

Vegetation Monitoring
at Kings Mountain National Military Park,
South Carolina:
A Report on the Summer 1994 Field Season

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Abstract

Seventeen 0.1 ha (20 x 50 m) permanent vegetation plots were sampled in Kings Mountain National Military Park. The plots were stratified by elevation, aspect, slope inclination, and site moisture class.

In many wooded areas of the Park the species richness is low compared to other, similar, wooded areas in the Piedmont of North and South Carolina. The causes of this are unknown, but past human history is probably a contributing factor. Very high levels of fuels (leaf litter and organic debris) may also contribute to the low diversity.

We propose additional sampling to complete a set of permanent sample plots for vegetation monitoring at Kings Mountain.

Introduction

Kings Mountain National Military Park is located in Cherokee and York Counties, South Carolina. It was authorized in 1931 to commemorate the Battle of Kings Mountain, which was fought on October 7, 1780 (Resource Management Plan, Kings Mountain National Military Park). The primary resource is approximately 1,646 hectares of protected lands in the northern Piedmont section of South Carolina (Basic Operations Declaration, Kings Mountain National Military Park).

This report is a detailed account of field work conducted during two trips to Kings Mountain National Military Park between the dates of June 27 through July 5, 1994, and August 31 through September 8, 1994.

Project Objectives

The purpose of the work was:

(1) To contribute to a comprehensive long-term vegetation monitoring plan for Kings Mountain National Military Park

and

(2) To establish permanent plots in order to:

- describe the rate and trajectory of vegetation change, including change in vegetation structure, composition, and dynamics;
- assess the impacts of particular threats;
- assess the response of sensitive resources;
- gauge the significance of vegetation changes for park management goals;
- help define research questions that will assess the causes of change;
- help define research that will evaluate alternative management strategies;
- build an understanding of ecosystem processes so that future changes can be better predicted;
- establish field research sites that will attract additional research studies;
- and promote participation in regional and international monitoring networks.

The field work reported here was part of a project carried out in five NPS units in the southeast: Chickamauga and Chattanooga National Military Parks, Georgia and Tennessee; Kennesaw Mountain National Battlefield Park, Georgia; King's Mountain National Military Park, South Carolina; Russell Cave National Monument, Alabama; and Shiloh National Military Park, Tennessee. For each area we sought to establish a preliminary set of monitoring plots organized around the highest priority

natural resource issues and to suggest the priorities for fuller development of a vegetation monitoring program. Implications for park management policies and practices are also considered.

The field work focused on the establishment of seventeen 20 x 50 m permanent sample plots, distributed throughout the park from low to high elevations, in pairs at a variety of aspects (i.e. one of a plot pair on a northwest-facing slope, the other on a southeast-facing slope), and in mid and late successional stands.

The flora and vegetation of Kings Mountain National Military Park

The current list of vascular plants at Kings Mountain National Military Park has been compiled and documented by Devin Kennemore of The University of South Carolina at Columbia. The final report is nearing completion at this time. Previous studies of the vegetation at Kings Mountain are rudimentary lists of the flora and vegetation communities by Barnwell (1992).

Upland forests are dominated by Oak, (Quercus spp.), Hickory (Carya spp.) and, formerly, Short-Leaf Pine (Pinus echinata). Much of the Pine has been recently eliminated by the southern pine beetle, a native insect which has periodic outbreaks. Past disturbance may have lead to extensive areas of Pine dominance--with the canopy trees becoming vulnerable to the beetle in even aged blocks. Understories vary from dominance by Mountain Laurel (Kalmia latifolia) on north facing slopes, to dominance by tree saplings (mostly Oaks), to dominance by Sparkleberry (Vaccinium arboreum) on dry ridgetops. The herb layer in much of the upland wooded areas is scant. This brings the overall diversity of the average plot down considerably.

Floodplain areas such as that adjacent to Kings Creek are dominated by Sycamore (Platanus occidentalis) and Black Walnut (Juglans nigra). These areas have higher diversity and a dense herb layer, although much of the herb cover is the exotic Japanese or Bamboo Grass (Microstegium vimineum).

In a general sense, the purpose of the vegetation monitoring plots is to obtain baseline data so that changes in the health and condition of these natural resources can be detected (see Project Objectives, above). The importance of monitoring is well detailed in Sutter, Rollins & Livingstone (1994) and Sutter et. al. (1994). As human impacts grow, both in terms of the numbers of people who use the Park and as such human influences as pollution of air and water increase with the growth of adjacent human population, it is anticipated that this will be reflected in changes in the natural areas of the park.

The 1994 field work

The remainder of this report is divided into three sections

and accompanying Appendices.

The Methods section describes the procedures used to carry out this study. This section is divided into three parts: Site Selection Criteria (basic elements of sampling design); Sampling Protocol; and Site Locations and Descriptions (a description of the means for relocation of permanent plots).

The Results section presents preliminary summaries of each plot (raw data are included in Appendix A). The location of each plot is illustrated in annotated sketch diagrams, as figures, that accompany the text. Soil samples information is included in Appendix C.

The Discussion section draws together the findings for each of the areas studied and suggests priorities for future work.

Methods

The design for this project consists of stratified random sampling, using a plot size of 20 x 50 m (0.1 ha). This rectangular plot is further divided into ten standard 10 x 10 m subplots (in this report, the 20 x 50 m units will be termed "plots", the 10 x 10 m units will be termed "subplots" and the smaller units (e.g., 1 x 1 m) will be termed "quadrats"). This general plot design has been widely used in the woodlands of the eastern United States, in all but the lowest density old growth stands, where plot sizes of 0.4 to 1.0 ha are used (e.g., the work of P. White and R. Busing in old-growth hemlock-hardwood stands of Great Smoky Mountains National Park), and in the highest density stands, where plot sizes of 0.01-0.04 ha have been used (e.g., in the plots designed by P. White and others for the spruce-fir acid rain studies in the Smokies). We note that even the studies that used larger or smaller overall plot sizes, employ the 10 x 10 m subunits employed in the current study, as well as similar methods of measurement for these units.

The rationale for the basic sampling strategy is developed in White and Busing (1992). The importance of nested sampling for species presence and for documentation of the various scale dependencies that are common in vegetation data is described by Palmer and White (1994), Busing and White (1993), and Reed et al. (1992).

The plot design used here is similar to that widely implemented by the North Carolina Vegetation Survey, but is more completely monumented and more intensively sampled.

Site Selection Criteria

The process used to determine sites for monitoring follows three steps.

The first step in the selection of study sites is consideration of park monitoring objectives as identified in various sources.

The second step, if appropriate for a particular monitoring situation, is stratification of the factors thought to control the variation in the resources to be monitored.

In the last step, the available sampling effort is allocated to the potential sampling sites identified by the stratification parameters and sample locations are chosen in the field.

These steps are described in more detail below.

Monitoring objectives. The initial selection process was based upon threats to park resources or monitoring requirements

outlined in the park's Resource Management Plan, the Regional Action Plan, and the Inventory and Monitoring Needs Assessment (Langdon, no date), and from consultation with regional agencies (State Heritage Programs and The Nature Conservancy, South East Regional Office), local experts (Kennemore, pers. comm.), and park personnel (Cissel and Hanks, pers. comm.), and observations made during reconnaissance of the park. Certain sites were selected for their importance as natural resources, regardless of the presence of immediate or suspected threats. Nonetheless, they were considered important as part of a comprehensive survey of all a park's natural areas, in line with the Project Objectives.

The Resource Management Plan for Kings Mountain states that the lack of baseline data on natural resources at the park impedes natural resource management (KIMO-N-001). The ongoing inventory and the seventeen permanent monitoring plots begin to address the task of understanding the natural resources at Kings Mountain.

The Resource Management Plan also describes a need for to information on the effects of air and water pollution (KIMO-N-007). A third issue related to vegetation monitoring in the Plan is the need for a fire management plan (KIMO-N-005). Organic debris has accumulated in the Park to a very high level. Much of this buildup is related the Short-Leaf Pine mortality caused by the southern pine Beetle. The high fuel levels may also contribute to the low species diversity in the Park's wooded areas.

Park Personnel (Taylor, pers. comm.) also identified as a monitoring requirement the areas that have been devastated by the southern pine beetle. The beetle has removed much of the over-story Short-Leaf Pine that was present in the forest. Certain areas have not yet been affected by the southern pine beetle and these can be compared to those that are affected. The areas of Pine die-off have added a large amount of fuel to the affected areas.

Stratification and plot placement. Once the resources to be monitored are selected, the next step is to determine the range of natural variation in those resources and to develop a sampling scheme that encompasses that variation. Stratification is used to block the variation present into levels or categories, thus ensuring the range of variation is sampled and the sample variation is distributed among plots. Plots are then randomized within stratification blocks.

Stratification is used to produce an efficient sampling scheme in the sense that plots are allocated to the range of variation present in a systematic way. This also allows for a straightforward approach to replication, since replicates are chosen within the stratification parameters. Stratification

normally employs variables that influence vegetation composition, structure, and dynamics, including topographic variables (elevation, slope aspect, slope steepness, slope shape, slope position), soils, and disturbance history.

Plot locations. Once the stratification blocks are established, generalized plot locations are selected on topographic maps. The actual position of each plot is randomized within the area that fits the stratification criteria. However, many factors constrain the true randomness of the application of the plot.

First, the size of the sample area may be no larger, or possibly smaller, than the size of the plot (20 x 50 m). In such cases it is then only possible to center the plot on the sample area.

Where the sample area is sufficiently large to allow a random plot site assignment there are still constraints that must be considered. For example, the stratification assumes that the plot itself is characterized by the stratification parameters--e.g., it has one dominant slope aspect and does not have major breaks in topography, disturbance history, or soils. In this study, we position plots in intact forest not recently disturbed by tornado damage or other large windstorms.

Another factor in the positioning of the plot is slope inclination. We sought to position plots such that plot long-axis be close to parallel with the slope contours.

Sampling Protocol

The technique used to survey the 0.1 ha plots is described in this section (see also White and Busing 1993). It is similar to the sampling procedures of the North Carolina Vegetation Survey. The current protocol is a more detailed survey method that more precisely depicts the community structure. The increased detail allows greater resolution of the changes that take place through time. One major difference is the assignment of an absolute value to diameter-at-breast-height (dbh) of all trees, as opposed to a visual estimate of tree diameter and the grouping of trees into size classes. The diameter values are obtained using a steel tape measure graded in centimeters multiplied by pi, such that a direct reading could be taken from the tape. Other differences from the North Carolina Vegetation Survey plot technique is the sampling of all ten of the 10 x 10 meter subplots for herb and shrub cover, rather than just four, and the sampling of all stem sizes for trees--e.g., including tree seedlings and saplings. More effort is spent to mark the plots in the field and to map plot locations from landmarks.

The basic layout of the plot is a 50 x 20 meter rectangle. See the plot tree maps in Appendix A-3 for a graphic description

of the plot layout. It is marked along the center-line by 30 cm metal stakes placed every ten meters. The perimeter of the plot is not marked except temporarily at the corners and 10 meter points during the survey. The plot is slope corrected in the field. The following elements of the survey technique will be described individually: nested survey, herb cover and tree seedling density survey, shrub cover and tree sapling density survey, and tree survey.

The layout of the plot, including how the different quadrat sizes are nested within each other, and a brief description of how data from the plot are recorded, is provided in Appendix D.

Plant names and codes. In the field, plants were identified using the checklist of Kings Mountain National Military Park prepared by Kennemore (1994) and Radford et. al. (1968), or were collected for later examination. Unknown plants were assigned a temporary identification that often included key characteristics of the plant. Plant identifications were carried out in the herbarium at the University of North Carolina at Chapel Hill (NCU), using Radford et. al. (1968), Gleason and Cronquist (1991), Cronquist (1991) and Isely (1991). Voucher specimens will be stored at NCU and have Barnett-Lawrence collection numbers. The taxonomy used throughout this study is that of Kartesz (1994).

Species codes were used throughout the surveys. These are derived from the scientific name of the species observed. The species code uses the first four letters of the genus followed by the first three letters of the species epithet from this name. A list of the species codes used is in Appendix A-10

Nested sampling for species presence. Vascular plant presence in the plot is recorded using a nested series of quadrats in four of the 10 x 10 subplots, finally expanding to the full 20 x 50 m plot area. See Figures 1 and 2 in Appendix D for a visual representation of this.

The survey begins in the smallest quadrat of each of four 10 x 10 m subplot, and continues through successively larger quadrat sizes, with species added in the sequence that they are encountered. Each species is recorded (by code), along with a numeric denoting the quadrat size or level in which it is first found. Plants that are not found in any of the 10 x 10 m subplots but first encountered in the remaining area of the 0.1 ha plot after sampling of the 10 x 10 m units, are then recorded. The numerics for quadrat sizes are:

- 2 (0.01 m² or 10 x 10 cm)
- 1 (0.1 m² or 32 x 32 cm)
- 0 (1.0 m² or 1 X 1 m)
- 1 (10.0 m² or 3.2 x 3.2 m)
- 2 (100.0 m² or 10 x 10 m)

3 (1000 m² or 20 x 50 m).

In this manner, six areal orders of magnitude are scored for species presence. Variables are: subplot number (i.e., which 10 x 10 m subplot the quadrat is in), species code, and quadrat size numeric (-2 to 3 as described above).

The nested survey of the 0.1 ha plots begins in the 10 x 10 subplots numbered 4, 5, 6 and 7, (See Figures 1 and 2 in Appendix D, and Appendix A-3, Plot Tree Maps, for diagrams of the layout of these nested quadrats) and proceeds from small to larger quadrat sizes.

Nested survey data are listed in Appendix A-9.

Herb cover and tree seedling density sampling. This is conducted in a 1 x 1 meter quadrat in each of the 10 x 10 subplots according to the layout in Appendix A-10. Tree seedlings are considered to be stems of tree species less than 1 meter in height. Variables are: subplot number (i.e., which 10 x 10 m subplot the quadrat is in), species code, and either herb cover class (for herbs) or number of stems (for tree seedlings).

Cover is estimated by gauging the total amount of bare ground obscured by a particular species. Even if there is more than one layer of a plant, the area of overlap within the species is not added to the total area. Cover classes are used. Presence of a species that has negligible cover (e.g., <0.01% if measured accurately) is still counted in the base cover class of 3%. Overall totals for cover may exceed 100%.

The percent cover of mosses and lichens, rock, bare area, fallen logs, and standing water is also estimated. Unaccounted for area is assumed to be leaf litter.

Cover classes are:

0-5% cover	= 3
5-25%	= 15
25-50%	= 37
50-75%	= 62
75-95%	= 85
95-100%	= 97

Herb cover data summaries are listed in Appendix A-7, tree seedling data summaries in Appendix A-8.

Shrub cover and tree sapling density sampling. This is conducted in a 3.2 x 3.2 meter quadrat, nested upon that which is used for the herb cover survey, in each of the ten 10 x 10 meter subplots. Variables are subplot number (i.e., which 10 x 10 m subplot the quadrat is in), species code, and shrub cover class (for shrubs) and number of stems (for tree saplings). Cover

classes are the same as for herbs.

Tree saplings are recorded in two size classes; those between 1 meter and 1.4 m tall (breast height, bh) and those greater than 1.4 m tall but less than 1 cm in diameter at this height (<1 cm dbh).

Shrub cover data summaries are listed in Appendix A-4, below-breast-height sapling data summaries are listed in Appendix A-5, and above-breast-height sapling data summaries in Appendix A-6.

Tree sampling. All live woody plants greater than or equal to 1 cm at breast height (≥ 1 cm dbh) are measured using a steel tape measure marked off in centimeters $\times \pi$. Standing dead trees greater than or equal to 10 cm at breast height (≥ 10 cm dbh) are recorded. All trees, dead or alive, greater than or equal to 10 cm at breast height are mapped as circles (sized approximately proportional to dbh) on a diagram of the 0.1 ha plot. Dead trees are marked with an "x" in the circle. Fallen logs ≥ 10 cm in diameter are also sketched in on the maps. Other features, such as rock outcrops or pools of water, are added to the sketch maps.

The tree sampling is conducted one 10 x 10 m subplot at a time. This aids in the mapping of the trees and also for the calculation of the frequency of occurrence of each woody plant species.

As well as being mapped, all trees ≥ 10 cm dbh are assigned a dominance class between 1 and 5:

- 1 - dominant canopy tree rising well above average canopy height
- 2 - co-dominant canopy tree reaching average canopy height
- 3 - subdominant tree below average canopy height
- 4 - strongly suppressed, unhealthy or damaged tree
- 5 - standing dead tree

Raw tree data are listed in Appendix A-2, tree data summaries are listed in Appendix A-1, and plot tree maps are in Appendix A-3.

Soil samples. Soil samples are taken by collecting approximately 100 grams of soil from five points along the plot center-line. It is very important that the soil not be taken from within the nested series of quadrats that begin at the center-line in each 10 x 10 subplot. Rather, soil should be taken from the side of the center-line opposite the one where species presence was scored.

The humus layer and that part of the soil surface with large amounts of recognizable organic debris are removed and the soil

sample taken. These layers should be replaced after soil removal. The soil should be stored in either paper or cloth bags. Plastic bags do not allow efficient drying of the samples. After being air dried the five samples from a single plot are pooled, mixed, and a subset of this sent for analysis. The soil samples must not be oven dried since this will change the composition of the sample.

Soil sample data are located in Appendix C.

Site Locations and Descriptions

This section describes the means used to mark plots and documents plot locations for resampling. The process of "mapping in" a plot is also outlined.

Where possible (e.g., except on rock outcrops--exceptions are noted on maps and data sheets), plots are marked at the 0 m end of the center-line with a one meter long piece of 1.9 cm steel re-bar. At least two feet of this bar project above the litter layer. Where possible, a 30 cm length of steel tubing is placed in the ground at the 50 m end. 30 cm long pieces of PVC pipe are placed in the ground at the 10, 20, 30 and 40 m points along the center-line, unless the substrate at that point prevented it. A combination of steel and PVC markers are used to control costs and to ensure that, in the event of a fire, the location of the plot is not obliterated. The nature and position of the stakes is always indicated on plot maps and data sheets.

When plots are located far from any easily located landmark, trees are tagged with 2.5 cm numbered aluminum disks and "mapped" to the plot. This requires taking a bearing from the tagged, or "witness", tree to a specified point within the plot. This is usually the 0 m center-line stake. The distance from the witness tree to the stake is measured and included with the bearing in the vector (note that no correction to true North was used; compass angles were recorded directly from magnetic North). Witness trees are tagged and vectors calculated as necessary to form a chain linking a permanent landmark with the plot. This process is known as "mapping in" the plot.

In the event that witness trees fall it is still possible to use the bearings and distances to find the points from which to relocate plots or other witness trees. The use of stakes, landmarks, witness trees, distance-angle vectors and accurate placing of markers on topographic maps are part of the redundancy of marking the plot locations.

Each plot has its own set of instructions, often involving the locating of witness trees, that are described for each plot. Sketch maps are used throughout to clearly depict the location information (figures 1-8). The maps are not drawn to scale but contain the data necessary to relocate the plots in the field.

Arrow heads on direction lines indicate the direction in which the compass angle is taken. Distance lines do not have direction arrows since they indicate only a certain distance along a trail or road. In general, the distance is measured along the center of the trail or road. However, measuring tapes may, at times, touch the inside of bends in the trail.

Beside each direction arrow is a lower case letter that refers to a specific instruction or a combination of distance and bearing. For example, a direction arrow accompanied by the letter "c" means that the instruction following the annotation "c:" must be consulted. Witness trees are marked in figures as open circles accompanied by # and a number. The same number annotation must be consulted to find the species and diameter-at-breast-height (dbh), in centimeters, of the tree. In the field, witness trees are identified by the attachment of a 2.5 cm aluminum tag at breast height. The tag bears the same number as the annotation number in the figure.

For clarity, an example is described here. An arrow pointing from circle (tree) #33 to circle #34 (tree) with the letter "c". Annotation "c:" is 45.5 m @ 107°. This is read as: it is 45.5 meters from tree #33 to tree #34 at a compass bearing of 107°.

Where a witness tree borders a trail or is visible from a trail, the tag is placed on the side of the tree away from the side visible from the trail.

Certain witness trees are multiple-trunked at or below breast height. This is marked on the figures where appropriate. The dbh reading refers to the largest of the trunks. The field tag is attached to the trunk that is measured. In certain instances, two or more plots are located so close to each other that the means of locating one of the plots is a means to locate the others.

Results

In this section each of the seventeen 20 x 50 m plots is briefly described. The plot descriptions include all permanent markers and detailed instructions on how to locate each plot. The vegetation is briefly characterized. The characterizations are based on the data summaries in Appendix A. Dominant species are those with importance values and relative importance values of at least ten percent. Species are listed from most dominant to least dominant.

Plot Descriptions

Information relating to the permanent plots, such as survey date, photograph frames shot, canopy height and inclination, are provided in Table 1. Figures 1 and 4 are scanned portions of USGS topographic map: Grover, N.C.-S.C. (USGS 7.5 minute series). For additional plot information, such as photograph frames shot, canopy height and inclination, see Appendix E.

Plot KIM01

This plot is located on a northeast-facing upper slope in an area in which Short-leaf Pines (Pinus echinata) have been nearly eliminated by the Pine Beetle. The dominant trees are Sourwood (Oxydendrum arboreum), Red Maple (Acer rubrum), Southern Red Oak (Quercus falcata), Black Gum (Nyssa sylvatica), Chestnut Oak (Quercus prinus), Sweetgum (Liquidambar styraciflua), and Scarlet and Red Oaks (Quercus coccinea and Q. rubra respectively)

The shrub layer is dominated by Blueberry (Vaccinium pallidum), and Red Maple and Southern Red Oak seedlings. Greenbrier (Smilax glauca) is also common.

Herb cover is absent. This could be the result of past agriculture (e.g., if the land was in row crops) or low moisture and nutrient availability (possibly the result of the deep accumulation of leaf litter). Overall diversity in this plot (species richness) is very low, woody plants of the shrub layer up to the canopy only. See Figures 1 and 2 for location information.

Plot KIM02

This plot is located close to and downslope of plot KIM01. The slope is north-facing the plot is at the top of a south-north running ravine. The dominant trees are a similar mix but both Red Maple and Southern Red Oak are more important than Sourwood. White and Black Oaks (Quercus alba and Q. velutina respectively) occur as canopy trees.

The shrub cover is more dense than KIM01, most of it coming from tree saplings of Red maple, Southern Red Oak, Black Cherry

(Prunus serotina) and Black Gum. Grape vine (Vitis rotundifolia) is common.

Wild Ginger (Hexastylis minor) is the only herb present, in one of the subplots. Diversity is higher than plot KIMO1 because of higher woody plant diversity. See Figures 1 and 2 for location information.

Plot KIMO3

This plot is located on the opposite side of Dellingham branch on a south-facing upper slope. This area has been devastated by the Pine Beetle and no Short-Leaf Pines are standing in the plot. Fuel loading is high. The tree class is dominated by Red Maple and Flowering Dogwood (Cornus florida). There is higher woody plant diversity here than in both plots KIMO1 and KIMO2, increasing the overall plot diversity by the same amount. Canopy trees are Red Oak, Chestnut Oak, Post Oak (Quercus stellata), Southern Red Oak, White Oak, Black Oak, Mockernut and Shagbark Hickory (Carya alba and C. ovata respectively) and Tulip Poplar (Liriodendron tulipifera).

The shrub layer is dense in some patches of Mountain Laurel (Kalmia latifolia), the remainder being made up of a wide variety of tree saplings.

The herb layer is represented by one occurrence of Solomons Seal (Polygonatum biflorum). Overall this is one of the highest diversity wooded areas at Kings Mountain. See Figures 1 and 2 for location information.

Plot KIMO4

This plot is located slightly up slope of plot KIMO3 on a ridge crest that runs north-south. The composition is very similar to plot KIMO3 but with less evidence of there having been a stand of Short-Leaf Pine present in the past. Tulip Poplar is much more prominent. Shrub cover is also similar to plot KIMO3

Herb cover is again virtually non-existent. Overall diversity is slightly lower than plot KIMO3. Fuel loading is high. See Figures 1 and 2 for location information.

Plot KIMO5

This plot is located at the park's lowest elevation in a floodplain of Kings Creek. The canopy is dominated by Sycamore and Black Walnut (Juglans nigra), and the rest of the tree class is Ash, Box Elder (Acer negundo), and Hackberry (Celtis laevigata).

Dominant shrubs are saplings of Tupelo Gum (Nyssa aquatica) and Box Elder. The exotic Multiflora Rose (Rosa multiflora) is

abundant in patches. Japanese Honeysuckle (Lonicera japonica) is also common.

Fuel loading is low in this plot and the herb layer is dense, with most of the cover supplied by the exotic Bamboo Grass (Microstegium vimineum).

This is one of the most diverse areas at Kings Mountain, despite its locally abundant exotics. The rare grass Elymus riparius occurs here. The status of this population should be evaluated since it appears that much of its available habitat is overwhelmed by Bamboo Grass. See Figures 1 and 3 for location information.

Plot KIM06

This plot is located on a northwest-facing mid slope. The slope is very thickly covered with Mountain Laurel that makes maneuvering at times difficult. The tree class is dominated by Mountain Laurel and Sourwood. Canopy trees include White Oak, Tulip poplar, Scarlet and Southern Red Oaks, and Sweetgum. Short-Leaf Pine is present and does not appear to have been affected by Pine Beetle.

The shrub layer is dominated by Mountain Laurel. Herb cover is sparse but that is to be expected in a Mountain Laurel habitat. Overall diversity is normal for this habitat type. See Figures 4 and 5 for location information.

Plot KIM07

This plot is located on the southeast-facing slope opposite plot KIM07. There does not appear to be a strong dominant and the canopy is one of the most diverse of those sampled in the park. It includes some undamaged Short-Leaf Pines.

The shrub layer reflects the canopy in being quite diverse. Herbs occur more frequently than in other upland plots, but are still scant. The overall diversity is the highest of all seventeen plots at Kings Mountain, but is not unusually high for Piedmont vegetation. See Figures 4 and 5 for location information.

Plot KIM08

This plot is one of five (KIM08-KIM012) that sample a ridge and ravine system that runs north-south, east of Piedmont road and south of the main road through the park.

Plot KIM08 samples an upper slope/ridgetop. The canopy is dominated by White and Scarlet Oaks, with some Tulip Poplar and Black Oak. The subcanopy is predominantly Red maple and Sourwood with some Flowering Dogwood. The shrub layer is dominated by Red

Maple seedlings. The herb layer is absent. Overall diversity is low. See Figures 4 and 6 for location information.

Plot KIM09

This plot is down slope of, and mapped to, Plot KIM08 on a west-facing ravine slope. The slope is not large and the plot covers the mid-lower portions. The canopy, subcanopy and shrub layers are very similar to Plot KIM08. The herb layer is better developed and the overall diversity of the plot is substantially higher than Plot KIM08. See Figures 4 and 6 for location information.

Plot KIM010

This plot is located on the upper slope/ridgetop of a ridge immediately west of the one on which Plots KIM08 and KIM09 are located. The canopy is dominated by Chestnut and Southern Red Oaks, the subcanopy by Black Gum, Red Maple and Sourwood. The shrub layer is dominated by Green Greenbrier (Smilax bona-nox) and saplings of Red Maple and Oaks.

The herb layer is very sparse and overall diversity in the plot is low, intermediate between Plots KIM08 and KIM09. See Figures 4 and 6 for location information.

Plot KIM011

This plot is located on a ridgetop within view of the trail that runs from the locked gate at the main park road into Kings Mountain State Park. Moving from the gate south, the plot is on a slight rise (the backbone of the ridge) to the southwest of the road, about 50 m from it.

The canopy is dominated by Chestnut Oak. Scarlet Oak and Short-Leaf Pine are also common. The understory is dominated by Sparkleberry (Vaccinium arboreum) in a dense stand on the crest of the ridge. This may serve as a means to relocate the plot.

The herb layer is absent. Overall diversity is very low, similar to Plot KIM08. See Figures 4 and 6 for location information.

Plot KIM012

This plot is located downslope of, and is mapped to, Plot KIM010 on an east-southeast-facing ravine slope. The canopy is dominated by Southern Red Oak, the understory by Red maple, Sourwood, Flowering Dogwood and Black Gum. The shrub layer contains many Grapevines and tree saplings, Mockernut Hickory (Carya alba) being prominent.

The herb layer is again sparse, overall diversity is,

however, substantially better than Plot KIMO11. See Figures 4 and 6 for location information.

Plot KIMO13

This plot is one of a pair (with Plot KIMO14) that are situated on either side of Lookout Tower Mountain, the highest point in the park. This plot is on the south-facing slope. The canopy is dominated by Chestnut Oak. The sub-canopy is patchy, and local dominants include Sparkleberry, Blackjack Oak, Sourwood and Mountain Laurel. The shrub layer is thin and reflects the composition of the sub-canopy.

The herb layer is almost absent. This area is not likely to have been used as agricultural land because of its inclined and rocky nature. The extremely high fuel buildup may be related to the low diversity. If low moisture or a high ratio of carbon to nutrients slows decomposition, nutrient availability could limit herb richness. In places the layer of dried leaves are close to knee-deep and, thus, presents a formidable physical barrier to seedling establishment. Overall diversity is one of the lowest for all of the plots at Kings Mountain. See Figures 1 and 7 for location information.

Plot KIMO14

This plot is one of a pair (with Plot KIMO13) that are situated on either side of Lookout Tower Mountain, the highest point in the park. This plot is on the north-facing slope. The canopy is dominated by Chestnut Oak. The sub-canopy is predominantly Sourwood, with Black Gum, Flowering Dogwood and Mountain Laurel.

The shrub layer contains patches of Blueberry (Vaccinium pallidum) but otherwise shows similar composition to the sub-canopy. The herb layer is again very scant, though the parasitic plant Pine-sap (Monotropa hypopithys) occurs here. The fuel loading is very high. See Figures 1 and 7 for location information.

Plot KIMO15

This plot is one of three that sample the vegetation of Brushy Ridge. The plots are located on the southeast-facing slope (KIMO15) the ridge crest (KIMO15) and northeast-facing slope (KIMO17).

The canopy is very low and inter-grades heavily with sub-canopy vegetation. It is dominated by Chestnut Oak, Blackjack Oak, Persimmon, Sourwood and Sparkleberry. The shrub layer reflects the subcanopy with the addition of Greenbrier, Grapevine and Winged Sumac (Rhus copallina).

The herb layer is scant and overall diversity low. Fallen logs account for about 10% of the ground cover. This adds to the high fuel level. See Figures 4 and 8 for location information.

Plot KIMO16

This plot is one of three that sample the vegetation of Brushy Ridge. The plots are located on the southeast-facing slope (KIMO15) the ridge crest (KIMO15) and northeast-facing slope (KIMO17).

The canopy is low, open, and blends with the sub-canopy. It is dominated by Chestnut Oak, Blackjack Oak, Persimmon, Sourwood and Sparkleberry. The shrub layer reflects the subcanopy.

The herb layer is almost absent, overall diversity is low. Fuel loading is not as high as in the two plots on the flanking slopes. See Figures 4 and 8 for location information.

Plot KIMO17

This plot is one of three that sample the vegetation of Brushy Ridge. The plots are located on the southeast-facing slope (KIMO15) the ridge crest (KIMO15) and northeast-facing slope (KIMO17).

The canopy is dominated by Chestnut Oak and Black Gum. The sub-canopy is dominated by Sourwood with locally thick patches of Mountain Laurel. The shrub layer is similar with Mountain laurel predominating.

The herb layer is almost absent, though this is common in habitats with heavy Mountain Laurel cover. Overall diversity is low, but close to normal for a north-facing Mountain Laurel slope. See Figures 4 and 8 for location information.

Discussion

The Resource Management Plan for Kings Mountain notes that at the time that the land within the park was originally set aside for preservation it was pasture and farmland. In the 50 or so years since then it has been allowed to succeed to forest. The Resource Management Plan also claims that the current vegetation resembles the former old-growth primary forest that existed prior to the 1800s. However, since the composition and age structure of the presettlement forest is unknown, this statement is unfounded. It is more likely that the current vegetation differs considerably from the original primary forest. The present wooded areas have very low diversity (species richness), of all levels in the forest structure (canopy, sub-canopy, shrubs layer and herb layer), in comparison to other Piedmont vegetation (Barnett-Lawrence et. al., 1994).

One of the reasons for the low diversity of the present forest is the historical use as agricultural land. Some woodland species may have survived this period of landuse, and others may have migrated back as forests became reestablished. In general, however, the past use of the land, such as plowing and exposure of once forest floors to full sunlight, may have permanently extirpated many of the species, particularly herbs, that are commonly associated with Piedmont forest. Woodland herbs often have low reproductive outputs and slow migration rates.

Current fuel loads may be a contributing factor in the low diversity within upland plots. There is heavy accumulation of organic debris (leaf litter, dead logs etc.), in places a layer as thick as 30 cm, above soil (A horizon). This material presents a physical barrier to seedling establishment. In addition, high carbon to nutrient ratios would reduce decomposition rate and accentuate any nutrient imposed limit to diversity.

The high fuel loading throughout upland areas of the Park is a concern that should be addressed through further surveys. A survey and map of fuel types and loading is a necessary step towards a fire management plan. The many trails and fire-roads dividing up the Park suit it well for a burn prescription (K. Taylor, pers. comm.).

The populations of Elymus riparius should be evaluated as its habitat is rapidly colonized by the exotic pest Bamboo Grass.

To complete the establishment of permanent sample plots for this park, 25 additional 0.1 ha plots are recommended. These should be stratified by elevation, topography, disturbance history and community type. This work would require one leader/taxonomist-ecologist (1 full-time position for four months to allow data curation, summary, and analysis) and a field assistant for plots and data entry (1 full-time position for

three months).

Other monitoring issues

In order to continue general monitoring of the current plots it is recommended that they be resampled every five years. If a specific threat is associated with a plot, if change appears rapid, or if mechanisms of change must be discovered, then the resampling should be carried out on an annual basis.

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Tables

Table 1: Plot information

Figures

Figure 1: Locations of Plots KIM01-KIM05 and
KIM013-KIM014

Figure 2: Plots KIM01-KIM04

Figure 3: Plot KIM05

Figure 4: Locations of Plots KIM06-KIM012
and KIM015-KIM017

Figure 5: Plots KIM06 and KIM07

Figure 6: Plots KIM08-KIM012

Figure 7: Plots KIM013 and KIM014

Figure 8: Plots KIM015-KIM017

Table 1: Plot Information

Plot	Date survd.	Photo frames NPS film roll# frame #	Cnpy. Ht. meters	In c. o
KIMO1	6/29/94	NPS'94#3 8 & 9	20-25	<5
KIMO2	6/29/94	NPS'94#3 10 & 11	20-25	21
KIMO3	6/30/94	NPS'94#3 12 & 13 (from 2m)	15-25	21
KIMO4	7/1/94	NPS'94#3 14 & 15 (from 1m)	25+	<5
KIMO5	7/2/94	NPS'94#3 16 & 17	25-30	0
KIMO6	7/3/94	NPS'94#3 18 & 19 (from 2m)	15-25	16
KIMO7	7/4/94	NPS'94#3 20 & 21	25-30	18
KIMO8	9/2/94	NPS'94#3 22 & 23	25-30	<5
KIMO9	9/2/94	NPS'94#4 6 & 7	25-30	11
KIMO10	9/3/94	NPS'94#4 4 & 5	25-30	0
KIMO11	9/4/94	NPS'94#4 8 & 9	25-30	0
KIMO12	9/4/94	NPS'94#4 1, 2 & 3 (3 from 2m)	25-30	12
KIMO13	9/5/94	NPS'94#4 10, 11 & 12	15-20	23
KIMO14	9/5/94	NPS'94#4 13 & 14	20-25	23
KIMO15	9/6/94	NPS'94#3 15 & 16 (5)	10-20	20
KIMO16	9/6/94	NPS'94#4 17 & 18	5-20	<5
KIMO17	9/7/94	NPS'94#4 19 & 20	10-20	18

Figure 1: Locations of Plots KIM01-KIM05, KIM015 and KIM017
 USGS Quad: Grover, N.C.-S.C.



Figure 2: Plots KIMO1-KIMO4

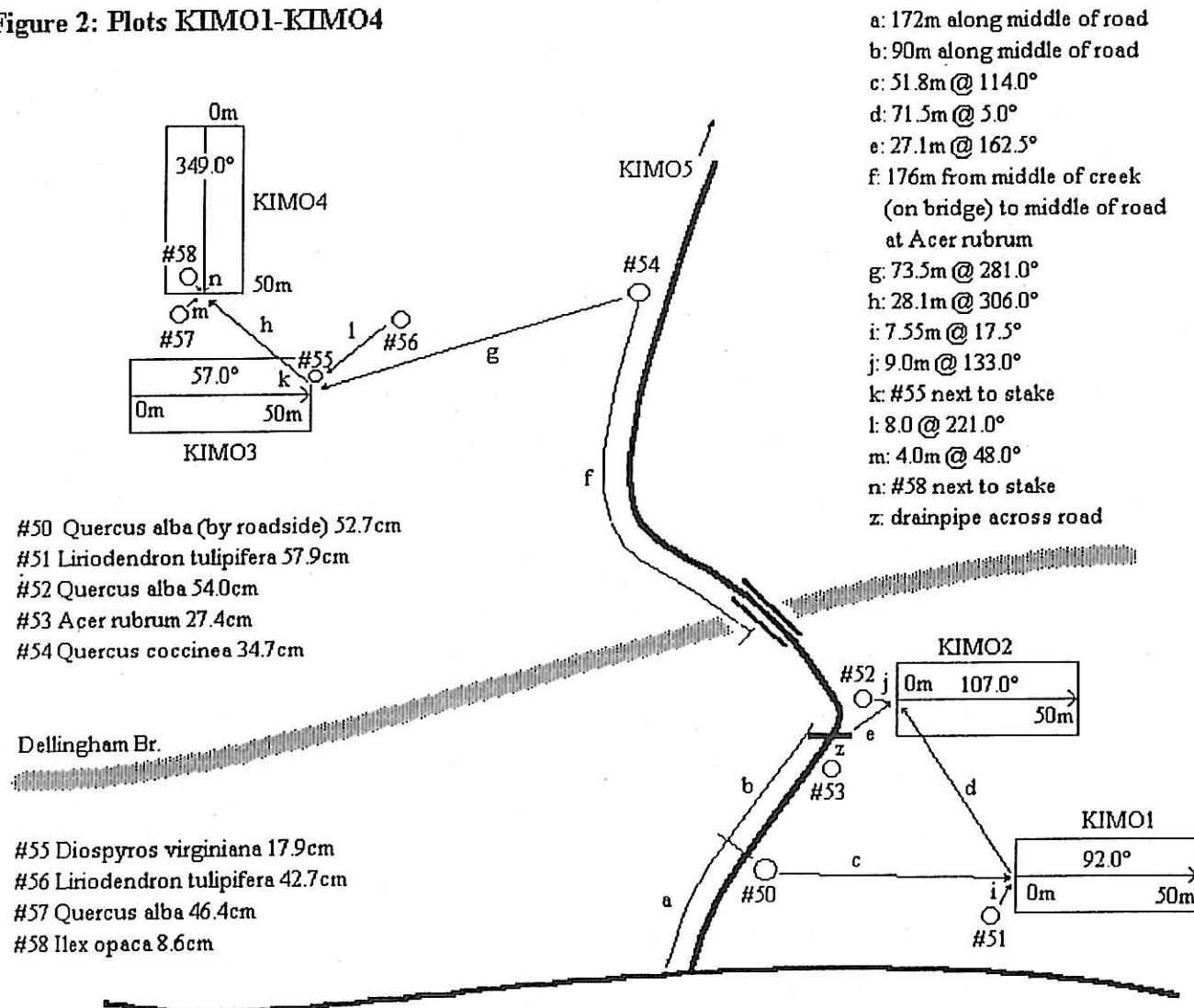


Figure 2: Plots KIMO1-KIMO4

Figure 2: Plots KIMO1-KIMO4

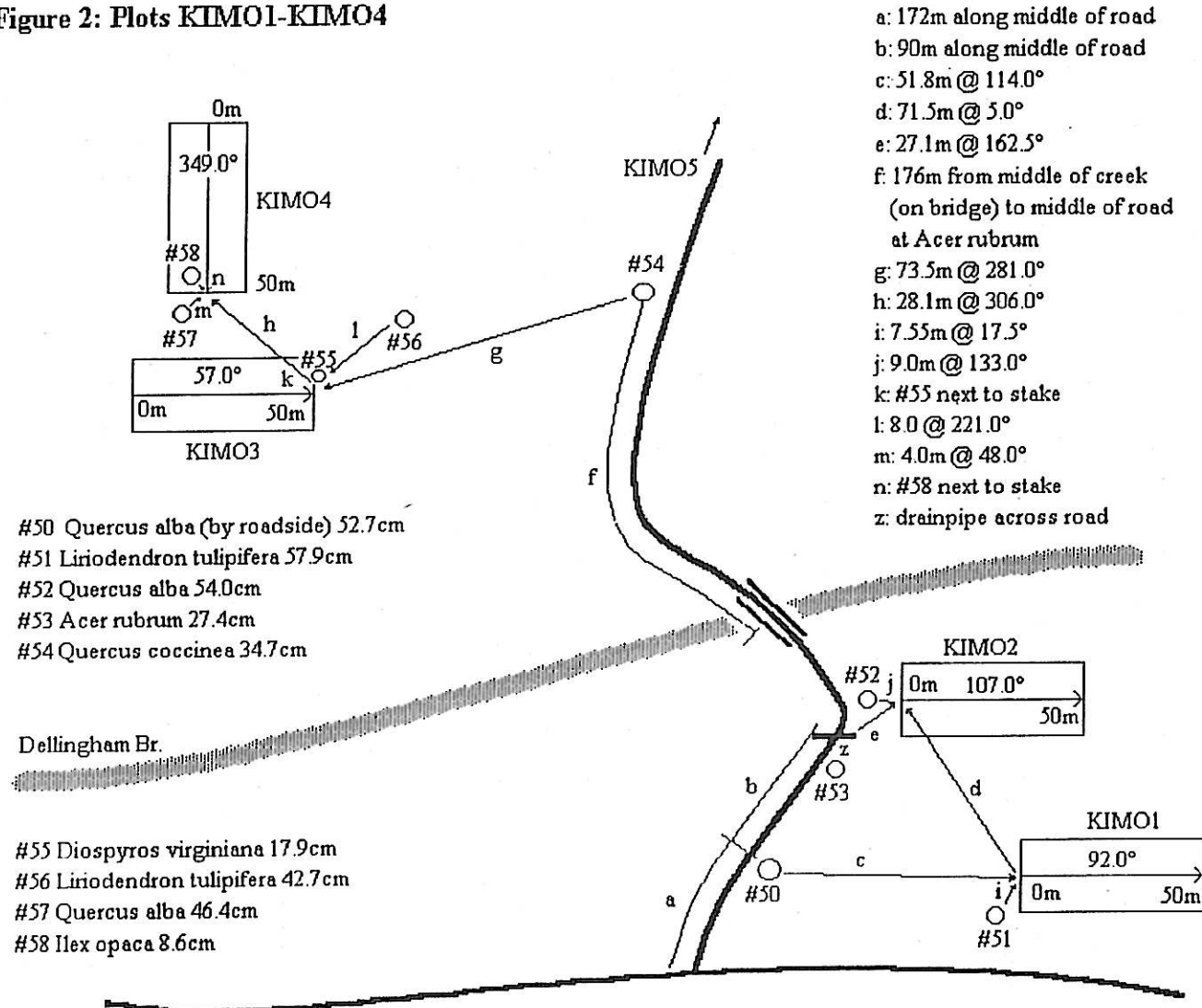


Figure 2: Plots KIMO1-KIMO4

Figure 3: Plot KIMO5

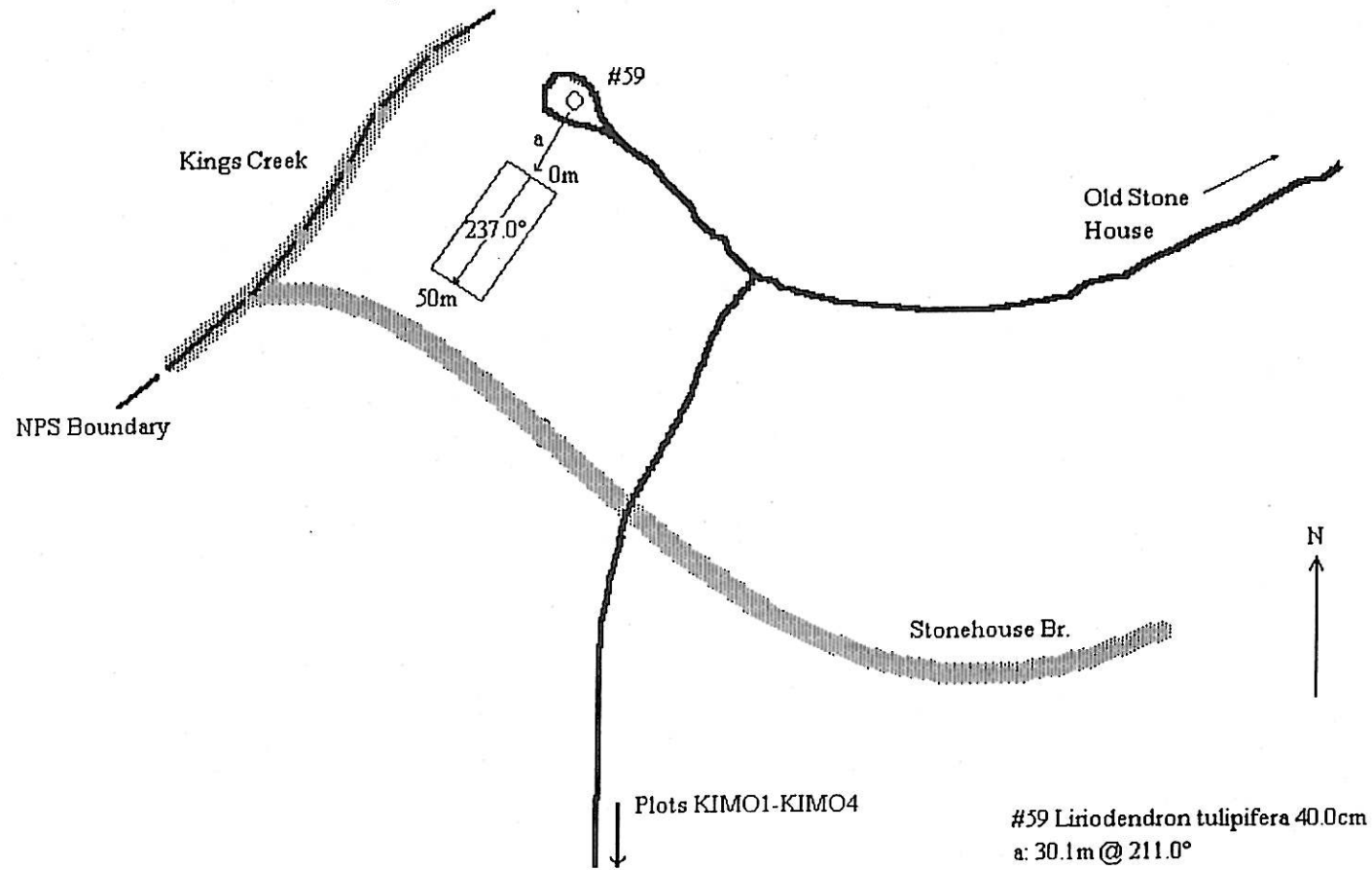


Figure 3: Plot KIMO5

Figure 5: Plots KIMO6 and KIMO7

#60 Quercus alba 60.8cm
 #61 Quercus prinus 49.8cm
 #62 Quercus alba 22.5cm

a: 30.2m @ 167.0° from apex of
 meander, between #60 and #61,
 to stake
 b: 75.5m @ (on average) 40.0°
 to headstone:
 "Maj. William Chronicle"
 c: 63.8m @ 329.0°

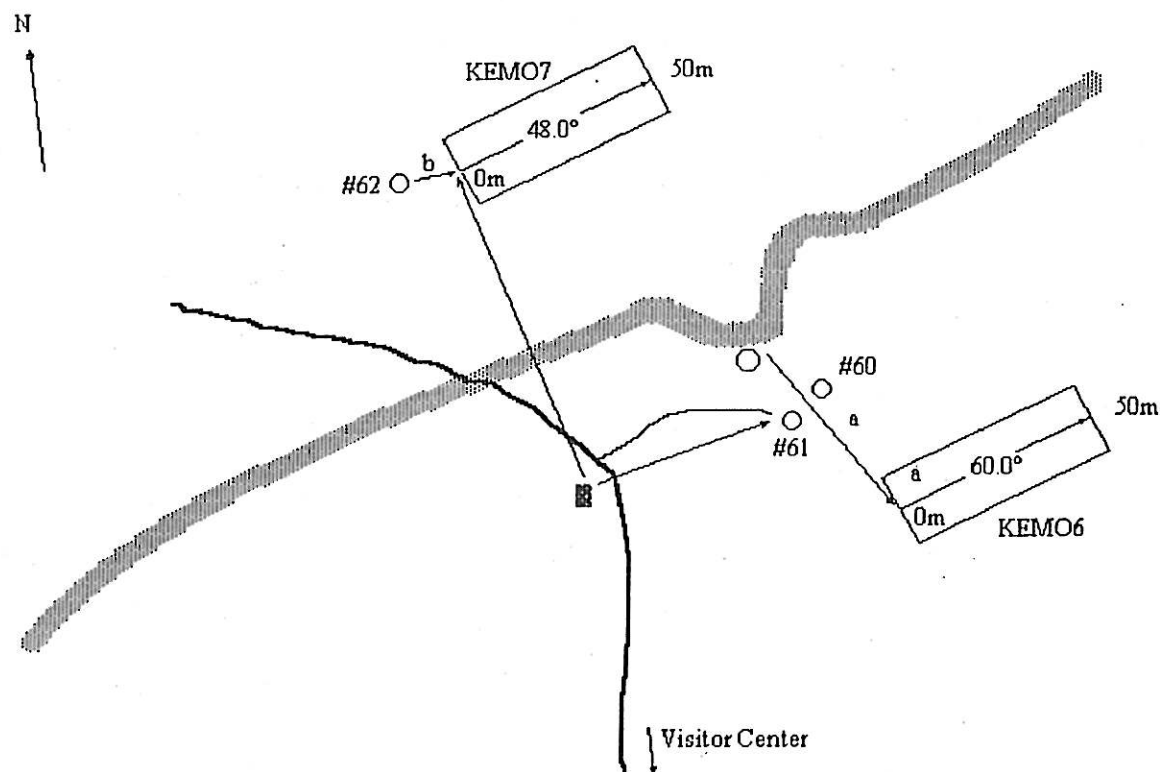


Figure 5: Plots KIMO6 and KIMO7

Figure 4: Locations of Plots KIMO6-KIMO12 and KIMO15-KIMO17
 USGS Quad: Grover, N.C.-S.C.

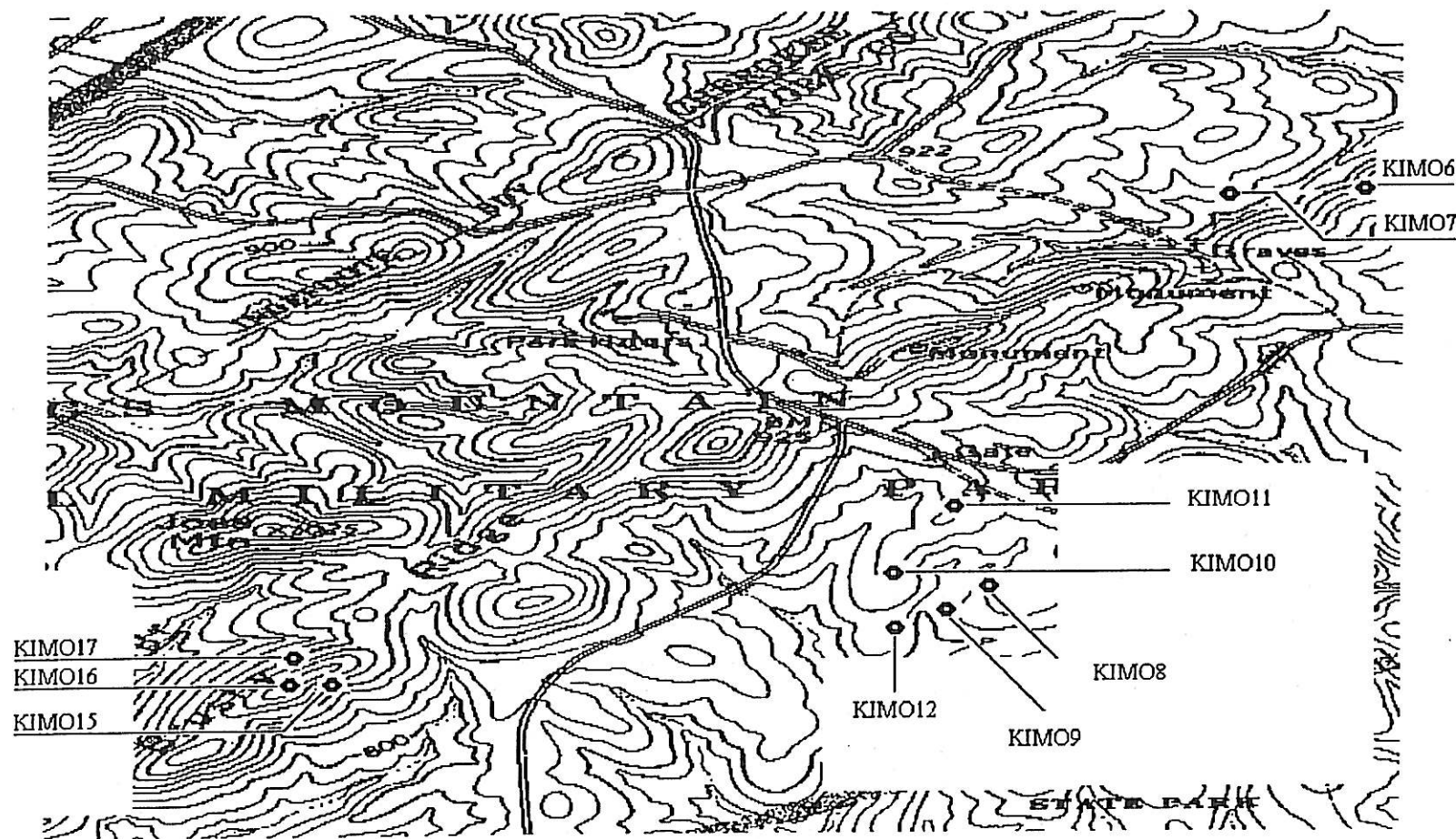


Figure 6: Plots KIMO8-KIMO12

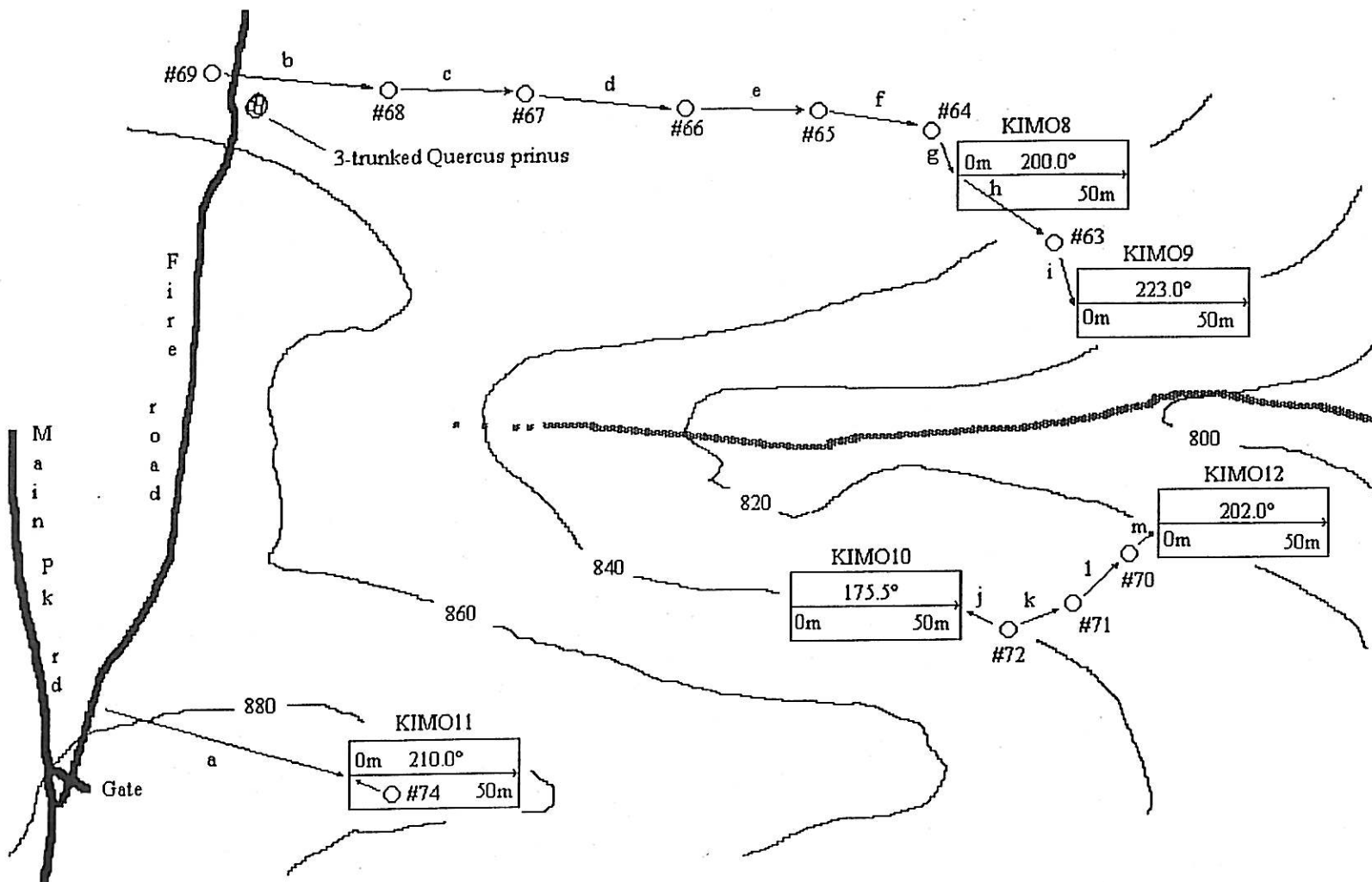


Figure 6: Plots KIMO8-KIMO12

Figure 6: Plots KIMO8-KIMO12

Notes for Figure 6:

a: about 50m, along a slight
rise to ridge crest
b: 44.6m @ 237.0o
c: 70.4m @ 229.0o
d: 68.7m @ 226.0o
e: 57.5m @ 228.0o
f: 51.8m @ 254.0o
g: 11.5m @ 298.0o
h: 37.6m @ 237.0o
i: 12.5m @ 278.0o
j: 5.6m @ 51.0o
k: 40.3m @ 157.0o
l: 55.1m @ 177.0o
m: 8.1m @ 127.0o

#63 Quercus alba 73.4cm
#64 Quercus coccinea 41.3cm
#65 Acer rubrum 46.8cm
#66 Quercus coccinea 43.3cm
#67 Quercus coccinea 40.8cm
#68 Quercus coccinea 42.2cm
#69 Quercus stellata 31.4cm
#70 Quercus falcata 37.4cm
#71 Quercus coccinea 38.0cm
#72 Quercus rubra 57.5cm
#74 Querucs prinus 62.5cm (I.D.# 19)

Figure 7: Plots KIMO13 and KIMO14

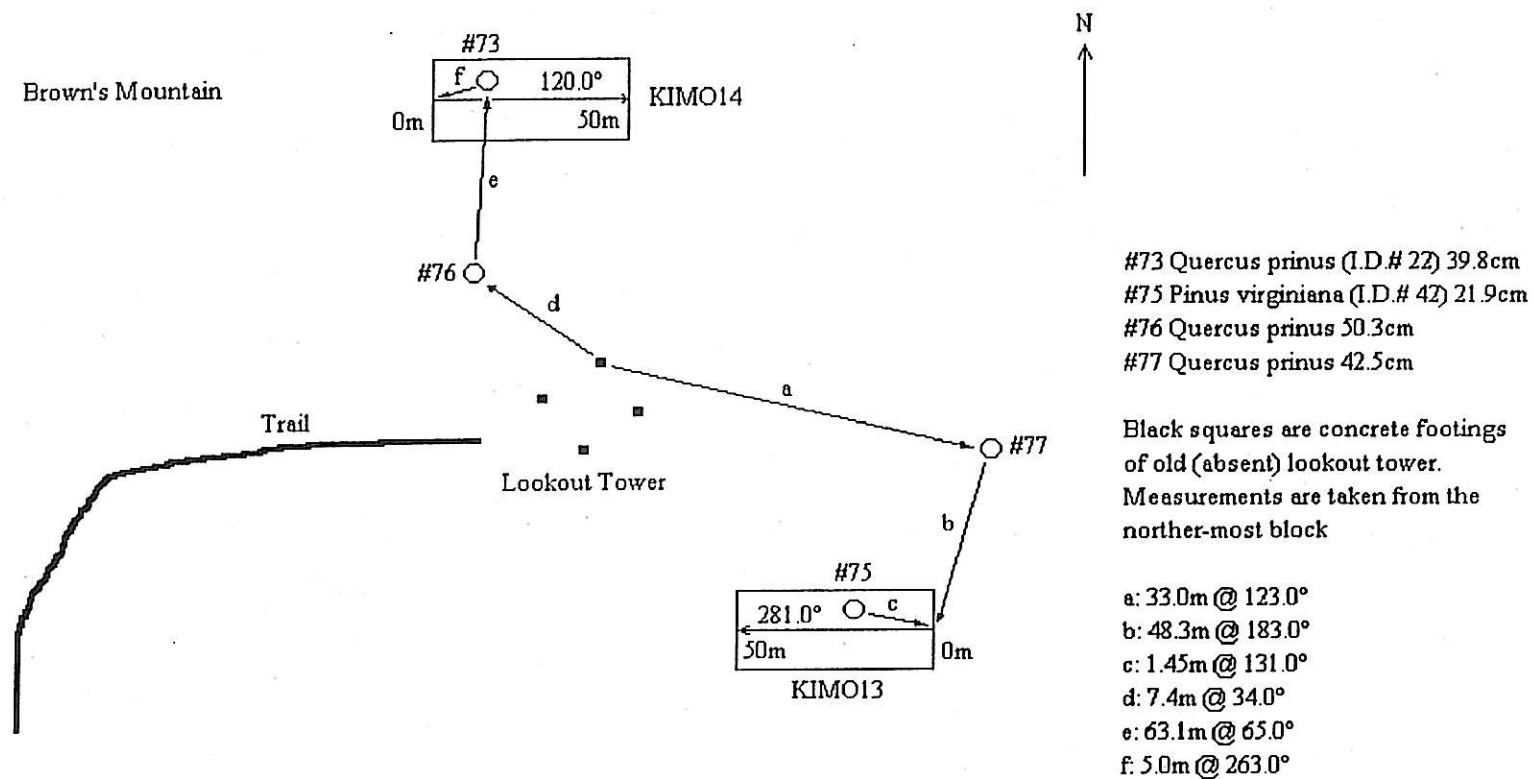
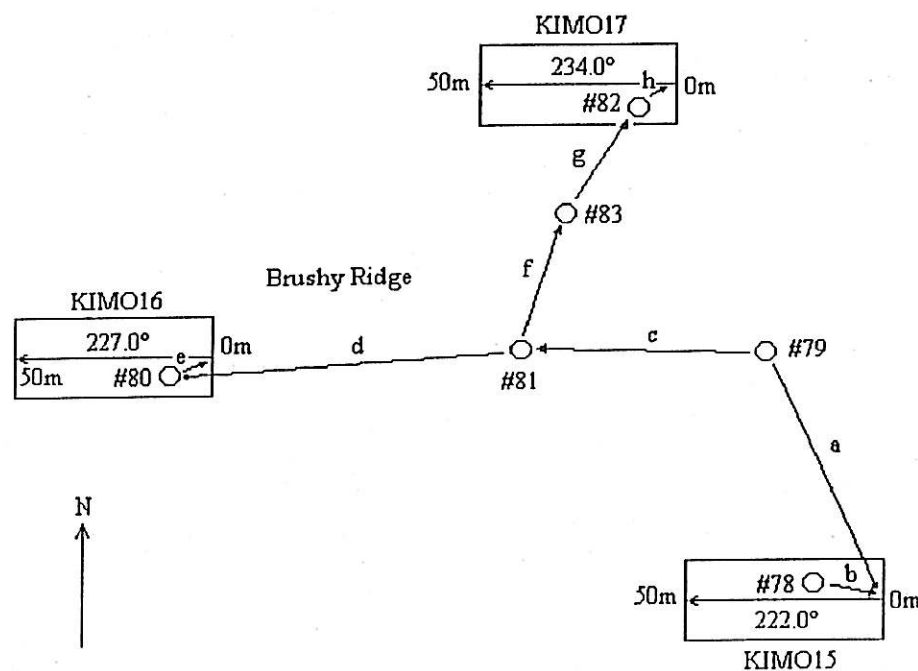


Figure 7: Plots KIMO13 and KIMO14

Figure 8: Plots KIMO15-KIMO17



#78 *Quercus prinus* 21.8cm
 #79 *Quercus prinus* 43.5cm
 #80 *Quercus prinus* (I.D.#1) 42.1cm
 #81 *Quercus prinus* 39.7cm
 #82 *Quercus prinus* (I.D.# 20) 46.6cm
 #83 *Quercus prinus* 48.4cm

a: 24.8m @ 137.0°
 b: 5.9m @ 141.0°
 c: 19.0m @ 247.0°
 d: 29.7m @ 223.0°
 e: 4.2m @ 340.0°
 f: 30.0m @ 297.0°
 g: 29.0m @ 294.0°
 h: 2.4m @ 333.0°

Figure 8: Plots KIMO15-KIMO17

Appendix A-10: Species Code List

This Appendix list all species codes alphabetically with the scientific species name that it abbreviates.

Species codes followed by an asterisk in parentheses (*) may occur in the data sets with or without an asterisk. In the case of *Quercus rubra* (Red Oak) this has special significance. The species code QUER RUB* indicates that the group of Red Oaks is implied, not the species Red Oak.

The abbreviation aff. between Genus and species name means affinity. i.e. *Aster aff. divaricatus*: Genus *Aster* with an affinity to the species *Aster divaricatus*.

Question marks ? indicate uncertainty in determinations.

In some cases, where correct identifications are in doubt, there are additional notes and collection numbers. Collection numbers are Barnett-Lawrence 94 collections and are deposited in the Herbarium at the University of North Carolina at Chapel Hill. It has not been possible, at the present time, to identify specimens and corroborate determinations because of the time restraint imposed by studying five NPS units.

Species Codes

ACAL VIR	<i>Acalypha virginica</i>
ACER NEG	<i>Acer negundo</i>
ACER RUB	<i>Acer rubrum</i>
AGRO SP	<i>Agrostis</i> sp. coll: 2476
ALLI CAN	<i>Allium canadense</i>
AMEL ARB	<i>Amelanchier</i> sp. coll: 2460
AMEL LAE	<i>Amelanchier</i> sp. (same as AMEL ARB)
ANTE PAR	<i>Antennaria plantaginifolia</i>
ANTE PLA	<i>Antennaria plantaginifolia</i>
AQUI CAN	<i>Aquilegia canadensis</i>
ARIS DRA	<i>Arisaema dracontium</i>
ARIS SER	<i>Aristolochia serpentaria</i>
ARIS TRI	<i>Arisaema triphyllum</i>
ASIM TRI	<i>Asimina triloba</i>
ASPL PLA	<i>Asplenium platyneuron</i>
ASTE SP	<i>Asteraceae</i> sp. (Unknown)
AURE PEC	<i>Aureolaria virginica</i> (same as AURE VIR)
AURE VIR	<i>Aureolaria virginica</i>
BAPT AUS	<i>Baptisia alba</i>
BIGN CAP	<i>Bignonia capreolata</i>
BOEH CYL	<i>Boehmeria cylindrica</i>
BROM PUB	<i>Bromus pubescens</i> coll: 2488
BROM SP	<i>Bromus</i> sp.
CAMP RAD	<i>Campsis radicans</i>
CARE AMP	<i>Carex</i> aff. <i>amphibola</i> coll: 2485
CARE CRI	<i>Carex</i> aff. <i>crinita</i> coll: 2486
CARE JUN	<i>Carex</i> sp. (unknown)
CARE LAX	<i>Carex</i> aff. <i>laxiflora</i>
CARE SP	<i>Carex</i> sp. (unknown)
CARE SP2	<i>Carex</i> sp. 2 (unknown)
CARY ALB	<i>Carya alba</i>
CARY GLA	<i>Carya glabra</i>
CARY OVA	<i>Carya ovata</i>
CARY SP	<i>Carya</i> sp. (seedling)
CELT LAE	<i>Celtis laevigata</i>
CELT OCC	<i>Celtis laevigata</i> (same as CELT LAE)
CELT SP	<i>Celtis laevigata</i>
CHAS LAT	<i>Chasmanthium latifolium</i> coll: 2489
CHIM MAC	<i>Chimaphila maculata</i>
CHIO VIR	<i>Chionanthus virginicus</i>
CHRY VIR	<i>Chrysogonum virginianum</i>
COCC CAN	<i>Cocculus carolinus</i>
COCC SP	<i>Cocculus carolinus</i> (same as COCC CAN)
CORE MAJ	<i>Coreopsis major</i>
CORN FLO	<i>Cornus florida</i>
DANT SP	<i>Danthonia spicata</i> (same as DANT SPI)
DANT SPI	<i>Danthonia spicata</i>
DESM CAN	<i>Desmodium</i> aff. <i>canescens</i>

	coll: 2472
DESM NUD	<i>Desmodium nudiflorum</i>
DESM PER	<i>Desmodium</i> aff. <i>perplexum</i>
	coll: 2472, 2473
DESM ROT	<i>Desmodium rotundifolium</i>
DESM TRA	<i>Desmodium</i> sp.
	Unknown: trailing habit possibly
	<i>Amphicarpaea bracteata</i> ?
DICH BOS	<i>Dichantheium bosci</i>
DICH DIC	<i>Dichantheium dichotomum</i>
DICH LAX	<i>Dichantheium laxiflorum</i>
	coll: 2470
DIOS VIR	<i>Diospyros virginiana</i>
ELYM RIP	<i>Elymus riparius</i>
	coll: 2487
EPIG REP	<i>Epigaea repens</i>
EUPH COR	<i>Euphorbia corollata</i>
EVON AME	<i>Evonymus americana</i>
FAGU GRA	<i>Fagus grandifolia</i>
FRAX SP	<i>Fraxinus</i> sp.
GALA APH	<i>Galax aphylla</i>
	coll: 2493
GALI CIR	<i>Galium circaezans</i>
GAYL SP	<i>Gaylussaccia</i> sp.?
	coll: 2459, 2475
GELS SEM	<i>Gelsemium sempervirens</i>
GEUM SP	<i>Geum</i> sp.
	coll: 2480
GOOD PUB	<i>Goodyera pubescens</i>
GOOD REP	<i>Goodyera pubescens</i> (same as GOOD PUB)
HELI SP	<i>Helianthus</i> sp.
	coll: 2479
HEXA MIN	<i>Hexastylis minor</i>
HIER PAN	<i>Hieracium venosum</i> (same as HIER VEN)
HIER VEN	<i>Hieracium venosum</i>
HIRS GRA	Poaceae: unknown
HYPE HYP	<i>Hypericum hypericoides</i>
ILEX OPA	<i>Ilex opaca</i>
IMPA CAP	<i>Impatiens capensis</i>
IPOM PAN	<i>Ipomoea</i> aff. <i>paniculata</i>
IPOM PUR	<i>Ipomoea</i> aff. <i>purpurea</i>
JUGL NIG	<i>Juglans nigra</i>
JUNI VIR	<i>Juniperus virginiana</i>
KALM LAT	<i>Kalmia latifolia</i>
LACT SP	<i>Lactuca</i> sp.
	coll: 2469
LEER VIR	<i>Leersia virginica</i>
	coll: 2478
LESP PRO	<i>Lespedeza procumbens</i>
LESP REP	<i>Lespedeza repens</i>
LIGU SIN	<i>Ligustrum sinense</i>
LIQU STY	<i>Liquidambar styraciflua</i>
LIRI TUL	<i>Liriodendron tulipifera</i>
LONI JAP	<i>Lonicera japonica</i>
LYCO FLA	<i>Lycopodium</i> sp.
LYON SP	<i>Lyonia</i> sp. ?

MATE SP	<i>Matelea</i> sp.
MEDE VIR	<i>Medeola virginica</i>
MENI CAN	<i>Menispermum canadense</i>
MICR VIM	<i>Microstegium vimineum</i>
MITC REP	<i>Mitchella repens</i>
MONO HYP	<i>Monotropa hypopithys</i> coll: 2491
MONO UNI	<i>Monotropa uniflora</i>
MORU RUB	<i>Morus rubra</i>
NYSS AQU	<i>Nyssa aquatica</i>
NYSS SYL	<i>Nyssa sylvatica</i>
O.L.V.	Unknown: opposite leafed vine
OSMO LON	<i>Osmorhiza longistylis</i>
OXYD ARB	<i>Oxydendrum arboreum</i>
PART QUI	<i>Parthenocissus quinquifolia</i>
PINU ECH	<i>Pinus echinata</i>
PINU SP	<i>Pinus</i> sp. (seedling)
PINU TAE	<i>Pinus taeda</i>
PINU VIR	<i>Pinus virginiana</i>
PITY GRA	<i>Pityopsis graminifolia</i>
PLAT OCC	<i>Platanus occidentalis</i>
POA SP	<i>Poa</i> sp.
POAC	Poaceae: unknown glabrous, leaves 1-2mm wide coll: 2477
POAC SP	Poaceae: unknown
POLY BIF	<i>Polygonatum biflorum</i>
PORT SP	<i>Porteranthus</i> sp. coll: 2456
POTE SIM	<i>Potentilla simplex</i>
PRUN SER	<i>Prunus serotina</i>
PTER AQU	<i>Pteridium aquilinum</i>
PYCN SP	<i>Pycnanthemum</i> sp.
QUER ALB	<i>Quercus alba</i>
QUER COC	<i>Quercus coccinea</i>
QUER FAL	<i>Quercus falcata</i>
QUER LYR	<i>Quercus lyrata</i>
QUER MAI	<i>Quercus marilandica</i>
QUER MARI	<i>Quercus marilandica</i> (same as QUER MAI)
QUER MIC	<i>Quercus prinus</i> (same as QUER PRI)
QUER NIG	<i>Quercus nigra</i>
QUER PHE	<i>Quercus phellos</i>
QUER PRI	<i>Quercus prinus</i>
QUER RUB	<i>Quercus rubra</i>
QUER STE	<i>Quercus stellata</i>
QUER VEL	<i>Quercus velutina</i>
RANU RAC	<i>Ranunculus recurvatus</i>
RHOD PER	<i>Rhododendron periclymenoides</i>
RHOD SP	<i>Rhododendron</i> sp. coll: 2463, 2464
RHUS COP	<i>Rhus copallina</i>
ROBI PSE	<i>Robinia pseudoacacia</i>
ROSA MUL	<i>Rosa multiflora</i>
ROSA SP	<i>Rosa</i> sp.
RUBU SP	<i>Rubus</i> sp.
RUME CRI	<i>Rumex crispus</i>

SAMB CAN	<i>Sambucus canaadensis</i>
SANI SMA	<i>Sanicula smallii</i>
SANI SP	<i>Sanicula</i> sp. coll: 2481
SASS ALB	<i>Sassafras albidum</i>
SCHI SCO	<i>Schizachyrium scoparium</i>
SCLE SP	<i>Scleria</i> sp.
SCUT ELL	<i>Scutellaria elliptica</i>
SCUT SP	<i>Scutellaria</i> sp.
SMIL BON	<i>Smilax bona-nox</i>
SMIL GLA	<i>Smilax glauca</i>
SMIL RAC	<i>Smilacina racemosa</i>
SOLI ARG?	<i>Solidago</i> aff. <i>arguta</i>
SOLI GLA	<i>Solidago</i> sp.
SOLI SP	<i>Solidago</i> sp. coll: 2492
TEPH VIR	<i>Tephrosia virginiana</i>
THAS BAR	<i>Thaspium barbinode</i>
THEL NOV	<i>Thelypteris noveboracensis</i>
TIPU DIS	<i>Tipularia discolor</i>
TOXI RAD	<i>Toxicodendron radicans</i>
TOXI TOX	<i>Toxicodendron pubescens</i>
TRIL SP	<i>Trillium</i> sp.
ULMU AME	<i>Ulmus americana</i>
UVUL PER	<i>Uvularia perfoliata</i>
UVUL SES	<i>Uvularia sessilifolia</i>
VACC ARB	<i>Vaccinium arboreum</i>
VACC PAL	<i>Vaccinium pallidum</i> coll: 2455, 2461
VACC SP3	<i>Vaccinium</i> sp. coll: 2462
VACC STA	<i>Vaccinium stamineum</i> coll: 2454
VACC TEN	<i>Vaccinium tenellum?</i> probably same as VACC SP3
VERB OCC	<i>Verbesina occidentalis</i>
VIBU PRU	<i>Viburnum prunifolium</i>
VIOL SP	<i>Viola</i> sp.
VITI AES	<i>Vitis aestivalis</i>
VITI CIN?	<i>Vitis cinerea?</i>
VITI ROT	<i>Vitis rotundifolia</i>
VOTR DIS	<i>Botrychium dissectum</i>