plant, grows under dense, deciduous hardwood stands. It dies back in late summer but young, green leaves persist under leaf litter.

Most of the principle foods of grouse in the three regions studied were also important in Virginia (Nelson et al., 1938); Pennsylvania

(Kuhn, 1940); New York (Bump et al., 1947); Ohio (Gilfillan and Bezdek, 1944); and Missouri (Korschgen, 1966) where the oak-hickory forests predominate. The diet of grouse in Virginia is compared with the results from this study in Table 8. The most striking difference in the two is the high ranking of acorns in Virginia and their low ranking in all regions of this study. Acorns were found in only four birds from the Plateau and Valley Regions. They occurred in one bird from the Blue Ridge. Acorns amounted to approximately 1.2 percent by volume of all foods in the Plateau and Valley Regions combined. Oak buds amounted to 0.2 percent by volume in the Valley and 0.5 percent in the Plateau. Oak mast production was only fair for both years of this study (Tennessee Wildlife Resources Agency, 1973). Korschgen (1966) reported the importance of acorns in the diet of Missouri grouse and Grange (1948) believed that acorns played a large part in determining the distribution of grouse in Wisconsin.

Plant Parts Consumed

Green material occurred more frequently and in greater volumes in all regions than either fruits, seeds or buds, comprising 62.5, 67.6, and 56.0 percent by volume in the Blue Ridge, Plateau and Valley Regions respectively (Table 9). A large quantity of the green matter came from plants which also provided fruits and seeds to the diet, such as greenbriar, honeysuckle and avens. Every grouse examined contained some green matter in its crop.

Grouse are reported to feed primarily on fruits in the fall (Anonymous, 1963; Svoboda and Gullion, 1972; Grange, 1948; Korschgen,

Table 8. Comparison of Fall and Winter Foods of Ruffed Grouse in Virginia and Western North Carolina and Eastern Tennessee

Food Item	Region					
	Virginia (184 crops)[a]			Eastern Tennessee Western North Carolina[b] (294 crops)		
	Frequency		Volume	Frequency		Volume
	(No.)	(%)	(%)	(No.)	(%)	(%)
Greenbriar	110	59.8	16.3	111	35.0	20.1
Oak	56	30.4	10.6	4	1.3	0.4
Grape	29	15.8	9.0	19	6.1	2.4
Mountain laurel	89	48.4	7.9	56	17.9	14.8
Wintergreen	71	38.6	6.1	5	1.6	0.4
Sheep sorrel	54	29.3	4.9	11	3.5	2.3
Blueberry	84	45.7	4.2	17	5.4	1.7
Rose	74	40.2	3.9	1	0.3	0.7
Ferns	46	25.0	3.5	138	44.2	14.0
Partridge berry	36	19.6	1.9	20	6.4	0.9
Sumac	19	10.3	1.4	8	2.6	0.4
Trailing arbutus	24	13.0	1.2	14	4.5	1.6
Hawthorne	20	10.9	1.1	6	1.9	0.7
Black birch	21	11.4	0.9	44	14.1	3.5
Eastern hophornbeam	7	3.8	0.9	3	1.0	0.0
Avens	23	12.5	0.8	54	17.3	3.3
Stonecrop	26	14.1	0.8	6	1.9	2.1
Alumroot	12	6.5	0.5	33	10.6	2.2
Cinquefoil	55	29.9	0.4	73	23.4	4.1
Blackberry	22	12.0	0.4	17	5.4	1.2
Witchhazel	41	22.3	0.3	7	2.2	0.4
Dogwood	40	21.7	0.3	23	7.4	4.4
Hawkweed	22	12.0	0.1	21	6.7	1.6
Beech	Trace	-	Trace	2	0.6	1.4
Honeysuckle	Trace	-	Trace	47	15.1	3.0

[a]Nelson et al., 1938.

[b]Volumes and occurrences computed by combining data for the Blue Ridge, Great Valley and Cumberland Plateau.

Table 9. Comparison of Total Volumes and Relative Frequency of Fall and Winter Food Types of Grouse in Eastern Tennessee and Western North Carolina, October-February, 1972-1974

Food Type	Volume		Frequency	
	(cc)	(%)	Times Occur.	% Rel. Freq.
Blue Ridge				
Green matter	828.0	62.5	346	70.9
Fruits	367.0	27.7	67	14.3
Buds and Catkins	118.0	8.9	56	11.5
Animal	5.6	0.4	10	2.1
Grit	6.9	0.5	6	1.2
	1325.5	100.0	488	100.0
Cumberland Plateau and Northwest Valley				
Green matter	340.3	67.6	245	77.3
Fruits	111.8	22.2	29	9.2
Buds and Catkins	45.7	9.1	37	11.7
Animal	3.9	0.8	3	0.9
Grit	1.7	0.3	3	0.9
	503.4	100.0	317	100.0
Valley				
Green matter	161.3	56.0	176	72.7
Fruits	121.6	42.3	45	18.6
Buds and Catkins	4.0	1.4	14	5.8
Animal	0.4	0.1	2	0.8
Grit	0.6	0.2	5	2.1
	287.9	100.0	242	100.0

1966; and Bump et al., 1947). Fruits ranked second by volume in each region for the fall and winter season. The fruit and seed group comprised 42.3, 22.2 and 27.7 percent by volume in the Valley, Plateau and Blue Ridge. Fruits were eaten primarily in October and November in each region except the Valley (Table 10). One bird collected in September from the Plateau had eaten large quantities of blueberry and dogwood fruits. A single bird from the Blue Ridge consumed over 400 greenbriar berries and another had eaten approximately 2,400 avens seeds.

In the northern and central states grouse are reported to feed primarily on buds and flowers from hardwood trees in late winter. Svoboda and Gullion (1972) and Gullion (1966) indicated that Minnesota grouse must have access to flower buds of aspens in the winter for their survival. Buds and catkins comprised approximately 9.0 percent by volume of the diet of grouse from the Blue Ridge and Plateau Regions, but only 1.4 percent in the Valley (Table 9). Black birch and blueberry buds were the most common types eaten. Bud-picking occurred in every month. A single grouse consumed over 430 black birch buds in the fall of 1972.

II. SEASONALLY IMPORTANT FOODS

The monthly differences in the volumes and occurrences of the principal foods are presented in Tables 11 and 12. The ranking of twelve principal foods for each month is presented in Table 13.

Table 10. Comparison of the Importance of Fruits[a] by Month and Region in Eastern Tennessee and Western North Carolina (Figures by Percent Volume)

Month	Blue Ridge	Plateau	Valley
October	17.7	46.2	0.0
November	35.1	41.0	22.0
December	13.8	15.2	24.3
January	15.4	8.5	14.4
February	2.0	1.1	7.0

[a]Fruits used to compute volumes were dogwood, greenbriar, grape, bittersweet, hawthorne, blueberry, partridge berry and honeysuckle.

Table 11. Monthly Comparisons by Region of Principal Fall and Winter Foods of Grouse in Eastern Tennessee and Western North Carolina, October-February, 1972-1974 (Figures by Percent Total Volume)

Food Item	Oct.	Nov.	Fall	Dec.	Jan.	Feb.	Winter
Blue Ridge							
Greenbriar	7.0	31.1	28.3	18.4	21.1	4.1	14.9
Mountain laurel	5.0	6.8	6.6	44.4	21.2	15.1	28.2
Christmas fern	-	2.1	1.9	4.0	12.2	23.2	12.5
Black birch	-	6.7	5.9	4.0	8.2	2.1	4.8
Cinquefoil	6.6	3.3	3.6	4.9	3.5	6.7	5.0
Avens	0.8	2.5	2.3	3.8	8.9	3.5	4.4
Unidentified ferns	-	3.3	2.9	2.6	2.9	7.3	4.1
Grapes	10.0	7.8	8.1	-	0.6	-	0.2
Sheep sorrel	-	1.0	0.9	3.3	4.0	7.4	4.8
Dogwood	53.9	0.4	6.5	0.1	-	-	0.0
Alumroot	3.3	2.0	2.1	1.5	2.4	2.4	2.0
Aster	1.0	0.5	0.5	2.8	1.3	5.2	3.1
Unidentified leaves and buds	-	1.9	1.7	2.4	1.2	2.0	1.9
Hawkweed	-	0.5	0.5	1.4	0.6	4.3	2.1
Trailing arbutus	-	1.6	1.4	1.0	-	-	0.4
Blueberry	-	1.1	1.0	-	1.3	1.0	0.7
Partridge berry	-	9.1	5.0	0.6	0.5	2.8	1.2
Honeysuckle	-	0.1	0.1	-	0.1	0.1	0.1
Sumac	-	-	0.0	-	-	0.1	0.0
Plateau							
Greenbriar	-[a]		-	28.0	7.9	6.3	11.6
Mountain laurel	-		-	-	4.0	16.4	10.1
Christmas fern	-		-	1.7	25.8	17.0	14.6
Black birch	-		-	-	1.6	0.5	0.6
Cinquefoil	-		-	0.3	8.1	2.9	3.4
Avens	-		-	2.0	0.5	-	0.6
Unidentified ferns	-		-	0.8	3.0	3.2	2.6
Grapes	-		-	1.5	-	-	0.3
Sheep sorrel	-		-	-	-	1.8	1.0
Dogwood	82.5		82.5	3.2	8.0	0.2	2.4
Alumroot	-		-	1.3	43.7	3.8	14.9
Aster	-		-	5.7	3.8	3.1	3.8
Unidentified leaves and buds	0.2		0.2	0.5	0.8	21.4	14.3
Hawkweed	-		-	-	3.0	1.0	1.2

Table 11 (continued)

Food Item	Oct.	Nov.	Fall	Dec.	Jan.	Feb.	Winter
Trailing arbutus	-		-	15.5	-	0.3	3.7
Blueberry	9.6		9.6	14.3	0.2	1.2	4.0
Partridge berry	-		-	-	0.3	-	0.6
Honeysuckle	-		-	4.3	-	1.7	2.0
Sumac	-		-	1.3	0.1	-	0.3
Valley							
Greenbriar		38.5	38.5	38.3	26.9	12.4	30.2
Mountain laurel		1.0	1.0	-	-	-	-
Christmas fern		10.0	10.0	-	13.2	60.6	12.7
Black birch		0.6	0.6	1.0	0.7	-	0.8
Cinquefoil		5.2	5.2	0.1	3.7	0.6	2.1
Avens		6.9	6.9	5.0	2.5	-	3.2
Unidentified ferns		3.5	3.5	1.7	6.1	-	5.2
Grapes		0.8	0.8	5.5	0.8	14.2	2.5
Sheep sorrel		-	-	-	-	-	-
Dogwood		2.0	2.0	0.4	0.4	-	0.4
Alumroot		0.8	0.8	2.6	0.2	-	1.1
Aster		3.7	3.7	1.4	4.8	-	3.1
Unidentified leaves and buds		1.5	1.5	1.8	2.4	4.9	2.4
Hawkweed		-	-	2.8	8.8	4.2	5.7
Trailing arbutus		2.0	2.0	-	0.3	-	0.2
Blueberry		-	-	-	-	-	-
Partridge berry		3.9	3.9	-	0.7	-	0.4
Honeysuckle		6.3	6.3	32.4	24.5	3.1	25.6
Sumac		4.4	4.4	2.8	0.3	-	1.2

[a]Numbers in this column indicate a combined reading for October and November.

Table 12. Monthly Comparisons by Region of Principal Fall and Winter Foods of Grouse in Eastern Tennessee and Western North Carolina, October-February, 1972-1974 (Figures by Percent Occurrence)

Food Item	Oct.	Nov.	Fall	Dec.	Jan.	Feb.	Winter
Blue Ridge							
Greenbriar	22.2	41.3	38.2	15.0	32.4	25.0	23.8
Mountain laurel	12.5	15.2	16.4	27.5	16.2	45.8	27.7
Christmas fern	-	15.2	12.7	15.0	24.3	62.5	29.7
Black birch	-	15.2	12.7	22.5	18.9	12.5	18.8
Cinquefoil	12.5	6.5	9.1	30.0	24.1	50.0	32.7
Avens	12.5	8.7	10.9	17.5	32.4	12.5	21.8
Unidentified ferns	-	19.6	16.4	17.5	27.0	41.7	26.7
Grapes	12.5	19.6	20.0	-	2.7	-	1.0
Sheep sorrel	-	6.5	5.5	10.0	2.7	8.3	6.9
Dogwood	50.0	8.7	14.6	2.5	-	-	1.0
Alumroot	25.0	17.4	18.2	7.5	10.8	8.3	8.9
Aster	12.5	8.7	10.9	12.5	10.8	20.8	13.9
Unidentified leaves and buds	-	15.2	12.7	2.2	13.5	8.3	7.9
Hawkweed	-	6.5	5.5	7.5	5.4	8.3	6.9
Trailing arbutus	-	4.3	3.6	2.5	-	4.2	2.0
Blueberry	-	5.1	3.6	-	8.1	4.2	4.0
Partridge berry	-	5.1	3.6	10.0	5.4	8.3	7.9
Honeysuckle	-	2.6	1.8	-	2.7	4.2	2.0
Sumac	-	-	0.0	-	-	4.2	1.0
Plateau							
Greenbriar	-[a]		-	89.1	41.2	32.7	40.8
Mountain laurel	-		-	-	11.8	32.7	23.7
Christmas fern	-		-	10.0	70.6	51.0	50.0
Black birch	-		-	-	23.5	12.2	13.2
Cinquefoil	-		-	40.0	29.4	30.6	31.4
Avens	-		-	30.0	11.8	-	6.5
Unidentified ferns	-		-	20.0	35.3	18.4	22.6
Grapes	-		-	20.0	-	-	2.6
Sheep sorrel	-		-	-	-	2.0	1.3
Dogwood	50.0		50.0	30.0	23.5	2.0	10.5
Alumroot	-		-	10.0	11.8	12.2	11.8
Aster	-		-	30.0	17.6	24.4	23.7
Unidentified leaves and buds	50.0		50.0	20.0	5.9	24.4	19.7
Hawkweed	-		-	-	23.5	2.5	6.6

Table 12 (continued)

Food Item	Oct.	Nov.	Fall	Dec.	Jan.	Feb.	Winter
Trailing arbutus		-	-	20.0	-	6.1	6.6
Blueberry		50.0	50.0	40.0	5.9	10.2	13.2
Partridge berry		-	-	-	5.9	-	1.3
Honeysuckle		-	-	70.1	-	6.3	13.2
Sumac		-	-	10.0	5.9	-	2.6
Valley							
Greenbriar	-	39.1	39.1	33.3	46.9	75.0	44.4
Mountain laurel	-	4.4	4.4	-	-	-	-
Christmas fern	-	2.1	2.1	-	34.4	75.0	25.9
Black birch	-	13.0	13.0	11.1	9.4	-	9.3
Cinquefoil	-	13.0	13.0	5.6	18.8	25.0	14.8
Avens	-	43.5	43.5	27.8	31.3	-	27.8
Unidentified ferns	-	34.8	34.8	16.7	37.5	50.0	31.5
Grapes	-	8.7	-	11.1	6.3	-	-
Sheep sorrel	-	-	4.4	-	-	-	5.6
Dogwood	-	4.4	4.4	5.6	6.3	-	5.6
Alumroot	-	4.4	17.4	11.1	3.7	-	11.1
Aster	-	17.4	8.7	5.6	15.6	-	22.2
Unidentified leaves and buds	-	8.7	-	16.7	21.9	50.0	22.0
Hawkweed	-	-	13.0	16.7	21.9	50.0	1.9
Trailing arbutus	-	13.0	-	-	3.1	-	-
Blueberry	-	-	17.4	-	-	-	1.9
Partridge berry	-	17.4	34.8	-	3.1	-	50.0
Honeysuckle	-	34.8	13.0	38.9	59.4	25.0	3.7
Sumac	-	13.0		5.6	3.1	-	

[a]Numbers in this column indicate a combined reading for October and November.

Table 13. Twelve Principal Foods of Grouse by Month and Region in Eastern Tennessee and Western North Carolina (Based on Percent Volume and in Descending Order of Importance)

October	November	December	January	February	Fall	Winter
Blue Ridge						
(9)	(46)	(40)	(37)	(24)	(55)	(101)
Dogwood	Greenbriar	Mtn. laurel	Mtn. laurel	Christmas fern	Greenbriar	Mtn. laurel
Grape	Grape	Greenbriar	Greenbriar	Mtn. laurel	Grapes	Greenbriar
Greenbriar	Mtn. laurel	Cinquefoil	Christmas fern	Sheep sorrel	Mtn. laurel	Christmas fern
Cinquefoil	Black birch	Black birch	Avens	Ferns	Dogwood	Cinquefoil
Mtn. laurel	American beech	Christmas fern	Black birch	Cinquefoil	Partridge berry	Black birch
Alumroot	Cinquefoil	Avens	Poison ivy	Aster	Black birch	Sheep sorrel
Aster	Ferns	Sheep sorrel	Sheep sorrel	Hawkweed	Cinquefoil	Avens
Katydid (insect)	Avens	Ferns	Ferns	Stonecrop	Ferns	Ferns
Caterpillar (insect)	Christmas fern	Aster	Alumroot	Clover	Avens	Aster
Strawberry bush	Alumroot	Unidentified leaves	Aster	Partridge berry	Alumroot	Hawkweed
Hophornbeam	Hawthorne	Alumroot	Unidentified leaves	Plantain	Christmas fern	Alumroot
Bittersweet	Unidentified leaves	Hawkweed	Blueberry	Unidentified leaves	Unidenti-fied leaves	Unidenti-fied leaves

Table 13 (continued)

October	November	December	January	February	Fall	Winter
Cumberland Plateau						
(2)		(10)	(17)	(49)	(2)	(76)
Dogwood[a] Blueberry Plant gall Beggarweed Stinkbug (insect) Unidentified leaves		Greenbriar Trailing arbutus Blueberry Azalea Aster Mayapple Honeysuckle Dogwood Oak Pussytoes Avens Christmas fern	Alumroot Christmas fern Cinquefoil Dogwood Greenbriar Mayapple Mtn. laurel Aster Wintergreen Pine Hawkweed Ferns	Unidentified leaves Christmas fern Mtn. laurel American beech Alumroot Aster Ferns Cinquefoil Blackberry Bittersweet Honeysuckle Wintergreen	Dogwood Blueberry Plant gall Beggar lice Stinkbug Unidentified leaves	Alumroot Christmas fern Unidentified leaves Greenbriar Mtn. laurel Blueberry Aster Trailing arbutus Cinquefoil Ferns Dogwood Honeysuckle

Table 13 (continued)

October	November	December	January	February	Fall	Winter
Great Valley						
(0)	(23)	(18)	(32)	(4)	(23)	(76)
No crops collected	Greenbriar Christmas fern Avens Honeysuckle Cinquefoil Sumac Aster Partridge berry Ferns Oak Blackberry Dogwood	Greenbriar Honeysuckle Grape Avens Hawkweed Sumac Alumroot Unidentified leaves Ferns Aster Bunch flower Black birch	Greenbriar Honeysuckle Christmas fern Hawkweed Aster Cinquefoil Ferns Avens Unidentified leaves Mayapple Partridge berry Cinquefoil	Christmas fern Greenbriar Unidentified leaves Honeysuckle Cinquefoil	Greenbriar Christmas fern Avens Honeysuckle Cinquefoil Sumac Partridge berry Aster Ferns Dogwood Trailing arbutus Unidentified leaves and buds	Greenbriar Honeysuckle Christmas fern Hawkweed Ferns Avens Aster Grape Unidentified leaves Cinquefoil Sumac Alumroot

[a]Foods identified in this column represent a combined collection during the months of October and November.

Fall (October-November)

Blue Ridge. Fifty-five crops were collected during the fall from the Blue Ridge Region over the two year period. The majority of the crops (46) were collected in November.

Greenbriar was the most important food in the fall, comprising 28.3 percent by volume (Tables 11 and 12).

Grape occurred in 20.0 percent of the birds and comprised 8.1 percent by volume of all foods in the fall (Tables 11 and 12).

The fruits and buds of dogwood occurred in 14.6 percent of the birds and comprised 6.5 percent by volume of all foods taken.

Mountain laurel, which is quite abundant in the Blue Ridge, comprised 6.6 percent by volume in the fall. It occurred in 16.4 percent of the birds. Mountain laurel gained importance in the diet from late fall to winter.

Black birch comprised 5.9 percent of all foods during the fall in the Blue Ridge. It occurred in 12.7 percent of the fall birds.

Partridge berry was not frequently consumed, but comprised 5.0 percent by volume. It was present in the fall diet only in November.

Alumroot did not occur in significant volume but occurred in 18.2 percent of the grouse (Tables 11 and 12). Alumroot was more important in the diet during the fall than in the winter.

Plateau. Only two crops were collected during the fall season in the Plateau. Dogwood fruits comprised 82.5 percent and blueberry fruits 9.6 percent by volume. Insects comprised the remaining 7.9 percent.

Valley. Twenty-three crops were collected in November for the two years of the study. None was collected in October.

Greenbriar was the primary food in the Valley during the fall, when it occurred in 39.1 percent of the grouse and comprised 38.5 percent by volume of all fall foods.

Christmas fern comprised 10.0 percent by volume but occurred in small numbers of grouse during the fall. Christmas fern was increasingly more important in the diet from fall to winter.

Avens was more important in the diet in the Valley during the fall than the winter. It was not consumed in large quantities (6.9 percent by volume) but occurred in 43.5 percent of the birds.

Honeysuckle comprised 6.3 percent by volume and occurred in 34.8 percent of the grouse during the fall. Honeysuckle fruits occurred more frequently in the fall diet than leaves.

Cinquefoil occurred in 13.0 percent of the birds, comprising 5.2 percent by volume of all fall foods.

Winter (December-February)

Blue Ridge. A total of 101 crops was collected in the Blue Ridge Region during the winter; 40 crops were collected in December, 37 in January, and 24 in February. Mountain laurel increased in importance as a food from fall to winter (Table 11, page 38). It was the primary food during winter. Mountain laurel occurred in 27.7 percent of the birds and comprised 28.2 percent by volume of all foods in winter.

Greenbriar continued to be an important food in winter, when it comprised 14.9 percent by volume and occurred in 23.8 percent of the birds (Table 11, page 38).

Christmas fern was not an important food during the fall, but increased in importance throughout the winter when it occurred in 29.7 percent of the birds. It comprised 12.5 percent by volume.

Cinquefoil occurred more frequently in the winter diet than any other food, but comprised only 5.0 percent by volume. It was more frequently taken in winter than fall but amounts consumed were similar for both seasons.

Black birch was consumed more frequently in winter than fall but amount consumed was slightly less in winter (Table 11). Several species of birch, including black birch, are preferred grouse foods in the northeastern United States (Judd, 1905; Terrill, 1924; Johnson, 1928; and Bump et al., 1947). Edwards (1957) reported heavy use of black birch by grouse in North Carolina.

Other foods which were unimportant in fall but important in winter were avens and sheep sorrel. Avens comprised 4.4 percent by volume and sheep sorrell, 4.8 percent.

Plateau. Seventy-six crops were collected during the winter in the Cumberland Plateau; 49 of these were taken in February.

Alumroot was the most important food in the winter diet in the Plateau. Alumroot leaves occurred in 11.8 percent of the birds and comprised 14.9 percent by volume of all winter foods.

Christmas fern increased in importance during winter when it occurred in 50.0 percent of the birds and comprised 14.6 percent by volume.

Greenbriar declined in use from early to late winter, but maintained its importance as a winter food (Table 11, page 38). It occurred in 40.8 percent of the birds and comprised 11.6 percent by volume. The lower volume in February as compared to previous months may have resulted from decreased availability of the fruits.

Mountain laurel was not present in the fall diet but comprised 10.1 percent by volume during the winter. It increased in importance in the diet from early to mid-winter.

Blueberry buds declined in importance from December through February (Tables 11 and 12, pages 38 and 40), but were present in 13.2 percent of the birds during winter. Blueberry fruits were not present in the diet during winter.

Other important foods during winter were aster (3.8 percent by volume), trailing arbutus (3.7 percent) and cinquefoil (3.4 percent).

Valley. Fifty-four crops represented the winter collections from the Valley Region; 18 crops were collected in December, 32 in January, and 4 in February.

Greenbriar continued to be the most important food during winter in the Valley. A decrease in amount consumed was evident from early to late winter (Table 11) but frequency increased (Table 12). The decline in amount consumed might reflect decreased availability of

fruits. The leaves and fruits of greenbriar comprised 30.2 percent by volume and occurred in 44.4 percent of the birds during winter.

Honeysuckle increased significantly in importance from fall to winter. The leaves occurred in 50.0 percent of the birds and comprised 25.6 percent by volume of all winter foods. Honeysuckle leaves rather than fruits were most important in the winter.

Christmas fern increased in importance in the diet from fall to winter in the Valley. This fern comprised 12.7 percent by volume and was present in 25.9 percent of the birds.

Hawkweed, unimportant in the fall diet, comprised 5.7 percent by volume and occurred in 22.0 percent of the birds during winter. Hawkweed increased in occurrence from early to late winter (Table 12, page 41).

III. CLIMATIC FACTORS RELATED TO THE DIET

Yearly Differences in the Diet

A comparison of the diet for each year in the regions studied revealed some differences, but most of the primary foods remained important both years.

Blue Ridge. Greenbriar and mountain laurel were consistently the most important foods each year. Greenbriar declined from 24.3 percent in 1972-73 to 11.3 percent in 1973-74, while mountain laurel increased in importance from the first year (17.3 percent) to the second (24.5 percent (Table 14). Christmas fern was important in the diet both years, but decreased approximately 50.0 percent in volume and occurrence the second year.

Table 14. Comparison of Important Foods of Grouse by Region and Year in Eastern Tennessee and Western North Carolina, October-February, 1972-1974 (Figures by Percent)

Food Item	1972-73						1973-74					
	Blue Ridge		Plateau		Valley		Blue Ridge		Plateau		Valley	
	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.	Vol.	Occ.
Greenbriar	24.3	36.9	9.3	38.2	53.1	85.2	11.3	23.7	13.5	48.8	10.4	22.2
Christmas fern	9.9	34.5	26.0	44.1	15.2	48.2	4.5	15.3	10.9	53.7	7.9	17.8
Mountain laurel	17.3	26.2	12.0	23.5	-	-	24.5	23.7	9.7	26.8	0.8	2.2
Cinquefoil	4.0	21.4	5.4	20.6	1.9	14.8	5.5	32.2	3.1	41.5	4.7	13.3
Avens	3.5	14.3	0.1	2.9	1.7	22.2	5.4	25.4	0.8	14.6	7.9	42.2
Unidentified fern	3.7	17.9	1.8	20.6	3.9	25.9	3.0	30.0	3.0	22.0	2.0	13.3
Dogwood	3.8	9.5	0.7	8.8	-	-	-	-	15.7	17.1	2.0	6.7
Grape	2.7	7.1	-	-	0.5	7.4	4.7	8.5	0.5	4.9	3.5	6.7
Black birch	6.7	17.9	1.9	29.4	0.8	11.1	1.0	18.6	-	-	0.5	11.1
Hawkweed	0.6	4.8	2.4	11.8	2.6	11.1	3.3	10.2	-	-	5.8	11.1
Alumroot	2.5	16.7	6.5	8.8	0.7	7.4	1.1	8.5	1.9	17.1	1.3	4.4
Trailing arbutus	-	-	-	-	-	-	2.8	8.5	5.5	12.2	1.7	8.9
Honeysuckle	-	-	2.4	5.9	8.6	40.7	0.1	2.4	2.0	19.5	28.3	46.7
Blueberry	0.8	3.6	2.4	8.8	-	-	0.7	5.1	6.5	19.5	-	-
Aster	1.6	10.7	3.2	11.8	2.6	7.4	2.9	17.0	2.5	34.2	4.2	17.8
Sheep sorrel	1.4	7.1	-	-	-	-	7.3	6.8	1.5	2.4	-	-
Plantain	0.8	4.8	-	-	-	-	1.4	1.7	-	-	-	-
Sumac	-	-	-	-	1.8	11.1	-	-	0.4	2.4	3.0	4.4
Partridge berry	-	-	-	-	-	-	2.4	17.0	0.9	12.2	3.5	11.1

Low-growing plants such as hawkweed, aster, plantain, cinquefoil, sheep sorrel and avens increased in importance the second year. The greater importance of these foods the second year may be attributed to their increased availability, because snows occurred less frequently the second year as compared to the first year.

Partridge berry and trailing arbutus did not occur in the diet the first year, but the second year they comprised 2.4 percent and 2.8 percent by volume, respectively.

The occurrence of black birch in the diet was similar for each year, but its proportion in the diet declined from 6.7 percent in 1972-73 to 1.0 percent in 1973-74. A colder winter the first year with considerably more snow than the second year apparently forced grouse to feed more heavily on birch buds and catkins. Grouse from other northern states are reported to feed heavily on birch buds during colder weather (Svoboda and Gullion, 1972; and Grange, 1948).

Dogwood was important in the diet the first year when it comprised 3.8 percent by volume and occurred in 9.5 percent of the birds (Table 14). It was absent from the diet the second year. Late spring freezes in 1973 were thought to have damaged dogwood blooms which resulted in lowered fruit production in 1973.

Plateau. Greenbriar, Christmas fern and mountain laurel remained the most important foods for both years. Greenbriar increased in importance from 9.3 percent by volume (1972-73) to 13.5 percent (1973-74); mountain laurel declined from 12.0 percent (1972-73) to 9.7 percent (1973-74); and Christmas fern, the primary food the first year (26.0

percent), declined to 10.9 percent the second year, although its occurrence was higher that year (Table 14, page 50).

Dogwood increased in importance from 0.7 percent (1972-73) to 15.7 percent (1973-74). It also occurred more frequently in the diet the second year (Table 14). Dogwood buds occurred more frequently than fruits in the diet but did not comprise as large quantities as did fruits. If the fruits are excluded from the data, dogwood bud consumption was nearly equal for both years.

Blueberry increased from 2.4 percent by volume (1972-73) to 6.5 percent (1973-74). Large quantities of fruits were present in two crops in the fall, 1973, but the remainder of the crops contained only leaf buds.

Alumroot, cinquefoil and aster were important foods each year. The volume of each declined slightly the second year, but they increased in occurrence the same year.

Hawkweed was absent from the diet the second year, but was important the first year when it comprised 2.4 percent by volume and occurrence in 11.8 percent of the birds. Conversely, trailing arbutus was absent from the diet the first year but was an important food the second year (Table 14).

Valley. Greenbriar, honeysuckle and Christmas fern were primary foods each year in the Valley. Greenbriar decreased from 53.1 percent (1972-73) to 10.4 percent (1973-74), while honeysuckle increased in importance from 8.6 percent (1972-73) to 28.3 percent (1973-74). Honeysuckle fruits occurred in the diet only during the second year.

Christmas fern decreased from 15.2 percent (1972-73) to 7.9 percent (1973-74).

As Christmas fern and greenbriar decreased in importance the second year, avens, cinquefoil, hawkweed, aster and sumac gained importance (Table 14, page 50). Partridge berry, absent from the diet the first year, was an important food the second year when it comprised 3.5 percent by volume.

Diet During Snow Periods

During periods of deep snow cover, grouse must seek food in trees. Arboreal feeding is mainly one of bud or flower picking. Important to their winter survival in most northern areas is the quality and depth of snow. At least in the northern states, adequate "snow burrows" are believed to be essential to their overwinter survival (Gullion, 1970).

In this study, snow did not occur in great enough amounts to severely limit ground feedings, especially in the Valley Regions (Tables 1 and 2, pages 10 and 11). Snow, averaging about four inches deep on the ground, and lasting from one to several days, occurred in only twenty days for all regions studied. This is reflected by the high percent of green material in the crops of birds collected during the light snow periods. However, buds and catkins of black birch were the most frequently consumed foods in the Blue Ridge and Plateau Regions during snow periods (Table 15). It appears that grouse in both regions rely on birch when other foods are not available because of snow cover. The high percentage of laurel consumed by grouse in the Plateau and Blue Ridge Regions during snows reflects the importance of laurel thickets

Table 15. Occurrence of Grouse Foods from 22 Crops Collected during Snow Periods, October-February, 1972-1974

Food Item	Region		
	Blue Ridge (7)	Plateau (5)	Valley (10)
Black birch	7	3	1
Mountain laurel	2	1	0
Greenbriar	3	2	4
Grape	1	0	1
Beech	1	0	0
Alumroot	1	0	0
Christmas fern	1	3	4
Grapefern	2	3	0
Dogwood	1	1	1
Partridge berry	1	0	0
Blackberry	1	3	0
Avens	1	1	0
Wintergreen	0	1	0
Sumac	0	1	0
Cinquefoil	0	1	0
Violet	0	1	0
Honeysuckle	0	1	5

as good shelter and food. Snow depth under laurel thickets is generally less than in surrounding areas. In the Valley, the diet of grouse during snow periods was similar to the diet during milder days, when honeysuckle, greenbriar and Christmas fern were the most important foods.

IV. FEEDING SITES

Availability of certain food plants determines somewhat the extent to which these foods appeared in the diet. The land types where some of the important foods appear more abundant listed in Table 16. This information was not derived by vegetation sampling procedures, but from field inspection of areas where grouse were collected in each region.

Examination of the frequency of occurrence of many important foods helped to make some inferences as to the nature of the feeding sites used by grouse. Many of the low-growing forbs found in the diet are most prevalent in open pastures, abandoned farmland and fruit orchards bordering woodlands. These open land types are most numerous in the mountainous sections of the Appalachians. During the fall and winter, grouse prefer these types, especially when woodlands are nearby. Open land adjacent to pine and laurel thickets are particularly attractive.

Three open land types are interspersed throughout the mountains. Descriptively, they are: (1) abandoned apple orchards; (2) open, grazed pastures with scattered locust and hawthorne patches; and (3) brushy, ungrazed pasture or pasture reverting to brushland. Plants

Table 16. Land Types, Slope Aspect, Site Conditions and Occurrence in the Diet of Some Grouse Foods in Eastern Tennessee and Western North Carolina

Plant	% Occurrence[a]	Plant	% Occurrence
Mountains-North Slopes		**Pasture and Fields**	
Black birch	14.1	Cinquefoil	23.4
Alumroot	10.6	Aster	14.2
Beech	1.4	Avens	17.3
Stonecrop	1.9	Hawkweed	6.7
Bittersweet	0.2	Sheep sorrel	3.5
Serviceberry	0.5	Dock	0.6
Ferns	44.2	Rose	0.3
Azalea	0.6	Hawthorne	1.9
Valleys and Hollows		**Mountains-South Slopes**	
Sheep sorrel	3.5	Greenbriar	35.0
Hawthorne	1.9	Trailing arbutus	4.5
Dock	0.6	Mountain laurel	17.9
Honeysuckle	15.1	Viburnum	0.2
Cinquefoil	23.4	Blueberry	5.4
Dogwood	7.4	Wintergreen	1.6
Aster	14.2	Cinquefoil	23.4
Hawkweed	6.7		
Mountain Coves		**Multisites**	
Dogwood	7.4	Fern	44.2
Fern	44.2	Greenbriar	35.0
Mayapple	1.2	Dogwood	7.4
Bunch flower	0.3	Honeysuckle	15.1
Partridge berry	0.9	Grape	6.1
Alumroot	10.6		

[a]Based on compilation of occurrence of foods in Blue Ridge, Cumberland Plateau and Great Valley.

such as avens, cinquefoil, sheep sorrel, aster, hawkweed and alumroot are very abundant on the three types listed above. Since most of these plants were frequently taken in all regions, it appears that these open areas warrant some management consideration. Sharp (1970) stressed the importance of discontinuous land types for grouse. He emphasized that mountainous regions in colonial times had areas of grasses and forbs interspersed among the forests, and that grouse responded favorably to these conditions. Ruffed grouse management in North Carolina (Hazel, 1953) and parts of Virginia (Richards, 1959) is directed toward the establishment of permanent openings.

V. NUTRITION

"Virtually no fruit or seed is totally indigestible to grouse" (Korschgen, 1966), and their capacity for browsing helps alleviate severe nutritional problems. However, only recently has the influence of winter food supply on year to year trends in grouse numbers been documented by researchers. Gullion (1970) determined that access to staminate flower buds of quaking and big-toothed aspens largely determines the presence or absence of breeding grouse each spring in northern Minnesota.

Evidence that grouse do select the most nutritious foods during times of environmental stress has been discussed. Stollberg and Hine (1952) compared composition of trees in woodlands and their occurrence in grouse diets and found that certain tree species ranked high as a food source but low in overstory density. In Minnesota, grouse appear

to select aspen buds first in the uppermost branches and gradually work down as the buds are depleted. The energy content of buds in the upper canopy are higher than in the lower buds. By comparing the nutrient content of aspen buds from different trees on the same sites, it was determined that the grouse were using the trees having the richer levels of nutrients (Svoboda and Gullion, 1972). Determining preferential use of highly nutritious food resources was beyond the scope of this study, but one observation can be made. The male catkins and leaf buds of black birch were frequently taken during the colder winter periods with snow present. Korschgen (1966), Bump et al. (1947), and Gullion (1966) indicated that birch buds are high in organic and mineral content.

Table 17 shows the nutrient content of some principal foods as determined by other investigators. The data presented by Treichler et al. (1946) more closely approximates those for the areas studied because they are from the same region in Virginia.

Table 17. Basic Nutrient Content[a] of Fall and Winter Foods of Ruffed Grouse in Eastern Tennessee and Western North Carolina

Plant	Part	Protein	Crude Fat	Fiber	NFE[b]	Gross Energy Cal./gm.[c]
Greenbriar	leaves	10.8[d]	10.4[d]	15.6[d]	59.4[d]	4.7[d]
Greenbriar	fruit	9.1,[d] 8.5[h] 8.9[f]	7.6,[d] 4.3[h] 4.02[f]	14.9,[d] 6.44[f]	65.4,[d] 60.75[h] 48.23[i]	4.5[d]
Black birch	buds	9.3[d]	2.5[d]	33.0[d]	39.1[d]	3.7[d]
Black birch	catkins	14.41[e]	8.44[e]	22.97[e]	50.87[e]	-
Christmas fern	leaves	16.3,[d] 11.22[e]	4.8,[d] 2.77[e]	18.3,[d] 20.03[e]	60.2,[d] 60.57[e]	4.3[d]
Mountain laurel	leaves	8.1,[d] 3.12[i]	11.1,[d] 11.28[i]	5.6[d]	62.2,[d] 28.88[i]	4.7[d]
Grape	seed	6.6[h]	7.40[h]	-	59.74[h]	-
Avens	seed	10.45,[f] 12.24[g]	16.26,[f] 19.04[g]	16.26	38.53[f]	-
Dogwood	fruit	6.49[h]	18.75[h]	-	38.44[h]	-
Sheep sorrel	leaves	20.6[d]	4.0[d]	7.9[d]	62.7[d]	4.4[d]

[a]Percent dry weight, oven dried.

[b]Nitrogen free extract.

Table 17 (continued)

[c]Cal./gm. = Calories per gram.

Sources: [d]Treichler et al., 1946--Virginia.

[e]Anonymous, 1963--Minnesota.

[f]Spinner and Bishop, 1950--Connecticut.

[g]Korschgen, 1966--Missouri.

[h]Billingsley and Arner, 1970--Southeast.

[i]Bump et al., 1947--New York.

CHAPTER V

SUMMARY

The objective of this study was to determine the principal fall and winter dietary patterns of ruffed grouse in eastern Tennessee and western North Carolina. The study was conducted in the Blue Ridge Region of eastern Tennessee and western North Carolina and the Cumberland Plateau and Great Valley Regions of eastern Tennessee. All three regions are a part of the Southern Appalachians. The oak-hickory and oak-pine forest types are dominant in the areas studied. The topography ranges from flat-topped mountain peaks in the Cumberland Plateau through rolling hills and valleys in the Blue Ridge Region. The hardwood timber in the Plateau and Blue Ridge Regions is important to the forest based economy of surrounding areas. The Valley Region is extensively farmed.

A total of 294 grouse was collected during the fall and winter from October 1972 through February 1974. Seventeen additional crops were collected from December 1969 through February 1970. A total of ten crops did not contain food.

Greenbriar was the most important food by volume in the Blue Ridge (20.2 percent) and Valley Regions (33.2 percent). In the Plateau, Christmas fern was the most important food (15.5 percent), and greenbriar was second (12.2 percent). Other important foods for each region were: Blue Ridge--Mountain laurel, Christmas fern, black birch,

cinquefoil, avens, unidentified ferns, grape, sheep sorrel, flowering dogwood, alumroot, aster and hawkweed; Valley--Honeysuckle, Christmas fern, unidentified ferns, avens, hawkweed, cinquefoil, aster, sumac, grape, partridge berry, oak, and alumroot; Plateau--Flowering dogwood, mountain laurel, blueberry, trailing arbutus, cinquefoil, alumroot, mayapple, aster, unidentified ferns, honeysuckle, blackberry and wintergreen.

Greenbriar is abundant in cut-over forests and in open woodlands throughout the regions studied. The fruits and leaves persist throughout the winter, and are available in late winter when other foods have been exhausted. Grouse fed on greenbriar leaves more regularly than the fruits.

Honeysuckle ranked second only to greenbriar in the Valley (18.0 percent). It is more widely distributed throughout the Valley than in the Blue Ridge or Plateau. The evergreen leaves were eaten throughout the winter in the Valley.

Mountain laurel leaves and buds ranked second in the Blue Ridge Region (19.6 percent), and fourth in the Plateau Region (10.4 percent). Dogwood was third (11.2 percent) in the Plateau. Mountain laurel is widely distributed throughout the mountainous areas in the Blue Ridge and Plateau Regions.

The principal foods by volume during the fall for each region were: Blue Ridge--Greenbriar (28.3 percent), grape (8.1 percent), mountain laurel (6.6 percent), dogwood (6.5 percent), black birch (5.9 percent), and partridge berry (5.0 percent); Plateau--Dogwood

(82.5 percent), and blueberry (9.6 percent) from only two crops collected; Valley--Greenbriar (38.5 percent), Christmas fern (10.0 percent), avens (6.9 percent), honeysuckle (6.3 percent), and cinquefoil (5.2 percent).

The principal foods by volume during the winter for each region were: Blue Ridge--Mountain laurel (28.2 percent), greenbriar (14.9 percent), Christmas fern (12.5 percent) and cinquefoil (5.0 percent); Plateau--Alumroot (14.9 percent), Christmas fern (14.6 percent), greenbriar (11.6 percent), mountain laurel (10.1 percent), and blueberry (4.0 percent); Valley--Greenbriar (30.2 percent), honeysuckle (25.6 percent), Christmas fern (12.7 percent), hawkweed (5.7 percent), and unidentified ferns (5.2 percent).

Many foods which were important the first year remained important the second year, except for local exceptions. In the Blue Ridge, low-growing plants such as hawkweed, aster, plantain and cinquefoil increased in importance the second year, but in the Plateau and Valley their importance did not change appreciably. Black birch decreased in importance the second year in the Blue Ridge, when snows were lighter than the first year. Dogwood was an important food the first year in the Blue Ridge, but not the second. In the Plateau, dogwood was an important food the second year but not the first. In the Valley, greenbriar decreased appreciably in importance, while honeysuckle increased substantially the second year.

During periods of snow, grouse from the Blue Ridge and Plateau fed primarily on black birch and mountain laurel. The diet of grouse

from the Valley was the same during periods of snow as at other times. Snows were lighter in the Valley as compared to the Blue Ridge and Plateau.

Open fields and pastures adjacent to woodlands in all regions appeared to be preferred feeding sites throughout the fall and winter. Many of the important foods in the diet are most abundant in these open areas.

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APPENDIX

Table 18. Collection Sites by County in Tennessee and North Carolina

County	Collection Sites
TENNESSEE	
Campbell	Cumberland Mountains, Walnut Mountain, Short Mountain, Stinking Creek, White Oak Mountain, Royal Blue
Carter	Iron Mountain
Claiborne	TVA Ridge, Tackett Mountain, Combs Ridge, Lone Mountain
Cumberland	Genesis, Rugby
Grainger	Clinch Mountain
Hancock	River Road, Newman's Ridge, Clinch Mountain, Sneedville, Powell Mountain
Hawkins	Caney Valley, Stanley Valley, Clinch Mountain
Johnson	Mountain View
Knox	Shipe Road, Copeland Road
Monroe	Tellico Wildlife Management Area
Morgan	Deer Lodge, Burgess, Catoosa Wildlife Management Area, Rocky Top
Scott	Cumberland Mountains, New River, Low Gap, Capitol Hill, Robbins
Sevier	Pittman Center, Allansville, Wears Valley, Rocky Flats, Shields Mountain
Sullivan	Newman's Ridge
Union	Norris Lake, Combs Ridge
NORTH CAROLINA	
Haywood	Chambers Mountain, Blue Ridge Parkway, Pisgah National Forest, Purchase Knob, Hemphill Bald, Black Camp Gap, Utah Mountain, Waterville, Harmen Den Wildlife Management Area, Hurricane Creek, Cataloochee Divide, Eagles Nest Mountain, Mount Sterling, Panther Creek

Table 18 (continued)

County	Collection Sites
Macon	Standing Indian Wildlife Management Area
Madison	Mule Stomp Mountain, Spring Creek
Jackson	Cullowhee Mountain, Cherry Gap
Buncombe	County Line Mountain

Table 19. Scientific Names of Animals and Plants used as Foods by Ruffed Grouse

PINACEAE

Pinus virginiana--Virginia pine

ANACARDIACEAE

Rhus typhina--Staghorn sumac
Rhus radicans--Poison ivy

CORNACEAE

Cornus florida--Flowering dogwood

LILIACEAE

Smilax rotundifolia--Greenbriar
Melanthium hybridum--Bunch flower

SAXIFRAGACEAE

Heucheria villosa--Alumroot

RANUNCULACEAE

Hepatica acutiloba--Hepatica

VITACEAE

Vitis sp.--Grape

ROSACEAE

Fragaria virginiana--Wild strawberry
Potentilla canadensis--Five-fingers, cinquefoil
Rubus sp.--Blackberry
Geum canadense--Avens
Rosa multiflora--Multiflora rose
Sorbus americana--Mountain ash
Crataegus uniflora--Hawthorne
Amelanchier arborea--Serviceberry
Prunus serotina--Black cherry

Table 19 (continued)

CELASTRACEAE

Celastrus scandens--Bittersweet
Euonymus americanus--Strawberry bush

BETULACEAE

Betula lenta--Black birch
Ostrya virginiana--Eastern hophornbeam

FABACEAE

Trifolium sp.--Clover
Desmodium sp.--Beggar lice
Lespedeza sp.--Lespedeza

POLYGONACEAE

Rumex acetosella--Sheep sorrel
Rumex crispus--Dock
Polygonum scandens--Climbing buckwheat

VIOLACEAE

Viola sp.--Violet

OPHIOGLOSSACEAE

Botrychium dissectum--Grape fern

ASPIDIACEAE

Woodsia obtusa--Blunt-lobed wood fern
Cystopteris protusa--Bladder fern
Polystichum acrostichoides--Christmas fern
Athyrium sp.--Lady fern
Thelypteris sp.--Beech fern

LYCOPODIACEAE

Lycopodium sp.--Climbing fern

POLYPODIACEAE

Polypodium virginianum--Rock cap fern

Table 19 (continued)

PTERIDACEAE

Dennstaedtia punctilobula--Hay-scented fern

ASTERACEAE

Hieracium sp.--Hawkweed
Aster sp.--Aster
Antennaria sp.--Pussytoes

PLANTAGINACEAE

Plantago sp.--Plantain

ERICACEAE

Kalmia latifolia--Mountain laurel
Rhodendron minus--Flame azalea
Oxydendrum arboreum--Sourwood
Epigaea repens--Trailing arbutus
Gaultheria procumbens--Wintergreen
Vaccinium sp.--Blueberry

FAGACEAE

Fagus grandifolia--American beech
Quercus velutina--Black oak

NYSSACEAE

Nyssa sylvatica--Black gum

HAMAMELIDACEAE

Hamamelis virginana--Witch hazel

OXALIDACEAE

Oxalis sp.--Wood sorrel

CRASSULACEAE

Sedum ternatum--Stonecrop

Table 19 (continued)

ACERACEAE

Acer rubrum--Red maple

ANNONACEAE

Asimina triloba--Paw paw

APIACEAE

Daucus carota--Wild carrot
Hydrocotyle sp.--Pennywort
Conium maculatum--Parsley

CAPRIFOLIACEA

Lonicera japonica--Japanese honeysuckle

BERBERIDACEAE

Podophyllum peltatum--Mayapple

RUBIACEAE

Mitchella repens--Partridge berry

JUNCACEAE

Juncus sp.--Rush, spikerush

LAMIACEAE

Mentha sp.--Mint

POACEAE

Poa sp.--Grass

CARAOPHYLLACEAE

Stellaria media--Chickweed

TETTIGONIIDAE

Scudderia furcata--Katydid

Table 19 (continued)

SCARABAEIDAE

Phanaeus sp.--Tumblebug

LOCUSTIDAE

Dissosteira carolina--Lubber grasshopper

PENTATOMIDAE

Thyanta sp.--Stinkbug

THOMISIDAE

Misumena vatia--Crab spider

Table 20. All Fall and Winter Foods from Crops of 156 Grouse Collected in the Blue Ridge Region of Eastern Tennessee and Western North Carolina, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
PLANTS					
Greenbriar	267.9	20.21	45	28.76	9.22
Mountain laurel	259.1	19.55	36	23.08	7.38
Christmas fern	108.8	8.21	38	24.23	7.79
Black birch	68.0	5.13	26	16.67	5.33
Cinquefoil	59.1	4.46	37	23.72	7.58
Avens	54.1	4.08	27	17.30	5.53
Unidentified ferns	48.1	3.63	35	22.44	7.17
Grapes	44.0	3.32	11	7.05	2.25
Sheep sorrel	42.7	3.22	10	6.45	2.05
Dogwood	34.3	2.59	9	5.78	1.84
Unidentified leaves and buds	32.5	2.45	24	15.38	4.92
Alumroot	29.2	2.20	19	12.17	3.89
Aster	26.9	2.03	19	12.17	3.89
Hawkweed	18.8	1.42	10	6.45	2.05
Hawthorne	14.4	1.09	6	3.85	1.23
Plantain	13.3	1.00	5	3.21	1.02
Blackberry	12.1	0.91	8	5.13	1.64
Stone crop	12.2	0.92	6	3.85	1.23
Trailing arbutus	11.8	0.89	5	3.21	1.02
Bittersweet	11.7	0.88	4	2.56	0.82
Mountain ash	11.3	0.85	2	1.28	0.41
Buckwheat	11.0	0.83	3	1.92	0.61
Wood sorrel	10.9	0.82	2	1.28	0.41
Blueberry	10.6	0.80	6	3.85	1.23
Lespedeza	10.3	0.78	4	2.56	0.82
Partridge berry	10.2	0.77	10	6.45	2.05
Clover	9.9	0.75	5	3.21	1.02
Chickweed	9.9	0.75	4	2.56	0.82
Strawberry bush	9.5	0.72	1	0.64	0.21
Witch hazel	9.2	0.69	7	4.49	1.43
Black cherry	9.0	0.68	2	1.28	0.41
Grass	7.0	0.53	4	2.56	0.82
Strawberry	5.4	0.41	9	5.78	1.84
Dock	3.7	0.28	3	1.92	0.61
Serviceberry	2.0	0.15	1	0.64	0.21
Red maple	1.7	0.13	5	3.21	1.02
Hepatica	1.5	0.11	4	2.56	0.82

Table 20 (continued)

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
Sourwood	1.1	0.08	1	0.64	0.21
Oak	1.1	0.08	1	0.64	0.21
Black gum	1.1	0.08	1	0.64	0.21
Wild carrot	1.1	0.08	1	0.64	0.21
Honeysuckle	0.9	0.07	3	1.92	0.61
Plant gall	0.9	0.07	1	0.64	0.21
Pennywort	0.8	0.06	1	0.64	0.21
Paw paw	0.8	0.06	4	2.56	0.82
Violet	0.7	0.05	3	1.92	0.61
Bunch flower	0.5	0.04	1	0.64	0.21
Eastern hophornbeam	0.5	0.04	2	1.28	0.41
Azalea	0.5	0.04	1	0.64	0.21
Subtotal	1312.1	98.99	472		96.73
Grit	6.9	0.52	6	3.85	1.23
Subtotal	6.9	0.52	6	3.85	1.23
ANIMALS					
Katydid	3.7	0.28	4	2.56	0.8
Stinkbug	2.7	0.20	3	1.92	0.61
Grasshopper	0.1	0.01	3	1.92	0.61
Subtotal	6.5	0.49	10		2.04
TOTALS	1325.5	100.00	488		100.00

Table 21. All Fall and Winter Foods from Crops of 77 Grouse Collected in the Great Valley Region of Eastern Tennessee, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
PLANTS					
Greenbriar	95.3	33.19	33	42.86	13.53
Honeysuckle	51.7	17.97	33	42.86	13.53
Christmas fern	33.8	11.76	21	27.27	8.61
Unidentified ferns	13.2	4.59	25	32.47	10.25
Avens	13.1	4.55	20	25.97	8.20
Hawkweed	11.7	4.06	7	9.09	2.87
Cinquefoil	9.2	3.19	12	15.58	4.92
Aster	8.8	3.05	7	9.09	2.87
Unidentified leaves and buds	7.7	2.66	17	22.07	7.01
Sumac	7.1	2.46	5	6.49	2.05
Grape	5.5	1.91	6	7.79	2.46
Partridge berry	4.7	1.63	5	6.49	2.05
Oak	3.0	1.04	1	1.29	0.45
Alumroot	2.8	0.97	4	5.19	1.64
Dogwood	2.7	0.93	4	5.19	1.72
Blackberry	2.5	0.87	3	3.90	1.23
Trailing arbutus	2.3	0.80	4	5.19	1.64
Black birch	2.0	0.70	8	10.39	3.32
Mayapple	1.5	0.52	1	1.29	0.41
Lespedeza	1.1	0.38	4	5.19	1.72
Mountain laurel	1.0	0.35	1	1.29	0.41
Strawberry	1.0	0.35	1	1.29	0.41
Bunch flower	0.9	0.31	1	1.29	0.41
Eastern hophornbeam	0.6	0.21	2	2.58	0.82
Beggar lice	0.6	0.21	1	1.29	0.41
Mint	0.5	0.17	1	1.29	0.41
Parsley	0.5	0.17	1	1.29	0.41
Paw paw	0.5	0.17	1	1.29	0.41
Bittersweet	0.4	0.14	1	1.29	0.41
Maple	0.4	0.14	1	1.29	0.41
Clover	0.3	0.10	2	2.58	0.82
Pennywort	0.3	0.10	1	1.29	0.41
Spikerush	0.2	0.07	1	1.29	0.41
Subtotal	286.9	99.72	235		96.63

Table 21 (continued)

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
Grit	0.6	0.21	5	6.49	2.05
Subtotal	0.6	0.21	5	6.49	2.05
ANIMALS					
Spider	0.1	0.03	1	1.29	.41
Tumblebug	0.3	0.10	1	1.29	.41
Subtotal	0.4	0.14	2	2.58	.82
TOTALS	287.9	100.00	242		100.00

Table 22. All Fall and Winter Foods from Crops of 78 Grouse Collected in the Cumberland Plateau Region of Eastern Tennessee, October-February, 1972-74

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
PLANTS					
Christmas fern	78.0	15.50	37	47.44	11.67
Greenbriar	61.4	12.20	33	42.31	10.41
Dogwood	56.3	11.19	10	12.82	3.15
Mountain laurel	52.3	10.39	19	24.36	5.99
Blueberry	26.4	5.24	11	14.10	3.50
Trailing arbutus	19.2	3.82	5	6.41	1.58
Cinquefoil	19.1	3.80	24	30.77	7.57
Alumroot	16.5	3.27	10	12.82	3.15
Rose[a]	16.3	3.23	1	1.28	0.32
Mayapple	15.8	3.13	12	15.38	3.79
Aster	13.8	2.75	18	23.08	5.68
Unidentified ferns	13.6	2.70	17	21.79	5.37
Unidentified leaves and buds	12.3	2.45	18	23.08	5.68
Honeysuckle	10.7	2.12	11	14.10	3.47
Blackberry	10.0	1.98	6	7.68	1.89
Wintergreen	8.7	1.72	5	6.41	1.58
Azalea	7.7	1.52	7	8.97	2.21
Bittersweet	6.3	1.25	4	5.13	1.26
Pussytoes	6.0	1.19	5	6.41	1.58
Sheep sorrel	5.3	1.05	1	1.28	0.32
Oak	4.5	0.89	2	2.56	0.63
Serviceberry	4.1	0.81	1	1.28	0.32
Plant gall	3.7	0.73	2	2.56	0.63
Hawkweed	3.6	0.71	4	5.13	1.26
Hepatica	3.4	0.67	2	2.56	0.63
Violet	3.0	0.59	3	3.85	0.94
Black birch	2.9	0.57	10	12.82	3.16
Virginia pine	2.5	0.50	1	1.28	0.32
Chickweed	2.4	0.48	3	3.85	0.95
Beech	2.0	0.40	1	1.28	0.32
Beggar lice	1.9	0.38	3	3.85	0.95
Grape	1.7	0.34	2	2.56	0.63
Sumac	1.6	0.32	2	2.56	0.63
Partridge berry	1.5	0.31	5	6.41	1.58
Avens	1.5	0.30	7	8.97	2.21
Black cherry	1.2	0.23	5	6.41	1.58

Table 22 (continued)

Food Items	Volume		Frequency		
	Total cc	% Rel. Vol.	Times Occur.	% Freq. Occur.	% Rel. Freq.
Bunch flower	0.4	.08	2	2.56	0.63
Red maple	0.2	.04	2	2.56	0.63
Subtotal	497.8	98.89	311		98.12
Grit	1.7	0.34	3	3.85	0.94
Subtotal	1.7	0.34	3	3.85	0.94
ANIMALS					
Katydid	3.9	0.77	3	3.85	0.94
Subtotal	3.9	0.77	3	3.85	0.94
TOTALS	503.4	100.00	317		100.00

[a]Rose hips were identified in a single grouse collected in 1969.

VITA

Steven Kent Stafford was born in Ocala, Florida, on May 10, 1942. He attended elementary school in Ocala, Florida, and graduated from Ocala High School in 1960. He received an Associate of Arts degree from Central Florida Junior College, Ocala, Florida, in 1962. He received a Bachelor of Science degree in Biology from Stetson University, DeLand, Florida, in 1964.

From 1964 through 1969 he was employed as a Regional Wildlife Biologist with the Florida Game and Fresh Water Fish Commission in Lake City, Florida. In February 1970 he was employed as a wildlife instructor at Haywood Technical Institute, Clyde, North Carolina. While working at Haywood Technical Institute, he enrolled as a graduate student at the University of Tennessee. He received the Master of Science degree in Wildlife Management in December 1974. He is a member of Gamma Sigma Delta, national agricultural honorary and Xi Sigma Pi, national forestry honorary.

He is presently employed as a wildlife biologist with the Florida Game and Fish Commission. He resides in Lake City, Florida, with his wife, Elaine, son, Steve, and daughter, Staci.