

THE ECOLOGICAL FACTORS AFFECTING THE DISTRIBUTION AND
ABUNDANCE OF THE RUFFED GROUSE IN VIRGINIA

By

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A DRUMMING LOG FROM WHICH A
RUFFED GROUSE WAS FLUSHED

FIGURE 1

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INTRODUCTION

Review of Literature

Most of the early and recent literature concerning the ruffed grouse in Virginia is limited entirely to short notes on the occurrence and distribution. Not many life history observations were made until recent years, and they are few in number and limited in scope. The early writings of the Colchists have not been reviewed fully; however, there are a number of references extant dealing principally with the distribution. The more recent writings of H. B. Bailey (13), H. H. Bailey (14), E. A. Smyth (92), are more or less lists of birds giving their general abundance and occurrence. An earlier publication of interest by William C. Rives (89) refers to the grouse as a common breeding resident in the mountains, and includes a considerable amount of interesting historical material, much of it quoted from the earliest writings on the bird life of Virginia, back to the beginning of Virginia's early history. Another early reference is in the Nuttall Bulletin (51), which is a review of a paper published by Percy E. Freke in Ireland, "On Birds Observed in Amelia County, Virginia", in which he says that a few ruffed grouse nest in thick pine woods in the low country of Virginia. Another note concerning Amelia County is by J. B. Lewis (83) in which he says that the ruffed grouse is not found in the county at the present time. Other writings of interest are several concerning areas bordering on the state. Miss M. T. Cooke

of Washington, D. C. (37) states that the ruffed grouse was "formerly a somewhat local permanent resident but now nearly extirpated within our area. According to L. G. Grinnell it is still found in very small numbers near Bush Hill and Accontink, Fairfax County, Virginia". R. C. McClanahan of the Biological Survey (83) has recently published the present and the original distribution of the ruffed grouse, not only in Virginia but of the range in the United States.

Recently Dr. Alexander Wetmore (94, 95) identifies the ruffed grouse from the western mountains of Virginia and those of the Tennessee Mountains as the subspecies togata.

In the spring of 1935 C. O. Handley and A. L. Nelson of the Biological Survey had 35 grouse nests under observation in the Massanutten and Blue Ridge Mountains in Shenandoah, Page, Rockingham, Greene, Madison and Rappahannock Counties.

In 1938 A. L. Nelson, T. E. Clarke and W. W. Bailey (84) published the first important work in Virginia concerning the food habits of the ruffed grouse. In this publication the foods taken are listed in the order of their percentage by volume, the number of stomachs in which found, and the parts of the plant utilized. The first twenty foods considered the most important are discussed in detail and illustrated with excellent photographs.

More recently, observations on grouse have been started by W. R. DeGarmo of the Virginia Cooperative Wildlife Research

Unit. The effect of clearings and openings in the forests on the various wildlife species is being studied. Most of the observations are being made on the Big Levels Game Refuge in Augusta County and at the Virginia Polytechnic Institute Sanctuary at Mountain Lake in Giles County. No material has been published to date.

An attempt was made to raise grouse in 1930, when W. B. Coleman, Manager of the White Oak Quail Farm, Richmond, Virginia (69) hatched 13 grouse eggs in an incubator and raised five of the birds to maturity. Since that time no important propagation experiments with grouse have been undertaken.

These few references are all the important material published on the Virginia ruffed grouse. The literature accumulated in the last 15 years or more concerning the ruffed grouse and related species in North America is considerable. All of the literature references on the subject covered by the author were reviewed and summaries of all the articles were recorded on 3 X 5 filing cards.

The New York State Game Commission with Dr. Gardiner Bump (20-32) in charge, cooperating with Dr. A. A. Allen of Cornell University (4-10) has done more intensive work than any other organization. Their work began in 1930 just at the low of the cycle and investigations have been carried on since that time in every conceivable phase of study relating to the species. At the present time all preparations are being completed for a thorough study of the species starting at the decline of the

cycle.

In Michigan, ruffed grouse investigations have been carried on since 1928 by the Game Division of the Conservation Department. From 1934 to 1939 most of the investigations were carried on by L. W. Fisher (50) who made special studies of censusing methods and habits of the ruffed grouse.

The work in Minnesota began shortly after the investigations in New York, and was under the able direction of Dr. R. T. King (74-76). The results of this investigation are exceedingly well stated in Dr. King's article, "Ruffed Grouse Management".

The New England Ruffed Grouse Investigation, under the sponsorship of the Massachusetts Fish and Game Association, and headed by Dr. A. O. Gross (62-67), has carried on some very interesting observations and obtained valuable information. Of special importance is the investigation of the ruffed grouse of the Matamak River in Labrador where agriculture and civilization have not penetrated to affect or infect the grouse of those extensive northern forests.

At the present time, many ruffed grouse projects are starting in the New England States and other states, financed largely by Pittman-Robertson funds. Tennessee has already started a ruffed grouse program and in the near future it is expected that Virginia will continue the investigations already started, but in a broader and more comprehensive aspect.

The Present Investigation

From the foregoing discussion of the investigation previously done on the ruffed grouse in Virginia, it is apparent that little is known concerning the life history and management of the species. The grouse range in the state is largely divided into two parts by the Valley of Virginia. In general these regions are the Piedmont Plateau and the Blue Ridge Mountains to the east, and the Alleghany Mountains and the Southwestern Plateau to the west. In Virginia the majority of the present grouse range is restricted principally to the Blue Ridge Mountains and the Alleghany Mountains. It is known among sportsmen that the grouse are exceedingly scarce in the Blue Ridge Mountains, especially the southern part, as compared with the Alleghany Mountains, where they are common. In the spring of 1939 plans were developed for a study to determine the possible factors affecting the abundance and distribution of the ruffed grouse in the state.

Food and cover, of primary importance for most game species, are factors that should be studied intensively. Several limited areas in both mountain ranges were chosen for such a study. General surveys were then made over a large part of the grouse range to check the results of the intensive surveys. Giles, Bland and Pulaski Counties in the Alleghany Mountains, and Floyd and Patrick Counties in the Blue Ridge Mountains were chosen as areas to be worked intensively. In the late summer, fall and winter general surveys were made of

the Blue Ridge Mountains in Augusta, Rockingham, Amherst and Bedford Counties. General surveys were also made of the Alleghany Mountains in Augusta, Bath, Botetourt and Tazewell Counties, as well as Buchanan and Dickenson Counties of the Southwestern Plateau. A detailed discussion of the methods and techniques used in making the vegetation surveys may be found in the introduction to the section on "Plant Distribution". These data form the greater part of the thesis. Tables were made for each area worked intensively. All species were listed, giving their relative abundance and the exposure, whether in the valley or on the lower slope, middle slope, upper slope or top. For the general surveys, the species were listed and their relative abundance noted.

Four questionnaires were sent to each game warden in the counties situated in or near the grouse range of the state. It was requested that one form be filled out by the warden himself and the other three by sportsmen in his respective county. A number were sent directly to sportsmen and other individuals. A copy of the questionnaire and a discussion of the results are included under the section, "The Distribution and Relative Abundance of the Ruffed Grouse".

A detailed map was prepared showing the forested areas of the state, with the grouse distribution and the abundance indicated. The materials available for copying the forest lands were aerial photographs and Land Use Maps of the Virginia State Planning Board and the Virginia Extension Service.

The ecological factors which influence the abundance and distribution of the ruffed grouse are considered under the three main headings: Physical, Climatic and Biological. Each factor is discussed in relation to its possible effect upon the ruffed grouse. A short outline of the factors in the order considered in the thesis will be helpful in following the discussion:

A. Physical Factors

1. Geology
2. Topography
3. Elevation
4. Slope
5. Fire

B. Climatic Factors

1. Temperature
2. Precipitation
 - a. Rainfall
 - b. Snowfall
3. Light

C. Biological Factors

1. Disease and Cycle
2. Predation
3. Habitat
4. Plant Distribution

Blood smears were made of all birds collected by the author and smears were made from the livers of those collected by other persons. No leucocytozoon parasites were present, however.

It is regretted that blood smears were not made of young birds to determine whether the leucocytozoon or some other disease parasites are the agents causing mortality in the brood. Detailed internal examination for parasites was made of two birds. The round worm, Heterakis gallinae, a common parasite of barnyard fowl, was found to be the most abundant parasite present.

Twenty-six grouse skins distributed over the range from Augusta County in northeast Virginia to Washington County in the southwest, were prepared. The greater number were collected at Big Levels in Augusta County, Blacksburg in Montgomery County and various parts of Giles County. It was hoped that the distribution of the subspecies could be worked out in the state. However, after examination of and comparison with the skins in the National Museum and the Biological Survey, it became apparent that at the present time there are considerable differences of opinion as to the factors used as a basis of identification of the two forms. By following the barring on the underparts most of the series being studied were Bonasa umbellus togata; whereas, using the coloring of the upper parts as the major character, most of the birds were labeled Bonasa umbellus umbellus. With this disagreement it is apparent that there is a need for a complete revision of the taxonomy of the species.

THE DISTRIBUTION AND RELATIVE ABUNDANCE OF THE RUFFED GROUSE IN VIRGINIA

DOTTING INDICATES RELATIVE ABUNDANCE
YELLOW INDICATES WOODED AREAS

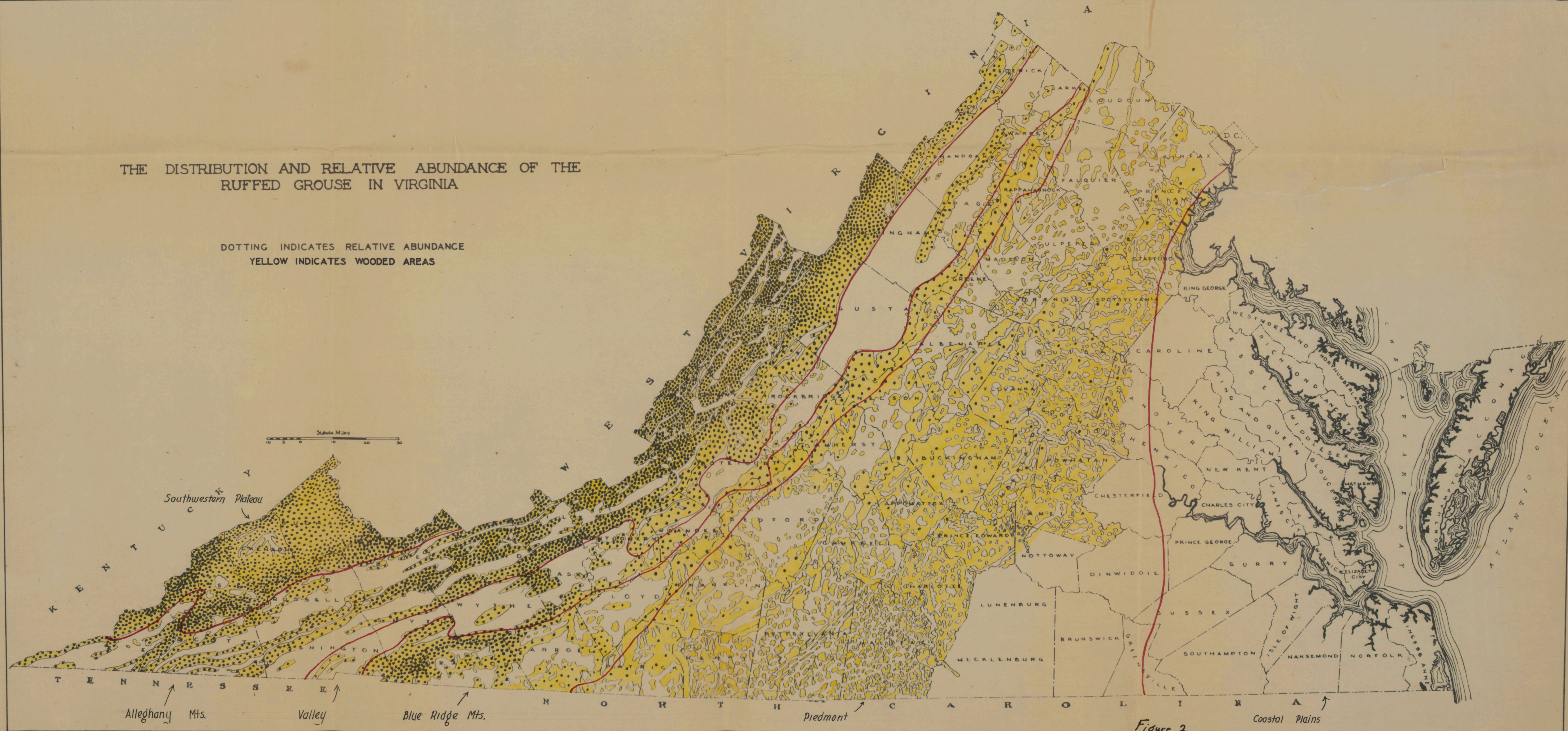


Figure 2

Virginia Ruffed Grouse, or Native Pheasant, Survey

(Please answer the following questions in the spaces provided and return this form to C. O. Handley, Leader, the Virginia Cooperative Wildlife Research Unit, Blacksburg, Virginia.)

1. In what areas of your county is ruffed grouse or native pheasant to be found?

2. In which of these areas is the ruffed grouse most abundant?

3. In your opinion, are there more or fewer grouse in your county now than there were in 1930? _____ . In 1938? _____ .
4. In what years (beginning with 1920 or as early as your experience allows) have grouse seemed to be most abundant? _____

5. In what years were grouse exceptionally scarce? _____

6. In your opinion, what are the causes for grouse not being more plentiful in your county?

7. What was the average size of grouse broods this year? _____
8. What comments can you make concerning where grouse are usually found, where and on what they feed, when they hatch off, etc.? (Use other side of sheet if necessary.)

FIGURE 3

Name: _____

County: _____

Mail Address: _____

THE ORIGINAL AND PRESENT DISTRIBUTION AND ABUNDANCE
OF THE RUFFED GROUSE IN VIRGINIA

Early in the investigation four copies of a questionnaire (Figure 3) were sent to each warden of the counties in and bordering on the grouse range. It was requested that the warden supply the necessary information on one form and have the other three forms executed by three leading sportsmen in his area. One hundred and thirty-five replies were received. Information concerning the distribution and abundance was obtained from these forms. Previous estimates on the kill in each county submitted by the game wardens were used to a limited extent in determining abundance. It was found, however, that the latter information was entirely unreliable in most cases. Personal observation and reports of hunters and residents of the various counties were used. It is regrettable that kill records are not available in the state, so that information on relative abundance of the ruffed grouse could be derived.

The major forest areas of the present grouse range in Virginia is shown in Figure 2. This information was obtained from Land Use Maps of the Virginia Extension Service and the Virginia State Planning Board. Aerial photographs were used in obtaining the information for a number of the counties. An attempt was made to show all forested areas of 700 acres or over in size. The forested areas are reasonably accurate for

most of the counties of the Alleghany Mountains, Valley and Blue Ridge where large blocks of forest lands and wide open valleys predominate. A different problem exists, however, in the counties of the Piedmont, where a large percentage of a county is forested but is broken up by hundreds of small patches of agricultural lands. A condition such as this is almost impossible to accurately indicate on a small scale map. Therefore, in counties such as Pittsylvania, Halifax, Amelia, Louisa and others of the Piedmont, the finely divided nature of the forests and cleared areas is drawn only to give the reader an idea of the conditions that are present. With such a large percentage of forest lands (see Virginia State Planning Board Map, Figure 10), one would say the conditions were probably good for ruffed grouse, where it is not realized how broken up and accessible is the habitat.

As censusing has not been adequately developed in the state, no figures are available on what we may call "abundant" or "common" in relation to the number of birds per unit area. Therefore, it has been suggested that the average number of birds flushed during a day's hunt be considered. The general consensus of opinion seems to be that eight to ten birds flushed in the course of a day's hunt would be a high average for most parts of the range where the birds are at least tolerably common. In various parts of the Alleghany Range one frequently flushes 25 grouse in a day's hunting. Therefore, should an average of 25 grouse be flushed in a day, the grouse

would be abundant. Should an average flush of fifteen birds a day be made, the grouse would be regarded as common. In areas where the ruffed grouse is present but exceedingly scarce, one may hunt many days without flushing a bird. At other times three or four birds may be flushed, so that any number below four birds flushed in a day would indicate that the grouse were scarce.

The present distribution of the ruffed grouse in Virginia, as developed in the manner mentioned above, is indicated on the map, Figure 2 . The dots on this map do not refer to any definite number of birds per unit area, but are meant to serve only as a general picture of the relative abundance, the heavier dotting indicating the areas in which grouse are most numerous and the lighter dotting indicating common to scarce.

The original distribution of the ruffed grouse in Virginia extended considerably farther east than it does at the present time, although the birds were probably scarce in the Coastal Plain. According to R. C. McClanahan of the Biological Survey, (83) the ruffed grouse was originally found from the western part of the state to the coast, even on the peninsula of Accomac and Northampton Counties. He does not indicate the grouse as previously occurring in the southeastern part of the state.

A. G. Bradley (19) writing of conditions between 1860-1880, says that the ruffed grouse was rare east of the Alleghanies. Another early writer, Freke, (1882) (51) mentions that a few

ruffed grouse nested in the thick pine woods in the low country of Virginia. William C. Rives (1890) (89) records the ruffed grouse as being a common breeding resident of the Mountains of Virginia. "Old-timers" in the Blue Ridge Mountains report that at one time the "pheasant" or ruffed grouse was much more common than it is today.

The present distribution of the ruffed grouse extends throughout the Southwestern Plateau, Allegheny Mountains, the Great Valley of Virginia, the Blue Ridge Mountains and most of the Piedmont Region of the state. The ruffed grouse occurs from the Blue Ridge eastward in the Piedmont to east-central Patrick, southeastern Franklin, southern Bedford, northern Campbell, southern Appomattox, northern Prince Edward, southern Buckingham, east-central Cumberland, northern Powhatan, south-central Goochland, western Hanover, central Spotsylvania and the heavily wooded sections of Stafford, Prince William and Fairfax Counties along the Potomac River.

The ruffed grouse is relatively abundant in the extensive forests of the Southwestern Plateau and the Allegheny Mountains from Lee and Wise Counties in the southwest and those counties bordering on the Virginia-West Virginia line north through Highland County. In the Alleghanies of Augusta and Rockingham Counties and the Massanutten Mountain of Rockingham and Shenandoah Counties, the ruffed grouse is nearly as abundant. The ruffed grouse is common in the Alleghanies bordering the Great

Valley of Virginia. In the more extensive woodlands of the Valley from Pulaski County northeastward, the ruffed grouse is tolerably common. In the Blue Ridge Mountains south to Roanoke County, the grouse is much less common than to the west, but on the whole may be considered as frequent to tolerably common. Although most of the Blue Ridge supports a relatively small grouse population, there are some limited sections in which the ruffed grouse is quite common. In the Blue Ridge to the south of Roanoke through most of Floyd County, parts of Carroll, Patrick and Franklin Counties, the ruffed grouse becomes less frequent, one being fortunate to flush more than four birds during a good day's hunt. In the Blue Ridge of northern Carroll and Grayson Counties, the ruffed grouse becomes very common. On White Top Mountain and Mount Rogers and the heavily forested hills nearby the grouse is as abundant as in most of the Alleghany Range to the north. Throughout the Piedmont the grouse becomes exceedingly scarce and is found only in extensive forest lands, where dense cover exists. It is reported by a number of individuals that most of the birds in these sections occur along the streams where the cover is densest.

ECOLOGICAL FACTORS AFFECTING THE DISTRIBUTION
AND ABUNDANCE OF THE RUFFED GROUSE

In wildlife management few conclusive results can be obtained within the space of one year's research. Frequently many years are required to procure accurate or trustworthy results. It is not within the scope of this thesis, therefore, to prove conclusively that any particular factor or group of factors regulate or limit the abundance and distribution of the ruffed grouse. The study was undertaken with the plan of investigating possible factors that may be of importance in limiting the abundance and distribution of the grouse. Each factor was investigated as thoroughly as time and practicability would permit. Food and cover, important considerations with all wildlife species, were investigated more fully than other factors, and the results of this phase of the investigation make up the main body of the thesis. Other factors, probably of equal worth, were investigated and their possible effects upon the grouse distribution are discussed.

It should be kept in mind that no single influence discussed is believed to be the sole factor limiting the abundance and distribution. A number of elements working together play a part in this phenomenon. In a few cases these may operate over the range as a whole. In most cases, however, the factors are entirely local in influence and may be of great importance in limited regions.

Physical Factors

Geology

Soils have been classified roughly on the basis of origin into residual, colluvial and alluvial; the alluvial soils being those deposited on the stream flood plains; the colluvial soils being those formed on or at the foot of the steep slopes by washing of the soil from above; and the residual soils those which result from the decay of underlying rocks. Obviously in the case of residual soils there must be a close relationship between the soil and its parent rock. In colluvial soils the relationship is not so close, but it is still there, nevertheless. Even in alluvial soils there is a close relationship between the alluvial soil and the residual soil from which it is derived. The relation of the vegetation to the underlying rock is largely due to the chemical and physical character of the soil, but it may also be affected by the elevation and topography, and these in turn are consequences of the character of the parent rock.

So it may often be shown that the distribution of various species of our native plants and certain introduced species also, is at least in part related to certain underlying soils or rock formations of a particular area. By field observation and collecting there has been brought to light the fact that in the southern Blue Ridge of Virginia there is a marked

scarcity and in some cases a complete absence of a number of the ruffed grouse food plants that are very abundant in the Alleghany Range and parts of the northern Blue Ridge. Also by field observations and the reports of others it is definitely known that the ruffed grouse is exceedingly scarce in the southern Blue Ridge and abundant in such of the Alleghany Range. That there is a relationship between the distribution of the various plant forms and the underlying rock formations is at once apparent by a survey of the Geologic Map of Virginia. Likewise it appears that there is a relationship between the distribution of the ruffed grouse and various herbaceous food plants in Virginia.

There are five major geographic provinces in Virginia; namely, the Coastal Plain, the Piedmont, the Blue Ridge, the Valley and Ridge, and the Southwestern Plateau. It is in these last three provinces that most of the ruffed grouse occur.

The rocks of these mountainous provinces are largely of sedimentary origin, laid down in the Paleozoic era. Then there came a series of great uplifts in the middle Permian time, raising these sediments to great heights. In the Valley and Ridge province as we know it today, there came a series of thrusts from the southeast, folding and faulting the sediments. This folding and faulting broke the sediments and raised them edgewise in long, linear formations. As erosion gradually tore down these formations, the softer materials were carried away first, leaving the more resistant rock formations running

northeast-southwest. This type of formation caused the rivers and streams to have definite courses of flow, either with the general trend of the ridges or cutting directly across as in the case of the New River.

The sediments of the Southwestern Plateau were also raised with those of the Valley and Ridge province but the rocks have been disturbed only slightly and consequently are flat-lying, or nearly so. Thus, when erosion set in there were no definite courses in which the rivers developed, so that as the softer materials were taken away, the harder rocks remained, forming small mountains and hills interspersed throughout the region in no particular arrangement. This is quite in contrast to the linear ridge and valley formation of the Alleghanies.

After erosion had gradually torn down these mountains of the Plateau and Ridge provinces, they were again raised to mountainous heights during the following Cretaceous time, and again at the close of the Tertiary.

The present topography shows the old Cretaceous peneplain on the tops of the present Alleghany ridges, the Tertiary peneplain in the rounded tops of the Valley hills, and the post-Tertiary erosion in the valleys which lie below the uplands of the Valley. The typical arrangement of the Alleghany Mountains today is a series of linear ridges, separated by deep valleys, extending the length of the state from Tennessee in the southwest to Maryland in the northeast. The Blue Ridge, on the other

hand, appears as a relatively narrow broken chain, for the most part consisting of isolated small mountains remaining here and there above the general level of the surrounding formations. These mountains at one time raised, as were the neighboring Alleghenies, have remained while the surrounding mountains of less resistant rocks have eroded away. The Piedmont province, to the east, was at one time raised up and formed high mountains, but these have been so eroded away in past ages that today it remains as a low peneplain gently sloping toward the coast from about 500-1500 feet in its western mountains at the foot of the Blue Ridge to about 150 feet at the Coastal Plain. The same feature continues on a gentle slope beneath the comparatively recent Coastal Plain, and probably continues well out beneath the ocean floor.

The Southwestern Plateau region is composed entirely of sandstone and shale formations. No limestone is present at all. The Alleghenies are also composed of sandstone and shale and in some cases, limestone. The valleys, on the other hand, are underlaid with limestone with smaller amounts of shale. The Blue Ridge from the standpoint of rocks is composed of two quite different materials. The southeastern portion is largely granite gneiss which shows indistinct ridges and rows of peaks, such as the Peaks of Otter. The northwestern portion is composed of sandstone and shales and is made up of sharp linear ridges with narrow valleys. The southern Blue Ridge south of Roanoke is made up principally of various schist formations.

The Alleghany Mountains are capped by the Silurian and Mississippian sandstones, while the slopes are largely of the Devonian and Ordovician shales. Some of the highest mountains of the Southwest are capped by the Mississippian sandstone. Almost all of these sandstone and shale formations give rise to very poor soils with steep slopes where farming cannot be undertaken and where timber production and grazing are the only profitable enterprises. So it is that these western mountains are extensively forested, well down to the valley floors and broken only by scattered farms and settlements.

The Great Valley of Virginia, situated between the Blue Ridge Mountains to the southeast and the Alleghany Mountains to the northwest, extends throughout the state. It is underlaid for the most part by the Valley limestone formations. In the southwestern part of the state the Mississippian limestone is found. Some sections are also underlaid by the Devonian shale formations. Locally from the northwest of the Great Valley, there are minor valleys with the same geology. In southwest Virginia, there are other limestone valleys to the northwest of the Great Valley, which are underlaid by Mississippian limestone. Many of these valleys are so narrow and the slopes so steep that very few extensive farms can be found. The limestone soils, as a rule, form better lands for farming and it is possible that previous to the white man when these areas were in woodland, there were much better conditions here for supporting an even larger grouse population

than we now find in the surrounding mountains.

The Blue Ridge Mountains, on the other hand, are capped mostly with quartzite and granite. The soils of quartzite origination are of very poor quality for farming and one finds few, if any, good farms along these parts of the mountain crests. Extensive granite formations are found not only on the Blue Ridge proper, but also in the western Piedmont from the northern end of the state south to Roanoke County. Granite soils, as a rule, form good farming lands, and throughout this section good farms are common. Even when the slope of the mountain is exceedingly steep, such sections will be cleared and farmed to the tops of the mountains. This is characteristic of the eastern Blue Ridge Mountains with the slopes well farmed to the tops, leaving just the crests of the mountains forested. This condition greatly limits the grouse range, not only in extent, but in some cases to the poorer soils. This is quite in contrast to the Alleghanies and the Southwestern Plateau, where the mountains are more commonly wooded all the way to their bases, and in many cases the valleys too.

It has been pointed out in a previous section that ruffed grouse are exceedingly scarce in the southern Blue Ridge, and that there is a corresponding deficiency in various food plants in this same section. With these same food plants being more common to the northward and abundant in most of the Alleghanies and the Southwestern Plateau, it would seem logical to compare the various growing conditions to see if

there is any radical change in the soil formation. A glance at the Geologic Map of the state shows a decided break in the general Blue Ridge formation southward. It is in this southern Blue Ridge that the various schist formations occur. They underlie not only the southern Blue Ridge but much of the Piedmont to the east, and a wide swathe in the Piedmont to the north. Grayson County, for the most part, is not of this formation, but of a type of granite more suitable for growing conditions. The schist formations give rise to some of the poorest soils of the state. The mountains have exceedingly steep and, in many cases, almost precipitous rocky slopes, the soils from which are of such poor quality that very few, if any, farms can be operated on a paying basis. However, there are a number of exceedingly poor farms scattered through these mountains. The valley lands, on the other hand, are predominantly in small farms. The steep, rocky slopes and poor soil conditions make timber production the only profitable enterprise. Grazing is done only to a very limited extent as compared with the widespread grazing in the Valley and the Alleghanies. The dominantly wide, open forest type of the Blue Ridge, much of it well supplied with dead chestnut, is in contrast to the dominant shrubby type of the Alleghanies. One may walk for hours along the crests and slopes of the southern Blue Ridge Mountains and see very few herbaceous food plants of any worth as winter food for the ruffed grouse. Incidentally, it was not uncommon to walk for as many as

three days in these mountains during the fall of the year and see only one, and sometimes no grouse. Of course there are ravines and places here and there where grapes, smilax, or some other species are common, but on the whole the region is quite poor. Laurel and rhododendron are common and may serve as food for some period of time, although not for year after year, as these are probably emergency foods.

Topography

In the previous discussion it was stated that Virginia may be divided into five distinct physiographic provinces or divisions. They are in order from the Atlantic westward: the Coastal Plain, the Piedmont, the Blue Ridge, the Appalachian Valley and Ridge and the Southwestern Plateau. The Coastal Plain lies between the Atlantic Ocean and the Fall Zone, and varies in elevation from sea level up to about 250 feet. It is not within the bounds of the ruffed grouse range of the state, yet the absence of grouse here is probably due to the physiographic peculiarities of this province.

The Piedmont province lies between the Fall Zone and the Blue Ridge, and, like the Coastal Plain, slopes gently seaward, but is in general of much higher elevations than the former. At the Fall Zone the elevation is between high tide and 250 feet and slopes upward to the Blue Ridge where, in the north it ranges between 500 and 750 feet and to the south near the North Carolina line it stands at 1000 to 1500 feet.

VIRGINIA STATE PLANNING BOARD
MAP IX-3-2

GENERAL TOPOGRAPHY OF VIRGINIA
Source: Sectional Airway Maps by U.S. Coast & Geodetic Survey
and Topographic Maps by U.S. Geological Survey

LEGEND
Contour Interval 250, 500, & 1,000 Feet As Noted
Elevations Above 4000 Feet As Marked

- Over 4,000 Feet
- 3,000 to 4,000 Feet
- 2,000 to 3,000 Feet
- 1,000 to 2,000 Feet
- 500 to 1,000 Feet
- 250 to 500 Feet
- Less Than 250 Feet

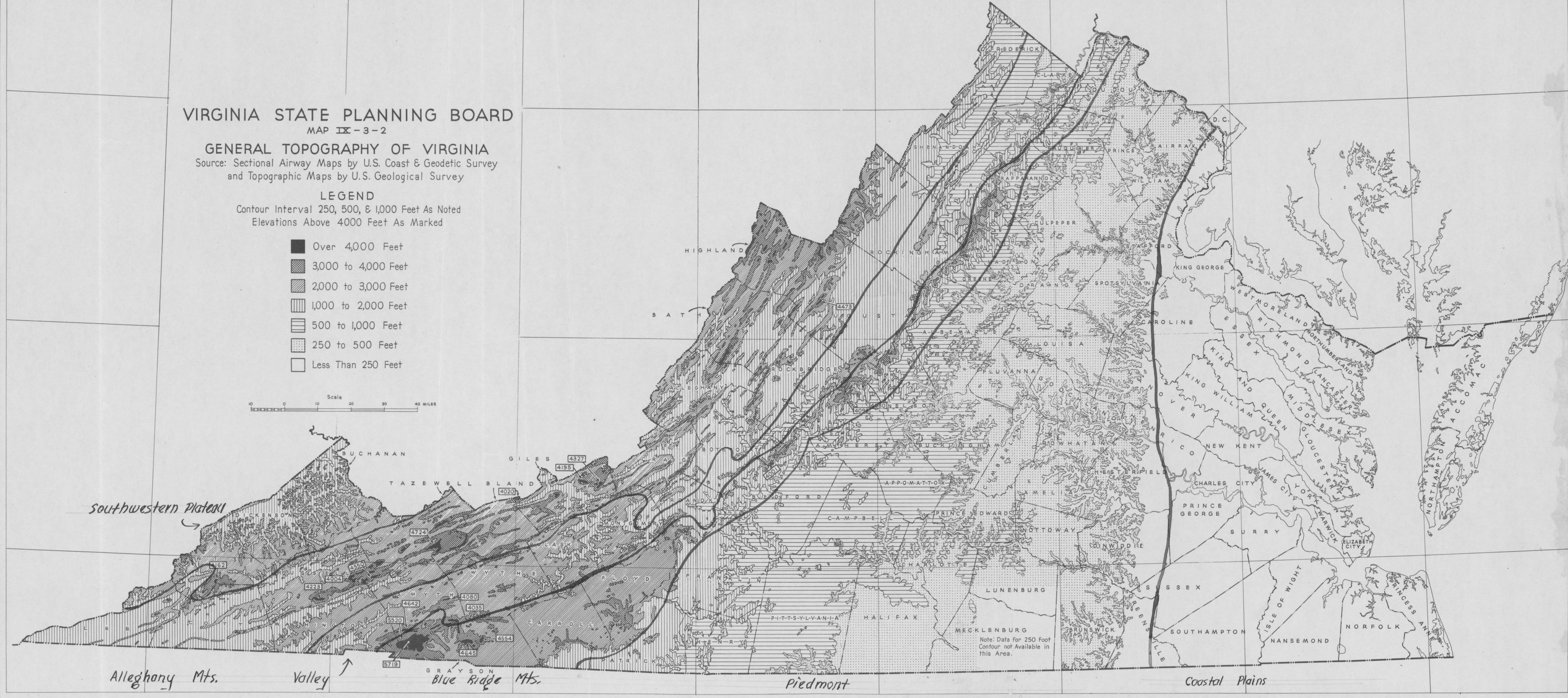
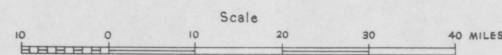


Figure 4

Due to the greater resistance to erosion of various rocks, there are numerous northeast-southwest ridges reaching heights of 500 to 1000 feet above the general level of the plain. These ridges occur entirely, however, in the western and central parts, as the hills in the eastern Piedmont are few and small. At the present time the ruffed grouse is scarce, except locally, over the whole of the Piedmont, and few if any are to be found southeast of a straight line drawn from Ashland, Hanover County to Martinsville, Henry County.

The drainage of the Piedmont is to the southeast by the same rivers that cross the Coastal Plain, plus the Roanoke River, which crosses the North Carolina line just west of the Fall Zone. All of the larger streams rise on the southeastern slope of the Blue Ridge except the Potomac, James and Roanoke Rivers, which rise in the Alleghanies.

The Blue Ridge extends as a more or less narrow range to the northeast of Roanoke and as a plateau and high peaks and ridges to the southwest. The latter includes most of Floyd, Carroll and Grayson Counties, and parts of Franklin and Patrick. The Blue Ridge in Virginia is relatively small as compared with its counterpart in North Carolina and the Alleghanies of Western Virginia. As will be developed more fully under that section dealing with "Habitat", this lack of extensiveness and the isolated nature of the mountain peaks appears to be a significant factor influencing the distribution and abundance of the ruffed grouse, which is

relatively scarce in most of the Blue Ridge Mountains.

In the northern part of the state the Blue Ridge begins at approximately 2500 feet, which is the average elevation of the Alleghanies directly to the west. Thence the Blue Ridge rises rapidly to the height of over 4000 feet at the Peaks of Otter. From the Peaks there is a rapid drop to the vicinity of Roanoke, where the Ridge becomes almost absent. Thence to the southwest the range begins to rise and also to spread out until it becomes county-wide as it passes into North Carolina. The range reaches 3500 feet in Floyd County; and in Grayson County, White Top Mountain and Mount Rogers are 5520 feet and 5719 feet respectively. As mentioned previously, in these mountains of Grayson County the ruffed grouse is common. These are some of the highest mountains of the state; however, they are not typical of this part of the Blue Ridge. The Blue Ridge to the northeast of Roanoke is made up of two ridges: a southeastern, which is a series of knobs such as the Peaks of Otter, and a northwestern, which is a definite ridge comparable to the ridges of the Alleghanies.

The topography of the Valley and Ridge region is very different from that of the Blue Ridge and other sections of the state. It is characterized by sharp, linear ridges extending northeast-southwest and separated by relatively broad valleys.

"Elevations in this region are best considered with reference to two

topographic features: first, the general height of the tops of the main mountain ridges, and second, the uplands in the valleys. These two levels are presumed to represent remnants of former more or less wide-spread plains, termed peneplains, developed near the level of the sea largely through the erosive action of streams. These old surfaces are referred to as the upland and valley-floor peneplains." (93)

On a clear day one may see from Bald Knob (4300 feet) in Giles County as many as a dozen parallel linear ridges all rising at about the same level of 3000 feet above sea level. Similar observations can be made from other vantage points along the Valley and Ridge region. However, the upland peneplain stands at different elevations in other parts of the range. In the northeast, near the Potomac the elevation begins at 2000 feet and thence southward to 3500 feet in Highland County, and maintains this through Eland and Taxewell Counties, and thence to 2000 feet at the Tennessee border.

"This peneplain is represented throughout the entire Alleghany Mountains of eastern United States. Virginia stands at the crest of the oval dome of the uplifted peneplain, the plain falling off gradually to low levels in Alabama to the southwest and in New York to the northeast. Above the upland peneplain level there are peaks and sharp ridges which rise 500 to 1000 feet." (93)

The ruffed grouse is abundant throughout most of the Alleghany Mountains. The characteristic linear ridge formation and the extensiveness of the forested areas appear to be significant

factors influencing the abundance of the ruffed grouse.

The valley-floor peneplain, on the other hand, stands at a rather uniform level of 1000 to 2000 feet below that of the upland peneplain. At its northern end the elevation is about 500 feet. This rises gradually southwestward to a height of 2000 feet on the divide between the Shenandoah and the James Rivers. Thence southwestward at the point where the James River leaves the valley, the elevation is 1100 feet. The elevation then rises to 1400 feet on the divide between the Roanoke and James Rivers and again drops back to 1100 feet at Roanoke. Thence westward it reaches 2100 feet at Christiansburg, the divide between the Roanoke River and New River, and southwestward to 2600 feet at Rural Retreat, on the divide between the drainage system of the New River and Tennessee River.

"Similar relations prevail in the narrower valleys northwest of the Great Valley.... On the divides, the stream beds lie near the level of the valley-floor peneplain, but they are cut below it as they approach the main streams. Thus, on the Augusta-Rockbridge County line, the upper waters of the Shenandoah River are near the peneplain level, but they are 200 feet below it in Jefferson County, West Virginia. This feature is even more marked along the New River, which flows 400 feet below the peneplain level." (93)

The Southwestern Plateau comprising a major part of Buchanan, Dickenson and Wise Counties of southwest Virginia is entirely different topographically from that

of the Valley and Ridge region. There are a few dips in the rock formations which tend to form ridges running northeast-southwest, but on the whole

"there is almost complete absence of linear ridges and broad valleys, while irregular hills and peaks of no particular trend are everywhere.....The hill tops rise to the same general level as do the ridge tops of the Valley and Ridge region. They are not broad and rounded but rather sharp, so that uplands are practically lacking. The Southwestern Plateau is drained largely to the northwest by tributaries of the New River and to a less extent to the south by branches of the Powell and Clinch Rivers. The streams flow in V-shaped valleys and have narrow flood plains or none at all. With little upland and little lowland the county is almost entirely in slopes-, many of them so steep that agriculture is carried on with difficulty." (93)

The more extensive forested areas and the marked absence of extensive agricultural enterprise favors greatly the production of a large grouse population in these counties.

"The hill tops stand at the remarkably uniform elevation of 2700 to 3000 feet above sea level with no considerable slope in any direction. On the main divides the drainage level is at or near the upper elevation. Northward and southward the streams have cut farther below this level until on the northwestern border of Buchanan and Dickenson Counties and on the southeastern border of the coal fields the streams are 1000 feet below the level of the hill tops, producing a very rugged topography." (93)

Elevation

The influence elevation plays in the distribution and abundance of the ruffed grouse is at this point purely a matter of conjecture. The Alleghany Range taken as a whole throughout the state is higher than the Blue Ridge, and, therefore, at corresponding latitudes supports environmental associations more closely comparable with those found in typical portions of grouse range to the north. It will be shown that there is a variation in the abundance of certain plant species between the two mountain ranges and there is a possibility that elevation may be at least a partial factor here.

By comparing the Topography Map of Virginia (Figure 4) with that of the grouse distribution map (Figure 2), it is striking how closely the species follows the higher elevations. The map shows most of the southwest and the counties bordering along the West Virginia line to the north as being above 2000 feet, and much of the section over 3000 feet. Where the grouse distribution becomes thin to the east, the elevation drops considerably. A glance at the Blue Ridge Mountains over 3000 feet shows a relatively narrow chain of mountains scarcely ten miles across. Most of the surrounding country immediately to the west is between 1000 and 2000 feet and most of the terrain to the east where the ruffed grouse is very scarce is below 1000 feet. A large part of the Piedmont region is less than 500 feet above sea level. The corresponding decrease in elevation

in many of the counties to the north is automatically supplemented by the increase in latitude so that there may be only a relatively slight difference between 2000 feet in the northern part of the state and 3000 feet in the southwest.

The apparent correlation between elevation and distribution may not be as significant as is first thought. There is a considerable difference in elevation between the various mountain tops and the adjacent valleys in many sections. Variation in elevations between the two ranges on the one hand may not be as great as the difference between mountain top and valley within a limited area of one range or the other.

From observation it is known that grouse may be found on the upper slopes and tops at one time and in the valleys and lowlands at another. Generally during extreme weather in the winter the grouse are found in ravines and the lowlands. The ideal grouse range of the state is largely in the lowlands, ravines and small spurs and hills at the bases of the main ridge. It is here that the greatest numbers of grouse are found during most of the year.

Slope

No specific data have been published concerning the effect slope may have upon the welfare of the grouse. Only through field observations of the favorite habitats of the birds can we draw conclusions. Very few grouse are found

on excessively steep slopes. Many of the slopes in the Blue Ridge are exceedingly steep and rocky and some almost precipitous. In these situations no grouse were flushed at all. Likewise, in the Alleghany Mountains few birds inhabit the overly steep slopes. It is on the more gentle slopes of the ridges and in the coves, ravines and valleys of the lowlands that most of the grouse are found. The smaller secondary hills at the bases of the main ridges are favorite habitats. This is especially noticeable during the fall and winter seasons.

Fire

There is no apparent correlation between the abundance of the ruffed grouse and the status of the fire protection of the counties in the two ranges. Many of the counties abundant in grouse are without fire protection and have been without that protection for many years. Fire protection depends a great deal on the density of population, the type of residents and their desire to have such protection. Many of the western counties are not densely populated, but are made up of extensive forest tracts. Here the people cannot afford fire protection and it seems that fire is not a big problem in these sections. The National Forest has incorporated a considerable amount of the extensive forest lands in these western counties, thus assuring the counties of adequate fire protection.

The affect of fire on the grouse abundance and distribution is entirely a local condition. In many respects it depends largely on the attitude of the people as to whether a county is over-run with fires. Patrick County has many possibilities for a larger grouse population, but it is almost impossible to hold a population where the vegetation of whole mountains is lowered to the ground. This sort of thing happens nearly every year. Here the people appear to be of a somewhat backward nature. Fires once started are allowed to burn over thousands of acres and envelope whole mountains, and no effort towards control is made until someones life is in danger. A high percentage of Patrick County's wooded areas have been burned in recent years. A small part of the Blue Ridge in the northern part of the county is still in good timber, but No-Business Mountain, Bull Mountain and Carter's Mountain, and much of the Blue Ridge proper are burned at least every other year, if not every year. Burns involving thousands of acres are not unusual.

In comparison, we might take Bland County. Here there are thousands of acres of beautiful forest lands unravished by recent fires. On investigation one finds the attitude of the people markedly different from that experienced in Patrick County. Here fire is definitely outlawed in the minds and actions of most of the people. If a fire starts or burns over some small area an investigation is made and people desire to know the particulars. With the general public whole-heartedly

against fire, this destructive agent can be adequately controlled. The Giles County warden reports that since the county has acquired fire protection the grouse have increased considerably. This is no doubt true of many counties.

In the Alleghany Mountains the topography probably has much to do with the effectiveness of a fire. The forested areas are extensive and the mountains run as a series of long, unbroken ridges as a rule relatively close together, and in many sections well wooded to the valley bottoms. Should a large area burn during the nesting or breeding season and destroy quantities of eggs and young grouse and possibly drive out the adults, this would not be so serious for there is a great expansive area close by which will serve as a ready supply to restock the burned-over area with surplus birds. This condition does not exist in the southern Blue Ridge of Virginia. Here the main mountain crests are flanked by isolated mountains so that looking out over the extent of the Blue Ridge it appears to be made up of a series of peaks which are the tops of smaller mountains of the general chain. The northern Blue Ridge is more on the order of the Alleghanies in many respects. In the southern Blue Ridge, if a fire should occur, in most cases a whole mountainside or both slopes will burn severely. Most of the destructive fires of Patrick County occur in the spring of the year, and many in June and some few in the mid-summer. At these seasons the grouse are either nesting or

the young have recently hatched. In any event both eggs and young would be destroyed by a fire. Fire statistics show that the majority of the fires occur in March, April and May, in all counties. The general topography of these mountains, that is, their isolation, makes it a longer period of time before a stock can again be built up, especially when any nearby range is not abundant enough in grouse to furnish a ready supply.

If one made a survey of Patrick County as a typical region of grouse habitat in the southern Blue Ridge of Virginia, one would at once be impressed by the great havoc of fire and place it at the head of the list. That would be quite true of Patrick County but not so of other parts of the Blue Ridge, nor of the Alleghenies. Fire in most respects is a local factor and only locally is it an important one.

Climatic Factors

Temperature

Temperature may play a large part in the general southward distribution of the species through the Appalachian system. The ruffed grouse being typically a bird of the colder climates, its center of population being that of New York and the New England states and parts of Canada, it would be expected that should the bird occur at all in the states southward, it would be in the colder Appalachian mountains. In Virginia the Appalachian Highland region, which includes the Mountain and Valley Zone, constitutes a notable southward extension of relatively low summer temperatures, to the east and west of which prevailing temperatures are materially and significantly higher.

Chapman (33a) points out that "the boundaries of the three transcontinental zones forming the Austral Region conform more or less closely to certain isotherms, or lines of equal temperature, but their eastern and western faunal subdivisions are determined by the annual precipitation of rain. Any factors such as altitude, exposure in relation to the sun, or proximity to water, which affect temperature exert a marked influence on the boundaries of faunas and must of course be considered in mapping faunal areas."

Chapman also states that "Merriam ('94) has shown that temperature is not active throughout the year, but only at

certain seasons. Merriam has therefore formulated the following Laws of Temperature Control: First 'Animals and plants are restricted in northward distribution by the total quantity of heat during the season of growth and reproduction' Second 'Animals and plants are restricted in southward distribution by the mean temperature of a brief period covering the hottest part of the year'".

Locally it is possible that temperatures at certain seasons of the year are a major factor in the grouse abundance and distribution. Variations in the average temperatures over a large part of the state are caused mainly by topography and the distance from the Atlantic Ocean and the Chesapeake Bay. The variations near the coast are relatively slight, whereas, in the highlands the elevation as between valley and mountain operates effectively to produce local climatic differences, and these are well marked. Because of air drainage frost often occurs on the valley floor when there is none on the surrounding hills. On the average, however, the higher elevations are colder.

The increasing altitude of the Valley areas from north to south through most of the zone, ranging from 500 to 600 feet in the northern portion of the Shenandoah Valley to as much as 2500 feet in the vicinity of Wytheville, relatively near the southern border of the state, tends to minimize, or even to reverse, the variations of temperature with latitude which might normally be expected to occur.

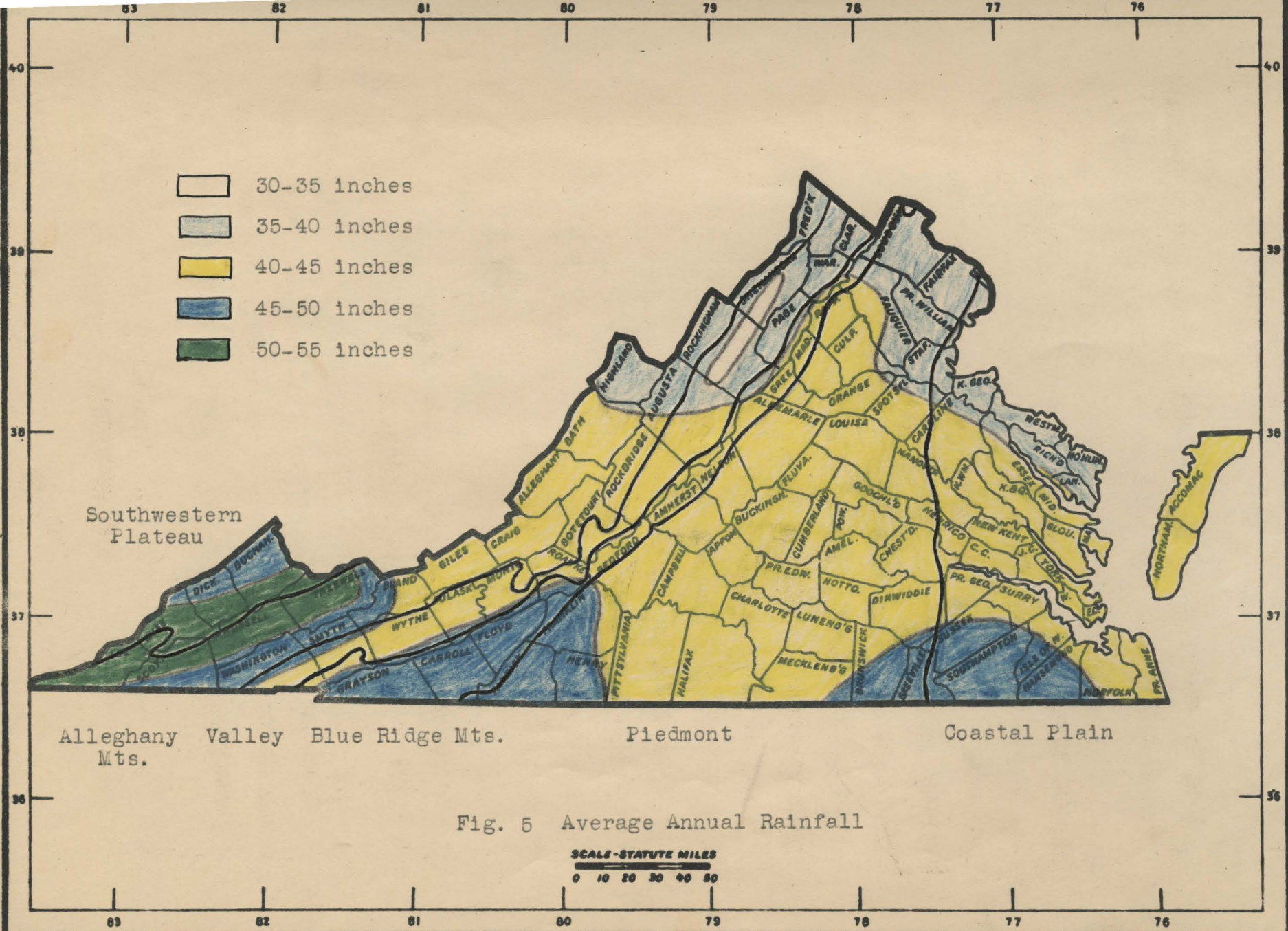


Fig. 5 Average Annual Rainfall

Precipitation

Rainfall:

Precipitation usually is ample and well distributed throughout the year and over all the state. Dry or wet periods of long duration are infrequent. Occasionally severe droughts do arise as in 1930.

In Figure 5 the various areas of average rainfall are roughly drawn. Only very general areas may be indicated since few of the climatic stations are situated on the mountains. The areas of heaviest rainfall are situated in the southern part of the state. Most of the southwestern part of the state, including the Southwestern Plateau and the Alleghany Mountains, comprises some of the best grouse range of the state. This region has an annual rainfall of over 45 inches. A wide swathe comprising parts of Dickenson, Buchanan, Wise, Lee, Scott, Russell and Tazewell Counties, has an annual average rainfall of between 50 and 55 inches. Another section with a precipitation of 45 to 50 inches yearly is the Blue Ridge Plateau and most of Franklin and Henry Counties, south of Roanoke, an area with relatively few grouse. In the southeast an area comprising all of Greenville County and most of Southampton and surrounding counties also has a rainfall of 45 to 50 inches.

To the north there is somewhat of a drop in the yearly precipitation. Most of the Coastal Plain, Piedmont, Blue

Ridge, Valley and Allegheny Mountains south of a line from southern Highland to northern Orange and southern Lancaster Counties has an average yearly precipitation of 40 to 45 inches. Greene, Madison, Rappahannock, and parts of Culpeper, Fauquier, Warren, Page and Rockingham Counties may be included also. The remainder of the state to the north has a yearly rainfall averaging 35 to 40 inches, with the exception of a small part of the eastern Allegheny Mountains in Shenandoah and Rockingham Counties, which is the driest part of the state, with an average yearly rainfall of only 30 to 35 inches. From the above discussion it is apparent that there is little difference between the annual average precipitation of the Piedmont and Coastal Plain, areas producing few grouse, and the Blue Ridge, Valley and Allegheny Mountains, where the grouse are more common. Over the state as a whole more than half of the annual amount of rainfall comes during the crop-growing season, April to September. November is the driest month. In some parts excessive rains may occur especially when tropical disturbances pass over. Severe dry periods as mentioned before, may occur.

There seems to be little correlation between the average yearly precipitation and the distribution of the ruffed grouse in Virginia. It is possible, however, as has been stated by Dr. Ralph King (76) that precipitation may cause considerable loss in limited situations. This is especially true at the

time of the hatch and the first few weeks of age. This period is the last week of May and the first two weeks of June, during the months of the greatest rainfall over most of the state. Here severe downpours or prolonged rains may cause complete wetting and chilling of the young. Excess water in depressions in the terrain serves as death traps to many young chicks the first few days of age. Streams and ponds are as a rule well supplied with water during this time of the year, so that an ample water supply is present and meets the brood's needs throughout all the summer - there is an abundance of fresh, succulent vegetation and insects and other small animals.

As mentioned before, November is the driest month of all and it is then that lack of water may become a factor over most of the range. About this time, as was pointed out by Dr. King (76) in his Minnesota survey, there is an almost complete dying down of succulent vegetation. Berries and other fruits have largely disappeared and it is yet a few weeks too early for the first snow. Here is a period of low water supply which may necessitate the grouse's traveling some distances in search of water in the foothills. This necessitates moving off the drier ridges and congregating in a more limited area nearer the water supply. This concentration is in most cases apparently only temporary. From personal observations and those of others, grouse are usually found in the ravines and watering places early in the day, returning to dry slopes for the remainder of the day. Some

believe the birds as a rule return to water in the afternoon. The writer has not observed this to any extent. On wet days or days of extreme weather conditions, the birds are often found in the more protected ravines and the flats.

Snowfall:

Taking the state as a whole, the average annual snowfall varies considerably. The heaviest known fall is in the Appalachian Mountains, where as much as 80 inches has been recorded in West Virginia. However, in the mountainous sections of Virginia the snowfall usually averages between 20 to 25 inches. In some of the higher mountains of the southwestern part of the state, the annual average is around 30 inches. The annual snowfall for the Valley of Virginia ranges between 20 to 25 inches. The Blue Ridge section of the state averages around 20 inches of snow annually, although some stations in the northern parts record as high as 31 inches. It must be remembered, however, that most of the climatic stations are not situated directly on the mountains, so that the figures as given in this discussion may be somewhat low. From the Blue Ridge to the coast the snowfall becomes considerably less. In general the snowfall in the Piedmont averages about 15 inches yearly and ranges from about 20 inches in the north to about 10 inches in the southern part. The snowfall in the Coastal Plain area ranges from approximately 15 inches in the north to less than five inches in the south.



RUFFED GROUSE TRACKS IN DEEP SNOW

FIGURE 6

According to King in his Minnesota survey, heavy snows are more or less favorable in that they serve as roosting cover. Snow in that section is of such a depth that the grouse plunge into it and roost beneath. Such conditions in Virginia rarely exist and only occasionally do snows reach a depth sufficient to permit a grouse to roost beneath it. In general, the heavy snows restrict the grouse diet to buds, fruits and evergreen leaves. As a rule under these conditions the grouse are found in the rhododendron and laurel thickets of the ravines and valleys where they may be easily trailed. When adequate food supply is not found close at hand, the grouse may be discovered congregated in sizeable bunches of as many as 12 or more birds feeding on sallow berries or some other desirable food supply. Grouse can subsist for long periods under these conditions, except that they are much more susceptible to predators. The devastating work of predators at this time of the year is a circumstance that should be investigated more fully.

Light

Light may play a part in the distribution of birds over North America as a whole, but for a limited area such as Virginia, the changes are apparently trivial.

There is no reason to believe that light or the length of day has any influence on grouse distribution in Virginia. Dr. H. A. Allard states that "I am not inclined to believe that light or length of day is a factor in these distributions,

since this would be about the same throughout Virginia. Even with respect to plant life here, something more than changes in the seasonal length of day appear to be operative, for latitudinal changes are too slight".

Biological Factors

Cycle and Disease

The present status of the so-called "grouse cycle" is not discussed since very little data is available concerning the operation of the cycle in Virginia. To all indications the cycle, if operative in Virginia, is now at its peak and will show a sharp decline within the next one or two years. The greater part of the grouse range in the state does not support a large grouse population, as compared with sections of the range in New York. The cycle, if it is in effect, is not apparent, therefore, to the average individual.

Although there may be a general cycle working in Virginia at approximately ten-year intervals, it apparently does not affect the whole range at one time, but is local. This is indicated by the game warden and sportsman reports. T. E. Clarke, Wildlife Technician of the George Washington National Forest, made some observations in this respect. He writes:

"The information that we have is purely the results of observation except in the case of North River, which is actual check. In 1935 the grouse kill in Bath and Allegheny Counties was extremely low. During the same season the grouse kill in North River was 307 and decreased as follows - 1936 - 51; 1937 - 22; 1938 - 28; 1939 - 31 (estimated).

During this same five-year period, the grouse population and kill continued to improve in Bath and Allegheny Counties and from all reports reached a new high last year.

Our check in Bath was through the use of census

cards and information gathered from reliable bird hunters.

The hunters of Bath reported a noticeable increase in the size of the broods as of November 15 toward the end of this five-year period. During the same period the broods flushed in North River continued to decrease in size and in 1938 the hunters reported killing only adult birds and never flushing more than two or three birds in any one brood.*

Returns from questionnaires submitted to game wardens and sportsmen indicate that there was a great scarcity of grouse in 1920. Another low period occurred in 1930-1931. Many reported various other dates as being low periods, but the majority were for 1920 and 1930. The year 1930 was one of extreme drought over most of the United States, affecting wildlife considerably. What effect this may have had on the ruffed grouse is only a matter of conjecture. Aside from the drought itself, forest fires raged everywhere, taking an enormous toll.

Another factor which needs further investigation is the mortality of the brood. The average brood found throughout the Blue Ridge Mountains in 1939 was apparently smaller than that found in the Allegheny Mountains. To all indications there was a good hatch, but within the first few days a large mortality occurred. Just what this factor is that reduced these broods is not known. Blood smears and detailed examinations of the young birds should be made to determine whether disease and parasites are prevalent. The broods observed at Mountain

Lake in Giles County were large (10) and remained large throughout most of the summer as far as known. In the future a thorough check should be made of nests and broods should be observed all summer if possible.

Predation

On the accompanying map, (Fig. 8) are listed by counties the total number of hunting licenses issued (hunting and fishing and hunting only). Little information can be derived from these figures, and they are of little value in determining the pressure that hunting would exert on the species in any particular part of the state. There is no marked contrast in the numbers of licenses sold in the various parts of the state, which might show a greater hunting pressure in one part of the range than in another. It is regrettable that kill records are not available. If these were obtainable some idea might be derived as to how intense the hunting pressure is in various parts of the state.

The Blue Ridge Mountains are easily accessible to hunting since they form a relatively narrow range, and are subject to a large potential, if not actual, hunting population from the heavily populated Piedmont to the east and the large population in the Valley of Virginia to the west. The Allegheny Mountains, on the other hand, are much more extensive and inaccessible. Figure 7 gives the percentage of land area in roads, highways, etc., and indicates to some extent the relative accessibility of

the various regions of the grouse range. It will be noticed that the greater part of the best grouse range has a low percentage of roads, while much of the state where the grouse is scarce has a high percentage. The only moderately large towns and cities close at hand are those situated in the Valley region. The Alleghany Range in Virginia is a small part of the extensive and rugged West Virginia Range, where population centers are few and scattered.

To all indications the most severe hunting takes place in the Alleghany Mountains where the grouse are known to be abundant. Where the grouse are known to be scarce and have been low for a number of years, a relatively small amount of hunting is done. The open woodland growth of the Blue Ridge would tend to make the species much more vulnerable to hunters if many hunted this section intensively. However, in spite of conflicting reports, it seems that the Blue Ridge is not hunted excessively, except perhaps in some local situations. Buffalo Mountain in Floyd County is hunted considerably as it has a much larger grouse population than other sections of the Blue Ridge. Other factors seem to be in operation which keep the grouse population at a low number. It is difficult to obtain accurate information as to the prevalence of hunting in an area because of conflicting reports of the residents. Therefore, most of the above statements are based on the author's observations and information from other individuals

which he considers reliable. As mentioned before, a number of the "old-timers" of the northern Blue Ridge report that the "pheasant" or ruffed grouse was much more common previously than it is at the present time. Some attribute this to extensive market hunting throughout the sections before laws were passed preventing such practices. Anywhere from \$.50 to \$1.00 was paid per bird in the Washington market. Sixty cents was the usual price paid, however. It is possible that the hunting element was so severe in years past that the birds were reduced to such a low stage that they will require a number of years to recover. It is also possible that the birds might easily be reduced to such a state in the type of habitat found in the Blue Ridge Mountains. The limited extent of the range might make it possible that the grouse population would remain low for a number of years with a relatively slight hunting pressure.

Although the Blue Ridge Mountains are more readily accessible to the greater hunting population, it does not necessarily follow that these mountains are more heavily hunted. Modern roads and automobiles have almost eliminated distance as a barrier to individuals desiring to hunt grouse in the remote parts of the state. There are few grouse hunters who regard 100 miles or even 200 miles as an excessive distance to travel for a day or two days' hunt. The modern automobile and mountain roads have brought most of the finest grouse range within a

few hours' ride from the centers of population. Therefore, it may not be unusual to find hunters coming from counties east of the Blue Ridge to hunt grouse in the counties to the southwest. With this fact in mind, figures of licenses sold in various counties lose their significance as indicators of the hunting pressure on ruffed grouse in any particular section of the state.

Although there is a marked contrast between the abundance of the ruffed grouse in the Blue Ridge Mountains and the Allegheny Mountains, there is no indication that this is influenced by any natural predators. Only in local conditions would predation be a factor. The fox, a well-known enemy of the grouse, is to all indications equally abundant in most parts of the mountainous sections of the state. The great horned owl, which is one of the chief predators on grouse in the north, is common in Virginia. There is little to indicate, however, that this species is any more a factor in one section than another. The skunk, a predator of lesser importance, is common over most of the mountainous regions. Other predators such as wild cats, snakes, weasels and other mammals are present in both mountain ranges. If predators are more destructive in one mountain range than the other, it would in all probability be in the Allegheny Mountains, where the range is more extensive and would serve as a more adequate habitat for all predators.

Little information is available on the relative abundance of "buffer" species, such as rabbits, shrews, mice, etc., which

may be numerous enough to relieve considerably the predators' drain on the grouse. These various species are common in all the mountainous sections of the state, except in over extensive stands of dense vegetation, and to all indications balance each other as factors in both mountain ranges.

Habitat

A glance at Figures 2 and 4 shows the Blue Ridge Range as a relatively narrow chain for most of its extent through the state. Southwest of Roanoke it spreads out through Carroll, Floyd, Grayson and Patrick Counties before entering North Carolina where it becomes a range of considerable extent. The northwest edge of the Blue Ridge forms a ridge comparable to the linear ridges of the Alleghany Mountains. The remainder of the Blue Ridge, however, is broken up and disconnected forming innumerable small mountain peaks rising above the general level. This is particularly noted in the vicinity of the Peaks of Otter and in the fanning out of the mountains in the southern part. These mountains are characterized by excessively steep slopes, most of which are completely cleared around the bases and in many cases, well up towards the top. Farming to the tops of the mountains is especially noticeable from Roanoke northward, where even excessively steep slopes are farmed. Figure 9 on farm density gives some idea of the general distribution of farms. Certain sections, however, are not comparable as the average size of farm is not stated. The

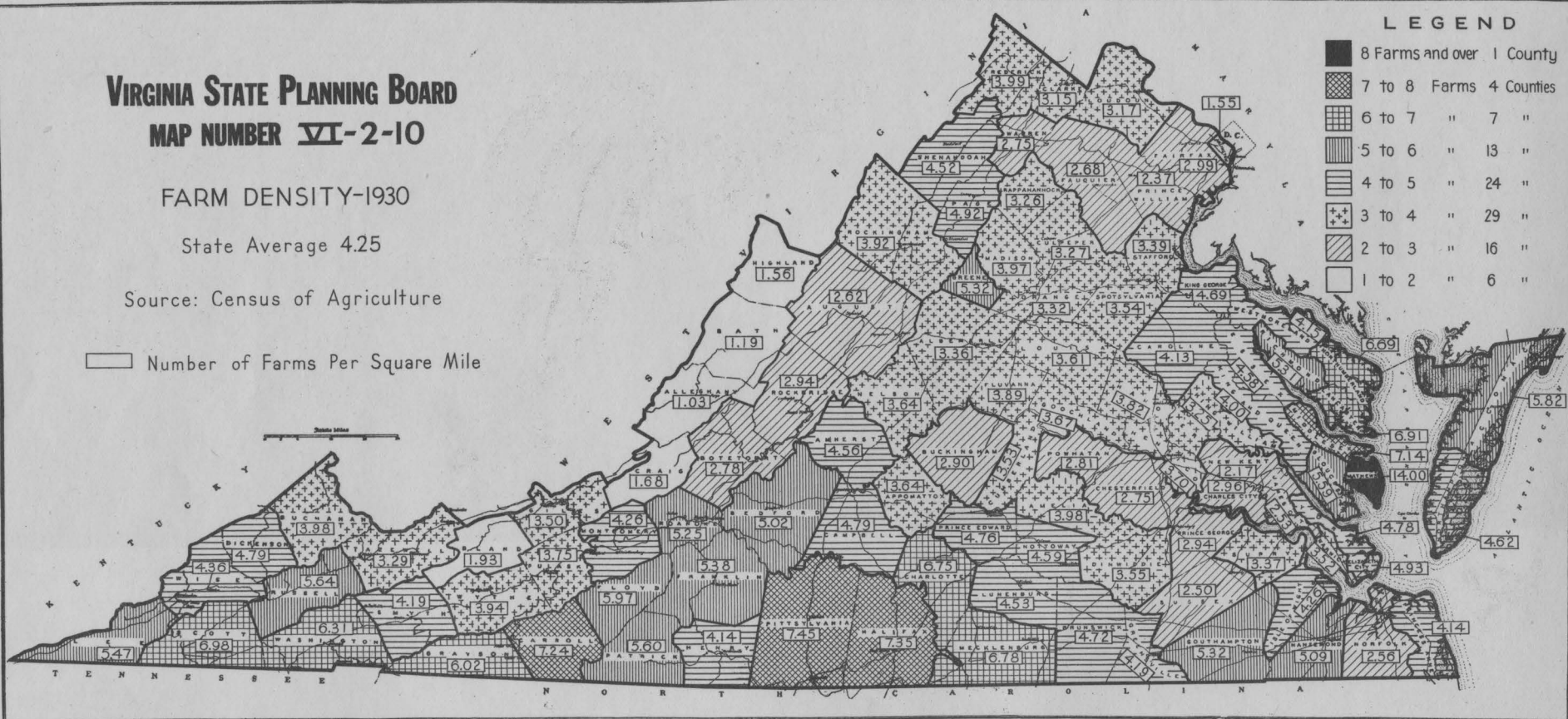
VIRGINIA STATE PLANNING BOARD
MAP NUMBER VI-2-10

FARM DENSITY-1930

State Average 4.25

Source: Census of Agriculture

Number of Farms Per Square Mile



VIRGINIA STATE PLANNING BOARD
MAP NUMBER VI-2-11

FARM DENSITY-1935

State Average 4.93

Source: Census of Agriculture

Number of Farms Per Square Mile

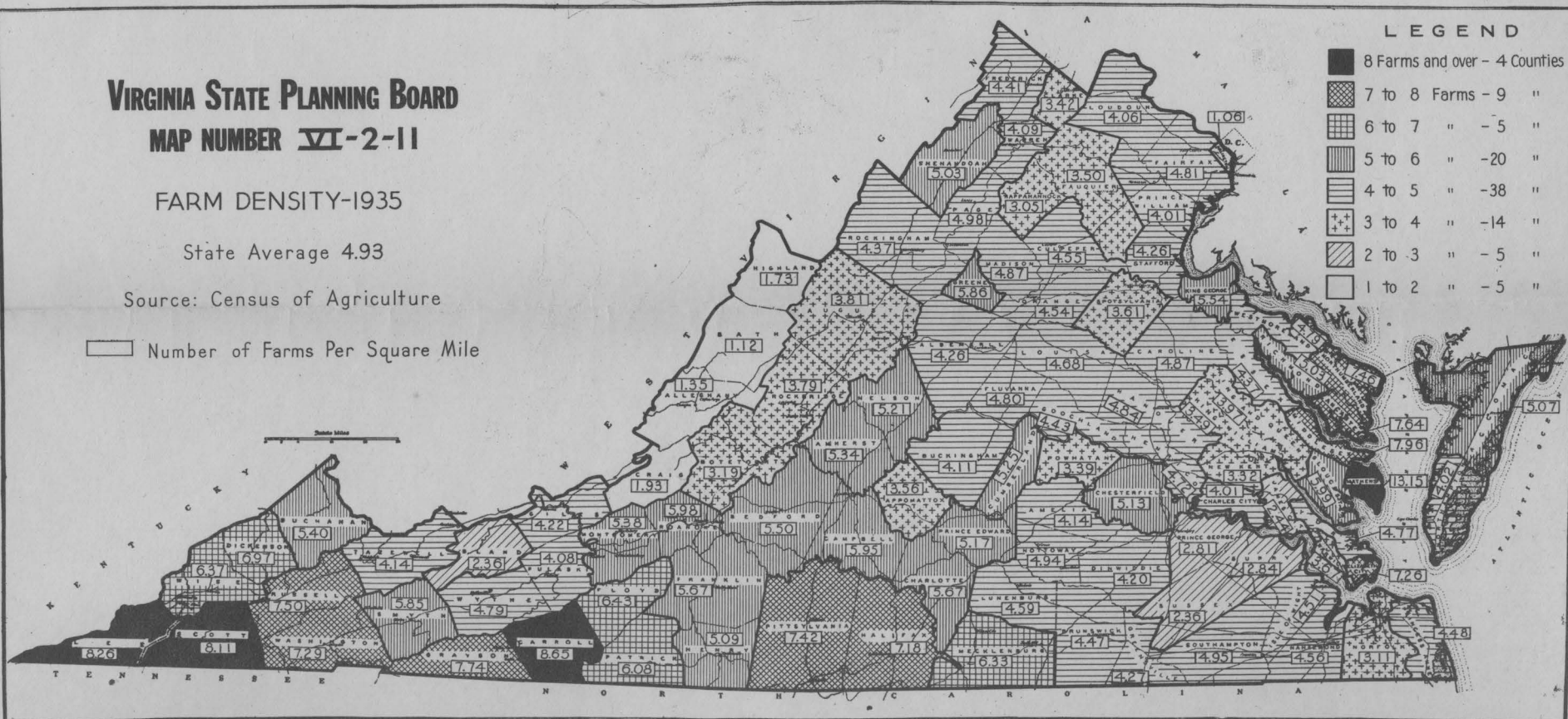




Figure 9

VIRGINIA STATE PLANNING BOARD







MAP NUMBER IX-5-2

PER CENT OF TOTAL LAND AREA AND ACREAGE ESTIMATED TO BE IN LAND IN FORESTS, PARKS AND WASTELAND - 1935

State Total 29.37 Per Cent - 7,567,341 Acres

 Per Cent of Total Land Area
 Number of Acres in Thousands

LEGEND

	50% and over	9 Counties
	40% to 50%	19 "
	30% to 40%	26 "
	20% to 30%	25 "
	10% to 20%	14 "
	Less than 10%	7 "

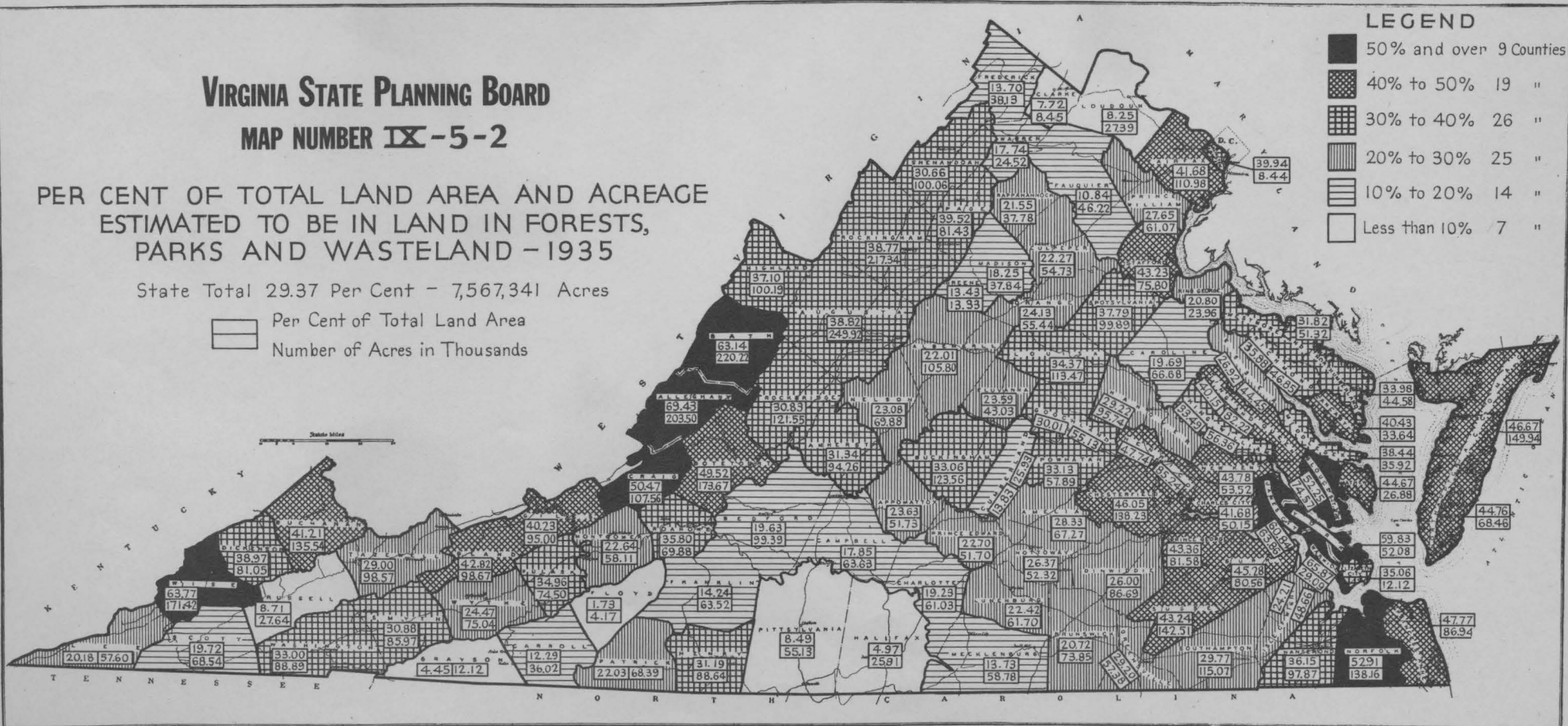


Figure 10

average-sized farm in the farming lands along the eastern slope of the Blue Ridge may be considerably larger than that in Buchanan County of the southwest, where there are hundreds of small farms in available ravines and valleys.

The Alleghany Mountains where the grouse are much more common, have an entirely different topography which undoubtedly is a factor for supporting a larger population. A study of Figure 2 showing the forested areas and Figure 10 showing the percentages and acreage of forest lands shows that the forests are much more extensive in the Alleghany Mountains. Not only is the range in the Alleghany Mountains much larger than in the Blue Ridge Mountains in Virginia, but it is only a small part of the range extending on into the adjoining West Virginia mountains. These mountainous regions of West Virginia are considerably more extensive than the mountains of Virginia, and support a large grouse population. The long, linear ridges placed side by side, and running southwest to northeast are well supplied with coves, ravines and small secondary spurs at the bases of the mountains, making the range especially desirable. The shale and sandstone slopes are often wooded to the mountain base and are in many instances practically continuous with the forested regions of adjoining mountains. The narrow valleys between the ridges do not permit large farms so the forested area of the valley slopes is nearly continuous. The limestone sections, which are almost



A typical scene of the Blue Ridge Mountains, characterized by the open woodland with a large amount of dead chestnut. Food plants are exceedingly scarce in such situations.



STAND OF WHITE PINE
Found in a few sections of the Alleghany Mountains where lumbering has not been severe.

entirely limited to the valleys, are cleared for agricultural purposes. Grazing is one of the most important industries in this area.

The characteristic proximity of one ridge to another in the Alleghany Mountains, and the great extent of the linear ridges with the many coves, ravines and other hiding places, make it possible for grouse populations to be replenished readily from the surrounding territory when excessive shooting or other debilitating factors have reduced the birds. This condition does not exist in most instances in the Blue Ridge Mountains. In the latter region most of the mountains are isolated from each other, some by only short distances and others by a considerable distance, making it possible to exterminate the birds. The grouse being non-migratory and having a cruising radius of perhaps not much more than three-quarters of a mile, would require a much longer time to restock these mountains from surrounding areas. This would be particularly slow if the birds were not overly abundant on the main ridge of the Blue Ridge itself.

The type of forest or plant growth makes the Blue Ridge Mountains more vulnerable to civilization. Due to fires which in the past burned over thousands of acres yearly and intense lumbering operations, the vegetation of the Alleghany Mountains has, for the most part, a dense, shrubby growth, the characteristic succession from these destructive agents. This shrubby nature of the vegetation is typical, as a whole, of the Alleghany region, although there are isolated large areas

where good stands of timber still remain. The Blue Ridge Mountains, on the other hand, have not been ravished by fire to as large an extent, so that the typical growth is the open woodland type. In the southern Blue Ridge, especially in Patrick County, fires are common every year. Where the fires have not been too frequent, and the vegetation has had a chance to grow, the growth is of the characteristic shrubby form. Most of the upper slopes and mountain tops are of the open oak-chestnut association with an enormous amount of dead chestnut remaining. Since agriculture has removed most of the range from the lower lands where food and cover might have been more plentiful, the present habitat is largely of these open woodlands of the upper slopes.

Investigations in New York and Michigan show that the ruffed grouse prefers the dense shrubby growth to that of the open woodland type. This seems to be the case in Virginia, also. Although the greater part of the range of the Blue Ridge Mountains is woodland in nature, there is a considerable amount of dense laurel on certain exposures, which forms excellent cover. Rhododendron is present in a few localities and forms good protection. However, if the cover is not adjacent to a good food supply, it is more or less ineffective. The distribution of laurel and rhododendron cover in the Blue Ridge Mountains is not as effective as in the Alleghany Mountains, where the growth is more uniformly dispersed.

It has been shown in other surveys that the grouse does not prefer extensive unbroken areas of a single type of growth.



IDEAL GROUSE RANGE
A view of the Alleghany Mountains taken in
Bland County



A typical ravine in the best grouse range,
characterized by a brushy habitat with an
abundance of food and cover.

FIGURE 12

This seems to be the case also in Virginia. Extensive stands of dense shrubs without a clearing or break will have just as few birds as an extensive unbroken woodland of large timber. The "edge effect" is certainly an important item for the ideal grouse habitat. It has been determined in the Michigan studies (50) that "77% of the grouse were flushed within 300 feet of the margin of the various cover types and that large unbroken stands of timber are not desirable for optimum grouse production". Mr. T. Fearnow says that in northern Pennsylvania in the vicinity of the Allegheny National Forest, there are extensive forest lands, but these are criss-crossed with a meshwork of gas lines which necessitates many miles of cleared strips through the forest. The grouse are abundant along these borders where the "edge effect" is greatly increased. He says that most of the grouse hunting in that section is done along these cleared strips.

Dr. Gardiner Bump of the New York Game Commission writes that

"In New York we have found that the admixture of conifers, such as pine, hemlock, spruce, and balsam, particularly young ones with branches reaching well to the ground, are a highly important element of good grouse cover. Likewise, a considerable degree of interspersation of types with attendant "edge" is important to good grouse productivity; whereas extensive tracts of the same type of cover are much less productive.

Similarly, moderately dense undergrowth and ground cover are important to good grouse range. Therefore, sizeable stands of mature timber which tend to shade out this undergrowth, represent unfavorable conditions. Likewise, grazing and burning are not desirable."

In Virginia it is only on the highest mountain tops that spruce and balsam are found. In some sections small growths of hemlock have been left but these afford very little cover. Pitch, mountain, scrub and white pines are common in the Virginia range, especially so in the Alleghany Mountains where there is a better dispersion with the hemlocks. Although pine is common in the state, in most cases it affords poor grouse cover except in the case of the young bushy pines. Young white pines are especially good for this purpose.

In Virginia the most effective and abundant cover is the dense patches of rhododendron and laurel. In some sections these are abundant in the ravines and valleys, and in other sections, on the slopes and tops of the ridges. As mentioned previously these cover types are much more uniformly dispersed in the Alleghany Mountain habitat than in the Blue Ridge Mountains, thus forming a more efficient and desirable arrangement.

Plant Distribution

Introduction

Food and cover were studied more intensively than the other factors mentioned in the thesis. The object of the survey was to determine whether there was a marked contrast in the plant species present, and their abundance in the two mountain ranges. This includes all species observed, with special care in recording recognized grouse food plants.

85
Station _____ Location _____

Date _____ Observer _____

Climatic:

Light: - sun, partial shade, full shade
Wind: - protected, slight, medium, strong

Edaphic:

Water content: - dry, moist, wet, saturated
Reaction: - very acid, acid, neutral, alkaline
Origin: - shale, sandstone, limestone, granite
Humus: - none, slight, medium, deep
Structure: - sand, gravel, stone, rock, clay, loam
Surface: - level, steep, medium, slight
Exposure: - N S E W

Biotic:

Vegetation: - none, slight, medium, dense
Type: - herbs, grass, shrubs, trees (evergr., deciduous)
Cover: -

Abundance of species: -

FIELD DATA SHEET

Figure 13

The technique developed was based on the principle of sampling the vegetation at various points and taking enough samples to obtain a reliable cross section of the vegetation of a particular region. Mimeographed forms (Figure 13) were carried into the field, enabling the observer merely to check the proper exposure, soil reaction, slope, etc. Space was given to noted on the type of cover, drumming logs, etc. The majority of the mimeographed sheet was given to space for the listing of plant species present and their abundance. A small section remained for recording remarks or other observations.

Representative sections were chosen in the Alleghany Mountains and the Blue Ridge Mountains to be studied intensively for the vegetation survey. Other surveys, much more general in character, were made to the north in both ranges and to the southwest in the Alleghany Mountains, and the Plateau region, to check on the results of the intensive surveys: whether typical or average for the two habitats.

In the intensive surveys a series of stations was made usually beginning in the valley or base of the mountain and proceeding directly or diagonally up the mountain slope to the top, thence along the top for several stations and back down the slope on a diagonal, away from the starting point. Usually 15 to 20 stations were made in a day over a period of about eight hours. If the mountain was not so high it was usually possible to work both sides during the same survey. The stations were spaced as well as possible to



Typical open woods of the Blue Ridge Mountains
in which food plants are scarce.



DENSE RHODODENDRON COVER
This is present in the Blue Ridge Mountains
but is more typical of the vegetation of the
Alleghany Mountains.

obtain a good sample of the vegetation in the area studied. Each station was 200 to 300 yards or less in length. Usually about the same distance intervened between this and the next station. On the previously-mentioned form the plant species seen were recorded and their relative abundance noted. Other data, such as exposure, moisture, slope, shade, soil reaction, etc., were also recorded. Notes concerning the cover and general aspects of the station were made. It was considered that a suitable sample of the vegetation of a given area could be taken if two or three series of stations were made perhaps five to ten miles apart, or even less, on the same mountain. If this were performed on several mountain slopes of varying exposures throughout the county, a reasonably good sample of the vegetation of that area would be obtained. The manner in which the stations were taken made it possible to secure a record of the conditions existing over the entire slope of the mountain including the top and the base or valley below. In this way some knowledge was gained as to the section of the mountain in which the various important food plants might be expected to occur.

At the beginning of the study, Giles, Pulaski and Bland Counties to the west were chosen as sample areas of good grouse range of the state and good sample areas of the Alleghany Mountains, to be worked intensively. On the other hand, Floyd and Patrick Counties to the east were chosen as poor grouse areas and as samples of the Blue Ridge type in the

state, to be studied intensively. Other areas might have been chosen which would have been more desirable, but the item of expense and time in traveling back and forth influenced the choice of these areas. The author was in the field most of the summer months and usually remained in the field four or five days at a time. Considerable time was saved by camping out in the various regions so that it was possible to start early in the morning and not leave the area at night.

Most of the intensive surveys were made throughout the summer months from about the middle of June until September. These areas were visited again for more general surveys later in the fall and early winter to determine the amount and type of cover present and the availability of the various winter food plants.

It was impossible for the author to be observing the various species in both areas at the same time so that there would be two- or three-week periods in which a section would not be visited while another section was being worked. This would tend to lead to a variance in the species found, since certain plants are found at only short periods of the year. Also, since the survey extended throughout the period mentioned a number of plants were encountered which were not in fruit or flower and were often difficult to identify. These species may have come into flower later in another area and would be recorded when this area was visited. However, nearly all these forms are of species comparatively insignificant as far as

concerns grouse foods. If a species occurred only once, or was very scarce, it was ignored as a rule. Grasses were not determined to species, so that they are all listed under the one heading, Gramineae spp. Other forms such as Smilax, Rhododendron, Vitis, etc., were recorded for species in most cases but are grouped in the tables under their generic headings. Frequently it could be observed that a certain plant was a Smilax, but the species was indefinite. It was not considered practical to investigate every species in a case like this, but merely list it as Smilax spp.

During June, before the intensive surveys began, a general survey was made into the southwestern counties of Wise, Scott, Russell, Washington and Grayson in order to become as familiar as possible with the better grouse range of the state. Only general notes were made as to the vegetative conditions in these areas.

During September and October general surveys were made of the Big Levels area in Augusta County, and this was considered as a sample of the northern Blue Ridge. Other sections studied in Augusta County were the North Mountain area and a section of the Shenandoah Mountain near the Bath County line. These were considered as samples of the northern Alleghenies. General surveys were made along the Allegheny Mountains in Bath and Botetourt Counties. General observations were made in Craig and Allegheny Counties. In the Blue Ridge other general surveys were made along the Skyline Drive from Luray south to Waynesboro.

A superficial survey was also made of the Cold Mountain area in Amherst County and the Thunder Mountain area in Bedford County in the late fall. In late winter a general survey was made of Dickenson, Buchanan, Tazewell and Bland Counties to the southwest.

In making the surveys in the above sections the plan followed was to list the plants that were observed during the course of the day's travel and then near the close of the day to record the relative abundance of these various species as they occurred. In this way much more territory was covered since it was not necessary to spend so much time writing up the various stations. It is the opinion of the author that these surveys made in this manner are just as accurate, if not more so, than those where many stations were made and a smaller area covered.

Following are tables listing the plant species found in the various areas studied. In those sections studied intensively the plants are listed alphabetically showing their abundance on various exposures and on certain sections of the mountain slope, such as upper slope, middle slope, valley, etc. Only those exposures are listed which were recorded during each day's trip. After each day's survey, field notes were made and these are used in some cases in determining the proper symbol for the abundance of the species. All those species listed as abundant, common or frequent-to-common are considered abundant or "A" in the table. All those species frequent and

generally present are listed as frequent or "F" and those species scarce are listed as present or "P".

The species are also listed for those areas in which the general surveys were made where a detailed list of the plants and their abundance was made. In the table only the relative abundance of the species is recorded. If several days were spent in a section, an average was taken for the plants recorded. These tables merely give one an idea as to the relative abundance of the various grouse food plants in the two ranges.

Accompanying each table is a general description of the area as to topography, cover, food and other factors. The plant species discussed more in detail are the first 20 to 25 species listed by T. E. Clarke, A. L. Nelson and W. W. Bailey in their publication Early Winter Food of Ruffed Grouse on the George Washington National Forest. This is the only available work of its kind for the state and therefore the plants as listed there will be discussed in detail. It must be understood, however, that the plants therein listed are only those utilized in the early winter. The plants utilized at this season are not necessarily those for other seasons such as midwinter, late winter and spring. From field observation the author is convinced that other species such as the rhododendron and azalea are utilized much more in late winter especially when snow is present on the ground. Many other radical changes might be made in this list for other

seasons of the year. This is one major problem that must be worked out before we have a very clear picture of the food habits of the ruffed grouse. It is exceedingly important that the food habits of the grouse be studied over such critical periods as late winter and early spring which may throw some light on possible factors affecting the distribution and abundance of the species.

A more general distribution of the grouse crops taken over the state is necessary as certain foods are of much greater importance in some sections than in others. As will be shown later, such plants as grape and coralberry appear to be vital in holding grouse in certain sections of the Blue Ridge Mountains.

Although a marked difference may be shown between the abundance of various grouse food plants in the two mountain ranges of the state, no conclusive proof can be drawn as to the actual influence this may have on the grouse abundance and distribution. Whether or not the ruffed grouse can subsist just as well in a region where only half or a third the number of food plants occurs as compared with an area where they are all present and common cannot be determined except by long-term experiments. It is possible that there are certain plant foods that occur in small quantities and yet a certain small amount of these is necessary to supply the needed vitamins or other nutritional elements to support or hold a population. Only through practical experimental work can this be determined.

Perhaps the important factor in the food habits of the species is the availability of any particular food. It appears that the ruffed grouse will partake of almost any plant available that can possibly serve as food. Even the brown leaves of smilax are relished. Later in the winter when the snow is deep, rhododendron and laurel leaves and azalea buds make up a large item of the diet. In the southern Blue Ridge, laurel is common. Can this plant, along with a few other species that may be present, support a good grouse population? Such foods as laurel and rhododendron have usually been considered emergency foods. This phase of the question must be investigated before definite proof can be shown that food abundance and distribution are factors here.

Although the first 20 or 25 plants listed in the George Washington National Forest publication are discussed in the following pages, these may not in some cases be any more important than some of the others listed farther down the scale. Perhaps in sections where the crops were taken, the first 20 plants listed were the most abundant and available species present in the area. In certain other areas this may not be the case. Where many clearings and old farmlands exist, such plants as sheep sorrel, aster rosettes, coral berry, strawberry, etc., may be very common and support many grouse. On the other hand, from field observation the first 20 plants as listed appear to be necessary staple foods upon which the ruffed grouse maintains its existence; and where these species

do not occur commonly the grouse population is correspondingly small. In much of the Blue Ridge section vast areas were covered along the slopes of the mountains where almost no plants could be found which could be considered grouse food. Many trees are present of course, many of which are of questionable worth as buffers. The marked absence of herbaceous or winter ground vegetation is the most noticeable factor. Such plants as arbutus, partridgeberry, smilax and others are quite scarce. Wintergreen, so abundant in the Alleghanies, is almost absent.

Determination of the optimum arrangement or interspersion of types most suitable for the species was not considered to any great extent in this thesis. In many cases, especially during the summer months, when a grouse was flushed a station was made at that point, the species of plants and their abundance and arrangement, whether of deciduous shrubs and trees, whether canopied, or brushy etc., were recorded. Notes were taken as to the presence of drumming logs and the general aspect of the surroundings. Many more such stations must be taken over a long period of time and throughout the year before any reliable evidence can be obtained. To go further into this problem was not considered practical for the comparatively short duration of the thesis. Experiments are being done in this respect in New York, and similar ones should be undertaken in Virginia.

As the survey progressed it became more apparent that the areas chosen in the Blue Ridge were not typical of this mountain

chain even in the state itself. The Big Levels area although considered Blue Ridge is really not so in rock formation but is much like that of the Alleghanies. The southern Blue Ridge is markedly different in rock formation from the section of the mountains to the north above Roanoke. It is in these various sections that there is found a decided difference in the food plants, which, as will be shown later, can be correlated with the rock formations underlying the various areas. It is regrettable that sufficient time was not available to go more thoroughly into the vegetation of the granite formations of the Blue Ridge which was observed only superficially.



AZALEA BUDDED BY RUFFED GROUSE
Ruffed grouse tracks may be seen in the snow
about the plant



MOUNTAIN LAUREL BROWSED BY RUFFED GROUSE
Ruffed grouse tracks and laurel debris may be seen
in the snow.

Giles County
(Dismal and No-Business Valleys)

Giles County, situated in the Alleghany Mountains, borders on the West Virginia line and is usually considered as containing some of the best grouse habitat. Intensive surveys were conducted principally on Brushy, Flat Top, Wolf Creek and Sugar Run Mountains, which form the Dismal and No-Business Valleys. This area is a section of the present Elk Range and is situated west of Pearisburg near the Bland County line. Casual surveys were made of the Mill Creek Valley, but this section will not be included in this survey. In most respects it is similar to the Dismal and No-Business Creek sections under discussion.

As seen from the fire tower on Sugar Run Mountain this area including the Mill Creek side appears as one vast forest blanket from the top of one ridge across the valley to the top of the next. East River Mountain and Walker Mountain in the distance appear well wooded. Only slight differences seem to be apparent in the forest type of the various slopes. Perhaps the slope itself is a factor here. As a rule the slopes are gentle in these wooded valleys, much in contrast to the exceedingly steep slopes of the Blue Ridge. However, there are certain sections where the slope is very steep such as the slopes on either side of Sugar Run and the lower end of Mill Creek.

The lower slope of Brushy Mountain is gentle but in some sections the upper slopes become quite steep and rocky. The

slopes of Flat Top on the Dismal Creek side and Wolf Creek Mountain on the No-Business side are very gentle sloping. The upper end of Brushy Mountain is much like this, also. Although the No-Business slope of Flat Top Mountain was not investigated it appears to be somewhat steeper than the others. From general observations the slopes of the Mill Creek section are similar to the gentle nature of the others mentioned. The valley of Dismal Creek is broad and much of the valley floor is low and rolling, especially at the upper end, where many small hills and ravines exist which make it difficult for one to get a sense of direction especially in the summer time when the leaves are on the trees so that landmarks are hard to find. The No-Business Valley is similar to that of the Dismal but not so wide.

In these areas a typical Alleghany vegetation may be found. Here the dominant form is the shrubby type which in some sections, especially in No-Business, is very dense. However, the tops of the ridges are as a rule much more open, being of the chestnut oak forest. The characteristic shrubby growth of these sections is probably the usual succession from fired and cut-over forest tracts. Fire has probably not been in these areas for 15 years or more. Lumbering has been considerable and the last stand of virgin oak is being cut at the present time.

There are very few farms or cleared areas until one gets well down towards the mouth of both the Dismal and No-Business Valleys. No farms exist in the Mill Creek section across the

ridge. One cabin and a small farm are present near the head of Dismal Creek. Otherwise very few extensively cleared areas are present.

To all indications this section should be well populated with grouse. Food and cover are abundant although perhaps not as much so as in sections of Bland County to the west. During the summer survey no grouse were seen or heard. Later, when Dismal Valley was visited in the fall by a party of six at a time of no snow and another time when the snow was deep a number of grouse were flushed. More were flushed during the snow as the birds were more concentrated and they were readily tracked before flushing. During these heavy snows the birds seemed to be living on smilax berries and leaves, laurel and rhododendron leaves, and azalea buds. During these heavy snows the birds were staying close to the dense patches of laurel and rhododendron and flushed with difficulty. At Mountain Lake W. R. DeGarmo has observed that the grouse tunnel and roost beneath the deep snows as is reported from the northern states.

Greenbriar,* oaks, laurel and wintergreen are all abundant, the latter especially in the valley, ravines and lower slopes. Rhododendron spp. are more abundant in the lowlands and ravines; azalea, however, is abundant in general over the whole range. Huckleberries (*Gaylussacia* and *Vaccinium* spp.) are abundant

* See Page 158 for corresponding scientific names

everywhere but mostly on the upper slopes. Grapes are not particularly common although on certain exposures such as northwest it is quite common in places. Some of the plants had considerable fruit this year. Sheep sorrel is recorded as occurring only on top where it was common in open places. This absence is probably due to a lack of suitable open areas which may also account for the shortage of self-heal except in open places along the top. These plants are all more common in fields and field borders. Rose is generally scattered over most of the mountain slopes. Christmas fern is not nearly as common as would be supposed. It is rather scarce over the area in general. Aster spp. are recorded as frequent to present on the lower and middle slopes and more abundant nearer the top. As this survey was made early in the summer a number of species develop later which were unidentifiable at the time. Maple leaf viburnum is by far the most abundant viburnum of this area and is generally frequent over the whole area. Antennaria is not recorded for this section but as it is a rather common species everywhere in more open places it is probable that it is in this section also and may have been missed or overlooked. Partridge berry is abundant most places on the valley, but is scarce elsewhere. As in many other cases it frequently occurs beneath hemlock. Smooth sumac and staghorn sumac are not recorded here but they are frequent along Pearis Mountain and sections on the northeast side of Sugar Run Mountain. These plants are more common to old fields and

cleared areas. *Menziesia* does not occur in the lowlands but is a plant of the upper slopes. It is present on the middle slopes and frequent among the rocks of the mountain tops. Beaked hazel is not very frequent in the valley but becomes increasingly more common on the upper slopes and top. *Arbutus* is more or less the opposite of this being quite abundant in the valleys and lower slopes and less frequent on the upper slopes and top. Service berry is generally frequent over most of the area. Hawthorn is very scattered, only a few plants being encountered here and there. Cherry birch is not so frequent in the lowlands but becomes more frequent towards the top. Hophornbeam is present to some extent, generally on the middle slopes. *Avens* although not recorded in the table is rather common on the northeast slope of Sugar Run Mountain overlooking Sugar Run.

Table 1

Abundance, Occurrence and Exposure
of
Various Plant Species in Giles County

A - Abundant
F - Frequent
P - Present

No. of stations Exposure	Valley, lower slope			Middle slope			Upper slope, Top						
	8 V	2 E	8 SE	4 S	1 NW	4 E	16 SE	4 NW	1 NE	1 E	9 SE	2 NW	4 T
<i>Amelanchier canadensis</i>	F		P	P	P	P	FP	F		F	P	F	P
<i>Aster</i> spp.			FP	P		P	F				AF		AF
<i>Betula lenta</i>			F						F		F	F	P
<i>Corylus rostrata</i>	F		P			AF	P			AF		AF	
<i>Crataegus</i> spp.	FP		P			P	P						
<i>Epigaea repens</i>	AF		F	AF			AF	F			F		F
<i>Gaultheria procumbens</i>	A	AF	A	A		P	AF	A			FP	AF	F
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	AF		A	A	F	A	A	A	F	A	A	A	A
<i>Kalmia latifolia</i>	A	FP	AF	AF			AF	F	AF		P		
<i>Menziesia pilosa</i>							P		F				
<i>Mitchella repens</i>	A		P		P		P						
<i>Ostrya virginiana</i>	P							P					
<i>Polystichum acrostichoides</i>	P	P	P			P	P				P		
<i>Prunella vulgaris</i>													AF
<i>Quercus alba</i>	F	FP	AF	F	F	P	F	FP	F		AF		F

Exposure	Valley. lower slope					Middle slope			Upper slope. Top				
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T
<i>Quercus borealis</i>										F			
<i>Quercus borealis maxima</i>	FP					P				P	FP	P	
<i>Quercus coccinea</i>	P												P
<i>Quercus ilicifolia</i>						FP				P			
<i>Quercus prinus</i>	F	F	AF	F		AF	A	A		A	A	A	AF
<i>Quercus velutina</i>	AF	A	A	A	F	AF	A	F		F	A	P	AF
<i>Rhododendron</i> spp.	A		F	P				FP	AF	P			P
<i>Rhododendron</i> (<i>Azalea</i>)	P	FP	AF	AF		AF	A	AF	AF		AF	AF	F
<i>Rosa</i> spp.	P					P	P	F					
<i>Rumex acetosella</i>													P
<i>Smilax</i> spp.	A	FP	A	F	F	A	A	AF		P	AF		F
<i>Viburnum</i> spp.	P												
<i>Viburnum acerifolium</i>			P		F			F		F		FP	
<i>Viburnum cassinoides</i>	P												
<i>Viburnum prunifolium</i>													P
<i>Vitis</i> spp.	P			P		FP	P			F	P	AF	FP

Exposure	Valley, lower slope			Middle slope			Upper slope, Top					
	V	E	SE S NW	E	SE NW	NE E	SE NW	T				
<i>Acer pennsylvanicum</i>			P		FP		P	F	P			
<i>Acer rubrum</i>	F	F	F	FP	F	F	F	F	FP			
<i>Achillea Millifolium</i>									P			
<i>Adiantum pedatum</i>			P									
<i>Aletris farinosa</i>	P											
<i>Alnus rugosa</i>	F		FP		P							
<i>Asphicarpa monoica</i>			P	P	FP		F	P	AF			
<i>Angelica villosa</i>					P							
<i>Apocynum sp.</i>								P	P			
<i>Aralia nudicaulis</i>	P		FP		FP		P		P			
<i>Asarum virginicum</i>	P				P	P		P				
<i>Asplenium montanum</i>				P								
<i>Baptisia tinctoria</i>	P	FP	AF	A	A	FP	A		A			
<i>Benzoin aestivale</i>					P							
<i>Berberis sp.</i>	P		P		P							
<i>Carex spp.</i>	P											
<i>Castanea dentata</i>	F	F	AF	AF	F	A	A	A	F	A	AF	A
<i>Castanea pumila</i>	F		A	FP	AF	AF	A		A		AF	
<i>Ceanothus americanus</i>	P	FP	P	P	F	F			F	F	FP	

Exposure	Valley, lower slope				Middle slope			Upper slope, Top					
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T
<i>Dryopteris marginalis</i>				P		P	P		P	F			
<i>Dryopteris noveboracense</i>	P		P	P		P	P						FP
<i>Epipactis pubescens</i>			P			FP	P			F			
<i>Erigeron</i> spp.	P												P
<i>Eupatorium purpureum</i>	P												
<i>Euphorbia corollata</i>	P	P	P	P		P	P						
<i>Fagus americana</i>						P							
<i>Fragaria</i> spp.	P					P							F
<i>Galax aphylla</i>	AF	F	A	A		P	A	F	F	AF	A		FP
<i>Gallium</i> spp.													P
<i>Geranium</i> spp.	P		P			P	P						FP
<i>Gerardia flava</i>			P		P	P				P			
<i>Gillenia trifoliata</i>	P	FP	FP				FP	FP		P			P
Gramineae spp.	AF	F	FP	F	A	FP	FP			F			AF
<i>Hamamelis virginiana</i>	AF		P			P	P	F					
<i>Helianthus</i> spp.			P	FP		P				P			FP
<i>Heuchera</i> spp.													FP
<i>Hicoria</i> spp.	P	P	P	P		P	P		P	P	F	F	F
<i>Hieracium</i> spp.													FP

Exposure	Valley, lower slope				Middle slope			Upper slope, Top					
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T
<i>Hieracium venosum</i>			FP	F			FP			P			P
<i>Hydrangea arborescens</i>	P		P										P
<i>Ilex</i> spp.				P			P						
<i>Ilex decidua</i>	P												
<i>Ilex opaca</i>	P												
<i>Iris</i> spp.	P												
<i>Juglans cinerea</i>	P												
<i>Juncus</i> spp.													FP
<i>Lespedeza bicolor</i>							F						
<i>Lespedeza frutescens</i>			FP	P		F	FP	P		F	P		P
<i>Lespedeza hirta</i>				P	F		P	P			P		P
<i>Lespedeza procumbens</i>				P				P			P		
<i>Lespedeza repens</i>					P								
<i>Leucothoe recurva</i>								F					
<i>Lilium canadense</i>													P
<i>Lilium superbum</i>	P												
<i>Liriodendron Tulipifera</i>	FP			P			FP	P					
<i>Lycopodium tristachyum</i>	P												
<i>Lyonia ligustrina</i>	FP	P			F			P	P				FP

Exposure	Valley, lower slope				Middle slope			Upper slope, Top					
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T
	<i>Lysimachia quadrifolia</i>	P		FP			F				P	AF	AF
<i>Magnolia acuminata</i>	P	P	P			P							
<i>Medeola virginiana</i>				P		P							
<i>Monarda</i> spp.													FP
<i>Monotropa Hypopitys</i>						P							
<i>Nyssa sylvatica</i>	AF		AF	F		F	AF	AF		F	P	F	P
<i>Osmunda cinnamomea</i>	P		P	F		P	P						
<i>Osmunda Claytoniana</i>	P		P										
<i>Osmunda regalis</i>	FP			FP									
<i>Oxydendrum arboreum</i>	F	F	F	P		P	F	F		FP		F	
<i>Parnassia asarifolia</i>				FP									
<i>Pedicularis canadensis</i>	P	P	P				FP			F		FP	
<i>Phlox</i> spp.	P												
<i>Phytolacca decandra</i>										P			
<i>Pinus pungens</i>	P		P			P	P	P					FP
<i>Pinus rigida</i>	P		FP	F			P	P		F			
<i>Pinus strobus</i>	P				AF	F	P	P		F		F	P
<i>Polygonatum biflorum</i>										P			
<i>Polypodium vulgare</i>					P						P	P	

Exposure	Valley, lower slope				Middle slope			Upper slope, Top						
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T	
<i>Potentilla</i> spp.	FP		P		AF	P	F				P		AF	
<i>Frenanthes</i> spp.											P		P	
<i>Prunus americana</i>	P													
<i>Paeonia quinquefolia</i>											P		F	
<i>Pteridium latiusculum</i>	AF	AF	A	A	F	AF	A	F			F	A	F	A
<i>Pyrola americana</i>	P				FP			P						
<i>Pyrus</i> spp.					FP									
<i>Pyrus americana</i>										F				
<i>Rhus toxicodendron</i>	P		P											
<i>Robinia Pseudo-Acacia</i>	FP	F	F	F		F	A	AF			F	AF	F	AF
<i>Rubus</i> spp.	P		F	F				P			FP	AF	F	
<i>Sagittaria</i> spp.	P													
<i>Salix humilis</i>													P	
<i>Sassafras variifolium</i>	AF	A	A	A	F	A	A	A			A	A	A	
<i>Silene stellata</i>													P	
<i>Smilacina racemosa</i>	P		P					P			F	FP	FP	
<i>Solidago</i> spp.								P				P	P	
<i>Spigelia marilandica</i>													P	

Exposure	Valley, lower slope				Middle slope		Upper slope, Top						
	V	E	SE	S	NW	E	SE	NW	NE	E	SE	NW	T
<i>Tephrosia virginiana</i>				A		P				P			P
<i>Thalictrum</i> spp.	P												P
<i>Thuja occidentalis</i>	P												
<i>Trautvetteria carolinensis</i>	P												
<i>Tsuga canadensis</i>	P		P	P				P					
Uabelliferae spp.				P									P
<i>Urtica</i> spp.			P										
<i>Uvularia</i> spp.			P			P							
<i>Veronica officinalis</i>	P												
<i>Viola</i> spp.	P		P		F	P							
<i>Zizia</i> spp.													P

Giles County
(Salt Pond Mountain)

Salt Pond Mountain is situated in Giles County about 20 miles north of Blacksburg, Virginia. It joins Big Mountain to the northeast and is located near other mountains of the general extensive Alleghany Range. This general survey was made along portions of Little Stony Creek and along the top and slopes of the mountain within a radius of two miles of the Biological Station of the University of Virginia. Two sanctuaries are present on the area, sponsored by the Virginia Polytechnic Institute and the University of Virginia, and a large part of the survey took place in these areas. This section as a whole is considered good grouse range, and in part of it grouse are evidently abundant. Most of the area is rather high, the mountain ranging from 3000 feet in the valley of Little Stony Creek to 4364 feet on the top of Bald Knob. The mountain top is considerably broad and the slopes in general are much more gentle-sloping than in any other areas studied.

Food and cover on the area as a whole are very good. Such species as white pine, hemlock, spruce, rhododendron and laurel form very effective cover. Nearly all the streams are dense with rhododendron. Laurel is abundant and in some sections is much too thick and extensive to support many grouse. In other parts of the area there may be relatively open areas especially in the chestnut oak forests or oak chestnut associations. Very little large timber is present since fire and

lumbering have been severe in past years. At present the dominant type of vegetation is a dense, shrubby growth, characteristic succession after fires.

On the whole, grouse food plants are exceedingly common. Wintergreen is abundant everywhere. Greenbrier is abundant especially along the streams and moist places. As mentioned before, rhododendron and laurel are abundant. Azalea, huckleberry, blueberries and various asters are also abundant. Arbutus and menziesia are frequent to abundant. Various oaks, are abundant. Partridge berry, *Viburnum cassinoides* and *Viburnum alnifolium*, service berry and cherry birch are frequent to present. Hawthorn and self-heal are present in small amounts.

Plant Species of the Mountain Lake
Area and their Abundance

(Six Stations)

A - Abundant
F - Frequent
P - Present

<i>Amelanchier canadensis</i>	F	<i>Prunella vulgaris</i>	P
<i>Antennaria</i> spp.	F	<i>Quercus alba</i>	A
<i>Aster</i> spp.	A	<i>Quercus borealis</i>	P
<i>Betula lenta</i>	F	<i>Quercus borealis maxima</i>	FP
<i>Betula lutea</i>	FP	<i>Quercus coccinea</i>	FP
<i>Crataegus</i> spp.	P	<i>Quercus prinus</i>	A
<i>Epigaea repens</i>	AF	<i>Quercus velutina</i>	A
<i>Gaultheria procumbens</i>	A	<i>Rhododendron calendu- laceum</i>	A
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	A	<i>Rhododendron</i> spp.	A
<i>Kalmia latifolia</i>	A	<i>Saxilax</i> spp.	A
<i>Menziesia pilosa</i>	AF	<i>Viburnum alnifolium</i>	F
<i>Mitchella repens</i>	F	<i>Viburnum cassinoides</i>	P
<i>Polystichum acrostichoides</i>	FP	<i>Vitis</i> spp.	P
<i>Acer pennsylvanicum</i>	FP	<i>Aralia nudicaulis</i>	AF
<i>Acer rubrum</i>	A	<i>Asclepias variegata</i>	P
<i>Acer spicatum</i>	P	<i>Asplenium montanum</i>	P
<i>Achillea Millefolium</i>	P	<i>Baptisia tinctoria</i>	AF
<i>Ambrosia artemisifolia</i>	P	<i>Campanula divaricata</i>	P
<i>Amphicarpa monoica</i>	FP	<i>Campanula</i> sp.	P
<i>Amianthemum muscaetoxicum</i>	P	<i>Carex</i> sp.	P
<i>Angelica villosa</i>	F	<i>Castanea dentata</i>	A

<i>Castanea dentata</i>	A	<i>Hieracium paniculatum</i>	P
<i>Chelonia glabra</i>	F	<i>Hieracium venosum</i>	P
<i>Cirsium</i> spp.	F	<i>Hypericum densiflorum</i>	P
<i>Clintonia umbellata</i>	AF	<i>Ilex monticola</i>	P
<i>Collinsonia canadensis</i>	F	<i>Juncus</i> spp.	P
<i>Convalaria majalis</i>	P	<i>Leucothoe racemosa</i>	FP
<i>Coreopsis major</i>	F	<i>Lilium philadelphicum</i>	P
<i>Cypripedium acaule</i>	P	<i>Lilium superbum</i>	P
<i>Cypripedium parviflorum</i>	P	<i>Lobelia inflata</i>	FP
<i>Daucus Carota</i>	P	<i>Lycopodium complanatum</i>	FP
<i>Dennstaedtia punctilobula</i>	P	<i>Lycopodium obscurum</i>	F
<i>Desmodium nudiflorum</i>	F	<i>Lycnia ligustrina</i>	F
<i>Dioscorea villosa</i>	A	<i>Lysimachia quadrifolia</i>	AF
<i>Disporum lanuginosum</i>	F	<i>Magnolia acuminata</i>	FP
<i>Dryopteris noveboracensis</i>	AF	<i>Meianthemum canadense</i>	P
<i>Eupatorium purpureum</i>	F	<i>Nedeola virginiana</i>	FP
<i>Fragaria</i> spp.	F	<i>Melanthium latifolium</i>	P
<i>Galax aphylla</i>	A	<i>Monotropa uniflora</i>	P
<i>Gentiana</i> spp.	F	<i>Nyssa sylvatica</i>	AF
<i>Gentiana Andrewsii</i>	F	<i>Osmunda cinnamomea</i>	AF
<i>Gerardia flava</i>	P	<i>Parnassia asarifolia</i>	P
<i>Gillenia trifoliata</i>	FP	<i>Pedicularis canadensis</i>	F
Gramineae spp.	A	<i>Pinus rigida</i>	F
<i>Hamamelis virginiana</i>	AF	<i>Pinus strobus</i>	F
<i>Helianthus</i> spp.	P	<i>Pogonia verticillata</i>	P
<i>Hicoria</i> spp.	F	<i>Poligonatum biflorum</i>	F

<i>Polypodium virginianum</i>	F	<i>Sassafras variifolium</i>	A
<i>Potentilla</i> spp.	F	<i>Saxifraga leucanthemifolia</i>	P
<i>Prenanthes trifoliata</i>	FP	<i>Senecia aureus</i>	P
<i>Prenanthes</i> spp.	P	<i>Smilacina racemosa</i>	A
<i>Psedera quinquefolia</i>	P	<i>Solidago</i> spp.	A
<i>Pteridium latiusculum</i>	A	<i>Stellaria</i> spp.	P
<i>Pyrus melanocarpa</i>	P	<i>Streptopus amplexifolius</i>	P
<i>Ribes</i> spp.	P	<i>Tsuga canadensis</i>	FP
<i>Robinia Pseudo-Acacia</i>	A	<i>Veratrum viride</i>	P
<i>Rubus</i> spp.	A	<i>Veronica officinalis</i>	FP
<i>Salix nigra</i>	P		

Pulaski County

Pulaski County lies directly west of Floyd County in the Alleghany Mountains. The county is much more heavily forested than either Patrick or Floyd, there being about 35% in forest lands. Much of this range, especially to the north, is some of the finest grouse range of the state. There is a decided difference, not only in the general topography, but also in the abundance of grouse food plants, between Floyd or Patrick Counties and Pulaski County. Here food, cover and the extension of the forested regions into secondary ridges and the lowlands of the valley make the area ideal as a grouse habitat.

Not as much time was spent in the county as in some other areas, but a fairly accurate cross-section of the vegetation was obtained. The survey was restricted entirely to the slopes of Walker and Little Walker Mountains, bordering both sides of Little Walker Creek. The Bland-Pulaski line runs along the crest of Walker Mountain in the northern edge of the county, and Little Walker Mountain is the neighboring ridge to the south, the two being separated by Little Walker Creek.

Two days were spent in making surveys on Little Walker Mountain, and two days were spent making similar observations on Walker Mountain. In the fall one day was spent on Little Walker Mountain to determine more accurately the abundance of the various food plants and to observe the type of soil upon which they flourish. Shale is usually considered poor in

quality as a farming soil, but this is evidently not the case for many of the valuable grouse foods such as wintergreen, arbutus, ginger, etc., which flourish on these exposed shaly slopes. Most of the important food plants abound in the lowlands and on the shale slopes of the secondary ridges or spurs from the main ridge. Toward the tops of the ridges, food plants become scarcer although still in sufficient quantity. This of course depends considerably on the species under question.

Little Walker Mountain from all reports supports a larger grouse population than the neighboring slopes of Walker Mountain. Food plants and cover are somewhat better on Little Walker Mountain, and the extensive lowlands and small hills at the base make a more suitable grouse habitat. The vegetation over much of Little Walker Mountain is exceedingly dense, making ideal grouse cover.

The surveys began on Walker Mountain approximately at the junction of the Giles-Bland-Pulaski lines. Little Walker Mountain was also surveyed opposite this area during the same week. Other surveys were conducted about five miles farther along the valley to the northeast. Fire has burned considerably in some sections but on the whole has not covered large areas. Where fire has recently occurred much of the returning vegetation is of grouse foods.

As mentioned before, wintergreen is perhaps the most abundant plant in this area. This is markedly in contrast to other areas observed in the Blue Ridge where it was not observed at any time. Arbutus is also quite common. Smilax is abundant,

especially in the more moist situations. Grape is so abundant on Little Walker Mountain that at times it serves as excellent winter cover. In all sections huckleberries and blueberries are abundant, and with much fruit. Laurel is common, although not in such dense patches as in some sections of the Blue Ridge. Rhododendron is more common in moist situations and on top of the mountain. Partridge berry is frequent in some of the low, damp places. Azalea is not recorded as common, but as this section is very typical of the Alleghany vegetation, the plant is probably much more abundant than it is here listed. Oaks, especially white, black, bear and chestnut, are very common. Serviceberry, beaked hazel, Christmas fern, prunella, and sumacs are frequent in certain sections. *Viburnum cassinoides* is very abundant in this section. *Viburnum acerifolium* is not recorded although it probably occurs about as abundantly as in other sections studied. *Antennaria*, cherry birch, various asters, hawthorn, hophornbeam and various rose species are present.

As this section was the first studied, there were of necessity certain inaccuracies due to the author's developing the procedure and technique to be followed for subsequent work. Although there are probably a number of plants omitted in this list, it is believed that most of the important species are accurately portrayed. It was the intention to return to this section for a more accurate observation, but time would not permit.

Table 2
 Abundance, Occurrence and Exposure
 of
 Various Plant Species in Pulaski County

A - Abundant
 F - Frequent
 P - Present

No. of stations Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	2 V	2 E	2 SE	1 SW	3 NW	5 E	6 SE	1 S	4 NW	2 SE	2 NW	6 T
<i>Amelanchier canadensis</i>	FP				FP				FP	AF	FP	F
<i>Antennaria</i> spp.			F									FP
<i>Aster</i> spp.	AF									FP		AF
<i>Betula lenta</i>									P			FP
<i>Corylus rostrata</i>					F	FP			FP			FP
<i>Crataegus</i> spp.												F
<i>Epigaea repens</i>	F			F	A	F			FP			
<i>Gaultheria procumbens</i>		A		A	A	F	FP	F	AF		AF	FP
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.		A	A		A	A	A	F	AF		A	A
<i>Kalmia latifolia</i>	FP	AF	F	F	F	F	P		F		F	FP
<i>Menziesia pilosa</i>									P			P
<i>Mitchella repens</i>	FP								F			
<i>Ostrya virginiana</i>	AF	FP										FP
<i>Polystichum acrostichoides</i>		FP	FP		FP							

Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T
<i>Prunella vulgaris</i>			FF									
<i>Quercus alba</i>	F	AF	F	A	F	F	FP		FP			F
<i>Quercus borealis maxima</i>	AF	FP	F		FP	F	FP			F		FP
<i>Quercus coccinea</i>					P							
<i>Quercus ilicifolia</i>			FP	AF	FP			F	AF		A	F
<i>Quercus prinus</i>	AF	AF	AF		F	AF	AF	A	AF	A	AF	A
<i>Quercus velutina</i>	F	A	F	A	F	AF	F		F	F		F
<i>Rhododendron</i> spp.	FP	FP				P			FP			F
<i>Rhododendron</i> (Azalea)						P						
<i>Rhus copallina</i>									P			
<i>Rhus glabra</i>	FP				FP					AF		FP
<i>Rhus hirta</i>									P			
<i>Rosa</i> spp.	FP								P	P		
<i>Sailax</i> spp.	AF	AF	AF	A	AF	AF	AF	F	F	AF	AF	AF
<i>Viburnum cassinoides</i>						FP						
<i>Viburnum prunifolium</i>										F		
<i>Vitis</i> spp.	A		F		F	P	AF		F	A		AF

Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T
<i>Acer pennsylvanicum</i>									P			P
<i>Acer rubrum</i>	AF	AF	F		AF	AF	AF		F			F
<i>Acer saccharum</i>	FP											
<i>Achillea Millefolium</i>												P
<i>Aesculus octandra</i>	AF											
<i>Alnus rugosa</i>	AF		FP									
<i>Ambrosia artemisiifolia</i>	FP											FP
<i>Amphicarpa monoica</i>		AF	A			F	F					AF
<i>Asclepias tuberosa</i>							P					
<i>Asplenium platyneuron</i>												P
<i>Astilbe biternata</i>						FP			FP			
<i>Baptisia tinctoria</i>		AF				AF	A	F	P			F P
<i>Castanea dentata</i>	FP	F	A		F	A	A		AF	F	A	AF
<i>Castanea puilla</i>		P			F	AF	FP		P			FP P
<i>Ceanothus americanus</i>		AF			FP	FP	F		P	AF		F
<i>Chrysanthemum Leucanthemum</i>												FP
<i>Cimicifuga racemosa</i>					F		P					FP
<i>Cirsium spp.</i>												F

Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T
<i>Clematis viorna</i>												F
<i>Collinsonia canadensis</i>					FP							
<i>Convallaria majalis</i>							FP					
<i>Coreopsis major</i>												FP
<i>Cornus florida</i>	F	A	F		F	F	P		F	FP		FP
<i>Cornus stolonifera</i>	F											
<i>Cunilla origanoides</i>				AF								FP
<i>Danthonia spicata</i>												FP
<i>Desmodium spp.</i>			FP			FP	FP					FP
<i>Desmodium nudiflorum</i>			AF	AF			FP					FP
<i>Dianthus spp.</i>										P		
<i>Diervilla lonicera</i>												P
<i>Dioscorea villosa</i>			FP	AF		F	F		FP	F		AF
<i>Diospyros virginiana</i>	FP	P		FP			F		P			P
<i>Dryopteris intermedia</i>												FP
<i>Eupatorium urticaefolium</i>										AF		FP
<i>Fagus grandifolia</i>	FP											
<i>Fragaria spp.</i>										FP		F
<i>Fraxinus spp.</i>	FP											

Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T
<i>Galax aphylla</i>	FP	AF				F	P		AF		FP	
<i>Galium</i> spp.											FP	
<i>Gillenia trifoliata</i>							FP					
Gramineae spp.			F	A		AF				A		
<i>Hammamelis virginiana</i>	AF	AF	FP		F	P	P		F		FP	
<i>Hepatica triloba</i>											FP	
<i>Heuchera</i> spp.							P					
<i>Hicorea</i> spp.	F	F	F		FP	F	P			AF	F	
<i>Hydrangia arborescens</i>									F			
<i>Hypericum</i> spp.											FP	
<i>Impatiens</i> spp.	AF								FP			
<i>Juglans cinerea</i>										FP	P	
<i>Juglans nigra</i>							P			F		
<i>Lespedeza hirta</i>				F		FP	P	F			F	
<i>Lespedeza frutescens</i>							FP				FP	
<i>Liriodendron Tulipifera</i>	FP	AF	P		FP	P			AF	FP		
<i>Lysimachia quadrifolia</i>											FP	
<i>Monarda</i> spp.										F		

Attention Patron:

Page 90 repeated in numbering

Exposure	Valley, lower slope					Middle slope				Upper slope, Top		
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T
<i>Monotropa uniflora</i>					P							
<i>Nyssa sylvatica</i>	FP	FP				F	P		F	FP		FP
<i>Osmorhiza longistylis</i>	F											
<i>Gemunda cinnamomea</i>	AF						P	F				
<i>Oxalis</i> spp.										P		
<i>Oxydedrum arboreum</i>	FP	F	FP			F	F		F	FP		
<i>Paronchia argyrocoma</i>												FP
<i>Pedicularis canadensis</i>									P			FP
<i>Phytolacca decandra</i>	FP						P			F		
<i>Pinus pungens</i>			FP	AF	F		P	AF	F			
<i>Pinus rigida</i>				AF		FP			FP			P
<i>Pinus strobus</i>	F		FP		F							
<i>Pinus virginiana</i>			FP	F	F		F					FP FP
<i>Platanus occidentalis</i>	FP											
<i>Polygonatum biflorum</i>						P	P			FP		P
<i>Polygonum arifolium</i>	F											
<i>Polygonum scandens</i>										P		
<i>Polypodium virginianum</i>												P

Exposure	Valley, lower slope				Middle slope				Upper slope, Top				
	V	E	SE	SW	NW	E	SE	S	NW	SE	NW	T	
Potentilla spp.		AF	FP				P		FP			F	
Prunus spp.												P	
Prunus serotina		FP			FP								
Psedera quinquefolia		F	AF		FP	P			FP	AF			
Pteridium latiusculum			FP	FP	AF	AF	P				AF	F	
Rhus Toxicodendron			FP		FP				FP			P	
Robinia Pseudo-Acacia		AF		AF	F	FP	F	AF	AF	F	F	A	
Rubus spp.		FP	AF		FP				FP	A		F	
Sagittaria spp.		F											
Salix humilis												FP	
Sambucus spp.		FP											
Sanguinaria canadensis												P	
Sanicula spp.							P						
Sassafras variifolium			A	F	A	AF	A	A	A	F	AF	AF	AF
Sailacina racemosa							FP	FP			FP	F	
Solidago spp.		AF										FP	
Tephrosia virginiana					AF	FP	F	F	P		AF	P	
Teuga canadensis		AF		FP					P				
Verbascum spp.										P			
Vicia caroliniana												FP	

Bland County

Bland County lies northwest of Pulaski County and southwest of Giles County, with its northern border on the West Virginia line. The county has nearly 43% of its area in forest lands, most of this composing the finest grouse range in the state. Of all the areas observed, none supported as high a grouse population nor such ideal environmental conditions as those found in Bland County.

Most of the county is extensively wooded, much of this in fine stands of timber, some of which is being lumbered at the present time. Beautiful stands of whitepine and various hardwoods are frequent. Most of the vegetation, however, is typically Allegheny, being extremely shrubby and brushy in composition. This condition is no doubt due to past intensive lumbering operations. The range is much more extensive than any observed in the Blue Ridge. The heavily wooded sections extend over thousands of acres, from one ridge crest to another in a continuous forest blanket. Most of the good grouse range is identical with this condition. Here, also, the slopes are gentler, and there is a wealth of coves, ravines and secondary hills at the base of the ridges, all of which go to make up ideal grouse range. As was found in Pulaski County, these smaller hills and lowlands are abundant in grouse foods. As most of the stations were taken in the lowlands and on the smaller ridges, the abundance of the various grouse foods on the upper slopes of the large ridges is not known. There

is no reason to think that it differs from the ridges of Giles and Pulaski Counties, all of which are very similar. From observations, it is believed that cover and food plants are somewhat more abundant in Bland County, although this cannot be definitely determined until more samples are taken.

The section worked most intensively was the Kimberling basin, or the "Wilderness", as the residents call it. It is an extensively wooded basin surrounded on three sides by mountains. Brushy Mountain is primarily the one that encloses this area. Kimberling is one of the best grouse sections according to Game Warden Bird. Certain parts of it are open timber, mostly white pine; while other sections, especially the smaller ridges, are dense with shrubs. Wintergreen,* arbutus, partridge berry, smilax, grape, etc., are abundant everywhere. Rhododendron, laurel and small pines form ideal cover.

Later in the winter the game warden showed the author the range between the towns of Bland and Surkes Garden, near the head of Poor Valley. This, in the wirtter's estimation, is the highest type of grouse range found in the state, and to all indications the grouse population compares favorably with that of similar sized areas in the northern states. In this section the slopes of the main ridge are gentler, many smaller

* See Page 158 for corresponding scientific names

hills are present between ridges, and there is a wealth of coves, ravines and valleys. The floor vegetation is abundant in grouse foods and cover plants are common.

This area and Kimberling are similar in make-up, so that a discussion of the vegetation of one might apply to the county as a whole. As mentioned before, wintergreen, arbutus, partridge berry, smilax and grape are abundant almost everywhere. White, black and chestnut oaks are abundant. Christmas fern is common in the lowlands and on some exposures. Huckleberries and blueberries are also abundant here as in other sections studied. Service berry, cherry birch and *Viburnum acerifolium* appear much more common. Azalea and other rhododendrons are common. Laurel is common. Beaked hazel, rose, pussytoes and various asters are frequent. Self-heal is quite common in open places. Hawthorn, hophornbeam and sedum do not appear to be as common as in some of the other counties investigated.

Table 3

Abundance, Occurrence and Exposure
of
Various Plant Species in Bland County

A - Abundant
F - Frequent
P - Present

No. of Stations Exposure	Valley, lower slope			Middle slope	
	B	1	1	2	2
	V	SE	EW	E	T
<i>Amelanchier canadensis</i>	AF	F	A	A	A
<i>Antennaria</i> spp.	FP				A
<i>Aster</i> spp.	A		F		
<i>Aster divaricatus</i>	FP				
<i>Betula lenta</i>	AF	A	F		AF
<i>Corylus rostrata</i>	FP			FP	
<i>Crataegus</i> spp.	FP				
<i>Epigaea repens</i>	F		A		A
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	FP		A	A	A
<i>Gaultheria procumbens</i>	A	A	A		A
<i>Kalmia latifolia</i>	FP	A	A	AF	AF
<i>Mitchella repens</i>	A	A			
<i>Ostrya virginiana</i>	FP				
<i>Polystichum acrostichoides</i>	AF		F	AF	
<i>Prunella vulgaris</i>	F	A		AF	
<i>Quercus alba</i>	A	A	A	AF	A

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Quercus prinus</i>	AF	A	A	A	AF
<i>Quercus velutina</i>	AF	A	A	A	A
<i>Rhododendron</i> spp.	A	A	F	FP	
<i>Rhododendron</i> (Azalea)	F	A		AF	AF
<i>Rosa</i> spp.	F	F		FP	
<i>Sedum ternatum</i>	F				
<i>Smilax</i> spp.	A	A	R	A	AF
<i>Viburnum acerifolium</i>	A	A	F		AF
<i>Vitis</i> spp.	AF		F	AF	AF
<i>Acer pennsylvanicum</i>	F			FP	
<i>Acer rubrum</i>	A	A	F	A	A
<i>Acer saccharum</i>	A		F	F	
<i>Adiantum pedatum</i>	F				
<i>Agrimonia</i> spp.	F				
<i>Alnus rugosa</i>	F				
<i>Ambrosia artemisiifolia</i>	FP			FP	
<i>Amphicarpa monoica</i>	FP				

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Angellica villosa</i>					FP
<i>Aquilegia canadensis</i>	FP				
<i>Aralia nudicaulis</i>					P
<i>Aristolochia macrophylla</i>	P				
<i>Asarum virginicum</i>	FP		F		FP
<i>Baptisia tinctoria</i>	P			FP	F
<i>Castanea dentata</i>	A	F	A	A	A
<i>Castanea pusila</i>	P				A
<i>Ceanothus americanus</i>				AF	
<i>Chimaphila maculata</i>	F			FP	
<i>Cimicifuga racemosa</i>	P				
<i>Clintonia umbellata</i>	F				
<i>Collinsonia canadensis</i>	F				
<i>Convolvulus repens</i>	P				
<i>Coreopsis major</i>		F			
<i>Cornus florida</i>	A	A	A	AF	AF
<i>Cunila origanoides</i>				FP	
<i>Cypripedium acaule</i>					FP
<i>Desmodium nudiflorum</i>	F			F	

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Dioscorea villosa</i>	AF	A		FP	FP
<i>Disporum lanuginosum</i>				FP	
<i>Dryopteris marginalis</i>	P			FP	
<i>Dryopteris noveboracensis</i>	FP	F			
<i>Epipactis pubescens</i>	FP				
<i>Eupatorium</i> spp.	P				
<i>Fagus grandifolia</i>	P	F			
<i>Fragaria</i> spp.				FP	
<i>Fraxinus</i> spp.	FP				
<i>Galax aphylla</i>	P	F			A
<i>Galium</i> spp.	P				
<i>Geranium maculatum</i>	FP				
<i>Gerardia flava</i>				FP	
<i>Gillenia trifoliata</i>	P				
Gramineae spp.	A	A		AF	
<i>Hamamelis virginiana</i>	AF	A	A	FP	
<i>Hepatica triloba</i>	AF	F		FP	
<i>Heuchera hispida</i>	P				

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Hicoria</i> spp.	A	A	A	AF	FP
<i>Hieracium venosum</i>		F		AF	
<i>Hydrangia arborescens</i>	F		F	F	
<i>Hypericum prolificum</i>	P				
<i>Juglans cinerea</i>	P				
<i>Liriodendron Tulipifera</i>	FP				
<i>Lobelia cardinalis</i>	F				
<i>Lobelia inflata</i>	P				
<i>Lyonia ligustrina</i>	P				
<i>Lysimachia quadrifolia</i>	P	F			F
<i>Magnolia acuminata</i>	P				
<i>Maianthemum canadense</i>	F				
<i>Medeola virginiana</i>	P				
<i>Nyssa sylvatica</i>	AF	F	A		A
<i>Oakesia puberula</i>					FP
<i>Oxalis</i> spp.	F	F			
<i>Oxydendrum arboreum</i>	F			A	AF
<i>Pinus strobus</i>	A	F	A	A	A

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Pinus virginiana</i>	P			AF	AF
<i>Plantago</i> spp.	P				
<i>Plantanus occidentalis</i>	P				
<i>Podophyllum peltatum</i>	P				
<i>Pogonia verticillata</i>	FP				F
<i>Potentilla</i> spp.	A	A	A	AF	AF
<i>Prenanthes</i> spp.	F				
<i>Psedera canadensis</i>	AF		F		
<i>Pteridium latiusculum</i>	P		A		FP
<i>Pyrola americana</i>	FP				
<i>Pyrularia americana</i>	F		F		AF
<i>Rhus Toxicodendron</i>	AF			F	
<i>Robinia Pseudo-Acacia</i>	F			FP	
<i>Rubus</i> spp.	F		F	FP	
<i>Sanguinaria canadensis</i>	FP			FP	
<i>Sanicula canadensis</i>	FP				
<i>Sassafras varifolium</i>	AF		A	FP	A
<i>Sailacina racemosa</i>	P		F		
<i>Solidago</i> spp.	P			F	FP

Exposure	Valley, lower slope			Middle slope	
	V	SE	SW	E	T
<i>Tilia americana</i>					F
<i>Thalictrum</i> spp.	P				
<i>Trifolium pratense</i>				F	
<i>Tsuga canadensis</i>	AF	A			
<i>Urtica</i> spp.	FF				
<i>Veronica officinalis</i>	AF	F			
<i>Vicia</i> spp.	F			F	
<i>Viola</i> spp.	A	A			
<i>Zizia</i> spp.	P	F			

Floyd County

As the general aspects of the Blue Ridge habitat were discussed previously, it is unnecessary to repeat a similar discussion in this section. A more or less detailed description of the areas of the county surveyed will be sufficient.

Buffalo Mountain lies south of Floyd C.H. in the extreme southern part of the county. It is the highest mountain in the county, rising to approximately 3500 feet and formed largely by a great rock formation rising almost vertically at its western end from the surrounding lowlands. From the highest point at the western end, the mountain top gradually slopes to and loses itself in the lower hills to the east. The slopes, however, are very steep, although not so extreme as in other sections of the county.

The general vegetation form is that of the open woodland type so characteristic of the Blue Ridge Mountains. This open forest is the most prevalent on the ridge itself, whereas in the lowlands there are a number of sections where the shrubs are quite dense and would serve as good cover. Laurel is especially good cover. Rhododendron is much more common here than in any other part of the county and serves as good cover in the lowlands. It is in these lowlands that a relatively large number of the grouse food plants are most common and it is here that most of the grouse are found. There appear to be better food conditions here than elsewhere in the county, and there is also a much larger grouse population. In general,

however, the open oak-chestnut woods of the ridge itself is very similar to the rest of the areas studied and produces very little food. In some of the more open places on the south slope, the grasses, huckleberries, etc. come through in good numbers and at certain seasons of the year furnish a valuable food supply.

Willis Ridge, to the west of Floyd about 4 miles, is similar to Buffalo Mountain in vegetation, but the lowlands are somewhat more cleared and food plants are much more scarce. The northwest slope of the mountain appears to have a much more luxuriant growth, producing a better condition than on the opposite side. The ridge itself may support a few desirable plants, but on the whole it is of the typical Blue Ridge open forest type where few food plants occur. The lowlands are somewhat more extensive on the southeast side and most of the area is in very dense laurel. This is exceedingly good cover although it is doubtful if there are many food plants available. Pine is much more common here than on Buffalo Mountain where there is an almost pure stand of hardwoods.

To the east of Floyd on the far side of the Parkway lies Hyeock Mountain and the Shooting Creek section, which were worked rather intensively. Part of the area investigated lies also in Franklin County but is very close to the Floyd County line and will be considered as part of Floyd County. The vegetation of the mountains in this section is quite similar to the typical growth of those mountains previously mentioned. The open woodland type is prevalent and on some of the slopes

the laurel becomes very dense. The slopes here, however, appear to be much steeper than elsewhere. Some of them, especially along Shooting Creek, are almost precipitous in places. In general these mountains are rather poor in food plants, except in a few rather limited low places and the widespread growth of Christmas fern on the north slopes.

In the mountains of the county as a whole, laurel and rhododendron form the finest cover and on a number of occasions grouse were flushed from these coverts by both dog and man. Of course grape is one of the most abundant foods although not as common as one would surmise. Many vines are present but this past year little fruit was observed. Huckleberries and blueberries are abundant in most places and probably furnish a more available food supply than grape. These species, along with the afore-mentioned laurel and Christmas fern, and together with various oaks and asters, form the bulk of the grouse food plants as listed. Chestnut, white and black oaks are the most common of the oaks. Wintergreen, so abundant in the Alleghanies, was not recorded in the county. Other foods such as partridge berry and arbutus are very scarce. Smilax, so abundant in the Alleghanies and forming such a large item in the grouse diet, is quite scarce. Antennaria, various asters, and other composites, self-heal, potentilla and other plants characteristic of fields and open places are fairly common. However, the examination of field vegetation was not undertaken extensively in any section of the state investigated. Cherry

birch and hophornbeam are fairly common in places. Beaked hazel is well represented especially on the drier upper slopes to the south. Amelanchier, hawthorn, avens, menziesia, rose and sedums are present in small amounts. Azalea is fairly common and furnishes some winter food in the form of buds. Sumac is common in a number of the old fields, although not encountered many times in the survey. *Viburnum acerifolium* is by far the most common viburnum in the county.

Table 4

Abundance, Occurrence and Exposure
of
Various Plant Species in Floyd County

A - Abundant
F - Frequent
P - Present

No. of stations Exposure	Valley, lower slope							Middle slope						Upper slope, Top							
	9	2	3	9	1	1	3	6	2	3	1	11	4	6	6	4	2	7	2	2	11
	V	NE	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Amelanchier cana-</i> <i>densis</i>	P											FP	F	P	FP	FP	FP		FP	FP	FP
<i>Antennaria</i> spp.	FP	AF	F									F	AF		P			P			FP
<i>Aster</i> spp.	A		A	FP	F		P	F	FP	F		A	AF	P	F	AF	FP	P			F
<i>Aster divaricatus</i>	P			P				F				P						F	F		F
<i>Betula lenta</i>	FP	AF	P	P		F	P	F		F	F	P	P	R	AF	AF		P		F	F
<i>Corylus rostrata</i>	FP												A	P		FP		P	AF		FP
<i>Crataegus</i> spp.	F			P	F			P				F	P		FP	F		FP	FP		P
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	F	A		P	AF		P			A		AF	A	F	F	F	A	P	A	F	A
<i>Geum canadense</i>				P				F				P				P		P			
<i>Geum virginianum</i>																		P			
<i>Kalmia latifolia</i>	P	F	F	P				P		F	AF	P		F	AF	FP	A	F		F	A
<i>Menziesia pilosa</i>															F						P
<i>Mitchella repens</i>				P				P				P									
<i>Ostrya virginiana</i>	P			P				A		P		FP			FP	FP		F	F		A
<i>Polystichum acrosti-</i> <i>choides</i>	P	A	F	AF		AF		A	F	P		AF	F		F	P		AF	F		P

Exposure	Valley, lower slope						Middle slope						Upper slope, Top									
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T	
<i>Frunella vulgaris</i>	AF		F	FP	F		F	P		P		FP			P	FP		P				
<i>Quercus alba</i>	AF	F	FP	F	A			P		P		AF	AF	P		FP	F	F	A		AF	
<i>Quercus borealis maxima</i>																		F			P	
<i>Quercus prinus</i>	F						AF	A	F		A	A	AF	A	AF	F		A	AF	AF	A	A
<i>Quercus stellata</i>													P						P			
<i>Quercus velutina</i>	AF	AF	F	AF	A		F	AF	FP	A		AF	AF	A	AF	AF	AF	F	A	F	AF	
<i>Rhododendron</i> spp.	P			F								FP	P		P	P		P			P	
<i>Rhododendron</i> (Azalea)	F			P	F		F					AF	P	F	AF	AF	FP		FP	FP	FP	AF
<i>Rhus glabra</i>	FP	FP	F	FP			FP	P	FP	FP		P	FP									P
<i>Rhus hirta</i>							FP					FP										
<i>Rosa</i> spp.	P					FP						FP	FP	P			P	P				P
<i>Sedum ternatum</i>			F							A	FP											FP
<i>Sailax</i> spp.	F	P	P	P			F			F		P			FP	FP	AF		F			P
<i>Viburnum acerifolium</i>	AF	F		P	F		FP	F		P	F	F	AF	AF	FP			AF	F	FP	AF	
<i>Viburnum prunifolium</i>													P		P	P						
<i>Vitis</i> spp.	AF	A	A	AF	F	AF	AF	F	F	F	F	AF	AF	FP	P	FP		F	FP	F	FP	

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Acer pennsylvanicum</i>	F			P		F		FP				FP	AF		F	AF		F		FP	P
<i>Acer rubrum</i>	A	F	FP	FP	AF	F	F	F		FP	AF	F	AF	AF	AF	P		F	F	F	AF
<i>Acer spicatum</i>															P	P					FP
<i>Achillea Millefolium</i>	FP														P						
<i>Actaea rubra</i>															P						
<i>Adiantum pedatum</i>	P	F		P				FP	FP	P		P		FP	P	FP		P		FP	
<i>Agrimonia spp.</i>				P									P		P		P				
<i>Aletris farinosa</i>																					P
<i>Allium cernuum</i>																					P
<i>Alnus rugosa</i>	P																				
<i>Ambrosia artemisiifolia</i>	P		F	P	FP			FP							P	P					
<i>Amphicarpa monoica</i>	F		A	P				FP		F					P	P					
<i>Apocynum spp.</i>															P						P
<i>Aquilegia canadensis</i>		P						P	P					P	P						
<i>Aralia nudicaulis</i>				P			P	FP	F	F		P		P	P		F		F	P	
<i>Arenaria groenlandica</i>																					P
<i>Arisaema triphyllum</i>		F		P				F	P		P		P				F				

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Aristolochia macrophylla</i>								P				P			P						
<i>Aronia melanocarpa</i>							P														
<i>Aruncus sylvestris</i>												P							P		
<i>Asarum</i> spp.	FP			P				F				P	P	P							
<i>Asclepias tuberosa</i>	P																				
<i>Ascyrum hypericoides</i>																			P		
<i>Asplenium montanum</i>				FP				F													
<i>Asplenium platyneuron</i>								FP	P		P				P	FP	FP	P			FP
<i>Asplenium trichomanes</i>															P						
<i>Athyrium asplenoides</i>																					
<i>Baptisia tinctoria</i>										F							F				P
<i>Bidens</i> spp.	P							F							FP						
<i>Batrachium virginianum</i>	P							P										P			
<i>Campanula americana</i>				AF																	
<i>Campanula aparinoides</i>																					P

Exposure	Valley, lower slope						Middle slope						Upper slope, Top								
	V	N	SE	S	SW	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T	
<i>Camptosorus rhizophyllus</i>																				P	
<i>Castanea dentata</i>	F		F	F	F	F	F		F		FP	AF	A	AF	AF	A	FP	A	AF	AF	
<i>Castilleja coccinea</i>																				P	
<i>Caulophyllum thalictroides</i>	P						P														
<i>Ceanothus americanus</i>	P				P															P	
<i>Celastrus scandens</i>																				P	
<i>Cercis canadensis</i>	F		AF	P			P	F			P									P	
<i>Chimaphila maculata</i>	P					P	P				FP	P	P	P	FP	P				FP	P
<i>Chrysanthemum Leucanthemum</i>						FP					FP										
<i>Cimicifuga racemosa</i>	AF	A		AF	A	F	A		FP		P	AF	A	AF		P	FP	FP	F		
<i>Circaea lutetiana</i>	P			P																	P
<i>Clintonia umbellata</i>												P									
<i>Socculus carolinus</i>	F																				
<i>Collinsonia canadensis</i>						P					P	P								P	P
<i>Convallaria Majalis</i>																					P
<i>Coreopsis major</i>																					
<i>Cornus alternifolia</i>																					P

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Cornus canadensis</i>				P								P	P								
<i>Cornus florida</i>	A	AF	A	A	A	A	A	A	AF	F	A	A	A	AF	AF	F	F	AF	A		AF
<i>Corydalis semper-virens</i>																					P
<i>Cunila origanoides</i>	F				F								F								P
<i>Cystopteris fragilis</i>	P																				
<i>Daucus carota</i>	F		AF	P																	
<i>Dennstaedtia punctilobula</i>																			F		P
<i>Desmodium</i> spp.		P	FP	P					FP		P										
<i>Desmodium Delinii</i>	F		P	P																	
<i>Desmodium nudiflorum</i>											P				P	FP	FP	P			
<i>Diodea teres</i>				P																	
<i>Dioscorea villosa</i>	AF	FP		AF	F		F	F			F	AF	FP	F	F	FP	AF	F	F	AF	
<i>Diospyros virginiana</i>													P								
<i>Disporum</i> spp.								P				P									
<i>Dryopteris hexagonoptera</i>	P							P													
<i>Dryopteris marginalis</i>	P	FP		FP		FP		A	FP	P		FP	F	AF	F	FP	F	FP	A	F	

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Epipactis pubescens</i>								P													
<i>Eupatorium</i> spp.	FP			P			F	P	F	F	F	FP	P	P	FP	A		P		F	FP
<i>Eupatorium purpureum</i>	P				FP				FP	P			P		P						P
<i>Eupatorium sessilifolium</i>	P																				P
<i>Eupatorium urticaefolium</i>	P			P				P							P						
<i>Euphorbia corollata</i>				P								F	FP								FP
<i>Fragaria</i> spp.	FP			FP	F		P	P	F	FP		P	P		P	P					P
<i>Fraxinus</i> spp.	AF	AF	F	AF				AF	AF			F	FP		FP	A		F		AF	
<i>Galax aphylla</i>	P							P				P	P		P						F
<i>Galium</i> spp.	P	F		FP	F		FP	FP	FP		P	AF	FP	AF	FP	AF	FP	FP	FP	AF	FP
<i>Geranium</i> spp.	P				F			P	P			FP	P	P	P		P				P
<i>Gerardia pedicularis</i>										P											
<i>Gerardia flava</i>	P				F							P			P						
<i>Gillenia trifoliata</i>	P				AF							FP	AF		FP				F	F	AF
Gramineae spp.	AF	AF	A	FP	A					F		AF	F		P			AF			P
<i>Hamamelis virginiana</i>	AF	A		FP		AF		AF				AF	AF	AF	AF	P		F			AF
<i>Hedeoma pulegioides</i>				F																	
<i>Helianthus</i> spp.	F			P			F	P				FP	P	P	P		P			FP	FP

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	E	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Hepatica triloba</i>	P	P																		P	
<i>Heuchera</i> spp.	P	P		P	P						P	P			F	A		P	FP	FP	
<i>Hicoria</i> spp.	F	A	F	AF		F	F	A	AF	F	F	AF	AF	F	FP	AF	F	A	AF	FP	A
<i>Hieracium venosum</i>											P		P								
<i>Houstonia purpurea</i>																		P			
<i>Hydrangia arborescens</i>	P			FP		AF		A	F	F		F	AF		F		AF	AF		FP	P
<i>Hydrophyllum virginianum</i>										F			P		P						
<i>Hypericum prolificum</i>																	P				
<i>Ilex montana</i>										P		P			F			P			
<i>Impatiens</i> spp.	FP	FP	F	F				AF	AF	F		P			FP	P		FP			P
<i>Ipomoea</i> spp.	P			P																	
<i>Iris</i> spp.	P							P										FP			P
<i>Juglans cinerea</i>	F			FP		F		F		F	P		P			FP					
<i>Juglans nigra</i>		F	AF	P				F										P			
<i>Juniperus virginiana</i>												P						P			
<i>Lespedeza frutescens</i>										F		P						P			
<i>Lespedeza hirta</i>										AF								FP			P

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Lespedeza repens</i>				P						F											
<i>Lilium canadense</i>												P									
<i>Liriodendron Tulipifera</i>	AF	AF	AF	AF	F	AF	AF	F	FP	P		FP	P	AF	FP	P		P			P
<i>Lobelia inflata</i>				P																	
<i>Lyonia ligustrina</i>																					P
<i>Lysimachia quadrifolia</i>	P			P			P	P		P		P		P	P		P			P	P
<i>Magnolia acuminata</i>	FP	F		FP				AF		P		F	F	F	P			F			
<i>Malus spp.</i>									P												
<i>Medeola virginiana</i>													P		FP						
<i>Melanthium parviflorum</i>															P						
<i>Mentha spp.</i>		P																			
<i>Monarda spp.</i>				P				P							P					FP	
<i>Monotropa uniflora</i>		P																			
<i>Nyssa sylvatica</i>	A	AF	AF	AF		A	FP	P		F	F	FP	AF	F	FP	P		P			
<i>Osmorhiza longistylis</i>															P	AF					
<i>Osmunda cinnamomea</i>	P					F	P				P		P								

Exposure	Valley, lower slope							Middle slope							Upper slope, Top						
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Oxalis</i> spp.	P		P	P					FP		P				P						P
<i>Pedicularis canadensis</i>																					P
<i>Phegopteris hexagonoptera</i>								P													
<i>Phlox</i> spp.																					P
<i>Pilea pumila</i>	P		P	FP					F		P				P		P				
<i>Pinus rigida</i>			P							P											
<i>Pinus strobus</i>							P		P				P				FP				P
<i>Pinus virginiana</i>			P				P		P												
<i>Phyma Leptostachya</i>									F												
<i>Phytolacca decandra</i>			P				F		FP		P										
<i>Plantago major</i>	FP					F									P						
<i>Platanus occidentalis</i>	F	F																			
<i>Podophyllum peltatum</i>								P							P						
<i>Polygala polygama</i>																					P
<i>Polygonatum biflorum</i>	P	P						P	P	P	FP			P	FP			F		P	
<i>Polygonum arifolium</i>																					P
<i>Polypodium virginianum</i>				P							P			P			P				FP F

Exposure	Valley, lower slope						Middle slope						Upper slope, Top								
	V	N	SE	S	SW	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T	
<i>Populus grandidentata</i>							P													P	
<i>Potentilla</i> spp.	AF	AF	F	P	AF	F	P		F		F	F	FP	FP	FP		A			P	
<i>Potentilla tridentata</i>																				P	
<i>Prenanthes trifoliata</i>	P																			P	
<i>Prunus</i> spp.															P						
<i>Prunus serotina</i>				P		P						P	P	FP	P				FP	P	
<i>Psedera quinquefolia</i>	F	A	F	A		A	F	AF	A	F	F	AF	F	AF	AF	AF	AF	AF	AF	A	AF
<i>Pycnanthemum pycnanthemoides</i>	P			P											P						
<i>Pyrus americana</i>														P						P	
<i>Pyrus melanocarpa</i>																				P	
<i>Rhus Toxicodendron</i>	P			P								FP		P						P	
<i>Robinia Pseudo-Acacia</i>	FP		A	FP	F	F	F	AF	FP	F	F	FP	AF	AF	AF	FP	FP	F			AF
<i>Rubus</i> spp.	AF		F	A	A	A	F	F	A	F	F	F	F	F	F	AF		AF			FP
<i>Rudbeckia</i> spp.	FP							F					P		F		P			P	
<i>Rumex</i> spp.	P			P																P	
<i>Salix humilis</i>													P							P	

Exposure	Valley, lower slope						Middle slope						Upper slope, Top								
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Salix nigra</i>			F																		
<i>Sambucus</i> spp.	P			P						FP	P	P			P	P					P
<i>Sanguinaria cana-</i> <i>densis</i>	FP	F		FP			FP	P		P		FP			P	FP			P	FP	FP
<i>Sanicula canadensis</i>	F			P						P					FP						
<i>Sassafras variifolium</i>	F		FP	F	A	F	AF	FP	AF	F		AF	F			AF	AF	P	FP		P
<i>Saxifraga leucanthemifolia</i>																					P
<i>Scutellaria serrata</i>	FP				F																
<i>Sericocarpus linifolius</i>																					P
<i>Sailacina bifolia</i>															P						P
<i>Sailacina racemosa</i>	F			AF		A	P		F	F	F	F			F	FP	F	A	F	AF	
<i>Solidago</i> spp.			F	P							F	FP			P		AF			FP	
<i>Streptopus aplexifolius</i>											P				P						
<i>Tephrosia virginiana</i>									A	P					P						
<i>Thalictrum</i> spp.	P		FP	P		AF	P				FP				P	F		F			P
<i>Tilia americana</i>	FP	AF	FP	AF			F		FP	F		AF			AF	F		F		AF	F
<i>Trifolium repens</i>			P																		

Exposure	Valley, lower slope						Middle slope						Upper slope, Top								
	V	N	SE	S	SW	W	NW	N	NE	E	SE	S	SW	NW	N	NE	SE	S	SW	NW	T
<i>Trillium</i> spp.	P			P				FP			FP	P			P	FP					
<i>Ulnus fulva</i>				FP																	
<i>Umbelleferae</i> spp.																					P
<i>Urtica</i> spp.	P										P				P						
<i>Verbascum Thapsus</i>				P																	
<i>Verbena urticae-folia</i>															P						
<i>Verbescina occidentalis</i>			FP	A	P			P	AF		P					FP		FP			
<i>Veronica officinalis</i>				P												F					
<i>Vicia</i> spp.											P										
<i>Viola</i> spp.		FP	F	F	F		FP	FP		A	P		FP	FP	AF			A		FP	
<i>Zizia Bebbii</i>											P						P			P	

Patrick County

Patrick County lies directly south of Floyd County and contains a large section of Blue Ridge. The main ridge of the Blue Ridge, however, is on the extreme western edge of the county, while most of the mountains within the county proper are off-shoots or isolated units. As the general topography has been touched on previously, only the vegetation will be discussed here.

There are found four main mountain sections in the county which would serve as suitable grouse habitat. These are: Bull Mountain, No-Business Mountain, Carter's Mountain and the Blue Ridge proper. All these sections, with the exception of No-Business Mountain, were surveyed intensively. According to Mr. Francis, the Game Warden, this section last mentioned is similar to others in the county and in his estimation does not contain many grouse.

Without a doubt, fire at the present time is the major limiting factor of game in this county. The extent and effect of fire has been discussed more fully in a preceding section of the thesis so that a detailed discussion of this point will not be necessary here.

Bull Mountain is a large forested area a mile or two east of the county seat, Stuart. Although extensive in area, fire has swept practically the whole mountain from all sides almost every year. Naturally, then, the typical vegetation is of a

short, shrubby type, characteristic of that which follows frequent fires. Rhodie Creek is the main stream which drains to the southwest, and it is along this that the grouse food and cover plants are the most abundant. Here rhododendron, * laurel and alder form good cover. Partridge berry, cherry birch and antennaria are fairly common near the sections of the stream not devastated by fire. Other possible food plants such as ginger and speedwell are frequent. Smilax is somewhat more common here than in Floyd County, especially in some of the more cleared areas of the valley. Grape is also common and more fruitful. The tops and slopes of the ridges as a whole are poorly represented in grouse foods. Although most of the important food plants are represented, they are not adequate in number. Sections of the slopes and tops of the ridge are so dense with shrub growth that penetration is almost impossible.

Other sections of Bull Mountain were investigated farther along the ridge and were found to be burned in much the same manner, if not more. The mountainside being steep and rocky, a fire once started below would burn quickly to the top. On much of this area the vegetation is hardly waist high due to constant burnings. In the moist sections at the foot of the mountain, the smilax appears to be the most common, some bearing good fruit. On the burned areas, huckleberries and blue-

* See Page 158 for corresponding scientific names

berries are by far the most abundant food plants.

Carter's Mountain is several miles to the southwest of Stuart, and consists of a rather extensive range. Here again fire is no doubt a factor, although the vegetation appears to be more typical of good grouse range than that observed at Bull Mountain. On the southern slope the range is extensive and gently sloping, being drained by two fair sized creeks; Ditch Creek and Peter's Creek. In the writer's estimation this area has more possibilities for a large grouse population than that observed in any other section of the county, in fact, of most of the southern Blue Ridge. The shrubby type is most prevalent, although considerably more open than found in much of Giles County in the Alleghenies. An extensive, dense stand of shrub growth is just as unproductive of good grouse population as an extensive, open type. The condition here on Carter's Mountain seems more favorable and appears much like the Dismal Area in Giles County. Laurel is abundant, as usual, and with rhododendron along the streams forms the best cover. As was the case in other sections, the food plants are somewhat more common near the streams. Sallax is generally scattered over most of the area and some in fruit. Arbutus and some partridge berry are present.

The northern slope of the mountain has a more woodland type of growth, where fires have not burned severely. Here Ailanthus is a common ravine species. This side of the mountain is far less extensive than the opposite slope and

probably for this reason contains very few birds.

Spoon Mountain and the surrounding mountains of the Blue Ridge in the northern part were also investigated. Although fire has razed much of the Blue Ridge in the county, this area studied has not had a fire for many years. Good stands of timber are found and much of it is being lumbered at the present time. Here is found the typical open woods type so characteristic of much of Floyd County. There is also a corresponding scarcity of food plants that are abundant in the Alleghany Mountains. Very few moist coves are present, and if such places did exist they are, as a rule, cleared and in farms. On certain exposures, especially to the west, cover is not a factor as dense stands of laurel sometimes cover an entire slope. Considerable investigation may disclose most of the grouse food plants present, but in small amounts. Grape is exceedingly common in some sections and probably serves as a food supply for a few birds. From conversations with inhabitants the observer found that most of the grouse shot were around patches of grape.

On the whole, the Spoon Mountain section will probably not support a large grouse population, but the Carter's and Bull Mountain areas appear to have more possibilities. However, it is the writer's opinion that these areas will not support the grouse population of a similar sized area in the Alleghany Range.

As mentioned previously, laurel is abundant, also huckleberry and blueberry in most places. Rhododendron is common

along streams in the Bull Mountain and Carter's Mountain areas, but less so on the Blue Ridge proper. Taking the county as a whole, Christmas fern, arbutus, partridge berry, cherry birch, self-heal, and the various asters are about as abundant as in Floyd County. The oaks are similarly distributed, the most abundant form being chestnut oak, with black oak second in abundance. Hophornbeam, menziesia, hawthorn and service-berry are present. Antennaria is frequent. Azalea is frequent, and in some places, abundant. Sumac and rose are frequent in open areas. Viburnum acerifolium is less common than might be supposed. Grape is one of the most abundant foods present, and, to all indications, a factor holding a few grouse. It is significant that nowhere has wintergreen been found in this county or Floyd County.

Table 5

Abundance, Occurrence, and Exposure
of
Various Plant Species in Patrick County

A - Abundant
F - Frequent
P - Present

No. of stations Exposure	Valley, lower slope							Middle slope							Upper slope, Top							
	8	1	2	3	1	1	1	8	5	4	13	4	2	3	3	2	5	4	1	1	2	8
	V	N	E	SE	S	SW	W	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
<i>Amelanchier cana-</i> <i>densis</i>										P												FP
<i>Antennaria</i> spp.	F			F				F			P		F									FP
<i>Aster</i> spp.		AF	AF	P				F		F	FP	P		A	A		A		A			AF
<i>Aster divaricatus</i>							AF	AF	AF		F						FP	FP				A
<i>Betula lenta</i>	AF			F	F				FP				FP	F					P			FP
<i>Corylus rostrata</i>	P				AF																	F
<i>Crataegus</i> spp.														FP								P
<i>Epigaea repens</i>											P	P		F	F				P			P
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	F		AF	A	A	A		AF	P	A	A	A	F	F	A	AF	F	A	A	A		A
<i>Kalmia latifolia</i>	AF			A	A	A	A	AF	F	AF	A	A	A	F	A	A	F	A	A	A		A
<i>Menziesia pilosa</i>															F				P			
<i>Mitchella repens</i>	F																					
<i>Ostrya virginiana</i>	P																					

Exposure	Valley, lower slope								Middle slope								Upper slope, Top							
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Polystichum acrosti- choides</i>	A		FP	F	F		AF	AF	AF	F	P	P		AF	F	AF							P	
<i>Prunella vulgaris</i>	FP								P	FP				F									P	
<i>Quercus alba</i>	AF		F		A				P		P						F	P					P	
<i>Quercus coccinea</i>																			FP	FP				
<i>Quercus prinus</i>	AF	A		A	A	A	A		AF	F	A	AF	A	A	F	A	A	AF	A	A	A	A	A	
<i>Quercus rubra</i>											P	FP						FP					P	
<i>Quercus stellata</i>						F																		
<i>Quercus velutina</i>	AF	F	AF	A	A	A		F	A	F	F	A	A	AF	F	F	A	A	A	A	A	A	A	
<i>Rhododendron</i> spp.	A		P	AF		AF	AF	AF	F	P		P		A		A		F					FP	
<i>Rhododendron</i> (<i>Azalea</i>)	F		A						F	FP	F	AF	FP			AF		FP	FP	F		F	F	
<i>Rhus copallina</i>	P										P													
<i>Rhus glabra</i>	FP	AF	A		F				FP	FP	E	FP	P		F	F		FP					FP	
<i>Rosa</i> spp.	P										P			FP	F								P	
<i>Sailax</i> spp.	AF		FP	AF	F	AF			P	FP	FP	AF	AF	F	AF		F	F	P	AF	FP	FP	AF	
<i>Viburnum acerifolium</i>	FP										FP	P	P	P	F						FP	F	P	
<i>Vitis</i> spp.	AF		FP	AF	AF				AF	F	A	F	AF		A	F		AF	F		AF	FP	AF	

Exposure	Valley, lower slope								Middle slope								Upper slope, Top							
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Acer pennsylvanicum</i>							AF		P					AF										
<i>Acer rubrum</i>	A	A	FP	AF	F	A		A	A	AF	F	AF	F	A	A	A		F	F	A	F	A	AF	
<i>Adiantum pedatum</i>	FP							AF	F	P														
<i>Agrimonia</i> spp.	P										P			F										
<i>Ailanthus glandulosa</i>	FP	AF	F					FP	F					F										
<i>Alnus cernua</i>																							P	
<i>Alnus rugosa</i>	A		F								FP													
<i>Ambrosia artemisiifolia</i>	P		F	P							FP	F					FP					P		
<i>Amphicarpa monoclea</i>	F			F	F			FP	F	F	F			F	P	P	F	FP					P	
<i>Anemone virginiana</i>										P														
<i>Apocynum</i> spp.																							P	
<i>Aquilegia canadensis</i>									P															
<i>Aralia nudicaulis</i>				FP			F	AF	FP	FP														
<i>Arisaema triphyllum</i>	F							FP	F															
<i>Aristolochia macrophylla</i>							AF	F	P				FP											
<i>Asarum virginicum</i>	FP							FP	FP	FP		FP											FP	
<i>Asclepias</i> spp.	F	AF																						
<i>Ascyrum hypericoides</i>	FP			FP							P													

Exposure	Valley, lower slope							Middle slope							Upper slope, Top									
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Asimina triloba</i>	P					FP																		
<i>Asplenium montanum</i>									FP															
<i>Asplenium platyneuron</i>	P					F									F									
<i>Athyrium asplenoides</i>	P				P																			
<i>Athyrium thelypteroides</i>	P								P															
<i>Baptisia tinctoria</i>					F		F		P		FP	FP				P		F	FP	AP		R		
<i>Benzoin aestivale</i>																P								
<i>Campanula divaricata</i>												F												
<i>Castanea dentata</i>	FP	AF			AF	F			AF	FP	AF	A	A		A	A	A	A	A	A	A	A	A	
<i>Castanea pumila</i>					F							F	AF				F	F	F				AF	
<i>Cassia Chamaecrista</i>	P	P	F						F		P				F								P	
<i>Ceanothus americanus</i>	FP										AF		P										P	
<i>Cercis canadensis</i>	FP				F					P	P							P					P	
<i>Chimaphila maculata</i>	P								P														P	
<i>Chrysanthemum Leucanthemum</i>	P	F								P								P						
<i>Cimicifuga racemosa</i>	P				FP			F	F	AF	FP	FP						FP					AF	

Exposure	Valley, lower slope							Middle slope							Upper slope, Top								
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
<i>Clintonia umbellata</i>	P					F									FP								FP
<i>Convallaria majalis</i>	P			FP					P														P
<i>Coreopsis major</i>				FP	F	F	F		P		F	F	F	F	P	P	FP	F	F	AF			F
<i>Cornus canadensis</i>									P						P		P						
<i>Cornus florida</i>	AF			AF	A	F	F	A	A	A	AF	FP	F	AF	AF	F	F	AF		F	A	F	
<i>Gunilla origanoides</i>																			P				
<i>Cystopteris fragilis</i>									P														
<i>Daucus Carota</i>	P	F								FP		P			FP								
<i>Dennstaedtia punctilobula</i>	FP								P						F	F							P
<i>Desmodium</i> spp.	P			FP	F	AF			FP	F	AF	FP			F		P	P					AF
<i>Desmodium Delinii</i>	P			P						FP		P				P					FP		P
<i>Desmodium nudiflorum</i>	AF			F	F							FP	FP					FP	FP				FP
<i>Dioscorea villosa</i>	AF			F	AF		AF		AF		F	FP		F		A	FP	FP	P		AF	FP	F
<i>Diospyros virginiana</i>									P														
<i>Dryopteris intermedia</i>									P		FP												
<i>Dryopteris hexagonoptera</i>										FP					FP								

Exposure	Valley, lower slope							Middle slope							Upper slope, Top								
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
<i>Dryopteris marginalis</i>						AF	AF	F						F									
<i>Dryopteris noveboracensis</i>	AF							F			FP												P
<i>Epipactis pubescens</i>														FP									FP
<i>Eupatorium</i> spp.	P					P		F	P	P				FP		P							P
<i>Eupatorium purpureum</i>			F													FP							
<i>Eupatorium sessilifolium</i>			F													FP							
<i>Eupatorium urticaefolium</i>											P					FP	FP						FP
<i>Euphorbia corollata</i>											P					P							
<i>Fagus americana</i>	P																						
<i>Fragaria</i> spp.	FP		F	FP					F	P	FP			F		FP							FP
<i>Fraxinus</i> spp.	P						AF	F					FP	FP									P
<i>Galax aphylla</i>	AF			FP				P			P	FP	AF	P	AF	F						F	P
<i>Gallium</i> spp.	P				F				P	P	P	P				P	P						P
<i>Geranium</i> spp.	FP			FP							P					FP	FP						P
<i>Gerardia flava</i>				F							FP				P	FP	P	FP		F			P
<i>Gillenia trifoliata</i>	P			P				P			P				A			FP					F
<i>Gleditsia triacanthos</i>											P												

Exposure	Valley, lower slope							Middle slope							Upper slope, Top								
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
Gramineae spp.	AF			A	A	A	F	A	P	F	A	AF	FP		F	A	AF	F	FP	A		F	AF
Habenaria ciliaris							P																
Habenaria cristata												P											
Hamamelis virginiana	AF			P			F	AF	AF			P	A	P	A		P		F	FP	F		
Helianthus spp.	P	F							P			FP	FP				F	P	F			P	
Heliopsis spp.												FP											
Heuchera spp.	P			P				AF	P								FP					P	
Hicoria spp.	AF	F		FP	F	A	F	F	F	F	FP	F	FP		F		AF	AF	A	A	A		
Hieracium venosum	P											F	P	P					F				
Hydrangea arborescens	AF			FP	F	F	A	A	AF	F	AF			F	P		P					P	
Hypericum spp.											FP											P	
Hypericum graveolens	P																						
Impatiens spp.	FP							AF	F	FP	FP						FP						
Ilex spp.	P						F	AF				P	FP	F	P	FP	P				AF	F	
Iris spp.	P							AF	P	F		P											
Juglans cinerea																						P	
Juglans nigra	FP		F									FP											
Lespedeza bicolor	P		F														P						

Exposure	Valley, lower slope								Middle slope								Upper slope, Top							
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Lespedeza frutescens</i>	P		F	F	F				FP	P	FP								FP				FP	
<i>Lespedeza hirta</i>	P		AF	F	AF	F			FP	P	F	FP				AF	AF	FP	F				FP	
<i>Lespedeza repens</i>	P								FP	F	P					FP							P	
<i>Lespedeza virginica</i>											P													
<i>Liatris spicata</i>																							P	
<i>Lieriodendron Tulipifera</i>	AF	A	A	F		F			A	A	AF	F	P		F	F		A	FP				F	F
<i>Lilium canadense</i>						FP							P								FP		P	
<i>Lonicera japonica</i>															FP								P	
<i>Lycopus rubellus</i>	P																							
<i>Lyonia ligustrina</i>	P								P	FP	F	FP			FP	F	F	FP	FP			F	F	FP
<i>Lysimachia quadrifolia</i>	P			P					P	P		P	P											FP
<i>Magnolia spp.</i>	FP	AF					F		FP				P											FP
<i>Magnolia acuminata</i>																			FP					P
<i>Malus spp.</i>	P	F							FP		P													
<i>Medeola virginiana</i>													FP											P
<i>Monarda spp.</i>	P																		FP					
<i>Myrica asplenifolia</i>				FP	A						FP	AF	A			AF	FP	AF	A					F
<i>Nepeta hederacea</i>															FP									

Exposure	Valley, lower slope							Middle slope							Upper slope, Top								
	V	N	E	EE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
<i>Nyssa sylvatica</i>	A	F		A	A	A			AF	F	A	AF	A		A	A	A	AF	AF	A		A	AF
<i>Oakesia puberula</i>												F											
<i>Osmunda cinnamomea</i>		F		F			F	F		F	FP												
<i>Osmunda regalis</i>	F										F												
<i>Oxalis</i> spp.	F								P		PT			P									
<i>Oxydendrum arboreum</i>	AF	A	FP	AF	A	A		F	FP	AF	AF	AF			A	AF	AF		A	A			F
<i>Pedicularis canadensis</i>	F											FP				FP							P
<i>Phlox</i> spp.																							P
<i>Polygonum hydropiperoides</i>	F																						
<i>Phytolacca decandra</i>	P									P							P						
<i>Filea pumila</i>	F																						
<i>Pinus pungens</i>										P	P	F		F		FP						F	P
<i>Pinus rigida</i>	P	F	AF	F		AF			F	F	F	FP				FP	F	P	AF				F
<i>Pinus strobus</i>								F															
<i>Pinus virginiana</i>								P			P			P									
<i>Plantago</i> spp.	FP							F	FP					F									
<i>Polygala viridescens</i>						F																	
<i>Polygonatum biflorum</i>	F							F	FP			P					P						

Exposure	Valley, lower slope							Middle slope							Upper slope, Top								
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T
<i>Polymnia canadensis</i>																							P
<i>Polypodium virginianum</i>								P					AF	F									AF
<i>Potentilla</i> spp.	AF		AF	F		F				FP	F						FP	F	FP				FP
<i>Prenanthes trifoliata</i>	P							F		FP													
<i>Prenanthes</i> spp.											FP		P		FP								
<i>Prunus nigra</i>																							P
<i>Prunus serotina</i>	P		P					P															P
<i>Psedera quinquefolia</i>	AF			F	F		AF	AF	AF	F	AF	P		F	F			FP	P			A	FP
<i>Pteridium latiusculum</i>				F	A	F				F	AF	FP					AF	AF	F				F
<i>Pycnanthemum pycnanthemoides</i>			F									FP							F				P
<i>Robinia Pseudo-Acacia</i>	F	A	AF	F		A		AF	AF	AF	AF	AF	F	F	A		AF	A	F	A	F	F	A
<i>Rhus Toxicodendron</i>	P							P	FP										P				P
<i>Rubus</i> spp.	F	AF	F	P				F	F	AF	F			F	F		FP						AF
<i>Sambucus</i> spp.		F																					P
<i>Sanguinaria canadensis</i>	FP			P				P	P														P
<i>Sanicula</i> spp.	P							P				P											FP

Exposure	Valley, lower slope								Middle slope								Upper slope, Top							
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Sassafras variifolium</i>	AF	A	AF	A	A		A		AF	F	AF	A	A		F	F	A	A	F	A	F	F	A	
<i>Saxifraga</i> spp.									P															
<i>Saxifraga micranthidifolia</i>	FP				FP																			
<i>Scutellaria serrata</i>																		P						
<i>Sallacina racemosa</i>	FP			F	AF			AF	F	FP	FP				P		P	P		F	F	F		
<i>Solidago</i> spp.	P			FP	F	F	A	A	F	FP		P			F	FP	F	AF				AF		
<i>Symphoricarpos orbiculatus</i>													P											
<i>Tephrosia virginiana</i>				F	F						FP	P	FP				F					FP		
<i>Tilia americana</i>	P			FP			A	A	AF	FP		P			F					F	P			
<i>Thalictrum</i> spp.	P								F			P			F									
<i>Trifolium repens</i>									P															
<i>Trillium</i> spp.									P	P														
<i>Triosteum perfoliatum</i>												F					FP					P		
<i>Urtica</i> spp.								AF	P															
<i>Verbascum</i> spp.																							P	
<i>Verbescina occidentalis</i>	AF	F	AF	FP						P	FP	FP					F	FP				F		
<i>Veronica officinalis</i>	FP										P											P		

Exposure	Valley, lower slope								Middle slope								Upper slope, Top							
	V	N	E	SE	S	SW	W	NW	N	NE	E	SE	S	W	NW	N	E	SE	S	SW	W	NW	T	
<i>Vicia</i> spp.												P												
<i>Viola</i> spp.	A		F						FP	F	F	F				P		F					P	
<i>Zizia Bebbii</i>												FP												

Augusta County

Augusta County lies in the northern part of the grouse range of the state and is one of the largest counties, extending from the Alleghany Mountains along its western border to the Blue Ridge Mountains at its eastern edge. There are two main mountainous sections in the county: namely, the Shenandoah Mountain and its offshoot the North Mountain in the west, and to the east the Blue Ridge with its offshoot the Big Levels Area. About 38% of Augusta County is in forest lands and this largely in the above-mentioned mountainous areas. A wide swathe of the limestone of the Valley of Virginia extends through the center of the county, and is almost entirely cleared for agricultural purposes.

The Big Levels Refuge Area was selected as a sample of the Northern Blue Ridge, and the North Mountain area as a sample of the Northern Alleghanies of the state. A small section of the Shenandoah Mountain on the Augusta-Bath County lines was also investigated and will be included in the discussion of North Mountain.

Big Levels is situated in the southeast corner of Augusta County and at the beginning of the survey it was chosen as a typical sample of the grouse range of the Northern Blue Ridge Mountains of the state. After investigating the geological make-up it was found that the Big Levels is composed almost entirely of sedimentary rocks, sandstone, shale and limestone, the characteristic formations of the Alleghany Mountains. The

adjacent Blue Ridge, on the other hand, is composed principally of granite, with small amounts of quartzite and sandstone. It is interesting to note also that the vegetation is typical of that of the Allegheny Mountains, and not of the Blue Ridge.

The Big Levels Refuge of approximately 40,000 acres, was named for the flat tops characteristic of a number of the mountains in the area, which are in reality the remnants of an ancient peneplain of past geologic ages. Although much of the area is composed of steep, rugged mountains, some reaching 3500 feet in elevation, a large part, principally the northern end, is made up of extensive bottom lands at an elevation of approximately 1500 feet.

Since the area was lumbered thoroughly some years ago, the dominant type at the present time is a shrubby and sapling growth. On the steep hillsides where fire has previously burned, there are dense, almost impenetrable areas of bear oak. On many of the upper slopes and ridge tops the characteristic open chestnut oak is dominant. In the valleys and bottom lands an open sapling growth seems dominant. In general the winter cover of the Big Levels Area is poor compared with sections of the main Allegheny Range. Good evergreen cover is lacking except in certain sections of the lowland. Most of the ridges and tops are devoid of good winter cover.

In general, the grouse food plants are abundant over the Big Levels Area. Arbutus, huckleberry, blueberry, laurel, azalea, smilax, grape and white, scarlet, bear, chestnut and

black oaks are abundant over the area as a whole. Blackjack oak is abundant to frequent. *Rhododendron catawbiense* is common on the tops of some ridges and present to some extent in a few valleys. There is a marked scarcity of good rhododendron cover. *Viburnum nudum*, *V. cassinoides*, *V. dentatum* and *V. acerifolium* are present with the latter being fairly common. Serviceberry, antennaria, various asters, self-heal and sheep sorrel are abundant to frequent, depending to a large extent on the locality concerned. Cherry birch is frequent while yellow birch is present only in a few sections. Beaked hazel, hawthorn and Christmas fern are present. Partridge berry is frequent in the bottom lands. *Menziesia* is frequent on the upper slopes and top. *Ayens* is frequent only in certain spots over the refuge.

Plants of the Big Levels Area
in Augusta County

A - Abundant
F - Frequent
P - Present

<i>Amelanchier canadensis</i>	AF	<i>Quercus prinus</i>	A
<i>Antennaria</i> spp.	AF	<i>Quercus marilandica</i>	AF
<i>Aster</i> spp.	AF	<i>Quercus palustris</i>	FP
<i>Betula lenta</i>	F	<i>Quercus velutina</i>	A
<i>Betula lutea</i>	P	<i>Rhododendron nudiflorum</i>	A
<i>Corylus rostrata</i>	P	<i>Rhododendron</i> spp.	FP
<i>Crataegus</i> spp.	P	<i>Rhus copallina</i>	FP
<i>Epigaea repens</i>	AF	<i>Rhus glabra</i>	FP
<i>Gaultheria procumbens</i>	A	<i>Rhus hirta</i>	P
<i>Gaylussacia & Vaccinium</i> spp.	A	<i>Rosa</i> spp.	F
<i>Geum flavum</i>	F	<i>Rumex</i> spp.	F
<i>Kalmia latifolia</i>	A	<i>Sailax</i> spp.	A
<i>Menziesia pilosa</i>	F	<i>Viburnum acerifolium</i>	AF
<i>Mitchella repens</i>	F	<i>Viburnum dentatum</i>	P
<i>Polystichum acrostichoides</i>	P	<i>Viburnum cassinoides</i>	FP
<i>Prunella vulgaris</i>	FP	<i>Viburnum nudum</i>	P
<i>Quercus alba</i>	AF	<i>Vitis</i> spp.	A
<i>Quercus coccinea</i>	AF		
<i>Quercus ilicifolia</i>	AF		
<i>Acer rubrum</i>	A	<i>Alnus rugosa</i>	A
<i>Acer spicatum</i>	P	<i>Ambrosia artemisiifolia</i>	AF
<i>Achillea Millefolium</i>	F	<i>Asphicarpa sonolca</i>	P
<i>Agrimonia</i> spp.	P	<i>Andromeda floribunda</i>	FP

<i>Angelica villosa</i>	FP	<i>Daucus Carota</i>	FP
<i>Apocynum</i> spp.	FP	<i>Dennstaedtia punctilobula</i>	P
<i>Aralia nudicaulis</i>	P	<i>Desmodium nudiflorum</i>	P
<i>Aristolochia serpentina</i>	P	<i>Desmodium</i> spp.	AF
<i>Ascyrum hypericoides</i>	FP	<i>Dianthus Armeria</i>	P
<i>Asplenium platyneuron</i>	P	<i>Diodea teres</i>	P
<i>Athyrium asplenoides</i>	P	<i>Dioscorea villosa</i>	A
<i>Baptisia tinctoria</i>	AF	<i>Drosera rotundifolia</i>	P
<i>Benzoin aestivale</i>	P	<i>Dryopteris marginalis</i>	P
<i>Calycanthus fertilis</i>	FP	<i>Dryopteris noveboracensis</i>	AF
<i>Cassia nictitans</i>	P	<i>Echium vulgare</i>	P
<i>Castanea dentata</i>	A	<i>Erigeron annuus</i>	P
<i>Castanea pumila</i>	AF	<i>Erigeron canadensis</i>	FP
<i>Ceanothus americana</i>	A	<i>Erigeron</i> spp.	P
<i>Cephalanthus occidentalis</i>	P	<i>Eupatorium purpureum</i>	AF
<i>Chelone glabra</i>	P	<i>Eupatorium</i> spp.	P
<i>Chelone obliqua</i>	P	<i>Eupatorium urticaefolium</i>	P
<i>Chionanthus virginica</i>	P	<i>Euphorbia corollata</i>	P
<i>Chimaphila maculata</i>	P	<i>Fragaria</i> spp.	AF
<i>Chrysopsis mariana</i>	P	<i>Galium</i> spp.	FP
<i>Cichorium Intybus</i>	P	<i>Gerardia flava</i>	FP
<i>Chrysanthemum Leucanthemum</i>	P	<i>Gerardia pedicularis</i>	P
<i>Collinsonia canadensis</i>	FP	<i>Gerardia laevigata</i>	P
<i>Coreopsis major</i>	P	<i>Gillenia trifoliata</i>	P
<i>Coreopsis verticillata</i>	A	<i>Gnaphalium Helleri</i>	FP
<i>Cornus florida</i>	AF	Gramineae spp.	A
<i>Cypripedium acaule</i>	P	<i>Hamamelis virginiana</i>	AF

<i>Hedeoma pulegioides</i>	F	<i>Lyonia ligustrina</i>	AF
<i>Hicoria</i> spp.	AF	<i>Lysimachia quadrifolia</i>	AF
<i>Hieracium venosum</i>	FP	<i>Magnolia acuminata</i>	P
<i>Houstonia longifolia</i>	F	<i>Malanthemum canadense</i>	P
<i>Hydrangia arborescens</i>	FP	<i>Medeola virginiana</i>	F
<i>Hypericum gentianoides</i>	P	<i>Helanthium parviflorum</i>	P
<i>Hypericum mutilum</i>	P	<i>Myrica asplenifolia</i>	A
<i>Hypericum perforatum</i>	F	<i>Nyssa sylvatica</i>	A
<i>Ilex</i> spp.	FP	<i>Oakesia</i> spp.	P
<i>Ipomoea pandurata</i>	P	<i>Osmunda claytoniana</i>	P
<i>Iris</i> spp.	FP	<i>Osmunda cinnamomea</i>	AF
<i>Juniperus virginiana</i>	P	<i>Oxalis</i> spp.	P
<i>Lactuca</i> spp.	FP	<i>Parnassia</i> spp.	P
<i>Laportea canadensis</i>	F	<i>Parthenium integrifolium</i>	P
<i>Lechea racemosa</i>	F	<i>Pedicularis canadensis</i>	P
<i>Lespedeza frutescens</i>	F	<i>Phytolacca decandra</i>	P
<i>Lespedeza hirta</i>	F	<i>Pilea pumila</i>	A
<i>Lespedeza repens</i>	FP	<i>Pinus pungens</i>	FP
<i>Lespedeza stipulacea</i>	F	<i>Pinus rigida</i>	A
<i>Lespedeza</i> spp.	P	<i>Pinus strobus</i>	FP
<i>Liatris spicata</i>	P	<i>Pinus virginiana</i>	P
<i>Lycopodium complanatum</i>	FP	<i>Plantago lanceolata</i>	A
<i>Kiriodendron Tulipifera</i>	F	<i>Platanus occidentalis</i>	P
<i>Lobelia inflata</i>	FP	<i>Pegonia verticillata</i>	FP
<i>Lupinus perennis</i>	F	<i>Polygonum scandens</i>	FP

<i>Polypodium virginianum</i>	FP	<i>Umbelliferae</i> spp.	P
<i>Prunus serotina</i>	P	<i>Veronica officinalis</i>	P
<i>Potentilla</i> spp.	A	<i>Vicia</i> spp.	P
<i>Proserpinaca palustris</i>	P	<i>Vicia caroliniana</i>	F
<i>Pseodera quinquefolia</i>	P	<i>Viola</i> spp.	FP
<i>Prenanthes</i> spp.	P		
<i>Pteridium latiusculum</i>	AF		
<i>Pycnanthemum pycnanthemoides</i>	P		
<i>Pyrus arbutifolia</i>	P		
<i>Pyrus</i> spp.	P		
<i>Rhus Toxicodendron</i>	F		
<i>Ribes</i> spp.	B		
<i>Robinia Pseudo-Acacia</i>	A		
<i>Rubus</i> spp.	AF		
<i>Salix nigra</i>	FP		
<i>Sanicula gregaria</i>	F		
<i>Sassafras variifolium</i>	A		
<i>Scutellaria pilosa</i>	F		
<i>Silene stellata</i>	FP		
<i>Smilacina racemosa</i>	P		
<i>Solidago</i> spp.	A		
<i>Stylosanthes biflora</i>	FP		
<i>Symphoricarpos orbiculatus</i>	FP		
<i>Tephrosia virginiana</i>	A		
<i>Tsuga canadensis</i>	FP		

Augusta County
(North Mountain Area)

North Mountain, the second area studied, is situated in the southwest corner of Augusta County and lies adjacent to the extensive Shenandoah Mountain which borders the county to the west. North Mountain reaches a height of over 4000 feet and its geological make-up is similar to that of Big Levels and the Alleghany Mountains. The vegetation is typical of much of the Alleghany Range, except that a greater part of it is of the open woods type, approaching that of some of the Blue Ridge Range. The reason for this is that fire and lumbering have not taken their toll of all the timbered sections. Parts of the area are being lumbered at the present time, and probably in the future the vegetation will be of a dense, shrubby type. Aside from the large amount of sizeable timber, the North Mountain vegetation is much like that of the Big Levels Area. In some sections, especially near the Cold Spring Section below Elliotts Knob, the vegetation is exceedingly dense. Most of the other parts of the mountain, however, are of a more moderate to dense vegetation.

A day was spent surveying the slopes below Wallace Knob on the Shenandoah Mountain just across the valley from North Mountain. The vegetation here is almost identical to that of North Mountain, so the list of plants and their abundance are included in the table for the North Mountain vegetation.

Huckleberries, blueberries and greenbrier are abundant, as

would be expected. *Antennaria* is also abundant. Black and chestnut oaks are abundant everywhere. White, scarlet and bear oaks are rather common. Serviceberry, various asters, winter-green, laurel and grape are all common. Cherry birch, beaked hazel, hawthorn, trailing arbutus, partridge berry, Christmas fern, self-heal, azalea, rose and maple-leaf viburnum are common in places, but frequent over the range in general. *Menziesia*, hophornbeam, dwarf and smooth sumac, and other viburnum are present in smaller amounts. *Rhododendron* is no more common here than at Big Levels. The mountain form, *catawbiense*, is the most common variety found.

A short time was spent making a superficial examination of the Hone Quarry and North River sections, mostly in Rockingham County. There the conditions of food and cover appear to be very similar to that found in most of Augusta and Bath Counties.

Plants of the North Mountain Area
in Augusta County

A - Abundant
F - Frequent
P - present

<i>Amelanchier canadensis</i>	AF		
<i>Antennaria</i> spp.	A		
<i>Aster</i> spp.	AF		
<i>Betula lenta</i>	F	<i>Quercus ilicifolia</i>	AF
<i>Corylus rostrata</i>	F	<i>Quercus prinus</i>	A
<i>Crataegus</i> spp.	F	<i>Quercus velutina</i>	A
<i>Epigaea repens</i>	F	<i>Rhus copallina</i>	P
<i>Gaultheria procumbens</i>	AF	<i>Rhus glabra</i>	P
<i>Gaylussacia</i> and <i>Vaccinium</i> spp.	A	<i>Rhododendron</i> spp.	FP
<i>Kalmia latifolia</i>	AF	<i>Rhododendron calendu- laceum</i>	F
<i>Menziesia pilosa</i>	F	<i>Rosa</i> spp.	F
<i>Mitchella repens</i>	AF	<i>Sedum Nevii</i>	F
<i>Ostrya virginiana</i>	P	<i>Sailax</i> spp.	A
<i>Polystichum acrostichoides</i>	F	<i>Viburnum</i> spp.	P
<i>Prunella vulgaris</i>	F	<i>Viburnum acerifolium</i>	F
<i>Quercus alba</i>	AF	<i>Vitis</i> spp.	AF
<i>Quercus coccinea</i>	F		
<i>Quercus borealis maxima</i>	FP		
<i>Acalypha virginica</i>	P	<i>Ambrosia artemisi- folia</i>	P
<i>Acer rubrum</i>	AF	<i>Amphicarpa monoica</i>	F
<i>Acer saccharum</i>	F	<i>Angelica villosa</i>	FP
<i>Adiantum pedatum</i>	FP	<i>Aralia nudicaulis</i>	P
<i>Agrimonia</i> spp.	P	<i>Ascyrum hypericoides</i>	F

Asplenium platyneuron	FP	Gerardia flava	FP
Baptisia tinctoria	AF	Gillenia trifoliata	FP
Bidens spp.	F	Gramineae spp.	AF
Castanea dentata	F	Hamamelis virginiana	AF
Carex spp.	P	Helianthus spp.	F
Ceanothus americanus	A	Hepatica triloba	FP
Chimaphila maculata	FP	Hicoria spp.	A
Chimaphila umbellata	FP	Hieracium venosum	FP
Cimicifuga racemosa	F	Hypericum spp.	P
Collinsonia canadensis	F	Impatiens spp.	P
Coreopsis major	FP	Juglans cinerea	P
Cornus florida	AF	Juglans nigra	P
Cuscuta spp.	P	Juncus spp.	P
Cypripedium parviflorum	FP	Lespedeza frutescens	F
Dennstaedtia punctilobula	FP	Lespedeza hirta	F
Desmodium nudiflorum	AF	Lespedeza procumbens	FP
Dioscorea villosa	F	Lespedeza repens	P
Dryopteris noveboracensis	P	Liriodendron Tulipifera	FP
Epipactis pubescens	FP	Lobelia inflata	P
Erigeron spp.	P	Lycopodium complanatum	FP
Euphorbia corollata	P	Lycopus spp.	P
Eupatorium spp.	F	Lyonis ligustrina	FP
Fragaria	P	Lysimachia quadrifolia	FP
Fraxinus spp.	P	Magnolia acuminata	P
Galium spp.	FP	Monotropa uniflora	P
Geranium spp.	FP	Myrica asplenifolia	FP

<i>Nepeta hederacea</i>	P	<i>Rhus Toxicodendron</i>	FP
<i>Nyssa sylvatica</i>	F	<i>Robinia Pseudo-Acacia</i>	FP
<i>Oakesia puberula</i>	P	<i>Rubus spp.</i>	F
<i>Osmunda cinnamomea</i>	P	<i>Sanguinaria canadensis</i>	F
<i>Oxalis spp.</i>	FP	<i>Sanicula spp.</i>	F
<i>Pedicularis canadensis</i>	P	<i>Sassafras variifolium</i>	AF
<i>Pilea pumila</i>	P	<i>Smilacina racemosa</i>	FP
<i>Pinus pungens</i>	F	<i>Solidago spp.</i>	AF
<i>Pinus rigida</i>	F	<i>Spiraea latifolia</i>	F
<i>Pinus strobus</i>	F	<i>Thaspium barbinode</i>	P
<i>Pinus virginiana</i>	AF	<i>Tephrosia virginiana</i>	AF
<i>Plantago spp.</i>	F	<i>Tilia americana</i>	P
<i>Platanus occidentalis</i>	FP	<i>Trifolium pratense</i>	P
<i>Pogonia verticillata</i>	P	<i>Teuga canadensis</i>	FP
<i>Poligonatum biflorum</i>	P	<i>Ulmus fulva</i>	F
<i>Potentilla spp.</i>	AF	<i>Veratrum spp.</i>	F
<i>Prenanthes spp.</i>	P	<i>Verbescina occidentalis</i>	P
<i>Psedera quinquefolia</i>	F	<i>Veronica officinalis</i>	FP
<i>Pteridium latiusculum</i>	FP	<i>Vicia spp.</i>	F
<i>Pyrola americana</i>	P	<i>Viola spp.</i>	AF

Other Observations
in the Alleghany Mountains

After the investigation of the Augusta County vegetation, a day was spent making a survey of the plants of Bath County in the mountains just off the road leading north from the Douthat State Park. A list of the plants and their relative abundance was made. Due to the similarity of this list with those previously made for Augusta County, it was deemed unnecessary to include it in the thesis. The general aspect of the vegetation is much like that previously encountered. There are extensive areas of sizeable timber, and the characteristic shale slopes with open chestnut-oak forests are prevalent. In most cases these shale slopes with timber-size chestnut oak are relatively unproductive of good grouse food plants. In the cleared areas after lumbering or burning, these shale slopes are abundant with desirable food plants. On other areas visited by fire, a dense stand of laurel and bear oak exists at the present time. Here rhododendron is scarce, except in a very few places, as was the case in Augusta County. Alder * is much more abundant along the streams, as was the situation in Augusta County. Greenbrier, laurel, arbutus, huckleberry, blueberry, wintergreen, Christmas fern, grape, partridge berry, serviceberry, various asters, antennaria, hophornbeam and the

* See Page 158 for corresponding scientific names

various oaks (white, black, chestnut, scarlet and bear) are all very common and in some places exceedingly abundant. Maple leaf viburnum, self-heal, beaked hazel and various sedums are fairly common. Wild rose, and azalea are frequent in most places. Smooth sumac is present but was not encountered many times. Other plants were recorded that were not found on North Mountain, but on the whole the two lists are much the same, especially in regard to grouse food plants.

Observations with field glasses from the car, and short excursions on foot were made of the mountains along the route rhtough the remainder of Bath County and sections of Allegheny, Craig and Botetourt Counties. The section of Allegheny County observed was too industrialized to reveal much information on grouse habitat. The mountains through Craig County as far as could be seen are covered with a short, dense, shrubby growth, characteristic vegetation after fires have swept an area. However, most of the county to the west has much more ideal conditions and supports a large grouse population. In Botetourt County more small trips were made on foot into the adjacent hills. The general growth here is also the more open woodland and shrub type. However, this may not hold for the greater part of the county, since only a relatively small section was seen. Food plants are abundant here and probably in substantial amounts, as elsewhere in the range.

One day was spent in Carroll County making a survey in the northern part of the county, just south of Fort Chiswell. The

topography here is quite different from that of other sections observed. The mountains are not large and the slopes are much more gentle than the typical mountain conditions. The wooded sections are much more broken up than those of the Alleghanies in general. Shrub growth, especially young white pine, is the most prevalent type in the area. Most of the small ravines are well supplied with water. The valleys and ravine bottoms are more or less open but abundant with rhododendron. The extensive, yet broken-up nature of the range, and the presence of branches reaching to the ground in the coniferous shrubs, make the closest approach to the type of range in New York and other northern states that is found in any of Virginia. This condition, if supplemented with good stands of laurel and rhododendron, makes cover conditions ideal.

Food plants, on the whole, are common in this section. Wintergreen and arbutus are abundant almost everywhere. Galax and greenbrier are very common. Grape is quite common in nearly every section. Although a number of ravines were investigated, no partridge berry was found. Huckleberry and blueberries are present, but do not seem as abundant as in other sections. Viburnums are present to some extent. Sumacs are frequent in fields along borders. Various asters are common in open places. Christmas fern is common in a few places, but not in general over the range. Azalea is frequent and may serve as a good bud supply. Oaks in general are common and at this time the acorn crop appeared to be good. No list of the species and

their relative abundance was made as the survey was undertaken in December when only winter foods could be observed.

In the late winter a trip was made into Buchanan, Dickenson and Taxewell Counties to observe the conditions there for comparison with other areas studied. Since the topography of Buchanan and Dickenson counties is entirely different from that found in any other part of the state, and the rock formations are entirely of shale and sandstone, it is important to determine whether there is a radical change in the vegetation. Although the survey was not extensive, some idea of the situation there was obtained. To all indications the vegetation of these shale and sandstone slopes is similar to that of the shale and sandstone slopes of the Alleghanias. The topography in Buchanan and Dickenson Counties is similar to that of most of West Virginia, and is discussed more fully in the section headed Topography. Although no large cities are found there is a large population present, due to the hundreds of small mining camps in most of the ravines and valleys. Much of the potential grouse range is limited in the two counties and the large grouse populations are found only in the sparsely settled sections. Although most of the narrow valleys and ravines are cleared for farming and grazing, most of the hill tops are wooded. The slopes are exceedingly steep, making it poor for farming and probably for a large grouse population. However, back from the mining centers where the ravines and coves are not molested, a large number of grouse are found. Here most of the vegetation is of a brushy nature, very suitable for a large grouse population.

Some sections are being lumbered at the present time.

Food plants to all indications are abundant as would be expected where a large grouse population exists. On the upper slopes and toward the top, grape and greenbrier are abundant. Laurel and rhododendron are abundant in most places. The game warden says wintergreen is abundant most places. It seems, too, that arbutus is common, at least in the areas observed. Beech is exceedingly abundant and probably serves as a good bud supply. Partridge berry and various rosette plants are fairly common.

Since the author did not get into the most desirable part of the range, the picture was not complete and a rather negative impression was derived. However, upon talking to Warden Wilson of Tazewell, and several others, the author is convinced that there is a good grouse population present, although not around Grundy or any of the small towns and other areas visited.

Tazewell County was also investigated and found to be ideal for grouse. It compares almost identically with range in Pulaski, Bland and other sections of the Alleghany Mountains. Although a wide swathe is cleared through the center of the county for agricultural purposes, there are extensively forested areas on both sides where some of the largest grouse populations are maintained. Here there are again found long, linear ridges with many smaller hills at the bases and extensive slopes and ravines and coves quite in contrast to the condition in Buchanan and Dickenson Counties. In these valleys and ravines and on the

slopes of the spurs the grouse food plants are abundant. Smilax, laurel, rhododendron, arbutus, wintergreen and grape are abundant. Partridge berry is common. Christmas fern and various rosette plants are common. Here, as elsewhere, there appears to be a much better food supply on the northern slopes than on the southern slopes. The southern slopes do not necessarily have the better food conditions as frequently thought. On the southern slopes of most of the Alleghanies the scrub pine and other pines are abundant so that the smaller plants beneath are shaded out to a large extent.

In the early part of June before the intensive surveys were begun, the author, while engaged in 4H Club work in Rockbridge County, made a superficial survey of the vegetation and listed the various species and their abundance. This county is rated high as a grouse range, and to all indications food and cover conditions are good. The vegetation resembles very much the typical Alleghany form and the usual important food plants such as wintergreen, arbutus, smilax, oaks, etc., are abundant. There is a considerable amount of timber present, such as that found in the counties to the north and the shrubby type is not as dominant as in some other sections of the range.

Although more sections were visited in the Alleghany Range, the actual area covered was small and in order to get a fully accurate picture of the actual conditions existing, several more years of investigation will be necessary. In that time some idea may be derived as to what is definitely there. At the present time we have just an indication.

Other Observations
in the Blue Ridge Mountains

In October a survey was made of sections along the Skyline Drive from Skyland to Waynesboro. A list of plants and their relative abundance was made of the western slope below Skyland. Here grape and greenbrier* are very common. Virginia creeper is common in sections. In the open places some sumac is present and asters and strawberry are abundant. A few viburnums occur including maple-leaf viburnum, which is frequent. Wintergreen is very scarce. Arbutus and partridge berry were not found. Beaked hazel is common in many places. Self-heal is frequent in open places. Antennaria is common to abundant. Red oak is especially common. Christmas fern is common in a few places. Azalea and cherry birch are frequent to common. Laurel is common, but rhododendron is localized.

Other observations were made superficially along the Drive but no plant lists were made. Some sections are well wooded while others are in a shrubby growth characteristic of that succeeding fire. On the whole, the conditions found in this section are above the average for the general Blue Ridge Range. However, it does not measure up to the best range in the Alleghany Mountains. A more adequate survey will need to be taken before the exact conditions can be determined.

*See Page 158 for corresponding scientific names

Several days were spent investigating the range in Asheurst and Bedford Counties. Most of the time was spent on Cold Mountain in the former county and Thunder Mountain in the latter. Most of the areas studied are typical of the general Blue Ridge type of range, with the open woodland and enormous amount of dead and lumbered chestnut. These mountains are some of the highest of the Blue Ridge, and are a part of an extensively forested area. However, a considerable amount of the lower slopes and valleys are cleared. It is in the cleared areas and old fields that the most abundant grouse food plants are found. On the ridge slopes and tops there is a marked scarcity of food plants, save for laurel. Laurel, which occasionally occurs in dense patches, is the best cover. Rhododendron is confined mostly to the valleys and wet ravines. From all reports, in past years the grouse have been most abundant along the borders of these fields and it is in these fields that most of the food plants occur. Coral berry is abundant in open places and field borders. Hawthorn is also very common. These two, with possibly some grape, laurel and rhododendron, supply the majority of the grouses' livelihood in those areas. Other plants, such as pussytoes and sheep sorrel, are also common and good food plants. Some huckleberries and blueberries are common in places. Smilax is scarce. Wintergreen was not seen at all. Arbutus and partridge berry are very scarce. Most of the grape had no fruit. Potentilla, strawberries and various aster rosettes are common in fields,

as in other sections of the grouse range, and probably serve as a ready food supply when available. Christmas fern is frequent and beaked hazel is common, especially near the tops of the ridges.

These surveys were conducted rather hurriedly and superficially, and it is regretted that additional time was not available to study the vegetation of the main body of the Blue Ridge in order to get a more accurate account of the existing conditions. It is believed that the conditions of the central and northern parts of the Virginia Blue Ridge are better than those found in Floyd and Patrick Counties, but the material at hand is only an indication, and not a conclusion. To all indications, the range in general is poor but there are some isolated sections where the conditions are very good and a fine grouse population is supported.

Table 6

A Summary of the Relative Abundance of Important Ruffed Grouse Food Plants in the Allegheny and Blue Ridge Mountains

	Allegheny Mountains				Blue Ridge Mountains		
	W. Va. Co.	W. Va. Co.	W. Va. Co.	W. Va. Co.	Lloyd Co.	Patrick Co.	Augusta Co. S. Eastern)
Amelanchier canadensis (Serviceberry)	F	F	A	A	P	P	F
Antennaria spp. (Pussytoes)	F	F	F	A	F	F	A
Aster spp. (Aster)	A	F	F	A	A	A	A
Betula lenta (Cherry Birch)	F	F	A	F	F	F	F
Corylus Rostrata (Beaked Hazel)	F	F	F	F	F	F	F
Crataegus (Hawthorn)	F	F	F	F	F	F	F
Epigaea repens (Trailing Arbutus)	A	F	F	F		F	A
Gaultheria procumbens (Wintergreen)	A	A	A	A			A
Gaylussacia and Vaccinium (Huckleberries)	A	A	A	A	A	A	A
Geum spp. (Avens)	F				F		F
Kalmia latifolia (Mountain Laurel)	A	F	A	A	A	A	A
Menziesia pilosa (Menziesia)	F	F	F			F	
Mitchella repens (Partridgeberry)	A	F	A	A	F	F	F
Ostrya virginiana (Hophornbeam)	F	F	F	F	F	F	
Polystichum acrostichoides (Fern)	F	F	F	F	A	A	P
Prunella vulgaris (Self-heal)	F	F	F	F	F	F	A
Quercus spp. (Oaks)	A	A	A	A	A	A	A
Rhododendron spp. (Rhododendron)	A	F	A	F	F	A	F
Rhododendron spp. (Azalea)	A	F	A	F	F	F	A
Rhus spp. (Sumac)		F		F	F	F	F
Rosa spp. (Rose)	F	F	F	F	F	F	F
Rumex acetosella (Sheep Sorrel)	F						F
Sedum ternatum (Stone crop)			F	F	F		
Saxifraga spp. (Greenbrier)	A	A	A	A	F	F	A
Viburnum spp. (Viburnum) (Arrow-wood)	F	F	A	F	F	F	F
Vitis spp. (Grape)	F	A	A	A	A	A	F

Common and Scientific Names of Important
Ruffed Grouse Food Plants

Table 7

Aster	Aster spp.
Avens	Geum spp.
Azalea	Rhododendron spp.
Beaked Hazel	Corylus rostrata
Cherry birch	Betula lenta
Fern (Christmas)	Polystichum acrostichoides
Grape	Vitis spp.
Greenbrier	Smilax spp.
Hawthorn	Crataegus spp.
Hophornbeam	Ostrya virginiana
Huckleberry	Gaylussacia & Vaccinium spp.
Menziesia	Menziesia pilosa
Mountain laurel	Kalmia latifolia
Oaks	Quercus spp.
Partridgeberry	Mitchella repens
Pussytoes	Antennaria spp.
Rhododendron	Rhododendron spp.
Rose	Rosa spp.
Self-heal	Prunella vulgaris
Serviceberry	Amelanchier canadensis
Sheep sorrel	Rumex acetosella
Stone crop	Sedum ternatum
Sumac	Rhus spp.
Trailing arbutus	Epigaea repens
Viburnum	Viburnum spp.
Wintergreen	Gaultheria procumbens

Summary

In summary, it may be advisable to state briefly the conditions existing in the three regions of the state as they are indicated in the foregoing tables and discussions.

From intensive surveys in at least two counties in each of the mountain ranges, and a number of general surveys over both ranges and the Southwestern Plateau, the fact is disclosed that there is a marked diversity in the abundance of certain important grouse food plants. The factors effecting this abundance are not definitely known. Rock formations are different in the various areas and may be the underlying factor. The limit of the wooded sections to the upper slopes and tops of the ridges and the subsequent scarcity of lowland habitat in the Blue Ridge may be significant. The general topography, such as excessively steep slope and ruggedness, may play a part. The dominant heavy growth of timber over much of the Blue Ridge may shade out many of the important species in some sections. In any event, the Blue Ridge Mountains are lacking considerably in a number of grouse food plants. This condition is particularly noticeable in the Blue Ridge to the southwest of Roanoke. Deficiency of food plants also is apparent in sections studied of Bedford and Amherst Counties to the north of Roanoke. Most of the important species are recorded for both ranges, but the quantity varies considerably. One species, wintergreen, which is very abundant in the Alleghany Mountains, was only recorded for the Blue Ridge Mountains at Big Levels Refuge and in a small

section along the Skyline Drive near Luray, Virginia. The Big Levels Refuge, as was mentioned, is dominantly of shale, sandstone, and limestone, the typical formation of the Alleghany Mountains. Other important plants, such as greenbrier, partridgeberry, and arbutus, are much more common in the Alleghany habitat. Other plants, such as serviceberry and menziesia are more common in the Alleghany Range. In the Blue Ridge as in the Alleghanies, laurel is common; grape is very common; huckleberries are abundant in burned over areas; axilea is rather evenly distributed in the two ranges; the various species of oak appear rather evenly distributed. Christmas fern seems to be somewhat more common in the Blue Ridge, but this may not be noticeable. Rhododendron is far less abundant in the Blue Ridge as a whole. This plant, however, may not be much of a factor.

Just what effect this variance in plant abundance may have cannot be determined except by long-term experimentation. How many plants are necessary in an area to support one grouse from year to year must be determined. Also, it must be established which plants of the list are essential to the grouse's welfare and which ones are non-essential but may be eaten in quantity because of accessibility.

CONCLUSION

In summary it will be adequate to discuss the conclusions that may be formed concerning the possible factors that influence the abundance and distribution of the ruffed grouse in Virginia. It must be borne in mind that none of the factors discussed in the thesis have been proved as influencing the species in any way. The object of the investigation is to point out the possible factors and to investigate them sufficiently to draw reasonably sound conclusions as a basis for future investigation and management of the species.

The extent of the forested areas and their corresponding accessibility to men is one of the primary factors. The type of cover is in close association with this and together these factors are considered as first in importance. It has been shown that the distribution and abundance of many important grouse food plants vary considerably between the two mountainous regions of the state. In many sections of the Blue Ridge Mountains food plants are exceedingly scarce and in other sections are present only in limited quantities. An attempt is made to show a correlation between the distribution of certain of the food plants and the underlying rock formations, which in turn influence the distribution of the ruffed grouse. Dr. Bump has found that food is not a factor of importance in the distribution of the grouse in New York. In a glaciated state such as New York this is readily possible where the soil composition is uniform. In an unglaciated state such as

Virginia, there are definite well marked rock formations underlying various parts of the state and the soils derived from these rocks are correspondingly variable in composition.

Field observations and available references do not point to predation as a factor of importance influencing the abundance of the species in one mountain range as compared to the other. The important predators such as the fox and great horned owl appear to be about as abundant in one region as in another. Of course there may be various unknown predators of the young grouse decimating the broods to a greater extent in one section than another. Man is perhaps the most important predator of the species, although it certainly appears that where the grouse are most abundant there the hunting pressure is greatest. In the present age when nearly every hunter has access to an automobile there are but few spots in the grouse range more than several hours' journey from the centers of population. Once the ruffed grouse population had been reduced to the minimum, the numbers could easily be held down by a small hunting pressure in a range as limited as much of the Blue Ridge of the state. In a range well supplied with food and cover and of great extent, there is little chance of the species being depleted severely. They may be exterminated locally, but there is always plenty of new stock supplied from the surrounding areas.

Elevation appears to be an important influence in the distribution of the species over the range in general. The

grouse are common only in the mountainous regions. The species is almost absent in the Coastal Plain. Temperature is undoubtedly associated closely with elevation and may be of greater significance than is realized at the present time. The extreme temperatures may be an important element in restricting the distribution of the species in its range in North America.

Fire at one time was a much more important factor than now. Undoubtedly fire is an important factor in local situations, but not over the range in general. Fire is most certainly a limiting factor in Patrick County, where fires are widespread every year and left burning over large areas. The topography has some influence in this respect. In the Blue Ridge Mountains where many of the mountains are set off from one another a large fire may nearly exterminate the wild life of the whole mountain, especially if it occurs when the broods have just hatched. Restocking from surrounding areas would be slow. In the Alleghany Mountains where many adjacent linear ridges predominate and the range is more extensive a fire may extirpate the wild life in a locality but there is always adequate reserve in the surrounding areas to furnish a breeding stock. There is no correlation between the abundance of the ruffed grouse and the organized fire protection of a county. Many counties that have no organized fire protection have some of the largest grouse populations. Much depends on the type of range and the attitude of the inhabitants in the county toward fire and wild life in general.

Slope is certainly a factor in local distribution. Very few grouse are found on excessively steep or precipitous slopes. The ruffed grouse prefers a more gentle slope usually in the ravines and valleys and on the smaller hills about the bases of the main ridges. On the average, the slopes of the Blue Ridge Mountains are steeper than those of the Alleghany Mountains.

Precipitation varies considerably in local situations over the state. The average rainfall in the southern Blue Ridge region is higher than that for the Valley and the eastern slope of the Alleghanies. The average rainfall of the southwestern counties is somewhat higher, following more the curve of the rainfall for the Blue Ridge Mountains. The supposition that the species would not thrive as well under the more moist conditions as in the Blue Ridge, is offset by the fact that the rainfall is even greater in the southwest where the ruffed grouse is the more abundant.

Snowfall is not an important factor in Virginia. In most cases even during periods of excessively deep snows, the ruffed grouse manages to survive without much privation. The diversity of food preferences makes it possible for the species to survive on plant foods such as buds, leaves and fruit, above the snow when foods beneath the snow are not available.

According to Dr. H. A. Allard, authority on photoperiodism, light or the length of day is not a factor influencing the distribution of the ruffed grouse in Virginia. He says that

something more than changes in the seasonal length of day appears to be operative, for latitudinal changes are too slight.

Other factors may in the future be brought to the fore as important elements influencing the distribution and abundance of the species. The factors discussed above may also be changed radically and those considered of prime importance at the present time may be superseded by others when more facts are accumulated from controlled experiments and more thorough analysis of existing conditions.

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