

71-13,057

GERSMERL, Philip Joel, 1944-
A GEOGRAPHIC APPROACH TO A VEGETATION
PROBLEM: THE CASE OF THE SOUTHERN APPALACHIAN
GRASSY BALDS.

University of Georgia, Ph.D., 1970
Geography

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Frontispiece.--(Top) Old Bald in the Balsam Range, from the southeast slope, May 28, 1969. (Bottom) Round, Jane, and Grassy Ridge Balds, from left to right, in the Roan Mountain area, June 29, 1968.

**A GEOGRAPHIC APPROACH TO A VEGETATION PROBLEM:
THE CASE OF THE SOUTHERN APPALACHIAN GRASSY BALDS**

by

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B.A., Concordia Teachers College, 1966

**A Dissertation Submitted to the Graduate Faculty
of the University of Georgia in Partial Fulfillment
of the
Requirements for the Degree
DOCTOR OF PHILOSOPHY**

ATHENS, GEORGIA

1970

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Acknowledgements

The writer would like to express his appreciation to Dr. E. E. C. Clebsch of the University of Tennessee, for a home away from home and a first-rate Devil's Advocate; to Ranger Fleetwood and Mr. Freeman of the Blue Ridge Parkway District for their time and assistance in getting to the balds when the Parkway was closed and for the informative discussions on the way; to the National Park Service and the Mead Paper Company for permission to enter their lands and conduct the experiments; to Harry Hollin, Euler Stephens, Will Ellison, and the unidentified mountaineers on Old Bald, Caney Fork, Round Bald, Oldfield Bald, and Whitetop Mountain for irreplaceable conversations while blueberry pickin', ramp-collectin', or just passin' the time; to the members of his advisory committee, for suggesting the topic and guiding the work; for financial assistance from the NDEA Title IV Fellowship, the Graduate Research Assistantship, and the Graduate School Subvention Funds administered through the Geography Department; and to his wife, for being what she is.

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PREVIEW

CHAPTER I

INTRODUCTION

The Phenomena

Treeless mountains

Montane treeless areas are common phenomena throughout the world. The Alps gave rise to a generic name for upland pastures, separated from valley farms by thousands of feet of steep wooded slopes. Mention of the Scottish highlands evokes a stereotype pastoral scene, with gray sheet dotting rounded grassy hilltops under a somewhat leaden sky. The category of nonforested mountains includes the "lawns" of New England, the "parks" of the Colorado Rockies, the "balds" of the Bunya Mountains in Australia, and the thousands of mountain tundras on the loftier ranges of every continent.

These treeless areas are tractable to ecologic explanation to varying degrees. Some mountains extend to such rarified altitudes that they remain forever frozen, with no vegetation visible on the rocks and ice of their summits. At somewhat lower elevations, life mimics the Arctic tundra. At still greater degrees of thermal efficiency, greater variety of vegetation is found, until finally the environment is capable of supporting tree growth. These first trees are trees in botanical name only, their dwarfed and misshapen

appearance reflecting the severity of their habitat. On the warmer lower slopes, the trees stand more erect and occupy a greater proportion of the area; at some arbitrary degree of canopy closure, the vegetation is termed forest.

In this generalized description of the pattern of vegetative response to altitudinal temperature differences, the habitat conditions have been simplified by assuming no moisture or nutrient stresses. If these are added, the problem becomes considerably more complicated; the many "timberline" studies in the literature bear witness to this complexity. Adding the human element introduces further difficulties. For instance, the centuries of grazing on the Alpine meadows may have lowered the timberline by as much as two thousand feet.¹ Separating the vegetative response to natural conditions from the changes wrought by cultural land use poses a major problem in the study of montane treeless areas.

The southern Appalachian balds

Many southern Appalachian mountains are treeless near their summits. Locally known as "balds," these treeless areas are of several distinct types. The "heath balds" or "heath slicks" are nonforested areas dominated by heath species such as Rhododendron catawbiense, Kalmia latifolia, or Vaccinium spp. The "grassy balds" are open grasslands,

¹ Personal communication with David M. Sharpe, Southern Illinois University, August, 1969. Dr. Sharpe did his dissertation on the Rocky Mountain timberline.

dominated by species such as the mountain oatgrass, Danthonia compressa. Some workers recognize intermediate types, such as "shrub balds" where grassy areas have significant woody populations or "heath gardens" where the major invaders are heath species.² The grassy balds are the area of specific concern in this paper; unless otherwise indicated, the term "bald" will be used to denote a grassy bald.

The southern Appalachian grassy balds have been a long-standing ecologic problem. The theoretical thermal treeline for the region has been placed about 10,000 feet above sea level, according to one calculation, but the highest mountain in the region has an elevation of only 6,684 feet.³ Moisture stresses on trees also seem unlikely. The higher elevations receive between 70 and 90 inches of precipitation each year and fall well into the perhumid division in the Thornthwaite classification.⁴ The slight differences between the soils on the balds and in the forests "are probably consequent on the vegetational differences, rather than a cause of them."⁵

²George S. Ramseur, "The Vascular Flora of High Mountain Communities of the Southern Appalachians," Journal of the Elisha Mitchell Science Society, LXXVI (March, 1960), p. 90. (Hereinafter referred to as Ramseur, "Vascular Flora.")

³Paul M. Fink, "A Forest Enigma," American Forests, XXXVII (September, 1931), p. 538.

⁴Royal E. Shanks, "Climates of the Great Smoky Mountains," Ecology, XXXV (July, 1954), pp. 358-59.

⁵Alan F. Mark, "The Ecology of the Southern Appalachian Grass Balds," Ecological Monographs, XXVIII (October, 1958), p. 329. (Hereinafter referred to as Mark, "Ecology of Grass Balds.")

Even though no obvious natural explanation for their treelessness can be seen, the balds have been considered as natural phenomena. The early settlers used these upland grasslands as grazing land for their cattle, yet "it does not seem reasonable that those sturdy people, frugal as they were, would have taken the trouble to make such an extended system of pastures."⁶ "They certainly are not the work of the Cherokee Indians, original inhabitants of the region, for these people have among their legends a mythical account of the creation of the balds by the Great Spirit as lookout posts. . . ."⁷

Many theories have been proposed to account for the treelessness of the southern Appalachian grassy balds. Although suggested causes can be found as early as 1808, true ecologic study of the balds probably dates from the 1930's. The earlier naturalists, mostly "botanizers," were concerned more with collecting and describing plants than with interpreting vegetation patterns.

Early hypotheses attributed the treelessness of the balds to cold, ice damage, cold winds, or winter storms. In the 1930's and 40's, a wide variety of factors were suggested as possible causes: dessicating winds, Indian clearing,

⁶W. H. Camp, "The Grass Balds of the Great Smoky Mountains of Tennessee and North Carolina," Ohio Journal of Science, XXXI (May, 1931), p. 158, (Hereinafter referred to as Camp, "Grass Balds.")

⁷R. S. Yard, "The Great Smoky Wilderness," Living Wilderness, VII (March, 1942), p. 15.

soil factors, insect deforestation, soil temperature extremes, climatic changes, and fire. The 1950's saw the development of two theoretical systems which emphasized microclimatic extremes on certain physiographic sites or in a "bald susceptible zone" along the ecotone between two major forest types. In the 1960's, study was devoted mainly to the factors which delayed forest invasion of the balds; the problems of bald origin and bald maintenance were logically separated. An annotated bibliography of the theoretical literature is furnished in Appendix A.

Objective and Procedures

Objective

The overall objective of this research is to answer a single simple question: what are the factors responsible for the grassy balds?

Procedures in defining "bald"

The first process in a study of the southern Appalachian grassy balds is defining "bald" in such a way as to establish clear criteria for determining what phenomena are to be included in the study. To avoid reaching erroneous conclusions by arbitrarily restricting the input data, it is advisable to construct the definition inductively, making it as broad as necessary to include all possible subtypes of the major set. Then, the definition can be narrowed to the degree of precision required for meaningful conclusions about a

given facet of the problem; there may be as many subdefined groups as there are questions about the balds.

An inclusive definition begins with an examination of other references to grassy balds. The list of phenomena to be considered begins with those mountains which have been described as balds by ecologists or naturalists. To these are added those peaks which have historical or mythological references to their "natural" treelessness. Placenames furnish another source of information and lead to the inclusion of all mountains with the name "Bald," the adjective "bald," or closely related names such as "Bare Place," "Yellow Spot," or "Naked Place." An examination of the list thus compiled reveals that the lowest bald accepted by ecologists is more than 4,600 feet above sea level; the overwhelming majority of all peaks on the list are above 4,000 feet in elevation. To avoid omitting any possible bald, therefore, the final list also includes other mountains higher than 4,000 feet that are indicated as treeless on the U.S.G.S. 7-1/2 minute series of topographic quadrangles. This final criterion was modified somewhat, excluding those treeless mountains whose open summits were simply uninterrupted extensions of valley farms. In these cases, it was felt that even if the mountain were originally treeless, the vegetation surely was altered enough that intensive study would be of doubtful utility. In any case, only about twenty mountains, all below 4,500 feet in elevation, were dropped from the list for this reason. A complete tabulation of the



balds in the writer's file can be found in Appendix B.

Within this comprehensive initial definition, a number of subtypes can be recognized. Each subdefined type of bald has its own characteristics; each scheme of subdivision has its own application. For instance, Mark chose to divide the balds into four groups: balds, cleared fields, "watchtower" clearings, and forested mountains with the name "bald."⁸ Wells, a proponent of the theory of Indian origin of the balds, recognized three types: camp grounds, game lures, and watchtowers.⁹ For the purposes of the present study, the following subgroups have demonstrated their utility :



1) True balds, defined as presently grassy mountains with at least two references to their natural treelessness in the historical records or the ecological literature.

2) Historical balds, defined as mountains that have historical references to their natural treelessness but do not fit both criteria as true balds.

3) Artificial balds, or fields, defined as presently treeless mountains with historical records or evidence for their deliberate clearing by man.

⁸ Mark, "Ecology of Grass Balds," pp. 297-98.

⁹ B. W. Wells, "Southern Appalachian Grass Balds," Journal of the Elisha Mitchell Science Society, LIII (July, 1937), pp. 17-19.

4) Apparent balds, defined as mountains which have the physical or visual characteristics of balds but no historical or ecological references to their natural treelessness or artificial clearing.

5) Nominal balds, defined as mountains with the name "Bald" but neither the historical records nor the physical characteristics of balds.

Further discussion of this classification is reserved for Appendix B.

Procedures in approaching the problem

The analysis of a problem such as that posed by the southern Appalachian treeless anomalies, where physical and cultural factors interact in such a complex manner, necessarily involves probing in many different directions. Factors which may bear no other relationship to each other could be intimately intertwined within the small confines of a single grassy bald. For this reason, no single procedure for this research can be described, except to say that the study was broadly inductive. The writer began by assembling a card file of balds-according-to-the-comprehensive-definition. This involved searching topographic maps, copying locational data for each bald, and making sketch-maps to supplement brief descriptions of the topographic setting of each bald. The summer of 1968 was spent in visiting a number of balds which were selected from the card file in order to maximize the amount of possible information gained from the visits

while minimizing the effort expended in reaching the balds. At the same time, the theoretical literature related to the balds was surveyed. In the autumn of 1968, a number of balds were visited again to observe elements that should have been noted earlier but whose significance was not realized at the time of the first visit. Such an interplay of observation and modification of theory which in turn necessitates further observation is characteristic of studies of this nature; often, the whole answer simply does not fit into the constraints imposed by the manner in which a hypothesis first was examined. In the course of the next year and a half, the writer performed a number of research activities suggested by the reconnaissance visits. Field measurements of soil moisture, soil temperature, lower-air temperature, wind velocity, and evaporation were made. Distribution maps and latitudinal and range profiles were drawn in order to discover possible spatial relationships between the balds and other landscape features. Early records were searched in order to reconstruct the Indian occupancy patterns and the conditions under which the early European settler made his land-use decision. Different balds were visited, some of them repeatedly, under different weather conditions. Other sources of information, including interviews with knowledgeable people, were sought wherever possible. By early 1970, the outline of the problem was fairly clear. Further work was devoted to filling the gaps by obtaining key photographs, measurements, and historical

data. Appendix C is a calendar of the writer's research travels.

Procedures in presenting the findings

The means used in reporting the results of any research are conditioned by the nature of the problem. In the case of the grassy balds, it was deemed convenient to present the findings in a number of semi-independent sections, each treating a different aspect of the complex problem. These sections are organized as answers to questions which have emerged as significant during the three years of the study:

- 1) Does the existence of Indian legends about the balds prove the pre-European existence of the balds?
- 2) Could the patterns of Indian occupancy of the region have led to treeless mountains?
- 3) Are the balds on exposed sites?
- 4) Do the factors of exposure act with sufficient intensity to limit trees?
- 5) Are the balds on the ecotone between the coniferous and deciduous forest types?
- 6) Does this ecotone represent a bald-susceptible zone?
- 7) Do the Judaculla Fields pose unanswerable questions for the exposure or ecotonal hypotheses?
- 8) Can any type of fire lead to a grassy bald?
- 9) Are biotic factors such as reproduction and species competition important to the origin or maintenance of the bald areas?