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A chart quadrat study of the plant communities on the north-, east-, south-, and west-facing slopes at the base of The Knob on Pilot Mountain was conducted with particular emphasis on altitude, slope angle, soil depth, actual water and mineral content in addition to the phyto-sociological aspects of the problem.

Slope angles were found to be similar on all but the west side which had less main slope, but the fact that the west side is a ridge that slopes noticeably to the north and south may compensate for its lesser main slope in regard to the effect of slope on vegetation. The north had the greatest mean soil depth, organic matter content, and water content; and the south, the least. The altitude was approximately the same for each study area.

A series of photographs helps to substantiate the statistical results that each of the four communities, while closely related, has a different species and quantitative makeup.

A discussion involving possible reasons for dissimilarity in the vegetation of each of the communities is included.

THE INFLUENCE OF NORTH, EAST, SOUTH, AND WEST EXPOSURES ON PLANT COMMUNITY COMPOSITION AROUND THE BASE OF THE KNOB ON PILOT MOUNTAIN

by

John Stone Curtis

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of the Requirements for the Degree
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Approved by

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I am indebted to the Division of State Parks and especially to Superintendent Carl Ray Flinchum and Mr. Bert Coleman of Pilot Mountain State Park.

Finally, I wish to thank my wife, Linda, for doing so much work in all aspects of the research including the final typing.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Figure Page

INTRODUCTION

During his journey to Canada in 1792 André Michaux was impressed by the abrupt transition in vegetational character from the Canadian conifer forest on a south-facing slope to the stark, scantly treed tundra on the north-facing slope of the same ridge (Humphrey, 1961). The observant Michaux must certainly have realized, as have naturalists, botanists, and ecologists who have lived both before and after him, that it is the nature of mountains to have distinctive vegetational communities on north and south slopes. These differences, however, are usually more subtle and quantitative.

Besides the north-south slope diversity in plant communities, there has been a great deal of attention focused on the closely related problem of altitudinal stratification of plant communities. Cantlon's paper (1953) contains a review of the works on topography and microclimate in relation to vegetation. Cantlon's chief interest was in the area of differences in vegetation on north- and south-facing slopes. Whittaker (1956), Mowbray (1966), and Mowbray and Oosting (1968) have concentrated on a micro-climate "gradient analysis" of plant species with relation to altitudinal stratification on basally adjoining north and south mountain slopes.

It is interesting to note the number of studies done on north and south slopes of different or adjoining mountains (Cantlon, 1953; Smith, 1966; and Mowbray and Oosting, 1968). It appears that the study of a single mountain with suitable north and south slopes would be a valuable undertaking. Dr. H.J. Rogers suggested that the slopes of Pilot Mountain might be a worthwhile study. Besides the apparent symmetry of the north and south slopes, the east and west slopes in the area adjacent to The Knob appeared to share this symmetry to some extent. From the first photograph Figure 1 A, it can be seen that the north-, east-, and south-facing slopes adjacent to The Knob, or Big Pinnacle, appear to be at the same altitude and exhibit the same general slope. The photograph Figure 1 B was made from the Little Pinnacle and shows that the altitude and degree of slope of the west-facing slope close to The Knob seem very much like that of north and south.

Another obvious advantage to the study of Pilot Mountain is its distance from other mountains. Note that in the background of the photograph Figure 1 B Hanging Rock, Moore's Knob, and Signal Mountain, the nearest mountains to The Pilot, can be seen in the distance. Pilot Mountain rises relatively alone out of the Piedmont and has no other mountains to either shield it from or to channel wind and weather toward it. Removed, as it is, in geologic time and space from other mountains and their vegetation, it is note-

Figure 1 A. View of the eastern half of Pilot Mountain taken from the overlook on U.S. Highway 52. Note the symmetry of slopes adjacent to the Big Pinnacle and the presence of the Little Pinnacle and Ledge on the west. Pictures were made with a 35 mm camera (Miranda Sensorex) and 50 mm lens unless otherwise stated.

Figure 1 B. View of the western half of the Big Pinnacle taken from the Little Pinnacle and showing symmetry of slopes with Signal Mountain, Moore's Knob, and Hanging Rock Mountain visible in the background.

worthy that The Pilot has maintained a flora very much related to the other lower Southern Appalachians despite frequent burning (Williams and Oosting, 1944). Rogers and Barnett (1966a) have attempted to establish the relict nature of the flora on relatively nearby Hanging Rock Mountain and Moore's Knob, which along with Pilot Mountain are in the Sauratown Mountain Range. It seems likely that the mountain vegetation of The Pilot is likewise of a relict nature. If this is the case, then, the relative remoteness of Pilot Mountain from seed sources other than its own, removes from it another variable. That is, only successfully reproducing plants on the mountain would be present there.

Because of the apparent symmetrical nature of the slopes adjacent to The Knob our first objective was to determine if there is a difference in the community composition on the north-, east-, south-, and west-facing slopes at the same altitude adjacent to The Knob. Our second objective was to make a preliminary attempt to identify causative factors for any such variation. The third objective was to establish permanent quadrats within our study areas for future research as suggested by Oosting (1956).

DESCRIPTION OF THE STUDY AREA

Location

Pilot Mountain is located in Surry County off U.S. Highway 52 about 21 miles north of Winston-Salem, North Carolina, and about 50 miles from the University of North Carolina at Greensboro. It is the southwestern extremity of the Sauratown Mountains with Signal Mountain several miles distant and Hanging Rock 15 miles to the east-northeast; and although the Blue Ridge Parkway is about 25 miles to the north-northwest, most of the approximately 3,000 square miles visible from on top of the mountain are the characteristic gently rolling hills of the upper Piedmont Plateau. See Figure 2.

Topography

Each of the three sources we found that described Pilot Mountain assigned a different altitude for the top of the pinnacle. Williams and Oosting (1944) quoted the figure of 2,413 feet above sea level from Pratt's "Altitudes in North Carolina" in the _North Carolina Geological and Economic Survey Bulletin_ 27 (1917). W.C. Burton (1969) gives a figure of 2,441 feet, but Southern Mapping and Engineering Company of Greensboro ascribes an altitude of 2,419.8 feet on their topographic map (1958). Their

Figure 2. Mild telephoto view of Signal Mountain with Moore's Knob and Hanging Rock Mountain in the background and the relatively flat land of the Piedmont Plateau in the foreground. This photograph was made with a 35 mm camera and a 135 mm telephoto lens from the top of the Big Pinnacle.

reference was a 1929 U.S. Coastal and Geodetic Survey figure. All our sources tend to agree that the top of the pinnacle is about 1,500 feet above the surrounding Piedmont Plateau.

The gray rock pinnacle, which is generally referred to as "The Knob", rests atop the center of the main part of the mountain and stands out in bold contrast with the green, wooded slopes descending at a more gradual angle from it. According to Burton (1969), the highest part of the pinnacle is about 204 feet above the rest of the mountain; and the greatest sheer drop at the edge is 114 feet. Williams and Oosting (1944) observed that "about one acre of comparatively flat land is found on top of The Knob." Viewed from above, The Knob appears roughly in the shape of a round-cornered trapezoid measuring approximately 130 by 170 meters with the longer axis running from the north-northeast to the south-southwest.

Climate

The only climatological data available for the area is that recorded at the weather station at Mount Airy, North Carolina, which is at an altitude of only 1,048 feet. Although the overall climate for Pilot Mountain would approximate that of the weather station about 14 miles distant, the microclimate of the mountain would be a worthwhile study. The weather station reports for the area an annual average rainfall of 46.69 inches. The greatest rainfall occurs in the summer; the least, in November. The average temperature for July is 75.3° F, and for January, 38.0° F, giving a mean yearly temperature of 56.9° F.

Geology

Pilot Mountain is a monadnock with a weathering-resistant core of quartzite. Thus, quartzite is the parent material for the soil, and is the material from which the numerous rock outcrops and surface rocks are formed. The Knob itself is a large mass of quartzite (Williams and Oosting, 1944). From a distance Pilot Mountain reminds one of the mesas of the far west, but with two main differences. The first and most striking of these is that the western mountains stand almost devoid of vegetation. The second difference is that the large, flat-topped pinnacles of the mesas are composed of the hard, heavy, dark volcanic rock, basalt, whereas The Knob on Pilot Mountain is quartzite (Bowman, 1911). Both quartzite and basalt monadnocks have withstood the forces of weathering and time while their surrounding plateaus have worn away.

Soils

Because any recent soil analysis data for Pilot Mountain is unavailable, the following quotation of Williams and Oosting's (1944) description of the soil, based on the 1937 soil survey of Surry County by Davis and Goldston, is included.

> Quartzite caps Pilot Mountain, and hornblende schist occurs intermixed with gneiss along its western boundary. At all altitudes small outcrops of quartzite are numerous, and many slabs are scattered over the surface. The soils are derived from the underlying quartzite. Hartsells stony fine sandy loam occurs at the lower altitudes, and its steep phase, interrupted by rock ledges and outcrops, covers the steeper slopes. On gentle slopes the surface soil (A horizon) is from 5 to 8 inches thick and is a light gray to grayish-yellow fine sandy loam. In places organic accumulation produces a brown color. The subsoil (B horizon) is a pale yellow or grayish-yellow friable fine sandy loam which grades into yellow, disintegrating quartzite at a depth ranging from 15 inches to 4 feet. On the steep slopes and on most of the western half of the mountain the veneer of soil is very thin. A restricted area on the north slope below The Knob has a red soil with a brown surface (Hanceville).

The present investigation of the area adjacent to The Knob includes mineral, pH, organic content, soil depth, and slope determinations for the eight plots. These factors will be reviewed in the Results section.

MATERIALS AND METHODS

Location of Sample Areas

The field work was begun by locating the northernmost, easternmost, southernmost, and westernmost portions of the sides of The Knob. This was accomplished by walking around the base of The Knob and by using a Taylor Instrument Company Model Number 2920 compass. The midpoint of each of these portions of The Knob was chosen as the upper center division for two 10 m by 10 m (or 100 m^2) study plots. According to Oosting (1956), "Sampling forest vegetation has often been done satisfactorily by using 10 x 10m plots...." Thus, eight 100 m^2 plots were established with two plots facing each of the four major magnetic compass points. The actual distance downhill from The Knob for each plot was chosen so as to minimize interference caused by major paths which lead around The Knob, and so far as possible, to exclude areas of large surface rocks that were atypical of each of the study plots. The south side of The Knob, in particular, has been worn out so that it is somewhat concave due to weathering. This is shown by figure 3.

The initial laying out of the plots was accomplished with the use of 4 ten meter stainless steel cables made from 0.017 inch model airplane flying lines. Wire lines were selected so as to minimize stretch. These cables,

Figure 3. View of the base of The Knob just above the study plots on the south side where weathering has resulted in a rock-floored concavity in the wall of The Knob.

after being cut to length, were marked at one meter intervals using 3/8 inch lengths of 1/16 inch O.D. brass tubing which were crimped into place with the aid of crimping pliers (as used in making up salt water fishing leaders). The ends of the cables were fitted with Luxon slide-type line connectors (also used in making fishing leaders) which facilitated attachment of cables to each other and to strings attached to corner marking stakes. As for the actual laying out of the plots, the area must be seen to be appreciated; it was usually necessary to crawl through the dense vegetation using the compass as a guide to direction. On some plots it was necessary to make several attempts to lay out the cables so as to have the cables join at right angles. Figure 4 shows a quadrat grid pattern within the dense vegetation on the north side.

Plant Counts

Actual plant counts were made using strings around the periphery as well as marking the plots into one meter square quadrats to facilitate counting. Due to the fact that Pilot Mountain is open to the public we soon found it wise to avoid counting plants on weekends when the area was overrun by weekenders. Because we had some corner stakes removed by tourists we decided not to leave our counting strings set out when we were to be away from the mountain. As two or three days were necessary to lay out the strings

Figure 4. Quadrat grid pattern within the dense vegetation on the north side. Note The Knob's shadow angling across from the top right corner toward the bottom left edge.

and do our counting in each plot, we were fortunate to be able to camp near the park. Plants were counted over a period of about five months, and other data accumulated whenever we could get away from our other duties at the University over a total period of about twelve months. There were 22 trips made from Greensboro and a total of 29 days spent on the mountain. Only one of the two plots on each side was counted at a time so as to better insure against omission of some species that might be evident only as the season progressed.

The plants of each plot were represented on a one meter square chart divided into fourths for maneuverability in the brush. These one hundredth scale charts proved to be of a good size for this study. Heights and basal diameters were listed on the charts for the woody plants, but heights only were listed for herbs that showed some variability in this factor.

It was evident from our first visual inspection of our sample areas that any kind of quantitative assessment of abundance for the species present was going to be an involved undertaking. We could not find in the literature available that anyone had ever attempted such a study of areas commonly referred to as "rhododendron hells", laurel thickets, and blueberry patches. Besides those plants just mentioned the family _Ericaceae_ contains _Epigaea repens_ L., _Leucothoe recurva_ (Buckl.) Gray, and _Pieris floribunda_

(Pursh) B.&H., all of which are rhizomatous plants and are found in the study areas. The problem in counting these plants is that it is extremely difficult to identify an "individual" out of a thicket except by digging it up. This we did not do for two reasons: first, Pilot Mountain is a state park and it would not have been permitted; and second, we wished the area to remain in as natural a condition as possible so that future studies can be made, especially in regard to climax. The method by which we decided to count these plants was suggested by Kershaw (1964).

> ...but there always remains those cases where the 'individual' cannot be picked out with any great degree of certainty, e.g. *Vaccinium myrtillus*, many grasses, sedges, etc. In some instances a convenient unit of the vegetation can be used instead of the complete individual; thus, individual tillers, flowering culms, erect shoots, or, indeed, whole clumps could be a suitable reflection of the density of a species.

We counted shoots of *Rhododendron*, *Kalmia*, *Vaccinium*, *Pieris*, and *Leucothoe*; we counted leaves of *Galax*, *Epigaea*, and *Asarum*. Because this study was concerned only with the comparison of how successful each species is on each of the four slopes, we feel that this method is adequate.

Soil Depth and Slope Measurements

The soil depth measurements were made by driving a 3/8 inch diameter, 36 inch steel rod into the soil with a 16 ounce hammer until solid rock resistance was felt. This method has its drawbacks such as the fact that one is never totally sure whether another clout or two with the hammer will break through some thin rock and allow the rod to penetrate deeper into the soil. Stake driving was the only means available for determining soil depths because unnecessary disturbance of the plant community was undesirable, and, due to the very uneven soil depths expected, many depth samples were necessary for an overall comparison. A systematic sampling pattern was set up to give 50 measurements per plot and a total of 400 soil depth measurements for this study. These measurements were distributed evenly along lines run by compass. A meter stick was used both for spacing measurement points and to aid in sighting the compass.

In a similar manner, 400 points were chosen for slope angle measurements. Two measurements in degrees were made at each point. The first readings were made in the direction of the main downhill slope parallel to the compass lines; and the second readings were made at 90° to the first. Additional description of these measurements will follow in the Results section. The inclinometer was constructed from a meter stick and a 6 inch Sterling No. 582 protractor. A 3/8 inch length of 1/16 inch brass tubing served as a bushing for the pointer which was made from a $3\frac{1}{2}$ inch piece of brass rod with the end half inch bent 90° and inserted through the bushing with 1/16 inch I.D. washers soldered to the rod at each end of the bushing. This pendulum assembly was glued into place on the protractor with model airplane cement. The protractor assembly was attached to a meter stick as shown by Figure 5. The inclinometer could easily be readjusted in the field by the use of a level.

Other Procedures and Materials

The approximate altitude for the uppermost edge of each plot was determined by the use of a Lufft pocket altimeter.

Age determinations and dbh measurements were made for all pines above 10 cm basal diameter. The age determinations were accomplished with the aid of a Djos No. 4 ½ increment borer manufactured by Keuffel and Esser Company, Sweden. The core samples were placed in plastic soda straws and sealed with masking tape for protection in transport and until the growth rings could be counted. To facilitate ring counting, the cores were wet with water and a hand lens used.

The actual water content of 8 one quart soil samples, obtained five days after a rain and oven-dried to constant weight at 105° C, was determined as recommended by Oosting (1956). The Soil Testing Service of the N.C. Department of Agriculture measured pH values and organic matter, calcium, phosphorus, potassium, magnesium, and manganese content.

Figure 5. Diagram for the construction of the inclinometer used to measure slope angles. The drawing is not to scale.

A. 1/16 inch I.D. brass washers

B. 1/16 inch diameter brass rod

C. 1/16 inch I.D. x 3/8 inch brass tubing

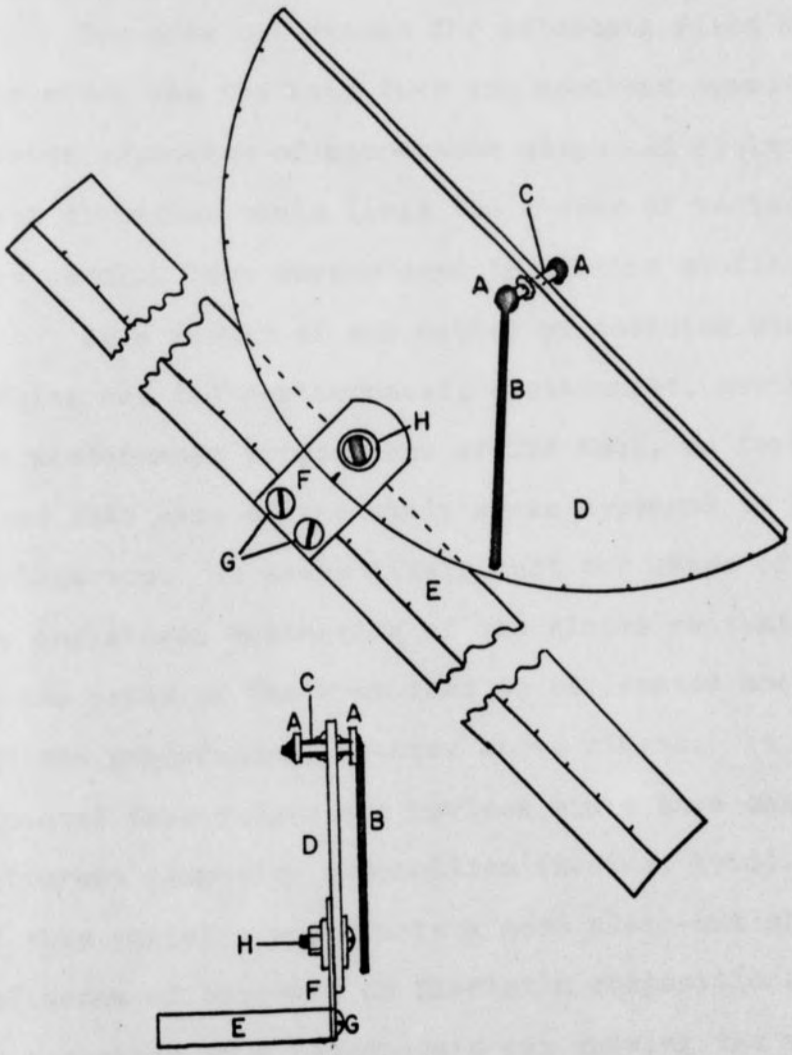
D. Sterling No. 582 6 inch plastic protractor

E. Meter stick

F. 1/32 inch brass plate

G. Wood screws

H. Machine screw, nut, and 2 washers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RESULTS

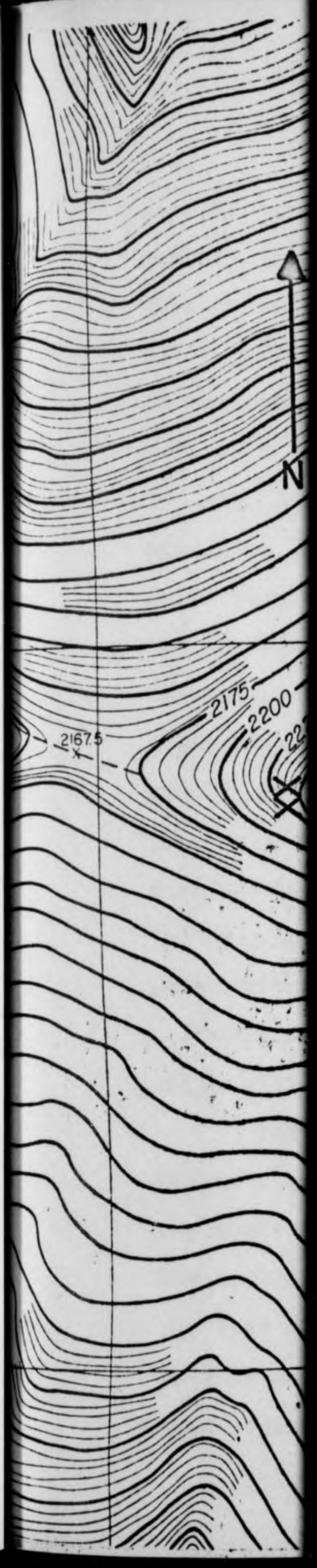
Slope Measurements

Our original reason for selecting Pilot Mountain for this study was the hope that its apparent symmetry would provide exposures of comparable slope and altitude. This ideal situation would limit the number of variables that have usually been encountered in similar studies.

As a result of our method of choosing study areas by picking out the northernmost, easternmost, southernmost, and westernmost projections of The Knob, we fortunately found that each of the study areas appeared to be located on a ridge top. It seems likely that the shape of The Knob has influenced weathering of the slopes so that depressions in the sides of The Knob tend to be located above ravines and the projections, located above ridges. It would be expected that ridges and ravines would have somewhat different community composition (Racine, 1966). Elimination of this variable would make a more clear-cut study of influence of exposure on floristic composition. Figure 6 is a section of a topographic map showing the approximate location of our 8 study plots.

Initial inspection of the study areas revealed a terrain that was somewhat irregular due to microdepressions and rock protrusions, but overall the study areas appeared

Figure 6. The topographic map was compiled by photogrammetric methods by Piedmont Aerial Surveys, Inc. and Southern Mapping and Engineering Company in June of 1968. Each plot is indicated by the letter "X".



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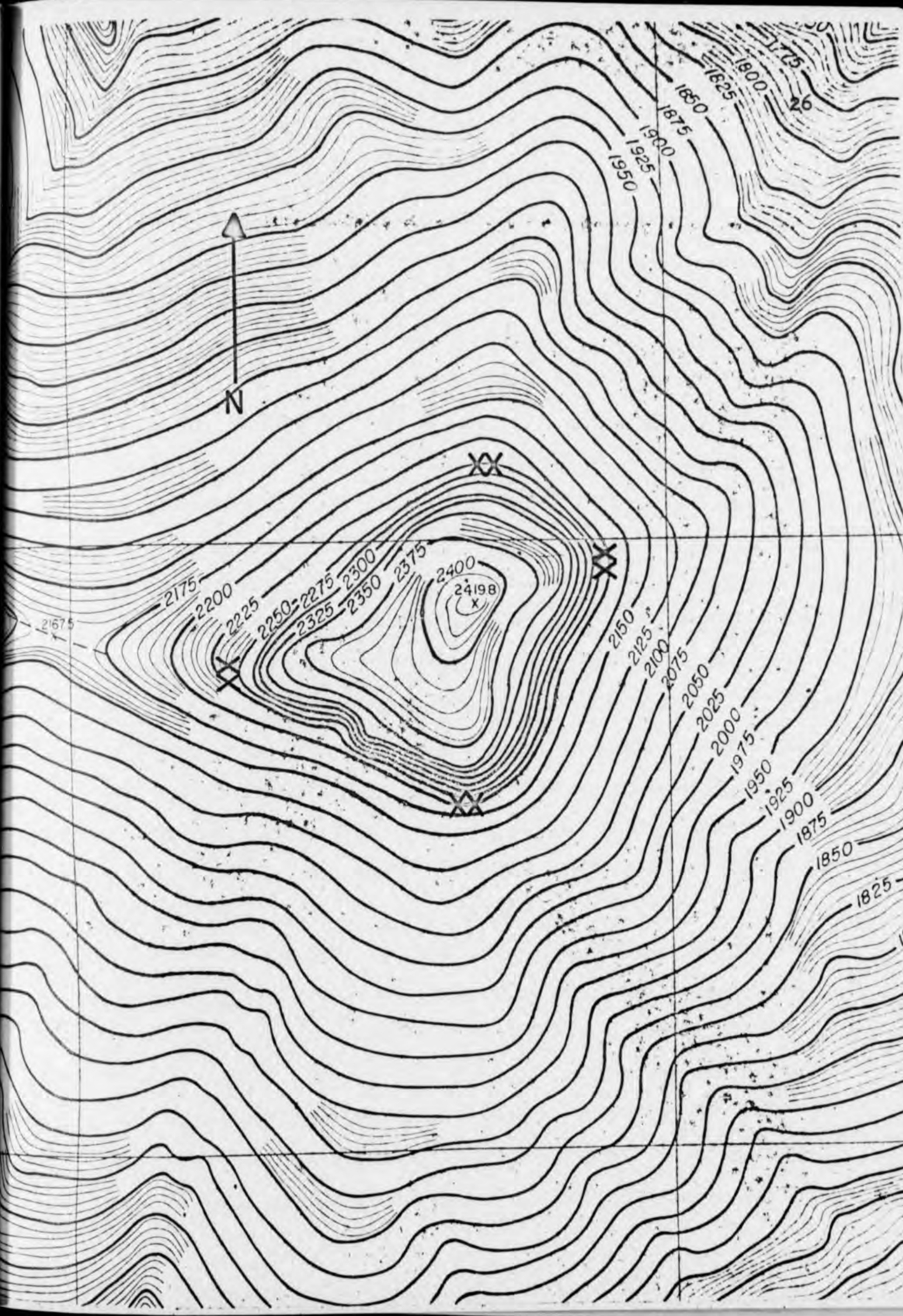

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similar to each other. We felt it necessary to confirm or qualify this observation; the inclinometer was used for this purpose. Slope readings down the main slope, shown as "A" in Figure 7, from The Knob were recorded as five columns of ten measurements each in each of the study plots; and each side is, therefore, represented by ten column values. The mean of the ten column means for each of the four exposures is shown in Table 1. The second measurements, which were made at 90 degrees to the first and are shown as "B" in Figure 7, were also recorded in columns, but means of the column means were calculated separately for each of the eight study plots and recorded in Table 1. In addition, the graphs in Figure 8 which plot column means for each study plot were constructed to better represent this factor. The difficulty in representing slope measurements is that, while the main downhill slope from The Knob is unidirectional, the measurements at a right angle to the main slope were often bidirectional, especially in the case of the west study plots which slope markedly to the north and south.

For the main downhill slope measurements we computed variance and used a z-test for comparing the difference of two means for standard normal distribution according to Hayslett (1968) and Walpole (1968). Comparisons of pairs of the four exposures are also listed in Table 1. The west side is significantly different from the other three sides with regard to the main downhill slope. The degree of

Figure 7. Diagramatic representation of a study area showing the plots in relation to The Knob and the two slope measurements.

A. Main Downhill Slope

B. Study Plot Slope Direction at 90^{o} to Main Downhill Slope

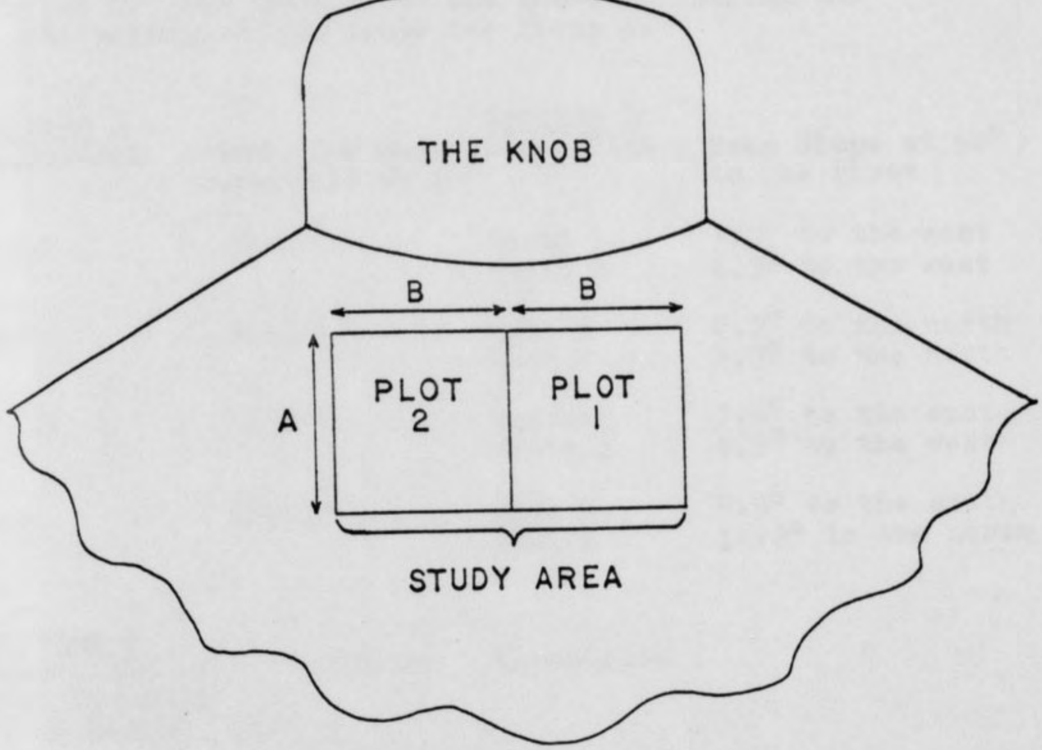
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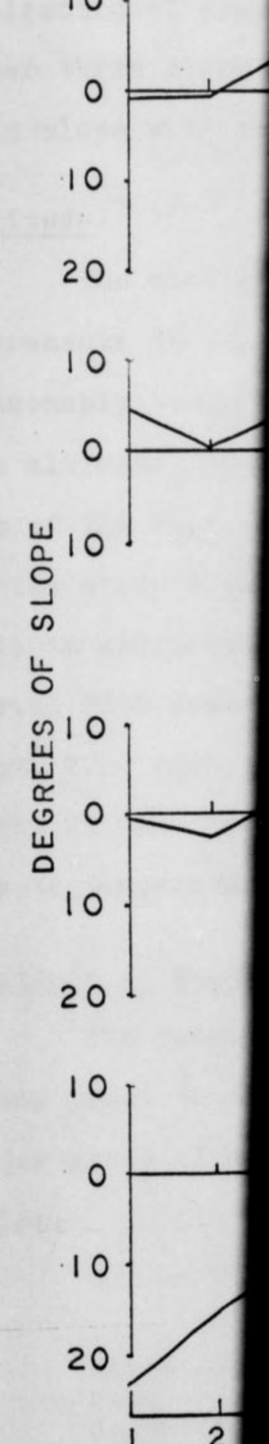
TABLE 1

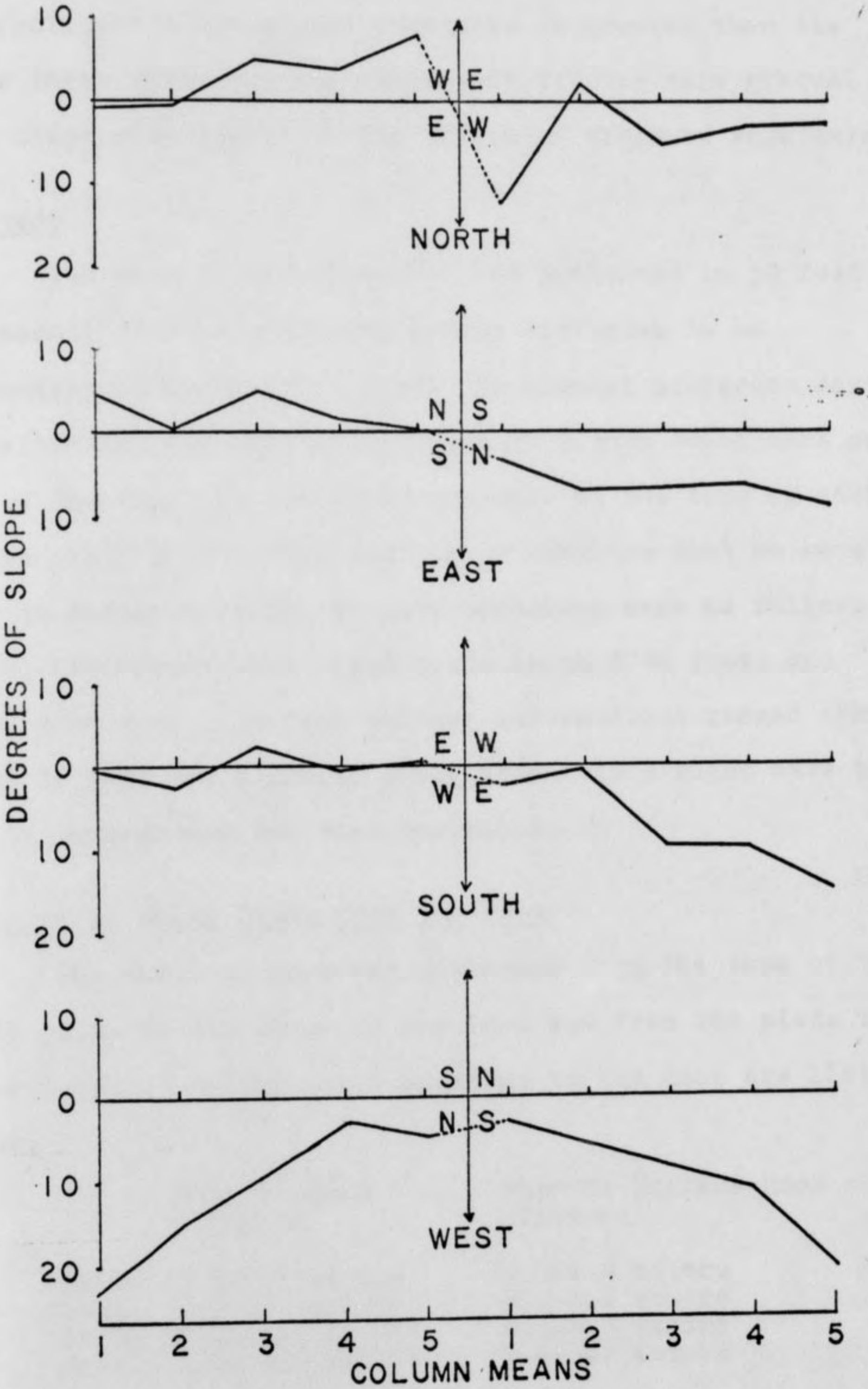
Section A. Mean angles for the main downhill slopes, the first measurement, on the four exposures or study areas.
Section B. Mean slope of each of the study plots, the second measurement, made at a 90° angle to Slope A.
Section C. The results of the z-test comparing the difference of two means for Slope A.

Section A Study Area	Mean for Main Downhill Slope	Section B Study Plot	Mean Slope at 90° to the First
North	29.75°	North 1 North 2	5.3° to the west 2.3° to the west
East	31.30°	East 1 East 2	6.2° to the north 2.3° to the north
South	30.29°	South 1 South 2	7.4° to the east 0.3° to the west
West	21.61°	West 1 West 2	9.9° to the south 11.0° to the north

Section C Comparison of Main Downhill Slope Means	z Value	Conclusion
North : South	0.329	Not significantly different
North : East	1.39	Not significantly different
North : West	7.14	Significantly different at .01 level
South : East	0.925	Not significantly different
South : West	5.28	Significantly different at .01 level
West : East	8.86	Significantly different at .01 level

Figure 8. Graphs showing the bidirectional character of slope measurements made at a 90° angle to the main slope for the two study plots in each of the four study areas. The left half of each graph represents Plot 2; and the right half, Plot 1 for each study area.





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COLUMN MEANS

bidirectional slope of the west side is greater than the other three sides and may compensate for the more gradual main slope with regard to the effect of slope on vegetation.

Altitude

The dial of the altimeter was graduated in 50 foot increments so that one could expect estimates to be reasonably accurate to 25 feet. On several different days the altimeter was set by the Geodetic Survey bench mark on top of The Knob and readings were made at the tops of each of the study areas. The instrument readings that we were able to estimate on two or more occasions were as follows: north, 2250 feet; east, 2250 feet; south, 2240 feet; and west, 2260 feet. In fair weather our readings ranged over about 20 feet for a single study area. This might have been due to temperature and wind variation.

Distance of Study Plots from The Knob

The range of measured distances from the tops of the study plots to the sides of The Knob and from the plots to major areas of surface rock adjacent to The Knob are listed below.

	Plot to Knob Distance	Plot to Surface Rock Distance
North	0.3-9.2 meters	0.3-4.6 meters
East	4.0-5.2 meters	4.0-5.2 meters
South	4.0-11.0 meters	0.3-4.3 meters
West	5.8-15.6 meters	0.9-3.7 meters

The presence of large areas of surface rocks and paths influenced the placement of study plots. The vegetation in the areas between the plots and The Knob appeared, in all cases, to have the same species as found within the plots, but the size of paths and rock areas was a variable which we attempted to eliminate.

Soil Depth Measurements

Soil depth measurements were made as described in the section on Materials and Methods. They were made and recorded as five columns of ten measurements each. The mean of the ten column means appears in Section A of Table 2 for the individual study areas. Use of the z-test as described above for slope measurements indicated that the soil depth in the north study area is significantly greater than in the other three study areas. Section B of Table 2 lists the comparison of pairs of means for the study areas. It is interesting to note that the soil depth means for east and west are intermediate between north and south with south having the least mean depth.

Soil Analysis Results

The actual water content of soil samples from each of the study plots, taken in mid-September and five days after a rain when soils might be expected to be at field capacity, is listed in Table 3. Also in Table 3 are the values for soil mineral and organic matter content and pH

TABLE 2

Section A. Mean soil depth for the four study areas.
Section B. Results of the z-test comparing the difference of two means for soil depths.

Section A

Study Area	Mean Soil Depth
North	45.5 cm
East	34.7 cm
South	27.6 cm
West	31.8 cm

Section B

Comparisons of Soil Depth Means	z Value	Conclusion
North : South	3.17	Significantly different at .01 level
North : East	2.68	Significantly different at .01 level
North : West	2.24	Significantly different at .05 level
South : East	1.79	Not significantly different
South : West	1.01	Not significantly different
West : East	0.63	Not significantly different

TABLE 3

Soil analysis data for the four study areas. Soil moisture is listed as percent dry weight. The pH, organic matter (OM), Ca, P, K, Mg, and Mn determinations were done by the Soil Testing Division of the North Carolina Department of Agriculture. Mineral measurements are listed as pounds per acre for a six inch depth.

	Soil Moisture	OM	pH	Ca	P	K	Mg	Mn
N1	85.0%	9.0%	3.6	512	16.8	109.4	129.6	8.0
N2	48.0%	7.8%	3.7	480	69.6	167.0	120.0	4.0
Mean	66.5%	8.4%	3.6	496	43.2	138.2	124.8	6.0
E1	46.9%	5.2%	4.2	448	93.6	123.8	81.6	7.2
E2	42.4%	6.5%	3.8	122	88.8	115.2	38.4	3.2
Mean	44.6%	5.8%	4.0	285	91.2	119.5	60.0	5.2
S1	19.3%	5.2%	3.6	144	16.8	86.4	26.4	2.4
S2	14.5%	5.2%	3.6	144	7.2	63.4	24.0	2.4
Mean	16.9%	5.2%	3.6	144	12.0	74.9	25.2	2.4
W1	18.9%	6.0%	3.7	240	9.6	83.5	36.0	3.2
W2	19.9%	4.8%	3.7	208	9.6	72.0	26.4	3.2
Mean	19.4%	5.4%	3.7	224	9.6	77.8	31.2	3.2

for each plot. Mean values for these measurements are shown.

The mean soil moisture content as percent of dry weight is greatest for the north and least for the south, although values for the south and west differ only slightly. The mean for the east is intermediate between that for the north and west.

The pH values for all sides ranged between 3.6 and 4.2; this appears to be a very small difference.

Organic matter and mineral content means, with the exception of phosphorus, were highest for the north study area and lowest for the south. The means for the east and west were intermediate between north and south. The mean value for phosphorus was greatest for the east study area, lowest for the west, with the north and south areas being intermediate.

Comparison of the Plant Communities in the Study Areas

A total of 26 different species and two other genera were represented in the study areas. The species composition of each of the four communities studied was different from the other three. Some species were common to all of the communities; others were shared by two or more of the communities. Only *Quercus rubra* var. *borealis* (Michaux f.), *Aureolaria virginica* (L.) Pennell, and *Pieris floribunda* (Pursh) B.&H. were found in only one study area each. There was only a single individual found for the first two of these species, but some 300 stems of *Pieris* were counted in the west study area. While *Pieris* was not found in either the north or east study areas, it was observed to occur on the northeast, adjacent to the east study area, and on the northwest.

Species which were found in all but the south study area include *Acer rubrum* L., *Galax aphylla* L., *Robinia pseudo-acacia* L., *Castanea dentata* (Marsh.) Borkh., and *Epigaea repens* L. Of these six, the last two species have been observed to occur on the south side outside the study area. Only one species, *Nyssa sylvatica* Marsh., was found in all but the west study area.

Plant species that were found only in the north and east study areas include *Hamamelis virginiana* L., *Rhododendron catawbiense* Michaux, and *Leucothoe recurva* (Buckl.) Gray. Of these, the *Leucothoe* also occurs on the northwest side of The Knob. Plant species found in only the south and west study areas are *Quercus marilandica* Muenchh., *Panicum* sp., *Monotropa uniflora* L., and *Pinus pungens* Lam. Of these *Pinus pungens*, the Table Mountain Pine, is found on all four sides, but outside the study areas.

Quercus prinus L. was found only in the east and south study areas; *Asarum* spp., only in the north and west study areas; *Quercus ilicifolia* Wang. and *Coreopsis major* Walt., only in the east and west study areas.

A species:area curve, for each of the four study areas, was made as described by Oosting (1956) and Smith (1966). Figure 9 shows the scheme of nested quadrats we used in counting the species on our field charts. The graphs in Figure 10 were constructed; and the number of species accumulated in the count of the field charts was plotted on y axis against the numbers of one meter square quadrats on the x axis. The graphs are indicative of adequate sampling.

Data for the phytosociological characters of the species encountered in the study are summarized in Table 4. Stratification (S) is expressed as 5 size classes according to Williams and Oosting (1944):

S 1, species found in the ground cover.
S 2, herbs and shrubs below one foot in height.
S 3, shrubs and transgressives below 8 feet in height.
S 4, trees of the understory.
S 5, trees of the upperstory.

Density, frequency, mean area, and abundance were calculated as described by Curtis and McIntosh (1950) by use of the following formulas:

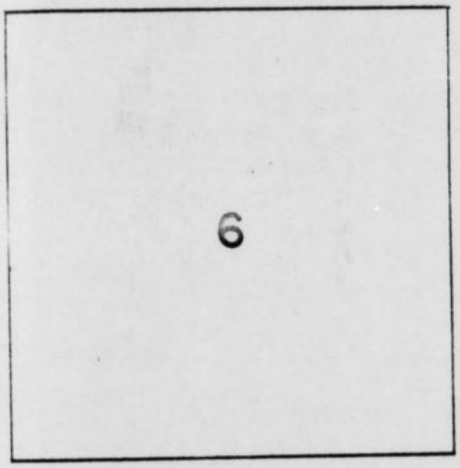
$$\text{Density } (=D) = \frac{\text{Total no. of individuals of a species found}}{\text{Total area examined}}$$

$$\text{Frequency } (=F) = \frac{\text{No. of quadrats in which a species occurs}}{\text{Total no. quadrats examined}} \times 100$$

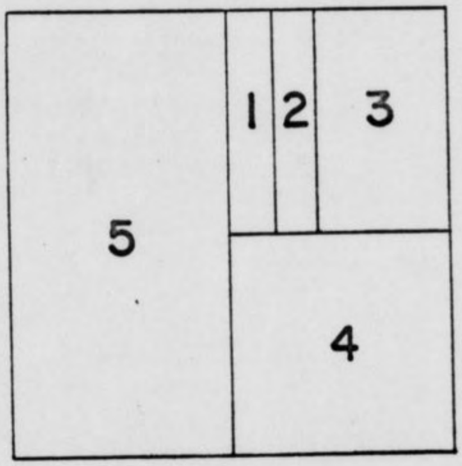
$$\text{Mean area } (=M) = 1/D$$

$$\text{Abundance } (=A) = 100D/F$$

Figure 9. Scheme of nested quadrats used in counting the number of species. Area 1 with 5 m^2 was counted first; then area 2 with 5 m^2; then area 3 with 15 m^2; etc. to give the cumulative area values shown on the graphs, i.e. 5 m^2, 10 m^2, 25 m^2, 50 m^2, 100 m^2, and 200 m^2.

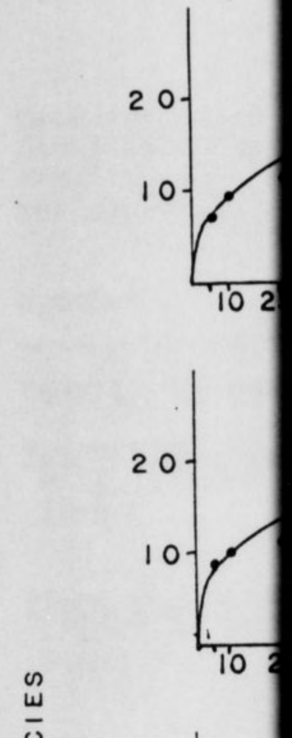


P 1



P 2

Figure 10. Species:area curves for each of the four study areas. Cumulative number of species plotted on the y axis; and number of one meter square quadrats, on the x axis.



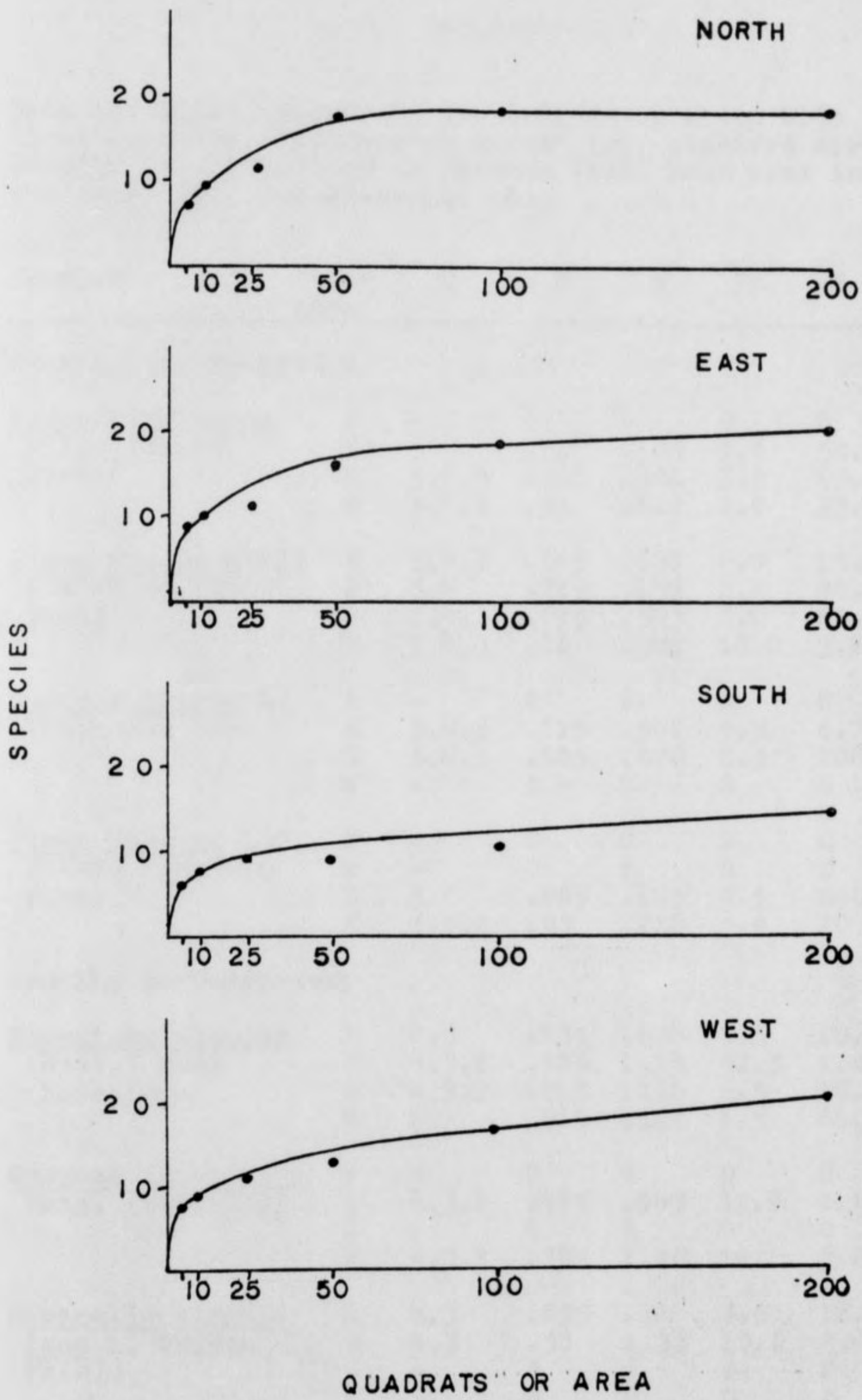

NORTH
EAST
SOUTH
WEST
SPECIES
20
10
10 25 50 100 200
QUADRATS OR AREA

TABLE 4

Data for plant species in the four study areas with Stratification (S), Density per m^2 (D), standard error of density (s), Frequency in percent (F%), Mean area in m^2 per plant (M), and Abundance (A).

Species	Study Area	S	D	s	F%	M	A
Usually in Upperstory							
Pinus virginiana Mill. (Scrub Pine)	N	-	0	0	0	0	0
	E	5	.02	.140	2.0	50.0	1.0
	S	5,4,3	.065	.302	5.5	15.4	1.18
	W	5,4,3	.03	.222	2.0	33.3	1.5
Pinus rigida Mill. (Black or Pitch Pine)	N	5,4,3	.065	.139	6.0	15.4	1.08
	E	5,4	.025	.139	2.5	40.0	1.00
	S	5,4,3	.095	.383	8.0	10.5	1.12
	W	5,4,3	.26	.541	18.0	3.85	1.44
Quercus prinus L. (Chestnut Oak)	N	-	0	0	0	0	0
	E	5,4,3	.115	.390	9.5	8.70	1.21
	S	5,4,3	.005	.070	0.5	200	1.0
	W	-	0	0	0	0	0
Pinus pungens Lam. (Table Mountain Pine)	N	-	0	0	0	0	0
	E	-	0	0	0	0	0
	S	5	.005	.005	0.5	200	1.0
	W	5,4,3	.05	.218	5.0	20	1.0
Usually in Understory							
Sassafras albidum (Nutt.) Nees (Sassafras)	N	4,3	.035	.034	3.5	28.6	1.0
	E	4,3,2	.925	1.54	42.5	1.08	2.18
	S	4,3,2	.095	.476	5.5	10.5	1.73
	W	2	.015	.122	1.5	66.7	1.0
Quercus ilicifolia Wang. (Bear Oak)	N	-	0	0	0	0	0
	E	4,3,2	.475	.949	19.0	2.11	2.5
	S	-	0	0	0	0	0
	W	4,3,2	.305	1.10	10.0	3.28	3.05
Hamamelis virginiana L. (Witch Hazel)	N	4,3	.055	.32	3.5	18.2	1.57
	E	4,3	.38	1.36	10.0	2.63	3.8
	S	-	0	0	0	0	0
	W	-	0	0	0	0	0

TABLE 4 (Continued)

Species	Study Area	S	D	s	F%	M	A
Nyssa sylvatica Marsh. (Black Gum)	N	4,3,2	.09	.35	7.0	11.1	1.29
	E	4,3,2	.325	.762	20.5	3.08	1.58
	S	3,2	.02	.172	1.5	50.0	1.3
	W	-	0	0	0	0	0
Oxydendrum arboreum (L.) DC Sourwood	N	4,3,2	.265	1.20	16.5	3.77	1.61
	E	4,3,2	.305	.838	16.5	3.28	1.85
	S	4,3,2	.025	.156	2.5	40.0	1.0
	W	4,3,2	.045	.321	4.5	22.2	1.0
Quercus marilandica Muenchh. (Black Jack Oak)	N	-	0	0	0	0	0
	E	-	0	0	0	0	0
	S	4,3,2	.28	.526	18.0	3.57	1.56
	W	4,3	.05	.453	2.0	20.0	2.50
Acer rubrum L. (Red Maple)	N	4,3	.05	.283	3.0	20.0	1.67
	E	3	.045	.365	2.0	22.2	2.25
	S	-	0	0	0	0	0
	W	3	.005	.070	0.5	200	1.0
Castanea dentata (Marsh.) Borkh. Americum Chestnut	N	4,3	.035	.365	1.5	28.6	2.33
	E	4,3	.005	.070	0.5	200	1.0
	S	-	0	0	0	0	0
	W	4,3	.01	.361	1.0	100	1.0
Shrubs and Transgressives							
Vaccinium spp. (Blueberries)	N	3,2	0.73	2.10	20.0	1.43	3.65
	E	3,2	10.56	9.32	86.0	.094	12.27
	S	3,2	12.14	13.6	89.0	.083	13.64
	W	3,2	20.59	16.0	92.0	.050	22.38
Rhododendron catawbiense Michaux (Rhododendron)	N	3,2	6.32	4.99	39.5	.158	16.0
	E	3,2	1.33	3.84	18.0	.758	7.36
	S	-	0	0	0	0	0
	W	-	0	0	0	0	0
Kalmia latifolia L. (Mountain Laurel)	N	3,2	2.72	3.25	66.5	.367	4.09
	E	3,2	3.12	3.89	60.0	.321	5.20
	S	3,2	.38	1.92	6.0	2.63	0.63
	W	3,2	3.10	4.76	51.5	.323	6.02

TABLE 4 (Continued)

Species	Study Area	S	D	s	F%	M	A
Pieris floribunda (Pursh) B.&H./ Gray (Fetter-bush)	N	-	0	0	0	0	0
	E	-	0	0	0	0	0
	S	-	0	0	0	0	0
	W	3,2	1.50	3.31	8.5	.667	17.64
Sorbus melanocarpa (Michaux) Schneider (Black Chokeberry)	N	3,2	.355	.894	19.5	2.82	1.81
	E	3,2	.25	.852	13.0	4.00	1.92
	S	3,2	.165	.783	3.5	6.06	5.41
	W	3,2	.08	.473	4.0	12.5	2.0
Leucothoe recurva (Buckl.) Gray (Deciduous Leucothoe)	N	3,2	.165	1.04	5.0	6.06	3.30
	E	3,2	.015	.212	0.5	66.7	3.0
	S	-	0	0	0	0	0
	W	-	0	0	0	0	0
Woody Vine							
Smilax rotundifolia L. (Greenbriar)	N	3,2	.355	.781	22.0	2.82	1.61
	E	3,2	.265	.752	15.5	3.77	1.71
	S	3,2	1.88	3.03	50.5	.555	3.72
	W	3,2	3.15	4.23	59.0	.318	5.33
Herbs and Subshrubs							
Galax aphylla L. Galax	N	1	7.65	10.9	60.0	.132	12.8
	E	1	2.7	12.0	6.0	.370	45.0
	S	-	0	0	0	0	0
	W	1	1.44	8.06	7.0	.694	20.6
Epigaea repens L. (Trailing Arbutus)	N	1	.015	.212	0.5	66.7	3.0
	E	1	2.38	7.66	15.0	.420	15.8
	S	-	0	0	0	0	0
	W	1	.24	2.09	2.0	41.7	12.0
Asarum spp. (Heartleaf)	N	1	.825	2.15	20.0	1.21	4.20
	E	-	0	0	0	0	0
	S	-	0	0	0	0	0
	W	1	.015	1.73	1.5	66.7	1.0
Pteridium aquilinum L. (Bracken Fern)	N	2	.06	.277	5.0	16.67	1.20
	E	2	.22	.618	14.0	4.54	1.57
	S	2	.13	.310	10.0	7.69	1.30
	W	2	.54	1.26	22.0	1.85	2.45

TABLE 4 (Continued)

Species	Study Area	S	D	s	F%	M	A
Robinia pseudo-acacia L. (Black Locust)	N	1	.01	.980	0.5	100	2.0
	E	1	.08	.322	6.5	12.5	1.23
	S	-	0	0	0	0	0
	W	1	.055	.350	3.0	18.2	1.63
Panicum sp. (Panic grass)	N	-	0	0	0	0	0
	E	-	0	0	0	0	0
	S	1	.03	.171	3.0	33.3	1.0
	W	1	.06	.277	5.0	16.7	1.2

Note: The following species had all Density values of 0.015 or less and were found in only 1 or 2 study areas: Monotropa uniflora L., south and west; Coreopsis major Walt., east and west; Quercus rubra var. borealis (Michaux f.), north; and Aureolaria virginica (L.) Pennell, east.

Using the Density values listed in Table 4, we computed variance and used a z-test, as described by Hayslett (1968) and Walpole, to compare the difference of pairs of mean densities for each species in the four study areas. Table 5 lists this information. Table 6 summarizes the results of Table 5 and includes the number of species in common, the number of species significantly different at the .05 level, and the number of species significantly different at the .01 level.

Considering the factors of size and numbers, the pines were clearly the dominant upperstory trees in our study areas. Of the three pine species encountered, only _Pinus rigida_, the Pitch or Black Pine, was found in all four study areas. Table 7 lists the number of rings, dbh, and estimated height for all pines above 10 cm basal diameter (or approximately 4 inches dbh). A comparison of the growth rings to size between _P. rigida_ in each of the different study areas is interesting.

TABLE 5

A statistical comparison of the difference of mean densities for pairs of study areas for each species.

Species	Areas Compared	z Value	Level of Significance
Pinus virginiana	N:S	3.5	.01
	N:E	2.0	.05
	N:W	1.91	ns*
	S:E	1.92	ns
	S:W	1.32	ns
	W:E	.537	ns
Pinus rigida	N:S	.288	ns
	N:E	1.88	ns
	N:W	4.56	.01
	S:E	2.43	.05
	S:W	3.52	.01
	W:E	4.75	.01
Quercus prinus	N:S	1.01	ns
	N:E	4.30	.01
	N:W	0	ns
	S:E	4.06	.01
	S:W	1.01	ns
	W:E	4.30	.01
Pinus pungens	N:S	1.01	ns
	N:E	0	ns
	N:W	3.24	.01
	S:E	1.01	ns
	S:W	2.78	.01
	W:E	3.24	.01
Sassafras albidum	N:S	1.66	ns
	N:E	8.08	.01
	N:W	1.26	ns
	S:E	5.1	.01
	S:W	2.30	.05
	W:E	8.26	.01
Quercus ilicifolia	N:S	0	ns
	N:E	7.08	.01
	N:W	3.94	.01
	S:E	7.08	.01
	S:W	3.94	.01
	W:E	1.65	ns

*ns = not significant

TABLE 5 (Continued)

Species	Areas Compared	z Value	Level of Significance
Hamamelis virginiana	N:S	2.43	.05
	N:E	3.34	.01
	N:W	2.43	.05
	S:E	3.96	.01
	S:W	0	ns
	W:E	3.96	.01
Nyssa sylvatica	N:S	.180	ns
	N:E	.280	ns
	N:W	.257	ns
	S:E	.414	ns
	S:W	1.16	ns
	W:E	6.04	.01
Oxydendrum arboreum	N:S	2.8	.01
	N:E	.374	ns
	N:W	2.50	.05
	S:E	4.64	.01
	S:W	.789	ns
	W:E	4.09	.01
Quercus marilandica	N:S	7.74	.01
	N:E	0	ns
	N:W	1.56	ns
	S:E	7.74	.01
	S:W	4.64	.01
	W:E	4.64	.01
Acer rubrum	N:S	2.5	.05
	N:E	1.53	ns
	N:W	2.18	.05
	S:E	1.74	ns
	S:W	1.01	ns
	W:E	1.52	ns
Vaccinium spp.	N:S	11.8	.01
	N:E	14.6	.01
	N:W	17.4	.01
	S:E	1.36	ns
	S:W	7.36	.01
	W:E	8.87	.01

TABLE 5 (Continued)

Species	Areas Compared	z Value	Level of Significance
Rhododendron catawbiense	N:S	17.8	.01
	N:E	1.12	ns
	N:W	17.8	.01
	S:E	4.87	.01
	S:W	0	ns
	W:E	4.87	.01
Kalmia latifolia	N:S	8.84	.01
	N:E	1.12	ns
	N:W	.93	ns
	S:E	8.95	.01
	S:W	7.5	.01
	W:E	.46	ns
Pieris floribunda	N:S	0	ns
	N:E	0	ns
	N:W	3.52	.01
	S:E	0	ns
	S:W	3.52	.01
	W:E	3.52	.01
Sorbus melanocarpa	N:S	2.26	.05
	N:E	1.20	ns
	N:W	3.5	.01
	S:E	1.05	ns
	S:W	1.31	ns
	W:E	2.47	.05
Leucothoe recurva	N:S	2.23	.05
	N:E	1.99	.05
	N:W	2.23	.05
	S:E	1.0	ns
	S:W	0	ns
	W:E	1.0	ns
Smilax rotundifolia	N:S	6.90	.01
	N:E	.967	ns
	N:W	9.18	.01
	S:E	7.3	.01
	S:W	3.44	.01
	W:E	9.46	.01

TABLE 5 (Continued)

Species	Areas Compared	z Value	Level of Significance
Galax aphylla	N:S	9.95	.01
	N:E	4.3	.01
	N:W	6.48	.01
	S:E	3.18	.01
	S:W	8.0	.01
	W:E	1.22	ns
Epigaea repens	N:S	1.0	ns
	N:E	4.35	.01
	N:W	1.51	ns
	S:E	4.4	.01
	S:W	1.62	ns
	W:E	3.81	.01
Asarum spp.	N:S	5.42	.01
	N:E	5.42	.01
	N:W	4.14	.01
	S:E	0	ns
	S:W	.122	ns
	W:E	.122	ns
Pteridium aquilinum	N:S	3.4	.01
	N:E	3.96	.01
	N:W	5.59	.01
	S:E	1.84	ns
	S:W	4.46	.01
	W:E	2.27	.05
Robinia pseudo-acacia	N:S	1.05	ns
	N:E	1.75	ns
	N:W	3.03	.01
	S:E	3.51	.01
	S:W	2.23	.05
	W:E	.744	ns
Panicum sp.	N:S	2.48	.05
	N:E	0	ns
	N:W	3.06	.01
	S:E	2.48	.05
	S:W	1.30	ns
	W:E	3.06	.01

TABLE 6

Summary of results shown in Table 5 listing the number of species in common, the number of species significantly different only at the .05 level, and the number of species significantly different at the .01 level, in addition to the .05 level, for pairs of study areas.

Study Area	*Species in Common	Significantly Different Species	
		0.05 Level	0.01 Level
North : South	9	5	10
North : East	13	2	9
North : West	7	4	13
South : East	10	2	12
South : West	12	2	10
West : East	8	2	14

* Number of species not significantly different in the compared study areas.

Note: 5 species were not significantly different for any sides due to small numbers: *Quercus rubra* var. *borealis*, *Monotropa uniflora*, *Coreopsis major*, *Aureolaria virginica*, and *Castanea dentata*; and were not included in this table.

TABLE 7

Size data on all pines above 10 cm basal diameter for each of the study areas. (dbh = diameter breast high)

Species	Rings	dbh in cm	Estimated Height in m
North			
Pinus rigida	31	21.8	6
" "	90	29.1	9
" "	33	11.6	5.5
" "	62	25.1	8
Pinus rigida average	54	21.9	7.1
East			
Pinus rigida	36	21.8	8
Pinus virginiana	37	18.8	7
" "	23	11.4	7
Pinus rigida	41	20.8	7
" "	35	10.3	5.5
" "	28	17.4	8
Pinus rigida average	35	17.6	7.1
South			
Pinus rigida	66	31.5	13
" "	63	24.2	9
" "	69	28.7	13
" "	62	24.2	12.5
" "	59	32.0	13
" "	63	28.8	7.5
" "	60	14.3	7
Pinus pungens	56	35.2	8
Pinus rigida	52	15.2	7
Pinus rigida average	61.7	24.8	10.2

TABLE 7 (Continued)

Species	Rings	dbh in cm	Estimated Height in m
West			
Pinus rigida	59	17.6	6
" "	81	14.5	5
" "	68	15.2	5.5
" "	40	10.2	3.2
Pinus pungens	43	18.8	6
Pinus rigida	104	27.1	8
" "	103	18.2	6
" "	38	11.5	5
" "	84	17.5	7
" "	35	18.5	6.5
" "	35	12.1	5.5
" "	37	15.0	6.5
Pinus virginiana	17	12.1	5
" "	16	9.3	4
Pinus rigida	34	11.7	5
" "	44	12.1	5
Pinus pungens	17	14.9	6.5
Pinus rigida average	58.6	15.5	5.7

DISCUSSION

Solar radiation appears to be the main factor influencing the plant communities found on the opposing slopes of Pilot Mountain. The amount of sunlight, or angle of insolation, has a great effect on the moisture and heat budget of the slopes. The amount of radiant energy received by a slope determines, to a large extent, the vapor pressure of the adjacent air layer which, in turn, determines the transpiration-evaporation rate. Wind, the other major factor influencing vapor pressure, prevails from the southwest on Pilot Mountain so as to increase the drying effect on the southern and western exposures. Dry soil particles do not adhere well to each other, nor do they encourage a dense vegetational growth to help bind them together. In the course of weathering, the loosely held soils of southern exposures generally tend to be carried down the slope so that south slopes are usually more gradual than north slopes. The fact that this is not the case near The Knob on Pilot Mountain reduces the effect of slope as a variable in determining which species are present. However, the south has fewer species and is less densely vegetated than the other three sides as can be seen in Figures 11 A and B. We found that the soil on the north had more organic matter, more water, and was deeper than on the south. Robert L.

Figure 11 A. View of the south study area taken from on top of The Knob.

Figure 11 B. Wide angle lens photograph of the south study area showing the relatively less dense vegetation.

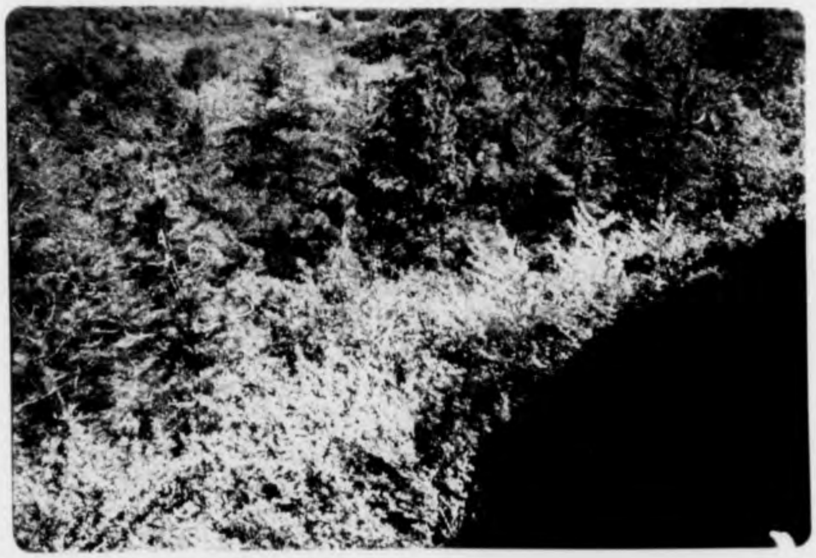
Smith (1966) summarizes the diversity of north and south slopes as follows:

> The whole north-south slope complex is the result of a long chain of interactions: the solar radiation influences the species of trees and other plants occupying the slopes. The species of trees in turn influence mineral recycling, which is reflected in the nature and chemistry of the surface soil and the nature of the herbaceous ground cover.
>
> Tree cover on the north-facing and south-facing slopes of the New Jersey hills does not reflect the microclimates of the two slopes as well as the herbaceous layer, according to Cantlon (1953), but differences do show up.

Considering the factors of size and number, the upperstory dominants of our study areas on Pilot Mountain consisted of three species of the genus Pinus. That the microclimate differences between the study areas do show up is evidenced by the fact that while the south, east, and west study plots contain pines dispersed throughout them, the north study area contains its few pines, almost in a row, across the bottom. Figures 12 A and B are photographs taken from a rock above the north study area. The photographs show the shadow line of The Knob and the distance to the nearest pines. Pinus rigida, the only pine species found inside the north study plots, and Pinus pungens, which appears to form a row on the other side of the path below the study area, appear normally to be able to rise above the shrub layer, but in the area adjacent to the Knob they are unable to do so. The Knob, or for that matter any steep

Figure 12 A. Photograph taken from a rock above the north study area showing the distance at which pines grow from The Knob. Note the early afternoon shadow of The Knob.

Figure 12 B. View from the rock above the north study area showing the north side of the mountain and the shadow of The Knob.



hillside, appears to limit the duration and total amount of direct sunlight available to such an extent as to prove limiting to pines. The other three study areas have pines growing all the way up to, and often out of, the base of The Knob.

Table 7 lists the number of rings, dbh, and estimated height for all pines above 10 cm basal diameter. Since *Pinus rigida* is the only pine found inside all the study areas, a comparison of the growth rings and sizes in *P. rigida* from the four study areas is interesting. There are twice as many trees of this species, above 10 cm, in the south study as in the north or east. There are three times as many in the west study area as in the north or east. See Figures 12 A and B, 13 A and B, and 14. This suggests that some factor or factors are limiting on the north and east. A look at the size and growth ring data in Table 7 reveals a marked difference in growth rates for the different study areas. It is rather obvious that while pines may be greater in number on the west, the growth rate is slower than on the other three sides. This could be due to the fact that especially during the dryer summer months the western side endures more hours of direct sunlight during the hotter part of the day. Another factor that according to Racine (1966) might increase the xeric character of the western slope is the fact that it is a narrow ridge. The eastern study area enjoys more direct

Figure 13 A. View of the east side showing the dense vegetation.

Figure 13 B. View of the west side taken from a rock above the study area.

Figure 14. Photograph of the west study area showing many pines above and _Pieris floribunda_ and _Kalmia latifolia_ below.

sunlight than the north, but does not experience the drying effects to as great an extent as the south and west, but competition between species probably becomes the limiting factor. The south slope, then, appears to supply the best combination of factors for pine growth. There are fewer competing species on the south than on the east or west; it appears that the xeric habitat on the south is not so limiting when competition is less of a limiting factor.

Williams and Oosting (1944) found the more nearly flat central area of the top of The Knob dominated by Quercus prinus, but in the steeper area near the edges of the cliff Pinus pungens and Pinus rigida are the dominant upperstory species.

> Oxydendrum arboreum, Nyssa sylvatica, Acer rubrum, Quercus borealis var. maxima, and Robinia pseudo-acacia are present in the understory.
>
> The shrub layer in the central area is dominated by ericads. On the west and north is a heath thicket in which the most important species, in order of their decreasing abundance, are: Pieris floribunda, Kalmia latifolia, Rhododendron catawbiense, Smilax rotundifolia, and Vaccinium corymbosum var. pallidum. Pieris disappears along the east rim, being replaced by Rhododendron catawbiense. Here the thicket is tall and, in addition to the rhododendron and other species listed above, includes Leucothoe recurva, Gaylussacia baccata, Vaccinium vacillans, and Hamamelis virginiana. Along the south rim the shrubs, chiefly huckleberries and laurel, are slightly less abundant. Herbs are scattered and of little importance except along the paths.

The plants we found surrounding the base of The Knob were generally of the same species as the community on top nearer the edges. This species composition closely approximates that of the southern Appalachian communities referred to as pine-heaths by Whittaker (1966). Our data suggests that the imposition of The Knob has dissected the pine-heath community into its more extreme subcommunities so that on the north we found primarily the shade-loving or tolerant species; the south and west sides of The Knob were dominated by the rock and shallow soil tolerating and more xeric species.

The species found in all study areas were tolerant of steep (30°) slopes. It is probable that the steepness of slope, rather than any other single factor, maintains pine dominance in the areas. Racine (1966) found ridge narrowness essential for pine dominance (over oak) in the relatively wet and deeper soiled Thompson River area of the Blue Ridge escarpment. We have noticed that the parking lot area on Pilot Mountain is dominated by chestnut oak, as is the top of the relatively broad saddle between the Little Pinnacle and The Knob, as well as the relatively flat area on top of The Knob.

Williams and Oosting (1944) considered fire to be a very important factor controlling the vegetation on the mountain. Mr. Bert Coleman, now a N.C. State Parks Ranger on the mountain, has lived in the vicinity all his life, and he remembers a great fire that swept over the whole mountain about 1902. He was properly impressed because he had just learned in Sunday school "that the earth would be destroyed by fire the next time." Williams and Oosting (1944) mention frequent fires until a serious one in 1927 which "burned over most of the mountain.... ...and practically all of the large trees are badly fire-scarred. Since the construction of the toll road [1929] , however, only two small fires have occurred." Mr. Coleman recalls a lightning-caused fire on top of The Knob in the mid-1940's that did not spread to the rest of the mountain. We found some charred bark on a few older pines on the south side, but no evidence of any recent fires of consequence. The spring of 1969 saw a small fire occur down-slope from the parking lot, and the possibility of important fires in the future cannot be ruled out. The number of small individuals of the predominant species found in the study areas suggest that the communities are succeeding themselves. Since the last major fire occurred in 1927, or 43 years ago, there is some doubt that the state of the vegetation is a pyro-climax, but, is due to the steep, rocky, xeric conditions.

SUMMARY

1. A phytosociological investigation of the north-, east-, south-, and west-facing slopes at the base of The Knob on Pilot Mountain was made during the year beginning in April 1969 and ending April 1970.

2. The top of The Knob or Big Pinnacle is some 2,419.8 feet above sea level and about 1500 feet above the gently rolling Piedmont Plateau which surrounds the mountain.

3. Two 10 m x 10 m study plots were located on each of the northernmost, easternmost, southernmost, and westernmost projections of The Knob near its base. The plants of the four study areas were listed on 1/100 scale charts and the areas were compared quantitatively for species composition. Several factors influencing the vegetation were analyzed.

4. It was found that the slope angles on the north, east, and south were not significantly different, but the slope of the west was significantly less; this factor, however, may be offset by the fact that the west side has a notable crosswise slope toward both the north and south.

5. Soil depth was significantly greater on the north than on the other exposures. The south had the least soil depth, and the east and west were intermediate. Actual soil moisture and organic matter content were also greatest on the north. The pH ranged between 3.6 and 4.2 for all study

areas. Mineral content values, with the exception of phosphorus, were highest in the north study area and lowest on the south.

6. The species of plants encountered in the study were found to approximate those making up Southern Appalachian pine-heaths. The species composition of each of the four study areas differed both qualitatively and quantitatively. In the Results and Discussion sections two methods were employed in describing the differences in the floristic composition of the four study areas. The first was a statistical comparison of the difference in the mean densities of a species in pairs of study areas; and the second was a discussion of the presence or absence of the 26 species and 2 other genera found in the study areas.

7. The possible factors involved in determining the composition of each of the study areas is discussed with special emphasis on the influence of The Knob in dissecting the pine-heath community into its more xeric, mesic, sun-tolerant, and shade-tolerant species.

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