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Discriminant Analysis of Some East Tennessee Forest Herb Niches

Linda K. Mann
University of Tennessee - Knoxville

To the Graduate Council:

I am submitting herewith a thesis written by Linda K. Mann entitled "Discriminant Analysis of Some East Tennessee Forest Herb Niches." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Ecology and Evolutionary Biology.

Herman H. Shugart, Jr., Major Professor

We have read this thesis and recommend its acceptance:

J. S. Olsen, H. R. DeSelm

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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We have read this thesis
and recommend its acceptance:

Jerry S. Olson

H. R. DeSelm

Accepted for the Council:

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Vice Chancellor
Graduate Studies and Research

DISCRIMINANT ANALYSIS OF SOME EAST TENNESSEE FOREST HERB NICHES

A Thesis

Presented for the

Master of Science

Degree

The University of Tennessee, Knoxville

Linda K. Mann

December 1977

DEDICATION

And NUH is the letter I use to spell Nutches
Who live in small caves, known as Nitches, for hutches.
These Nutches have troubles, the biggest of which is
The fact there are many more Nutches than Nitches.
Each Nutch in a Nitch knows that some other Nutch
Would like to move into his Nitch very much.
So each Nutch in a Nitch has to watch that small Nitch
Or Nutches who haven't got Nitches will snitch.

(Giesel, 1955)

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ABSTRACT

The purpose of this study was to evaluate the effectiveness of using discriminant analysis in assessing plant niches. As a preliminary to establishment of the Environmental Research Park Program at Oak Ridge, Tennessee, five sites were inventoried for herbaceous species. From this inventory, four sympatric species of *Galium* and seventeen co-occurring herbaceous species were selected for discriminant analysis. The four species of *Galium* were treated as two data sets: one was composed of information collected at one site (a mesic hardwood area) and the other contained data from two cedar sites of shallow soil over limestone bedrock. The seventeen herbaceous species all occurred in the mesic hardwood area.

Variables selected for the analysis included site characteristics such as aspect and percent slope, biotic variables such as total woody basal area and litter composition, and (for the seventeen species) soil characteristics including pH and texture. Biotic variables were included for possible allelopathic influence and as indicators of environmental variables.

Univariate and multivariate analysis of variance on the three data sets showed significant differences for most variables included in the analysis. All variables with zero value for one or more species and highly correlated variables were eliminated before the discriminant analysis was performed. F-ratios for overall discrimination among groups was highly significant ($p < 0.001$) in all three data sets.

The first discriminant function was found to be most highly correlated with variables related to canopy density in both Galium data sets, while the second is most highly correlated with variables related to pH. The third discriminant function (available only from the cedar set) was most highly correlated with cedar litter and cedar basal area. Species ordering on the discriminant functions satisfactorily approximated known general habitat descriptions.

In the seventeen species data set, percent beech litter, slope position, pH and steepness of slope, and soil texture were respectively most highly correlated with the first, second, third and fourth discriminant functions. These axes are interpreted as moisture axes, the first reflecting soil and air moisture, the second average moisture, the third drainage and the fourth water holding capacity.

Univariate comparisons of presence versus absence of seven of the seventeen species found to have the closest means of occurrence showed significant differences in mean pH values for all but one species. Discriminant analysis of presence versus absence data added little information to the univariate comparisons.

Combining the results of the univariate presence versus absence data with the discriminant analysis results in a comparison of fundamental and realized niche characteristics. The significance of pH values in determining species absence versus species presence implies the fundamental niches of these species include pH as a limiting factor. However, these species have quite similar mean pH values and results of the discriminant analysis implicate the importance of moisture axes in circumscribing realized niches.

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INTRODUCTION

Ecologists are, by definition, concerned with defining the relationships of species to one another and to their surroundings. Although much of this interest was originally generated by naturalists trying to understand what they could about such interactions the need for more quantitative information has taken on added importance in the face of ever increasing human populations and the concurrent destruction of natural habitat. To effect legislation such as the Endangered Species Act (and possible similar protective legislation for hundreds of plant species) synecological and other knowledge about the protected species is required: their habitats, their population dynamics, and their interaction with other species. Some such relationships are fairly apparent; e.g., preservation of several of the cedar glade endemic species of plants of middle Tennessee and Alabama can be effectively achieved by protection of the glades. For other species, factors controlling the species' survival are not as obvious.

Although considerable effort has been expended in recent years examining the niche relationship of animal species (Whittaker and Levin, 1975) little has been done in this country regarding species of herbs even though the preponderance of vascular species listed in the U.S. Congress <u>Report on Endangered and Threatened Plant Species of the United States</u> (1975) are herbaceous.

The present study of habitat and niche relationships of certain herbaceous plants was conducted in conjunction with the National Environmental Research Park at Oak Ridge. The ERDA charter of National Environmental Research Parks states a "National Environmental Research Park (NERP) is an outdoor laboratory where research may be carried out to achieve national environmental goals." Although the main orientation is toward the goals of the National Environmental Policy Act (NEPA), the Energy Reorganization Act, and the Nonnuclear Energy Research and Development Act, program directives for 1976 direct "special attention to endangered and threatened species" as well as compilation of a "regional environmental encyclopedia" which is to include species characterizations.

Although the NERP's are primarily concerned with inventorying ecosystems in terms of assessing future impacts of pollutants and other "environmental insults," a basic understanding of species interactions is necessary for evaluating the possibility of recovery from such insults. Species with highly specialized niche requirements may not survive under certain conditions. This may be especially true of rare or endangered species. Conversely species with broad requirements may not only survive disruption of an ecosystem but may expand into niches "vacated" by other species. This study was initiated in the hope that a better understanding of niche (or habitat) relationships of species may enable us to reduce the long term effects of environmental insults (particularly "mechanical" insults of logging and urbanization) by conscious effort to preserve those facets of a species niche discerned to be critical for its eventual survival.

CHAPTER I

LITERATURE REVIEW

The term "niche" was first introduced by Grinnell (1917) although the concept existed earlier and is implicit in Darwin's concept of "survival of the fittest" where the "fittest" exploits the niche most effectively. Grinnell used the word in relation to the nesting habitat of the California Thrasher. He assigned the California Thrasher to a "minor niche" in the chaparral ecosystem and implied that an ecosystem is composed of a collection of such niches occupied by all the species occurring there. In this sense, the niche as Grinnell defined it, is primarily one of place, space, address, or habitat as later authors call it.

Charles Elton (1927) is credited with having expanded the concept to include species function in the definition of niche. For Elton "the niche" of an animal means "its place in the biotic environment, <u>its relations to food and enemies</u>." Elton used the term to describe species occupying the same function in different communities while Grinnell used it to describe single species occupying different positions in the same community.

Gause (1934) combined both concepts defining niche as "what place the given species occupies in a community, i.e., what are its habits, food and mode of life." Gause recognized (as had earlier workers including Grinnell (1917)) that "as a result of competition, two similar species scarcely ever occupy similar niches." This concept was later developed as the competitive exclusion principle as discussed by Hardin (1960). This expanded the concept such that a species niche is not solely defined by its surroundings (habitat) or by its function in the community but also by its interactions with other species. Gause (1934) substantiated this experimentally with two closely related species of _Paramecium_ finding that given a resource (food in this case) one species exploited that resource more effectively than the other resulting in the exclusion from a microcosm of the lesser competitor.

This relationship of niche and competition was later expanded to include the more general concept of limiting factors. Levin (1970) defined a limiting factor as "any density dependent response which feeds back to affect the dynamics of the populations in question" (Whittaker and Levin, 1975). By including the concept of limiting factors in the definition of niche, a species niche is then defined in terms of external factors that relate to its survival as a population, internal factors such as density effects on reproduction again relating to the species survival as a population as well as habitat factors and behavioral or functional factors that affect survival of the individual, hence the population.

Hutchinson (1957) developed the abstract multidimensional concept of niche incorporating all the environmental factors acting on the

organism within a community. Each axis in the hyperspace of the niche is defined by Hutchinson as a linear representation of the environmental factors affecting a species. The niche itself is then defined as the hypervolume described by the limiting values of the coordinate system of a species. "Every point (of constructed hypervolume) corresponds to a set of values of the variables permitting the organism to exist" (Hutchinson, 1965). Hutchinson recognized that in addition to this abstract "fundamental" niche that there was an effective or "realized" niche whose boundaries were defined by interactions with other species (competition) and whose hypervolume was therefore a subset of the larger fundamental niche. Hutchinson (1967) defines the fundamental niche of a species in terms of ordering "linearly on the axes of an n-dimensional coordinate system, all the factors required to define a habitat." However, recognizing the fact that two species (e.g., of zooplankton) may occur in the same actual space (habitat), the fundamental niche would be different due to differences in limiting factors on other axes (e.g., food size) of a functional nature. It is worth noting that Hutchinson did not exclude habitat from his concept of niche, in fact, some of his examples (Hutchinson, 1965), draw strongly on habitat variables as niche dimensions.

Due to the long development of the niche concept, there has been some ambiguity in terminology. Whittaker, Levin and Root (1973) discuss this problem in some detail reaching the conclusions that habitat should be used as an intercommunity term (rather than intra-community as Hutchinson has used it), niche should remain as an

intra-community concept, and that a new term, ecotope, should be used to refer to the "compound hyperspace, representing the full range of external circumstances to which species in the landscape are adapted." They do not define the intra-community habitat of a species although they imply that it is included in the niche hypervolume. In addition, they define diversity as within-habitat diversity, a product of niche differentiation among species, and diversity as between habitat diversity, the product of habitat differentiation presumably among communities. The realized niche of a species occurring in several communities (different habitats) whose hypervolume is variously defined by different competitors in each community is therefore best referred to as an ecotope.

A number of studies have been directed at assessing niche relationships, especially among animals. Multiple discriminant function analysis has been used to evaluate niche separation and dimensionality in several species of bivalve mollusks (Green 1971) and four species of small mammals (Dueser et al., 1976). Within community habitat and niche relations of birds have been examined extensively both qualitatively as early as Grinnell (1917) and quantitatively in more recent papers (MacArthur, 1958; Root, 1967; James, 1971; and Brown and Wilson, 1956).

Studies attempting to quantify the niche of selected species utilizing Hutchinson's hypervolume concept involves attempts to define continuous variables analogous to the hypervolume axes. Usually this is done by using multivariate statistical techniques to reduce the number of variables to a few hopefully interpretable axes. James

(1971) used both principal components analysis and discriminant function analysis to describe bird distributions along gradients of habitat structure. Cody (1968) and Hespenheide (1971) have also used discriminant function analysis to delineate habitat preferences of grassland birds and flycatchers, respectively. Since these studies included within and between community relations, they would be classed as ecotope analysis rather than niche analysis by Whittaker et al. (1973). Shugart and Patten (1972), Anderson and Shugart (1974) and Couner and Adkinson (1977) have also applied multivariate techniques to assess the distribution of birds in relation to vegetation (habitat or ecotope).

It is perhaps appropriate that most of the research related to niches has been with birds since the word niche is derived from the latin root *nidus* meaning a (bird's) nest. However, it is unfortunate that little emphasis has been placed on niche relations among plants. There are several very obvious reasons for this lack of emphasis. Although most regional published floras usually describe plants as species, a great many genera are not at all clearly subdivided. Populations that appear to be good species in one area grade into one another in other locations (e.g., species of *Crataegus*, *Rubus* and *Desmodium*). Pielou (1974, 1975) discusses this problem and emphasizes that niches are not occupied by species but by local intrabreeding populations. Identification of a local intrabreeding population of plants given the vegetal world's inclination to apomixis, vegetative reproduction and hybirdization is not easy.

Another practical problem in niche studies of many plant species is the necessity of having flowering and sometimes fruiting material for determination. In the case of perennials, juvenile individuals might be present in great abundance but only investigations of at least 2 years duration would allow positive identification in many cases.

A number of environmental variables make up axes of plant niche hyperspaces. The major ones are light, nutrients, moisture, and temperature. Both the intensity and quality of light are important as is daylength. Nutrients in a plant niche include those cations and anions known to effect plant growth as well as pH, with its effects on nutrient availability, toxic elements and organic matter. Moisture and temperature include as axes both soil and air components. Other factors defining the plant niche include reproductive strategy, predation by herbivores, repeated disturbances and seasonal changes. Although many plants are wind pollinated, most of the great variety in floral characteristics of the vascular plants is directly attributable to pollination strategy, making pollinators a very important niche axes especially among annual species dependent on seed set for existance of the following year's population. Although predators are not usually included in niche characterizations they are none the less important axis as are disturbances such as fire and flooding and seasonal changes particularly the closing of forest canopy in early summer.

Species role in the community (niche sensu Whittaker et al., 1973) is much more difficult to define for plants than for animals. Food choice or height of feeding is much easier to quantify for a bird than nitrogen utilization or even rooting depth in a plant. In addition,

lack of mobility in plants limits the diversity of their role in the community. Pielou (1974) comments that

> niche diversification is far more often found among animals than among plants. This is not surprising since most vascular plants, being autotrophic and sessile, have no means of partitioning resources of food or of living space.

In any case, resource partitioning is undoubtedly more subtle for plants than for animals. Although Gause's Principle has been assumed to apply to plants as well as animals it is apparent that its expression is in differences of degree in the requirements for different environmental resources and that "marginal differentiation" in requirements may result in broad overlaps for plants with population densities changing rather than abrupt shifts in species (Whittaker, 1965).

Niche diversification among congeneric plant species in relation to microhabitats is mentioned briefly by McIntosh (1963). He notes that several species of *Aster* in the prairie are separated by adaptation to specialized microhabitats even though they are found in the same location with each reaching maximum population density in different sites. Nixon (1964) examined soil relationships of 2 species of *Lupinus* in Texas and found that although species overlapped in range, one occurred primarily on calcareous soils. In examining two sympatric species of *Erigeron*, Mooney (1966) discovered major differences in soil parent material on which the two species reached optimal development. He attributed the differences in distribution to differences in soil moisture and temperature related to soil texture and color. Hadley and Levin (1967) investigated the effects of soil heterogeneity in the pattern of distribution of a complex of three *Liatris* species and their

hybrids in a prairie community. They found a pattern related to elevation, soil moisture, organic matter, exchangeable cations and phosphorus. Sarukhan and Harper (1973) also found microtopography to be important in the distribution of 3 species of Ranunculus with moisture probably being a limiting factor. Werner and Platt (1976) found six co-occurring species of Solidago to be tightly packed along a moisture gradient with frequency of occurrence of each species approximating a normal distribution about a different soil moisture "optimum."

Willmot and Moore (1973) identified a difference in photosynthetic efficiency related to low light intensity as important in niche partitioning by two species of Dioica. Light intensity as well as pH and moisture were demonstrated by Vitt and Slack (1975) as important parameters in species distribution of 8 species of Sphagnum in a bog. Green and Palmbald (1975) approached the problem of resource allocation of closely related species from a different perspective. They found that two species of Astragalus differed in seed morphology and therefore their susceptibility to different types of seed predation.

Although the question of niche partitioning in congeneric species is important in terms of evolution of any particular group, the question of species packing and spatial pattern in any given ecosystem remains of interest. A number of authors have approached the problem of pattern from within communities rather than within taxonomically closely related groups. Whittaker (1975) has discussed vertical, seasonal, and horizontal aspects of niche partitioning in a Sonoran desert plant community pointing out the complex environmental gradients involved in

these three niche axes. The horizontal pattern of species (especially of herbs) has been investigated by a number of authors and is the primary object of study in this paper.

Non-randomness in the distribution of plants has been attributed to differences in dispersal mechanisms, differences in environment, and species interrelations including density dependent phenomena (Whittaker 1975, Greig-Smith 1964). Differences in environment may include moisture, humidity, light, soil texture, soil depth, soil chemistry, drainage, microrelief, microtopography, burning and history while species interrelations include alleopathy and competition (Smith and Cottam 1967, and Greig-Smith 1964). The distribution of plant populations as determined by environmental factors was well stated by Gleason (1926) in his individualistic concept of plant associations. Abundant literature exists concerning the distribution of different communities in relation to differences in environment including Braun (1935) who looked at community distribution in relation to aspect, slope, soil texture and soil depth; Cain (1931) who observed the relationship of soil reaction to species distribution, Shanks and Norris (1950) who noted the effect of microclimate on the distribution of forest herbs; Crandall (1958) who added elevation and soil parent material as factors; Ross (1958) who found soil depth, soil moisture, and microclimate most important as forest type factors; and Rasche (1958) who found soil pattern and ground water patterns most important in community distribution.

Several authors have examined the problem of pattern within communities of herbaceous species in relation to one or more

environmental factors. Hall (1971) found that pattern on a small scale in *Brachypodium* and *Bromus* and on a larger scale in *Festuca* was related to boron concentrations in a chalk grassland community. Owen and Harberd (1970) found that distribution of *Agrostis* was correlated with low pH and that distribution of *Festuca* was related to micro-relief in a grassland community. Struick and Curtis (1962), in a study of woodland herbaceous species, also found correlations with microtopography as well as with canopy openings.

To explore the possible effects of soil heterogeneity on species distribution, Snaydon (1962) measured soil pH, moisture percentage, exchangeable hydrogen, total exchange capacity and calcium, phosphorus and potassium concentrations in an intensive sampling grid at one location and in paired samples from many widespread sites. He found significant differences in soil nutrients between samples where *Trifolium repens* occurred and where it was absent.

Bratton (1975) also attributed pattern among herbs in a cove hardwood forest to substrate heterogeneity, especially as manifested in differences in water holding capacity, and in a beech wood she found species distributed along a topographic moisture gradient. Sharitz and McCormick (1973) identified soil depth and available moisture as factors affecting distributions of *Sedum* and *Minuartia* on granitic rock outcrop communities.

Differences in soil pH have also been noted for many plant species. Stone (1944) and Lunde (1962) made extensive measurements of pH in relation to a number of herbaceous vascular species. Lunde (1962)

found that pH was partially correlated to relative base saturation and calcium content. He quantified the "normal amplitude" of pH for many species. Although Stone (1944) found no relation between pH and species occurrence, she concluded that each grew best within a limited optimum range. Working with calcicolous plants in Japan, Terao (1961) found bell shaped distributions of species in relation to pH and soil calcium. Woodruff (1935) also found wide variability in pH of soils with different species of ferns although there were conspicuous differences in mean pH values.

Oosting and Hess (1956) noted the effect of differences in micro-climate on the distribution of hemlock and some herbs in a Pleistocene relict community in North Carolina. They found these species were associated with high humidity though not necessarily with high soil moisture. Whittaker (1956, 1967) plotted species density against a topographic moisture gradient for a number of tree species in the Siskiyou Mountains of Oregon and The Santa Catalina Mountains of Arizona and found differences in optima for many of the species studied.

Curtis and McIntosh (1951) and Gilbert and Curtis (1953) explained pattern in terms of a continuum index based on a climax adaptation number and importance values. Soil properties such as calcium, water holding capacity, and organic matter of the horizon were correlated with the continuum index. Gilbert and Curtis (1953) showed several species of forest herbs to be unimodally distributed in frequency along the continuum index.

Several authors have approached the problem of pattern among species and communities by using species associations and ordination

techniques. Whittaker (1973) has provided an excellent review of this material. Principle component and ordination axes can often be related to environmental gradients such as moisture or nutrients. Smith and Cottam (1967) used Cole's index of association values for ordination and explained that species that were highly associated had different temporal or rooting strategies. However, they did not assess environmental factors.

Few ecological researchers have used discriminant function analysis to examine species relationships, despite its apparent usefullness. Cody (1968) and Hespenheide (1971) used discriminant analysis to reduce multidimensional habitat data for breeding birds to a single function. By using abundance of different herb species as variates, Norris and Barkham (1970) were able to discriminate among several beech woodlands. Green (1971) used multiple discriminant analysis to identify functional niche separation of molluscs among several physical and chemical variables. Dueser et al. (1976) used discriminant functions based on structural forest characteristics to define niche partitioning among four species of small mammals. Garten (in press) has also used discriminant analysis to differentiate among nutrient composition of several plant species and their associated soil nutrients. Green (1971) has discussed the utility of discriminant analysis in assessing realized niche hypervolumes.

Discriminant analysis is appropriate for the analysis of plant niche relationships or pattern in relation to environmental factors for a number of reasons. First, it reduces the variables to new independent

(orthogonal) linear additive functions of the original variables (Cooley and Lohnes, 1971). These functions become axes describing a new space in which the original values of the variables for each species can be plotted. Since the axes are derived to maximize differences between groups and since the discriminant functions are orthogonal to one another, mean species differences (centroids of groups) are more easily identified. Secondly, since the coefficients of the original variables used in the discriminant functions can be ranked as to their contribution to the functions, ecological interpretation of the axes is usually possible. Third, discriminant analysis does not assume linearity of ecological gradients as do principal components and cluster analysis (Ihm and Groenewoud, 1975). In fact it assumes that environmental variables used in the analysis have normal distributions as many such variables actually do (Ihm and Groenewoud, 1975; Whittaker, 1956). Fourth, if the underlying statistical assumptions can be met, the analysis provides a statistic similar to the F ratio of analysis of variance to differentiate between population centroids. A significant F ratio for overall discrimination indicates that there is a significant difference in the population means of the species studied in relation to the environmental variables measured.

Although discriminant analysis assumes normality of variates, this assumption is not actually justified by most data sets. Harris (1975) discusses the robustness of normal-curve based F tests which can be considered valid for even U-shaped populations and concludes that this robustness probably extends to multivariate tests, also. Marriott

(1974), in a discussion of discriminant analysis concludes that the "central limit theorem ensures robustness for almost any distribution in which the variance is independent of the mean (or of group (species) membership)," although heterogeneity of the dispersion (covariance) matrixes is a more serious problem requiring quadratic rather than linear discriminant analysis. Finn (1974) says that the Heck chart value (used as a test of significance of discriminating ability) approach is too conservative for most purposes. Michaelis (1973) examined the problem of inequality of dispersion matrixes of multiple groups by comparing results from linear and quadratic analyses of biological (medical) data. He found little difference between the accuracy of the two methods when distances between centroids were not relatively small. Unfortunately, he doesn't elaborate on how small these differences may be before serious error is introduced.

Although previous investigations have established the appropriateness of using discriminant analysis in evaluating niche relations of some animal species, such analyses have not been applied to plants. The present study consisted of an initial herbaceous inventory followed by an evaluation of the effectiveness of using discriminant analysis to interpret soil, site, and biotic factors as plant niche parameters. The problem of plant niche relations is approached by exploring resource allocation first among a group of closely related sympatric species and second among members of a guild or functionally similar group of species.

CHAPTER II

METHODS AND PROCEDURES

The Oak Ridge ERDA property consists of approximately 15,000 ha of land in Anderson and Roane Counties, Tennessee. Melton Hill and Watts Bar Reservoirs on the Clinch River form southern and eastern boundaries of the area while the city of Oak Ridge forms the northern boundary. The area has been under government control since 1942 and has not been disturbed except for experimental use, regulated forest management, highways and utility lines. The geology of the area consists of parallel southwest-northeast oriented ridges of sandstone, shale, and cherty dolomite, separated by valleys underlain by less weather resistant limestones and shales. Topography ranges from gently sloping valleys, rolling to steep slopes, to ridges with elevations ranging from 230 to 410 meters above mean sea level. The climate is typical of the humid southern Appalachian region with a mean annual rainfall of 136 cm and mean annual temperature of 14.3°C. Although storm fronts usually come from the northwest or southeast prevailing winds, generally follow the valleys from southwest to northeast. Seasonal precipitation is characterized by wet winters and springs and dry summers and autumns. Soils are primarily Ultisols (Kitchings and Mann, 1976).

As preparation for the NERP at Oak Ridge, five sites on the Oak Ridge ERDA property had been designated as natural or reference areas by Spring 1976. Prior to establishment of the NERP program at Oak Ridge, transects were established in each of the five designated areas to inventory overstory and shrub vegetation. This was later extended to include herbaceous vegetation. Transects and plots were originally spaced on a 10% forestry cruise basis (4 chains by 5 chains). Since this intensity of cruise did not provide an adequate sampling of the three smallest areas, additional plots were added to result in a 20% cruise (2 chains x 4 chains). Three concentric plots 1/5 acre in diameter for trees > 24.4 cm dbh, 1/10 acre for trees > 9.0 cm dbh and 1/100 acre for shrubs > 0.5 cm in diameter were used to sample woody vegetation. Three circular m^2 plots were established within the smaller diameter woody plot and were arranged symetrically around the center of the plot. Cover and number of herbaceous species were tallied on each of the m^2 plots throughout the growing season. This information comprises Appendix A. Number of species and cover represent maxima for each species on a plot during the sampling period. Environmental data collected at each m^2 plot were slope angle (percent), slope aspect relative canopy closure, litter depth and litter composition (Appendix B). Soil data were collected from location 1 only. Basal area data was available from the earlier inventory.

Slope percentage was measured with an abney level. On plots with slope less than 10%, readings were made by sighting across two meter sticks set on the highest and lowest sides of the plot. Aspect was

recorded from compass readings and transformed by summing the sine and cosine of degrees from north (Stage, 1976) to give a maximum at 45° NE. Slope position was calculated as the percentage of total slope length each plot center was from the valley bottom Slope length and plot location on the slope were calculated from topographic maps with all slopes being treated as right triangles in cross section. Slope position and aspect were included in the analysis because of their documented affect on microclimate and moisture (Cottle, 1932; Potzger, 1939; Hough, 1945; Jackson and Newman, 1967).

Litter depth and composition were included for several reasons. Litter presence has an affect on moisture retention in soil (Koshi, 1959) as well as presenting a possible mechanical barrier to establishment of some species. Leaf litter of a number of species of trees has also been demonstrated to have an allelopathic effect. Although many authors have felt that the high humidity in the eastern deciduous forest results in rapid breakdown and leaching of any potentially allelopathic substances, Muller and Chou (1972) have documented an instance of a woody plant inhibiting toxin released by a species of Quercus in the southeast. At least two other species of oak are known to have an effect on herbaceous species in drier locations and it has been suggested that litter of Fagus grandifolia and Acer saccharinum may also exert a similar influence (Muller, 1974). Other species of trees which occur in the study areas that have been found to inhibit the growth of herbs are Platanus occidentalis, Celtis laevigata and Pinus strobus (Rice, 1974). Three species of juniper, another species of pine, another species of maple, and the European beech have

also been shown to exert an allelopathic influence on herbs (Rice 1974) implicating Juniperus virginiana, the yellow pines (Pinus virginiana and P. echinata), and possibly other members of the genus Quercus.

Another aspect of litter composition is the relative nutrient contribution of various species to the upper layers of the soil where most of the herbs included in this study are rooted. Chandler (1941) found a linear relationship between the percentage of calcium in leaf litter and pH of the upper three inches of soil. A number of authors (Monk, 1966; Ovington, 1953; Coile, 1938) have noted the effect of conifer litter in depressing soil pH. A number of authors have discussed differences in nutrient composition of foliage of different species (Chandler, 1939; Auchmoody and Hammack, 1975; Scott, 1955; and Woodwell, et al., 1975) and Coile (1938) has discussed their probable effects on herbaceous vegetation. Of the major overstory species included in this study, red cedar litter is apparently highest in bases while most species of oaks are intermediate and beech and the yellow pines are lowest in base content of litter. Many of the species considered mesic associates (e.g., tulip poplar, basswood, and hophornbean) are among the highest in litter base content.

Oak, beech, pine, and grass litter contributions to the cover of each plot was relatively easy to estimate. Unfortunately, scheduling necessitated making litter estimates in mid-summer by which time most of the leaves of other species were decomposed to the point that identification was impractical if not impossible. Litter was therefore only categorized as to the contribution of those sources. Recognizing that canopy drip might also be a factor (Rice, 1974), basal area of

each woody species occurring on the larger concentric plots was included in the initial analysis.

Due to the known allelopathic effect of some species of eastern grass (Rice, 1974), grass litter was also included as a variable but was not identified as to species and is therefore not as likely to show any effect on distribution of species. Percent moss and lichen ground cover in the plot was also recorded.

Relative canopy closure and total basal area were included in the analysis because of their effects on microclimate and light availability (Koshi, 1959; Oosting, 1956; Jemison, 1934; Robinson, 1966). Relative canopy closure was estimated by straddling the plot and looking vertically above the center of the plot through a rectangular cardboard tube with a screen mesh grid taped over the end. The grid consisted of 16 intersections which were counted if they intersected part of the canopy. The resulting score was recorded as a percentage of the 16 total possible intersections.

All soil measurements were made on the upper 8 inches soil which was assumed to include most of the rooting zone of the species under consideration. Percent sand, silt and clay were estimated using the hydrometer method (Day, 1965), soil weight loss on ignition at 350°C was measured to approximate organic matter content and pH was measured in a 2:1 0.05 M CaCl:soil slurry with a pH meter.

Data computations were carried out using the computer facilities at Oak Ridge National Laboratory. Computer packages SAS 76 and Mudaid were used for a variety of analyses including univariate and multivariate analysis of variance. Discriminant analysis was performed on the data using the programs outlined in Cooley and Lohnes (1971).

CHAPTER III

RESULTS AND DISCUSSION

Introduction

Preliminary evaluation of the data showed that, of those species occurring on the inventory plots, four species of *Galium* and six of *Aster* were widespread enough and abundant enough to be suitable for an assessment of niche partitioning of selected environmental variables among congeneric species. Because of difficulties in positive identification of species of *Aster*, especially in non-flowering material, *Galium* was selected.

Although these species occurred abundantly in four of the five areas under consideration, vast differences in geology, overstory community composition, and past forest management of some of the areas cast doubt upon the different locations necessarily being occupied by reasonably uniform genetic material. To avoid the possibility of the presence of ecotypes confounding the analysis, two of the areas containing relatively few plots on which *Galium* occurred (locations 4 and 5, Appendix A) were eliminated and the remaining three locations were analyzed as two groups.

One of the remaining locations (location 1, Appendix A) is primarily a north slope mature mesic hardwood site occurring on Armuchee silt loam derived from Reedsville shale, Sequatchie limestone, and Rockwood Formation parent material. The other two locations occur on Chickamauga limestone as rolling stony land with Colbert and Talbott soil materials and are superifically similar in species composition of woody vegetation. Location 2 contains a number of prairie disjunct species and can be classed as a cedar barren while location 3, perhaps because of topographic position and aspect is moister in parts and has denser tree cover. Location 3 seemed similar enough to location 2 to combine the two for analytical purposes since at most they seem to represent opposite ends of a moisture gradient operating on similar soils and geology. These two will be referred to as the "cedar areas" in the following discussion.

Distribution of Galium

The four species selected are *Galium aparine*, *G. circaezans*, *G. triflorum* and *G. pilosum*. All four occurred in the cedar areas but *G. pilosum* was absent from the mesic area. Figures 1, 2, and 3 illustrate the topography, position of plots and abundance of each species used in the two analyses. For statistical analyses each individual was treated as a separate observation.

Fernald (1950) describes all but *G. aparine* as perennials, and gives various descriptions of woodlands as their habitats. All four occur from at least as far north as New England and Michigan south through Tennessee to Florida (*G. circaezans* and *G. aparine*) or Texas (*G. triflorum* and *G. pilosum*). He lists *G. pilosum* as occurring in dry

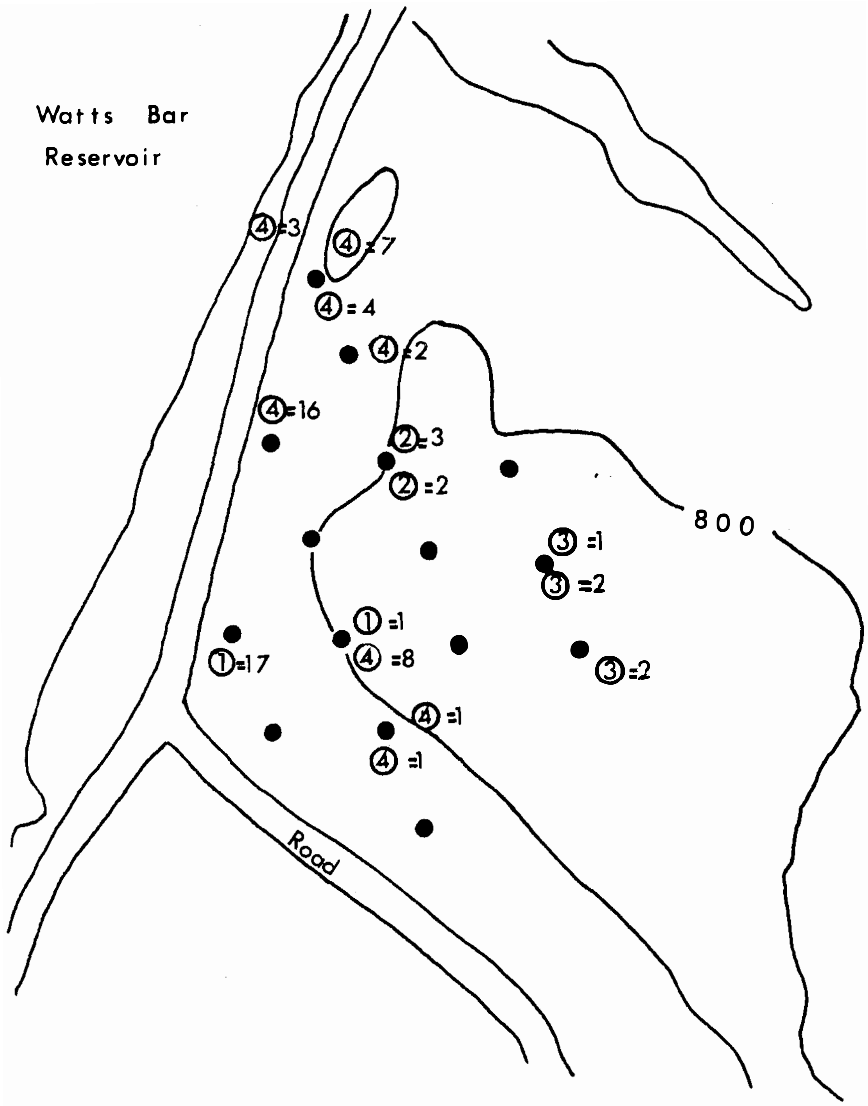

Figure 1. Location Two, cedar barren area. (Numbers of each species occurring at each sample plot are preceded by the following encircled code numbers: 1 = Galium aparine, 2 = G. circaezans, 3 = G. triflorum, 4 = G. pilosum.)

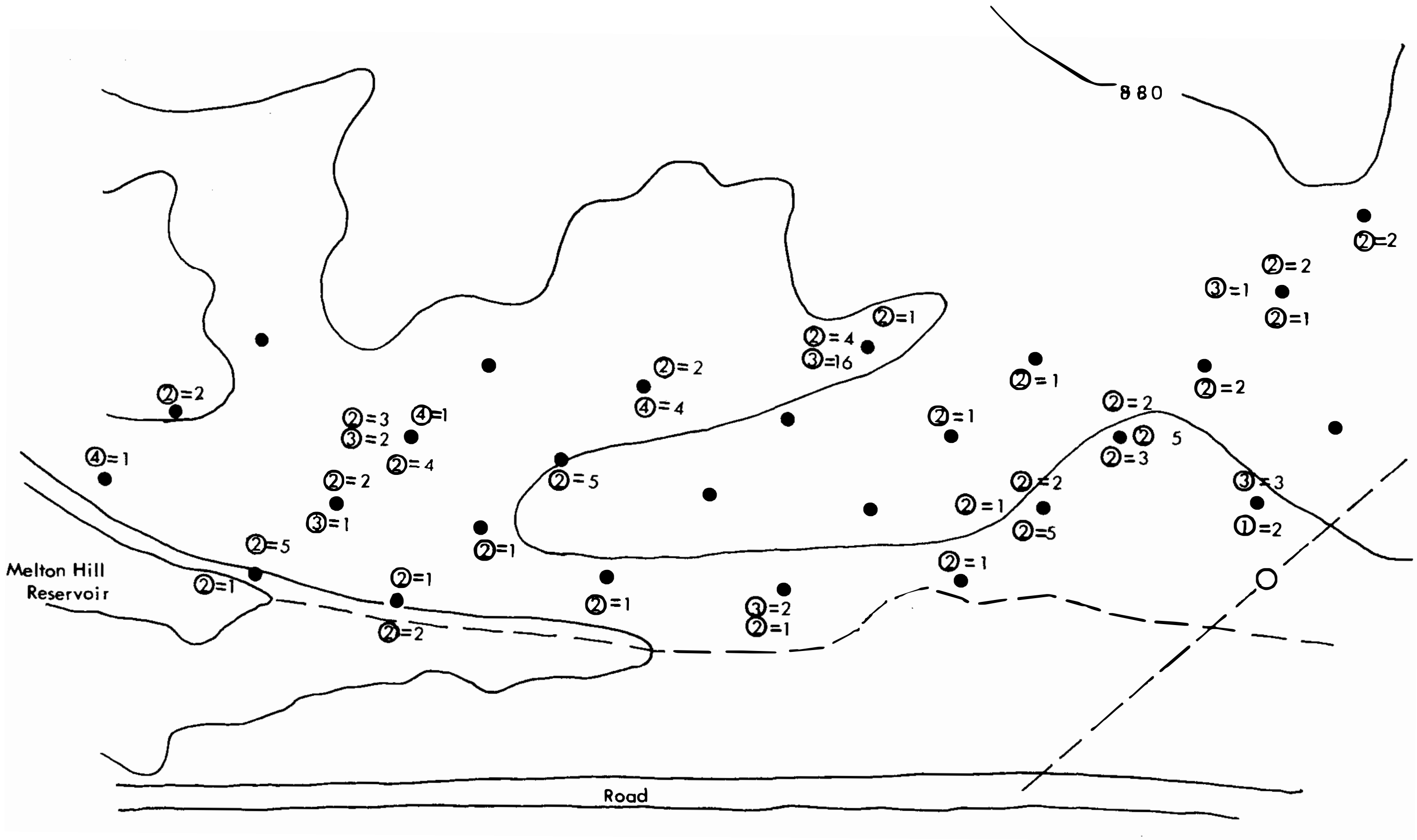

Figure 2. Location Three, forested cedar area. Coding is as in Figure 1.

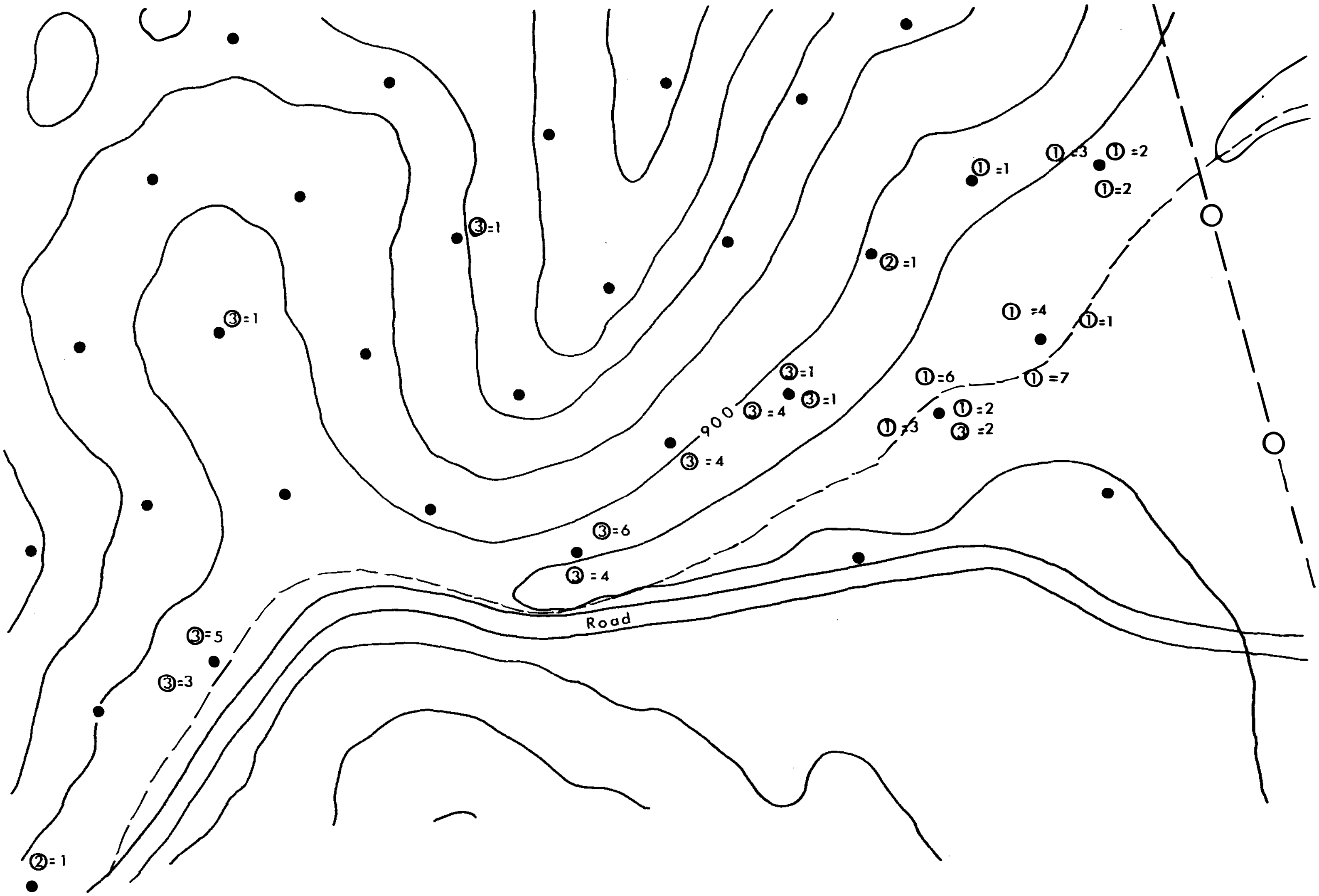

Figure 3. Location One, mesic area. Coding is as in Figure 1.

woods and copses, _G_. _triflorum_ in woods and thickets, _G_. _aparine_ in rich woods, thickets, seashores and waste ground and _G_. _circaezans_ in rich woods. Although there is considerable overlap in these habitat descriptions, it might be hypothesized from these descriptions that _G_. _pilosum_ would occur in dryer sites, _G_. _circaezans_ in mesic, fertile wooded sites, _G_. _aparine_ possibly in more open or disturbed mesic fertile sites and _G_. _triflorum_ in sites intermediate in moisture, fertility and forest density, or that at least their optimal densities would occur there.

Since discriminant analysis cannot be performed using more variables than the smallest number of observations in any group, analysis of variance was used to help determine which variables would be most useful in the discriminant analysis. There were significant differences in the mean basal areas of many species of trees associated with the four species of _Galium_ (Appendix C). McIntosh (1962) observed a similar phenomenon for herbs occurring in a Wisconsin woodland and noted that it was not paralleled by any apparent differences in relation to the environmental factors studied. The implications of possible allelopathic effects are worth noting.

Since so many of the tree species in each area were significantly different for species of _Galium_, the decision was made to exclude them from the discriminant analysis since most tree species had zero basal area on plots where one or more species of _Galium_ occurred. Presence of zeros or invariant variables creates problems in discriminant analyses because of the impossibility of inverting matrixes containing such data. Instead, composite variables were constructed using the

added basal areas of all pine species as one and the added basal areas of all oak species as another. Other variables included in the initial multivariate analysis are shown in Tables 1 and 2. To obtain the maximum amount of discrimination and comply with the number of variables allowed in the analysis (least number of observations for any species minus one), those variables shown in Tables 1 and 2 to be correlated with $r^2 \geq 0.5$ were eliminated also.

The variables used for discriminant analysis in the cedar areas were then ridge height (to see if there were major differences between the two areas) plot position on the slope, litter depth, oak litter, cedar litter, other litter, moss cover, canopy closure, aspect, percent slope, Juniperus virginiana basal area, Pinus basal area, and total basal area. Stepwise discriminant analysis (Coole and Lohne, 1971) was then used with this data.

Although the data did not pass the test of equality of dispersion matrixes, centroids for the four species were well spaced in the discriminant space and the F ratio for overall discrimination = 4.2 with 39 and 465 degrees of freedom, at a significance level of < 0.001. Following Michaelis' (1973) comments (see previous discussion), it may therefore be assumed that there are significant differences in centroids and that their positions in an abstract hyperspace can be defined by the selected environmental variables. Figure 4 shows the relative position of each species on the first, second, and third discriminant functions and Figure 5 shows their relative positions in the three dimensions defined.

TABLE 1

CORRELATION MATRIX OF VARIABLES FROM LOCATION ONE RELATED TO THREE SPECIES OF *GALIUM*

Variables	Plot Altitude	Slope Height	Plot Position	Litter Depth	Percent Oak Litter	Percent Beech Litter	Percent Other Litter	Canopy Closure	Aspect	Percent Slope	Oak Basal Area	Total Basal Area
Plot Altitude	1.000	0.219	0.736	0.132	0.643	0.083	-0.398	0.184	0.262	0.632	-0.812	-0.237
Slope Height		1.000	0.527	0.082	-0.150	0.365	-0.214	0.104	0.041	0.475	0.073	0.387
Plot Position			1.000	0.163	0.159	0.433	-0.567	0.474	0.205	0.692	0.400	-0.229
Litter Depth				1.000	0.115	0.425	-0.354	0.114	0.102	-0.072	0.024	0.157
Percent Oak Litter					1.000	-0.255	-0.137	0.085	0.112	0.280	0.826	-0.163
Percent Beech Litter						1.000	-0.863	0.395	-0.016	0.291	-0.223	-0.176
Percent Other Litter							1.000	-0.439	-0.093	-0.518	-0.162	-0.387
Canopy Closure								1.000	0.034	0.512	-0.041	-0.183
Aspect									1.000	0.001	0.184	-0.056
Percent Slope										1.000	0.553	-0.128
Oak Basal Area											1.000	-0.220
Total Basal Area												1.000

TABLE 2

CORRELATION MATRIX OF VARIABLES FROM LOCATIONS TWO AND THREE RELATED TO FOUR SPECIES OF *GALIUM*

Variables	Plot Altitude	Slope Height	Plot Position	Litter Depth	Percent Oak Litter	Percent Cedar Litter	Percent Other Litter	Percent Moss Cover	Percent Grass Litter	Percent Canopy Closure	Aspect	Percent Slope	Cedar Basal Area	Oak Basal Area	Pine Basal Area	Total Basal Area
Plot Altitude	1.000	0.488	0.180	-0.100	0.407	-0.028	-0.037	-0.330	-0.003	0.214	-0.029	-0.106	-0.345	0.379	-0.309	0.086
Slope Height		1.000	-0.130	0.010	0.059	0.042	0.188	-0.082	0.119	0.141	0.188	-0.062	-0.050	0.002	-0.112	0.238
Plot Position			1.000	-0.214	-0.044	-0.241	-0.020	-0.251	-0.132	0.036	-0.046	-0.405	-0.064	-0.065	0.152	0.027
Litter Depth				1.000	0.134	-0.090	-0.159	0.138	-0.097	0.107	-0.078	0.151	-0.132	0.094	-0.123	-0.014
Percent Oak Litter					1.000	0.014	-0.284	-0.407	-0.120	0.240	-0.144	0.205	-0.125	0.735	-0.468	0.234
Percent Cedar Litter						1.000	-0.014	-0.093	0.203	0.057	0.150	0.280	0.328	0.011	-0.395	-0.231
Percent Other Litter							1.000	-0.032	0.194	0.091	0.159	0.222	0.161	-0.199	-0.084	0.118
Percent Moss Cover								1.000	0.040	-0.149	0.163	0.018	0.108	-0.337	0.255	-0.179
Percent Grass Litter									1.000	-0.062	-0.097	0.164	0.138	-0.242	-0.102	-0.231
Percent Canopy Closure										1.000	0.109	0.296	0.215	0.149	-0.341	0.252
Aspect											1.000	0.017	0.221	-0.135	0.059	0.199
Percent Slope												1.000	0.221	0.300	-0.548	0.093
Cedar Basal Area													1.000	-0.434	-0.096	-0.071
Oak Basal Area														1.000	-0.558	0.340
Pine Basal Area															1.000	0.123
Total Basal Area																1.000

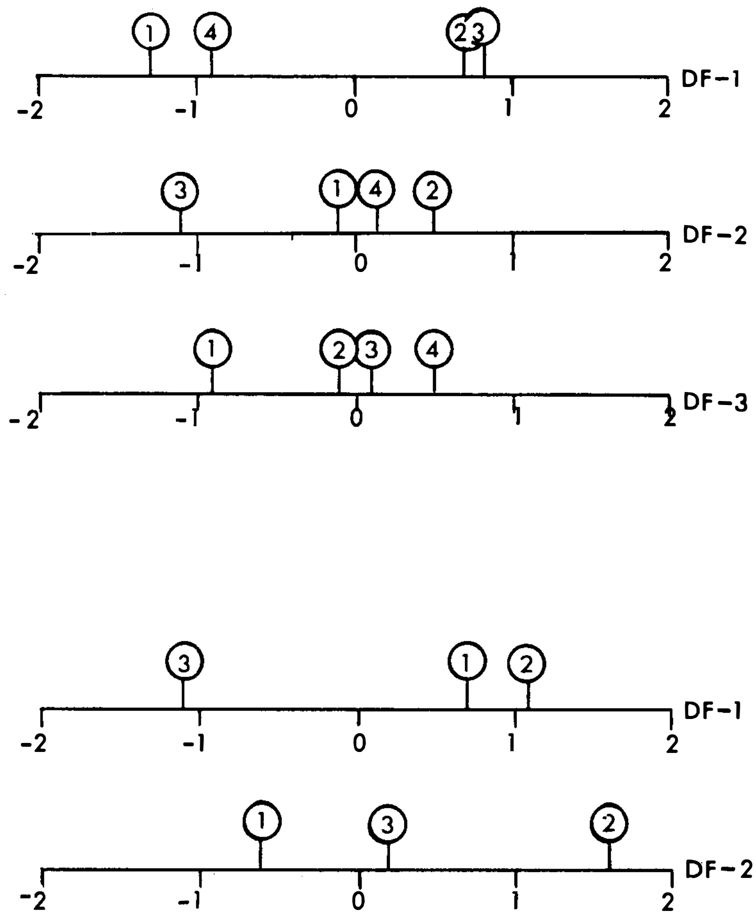

Figure 4. Positions of species centroids on each of the separate discriminant functions. (The upper diagrams are for the four species of Galium occurring in the cedar areas while the lower applies to the three found in the mesic area. 1 = G. aparine, 2 = G. circaezans, 3 = G. triflorum, and 4 = G. pilosum. DF-1 in both locations is related to canopy closure with -2 most open in the cedar areas and -2 most closed in the mesic area. DF-2 and DF-3 in the cedar areas are related to pine and cedar respectively with -2 most pine on DF-2 and +2 most cedar on DF-3. A value of +2 on DF-2 is most oak and pine in the mesic area.)

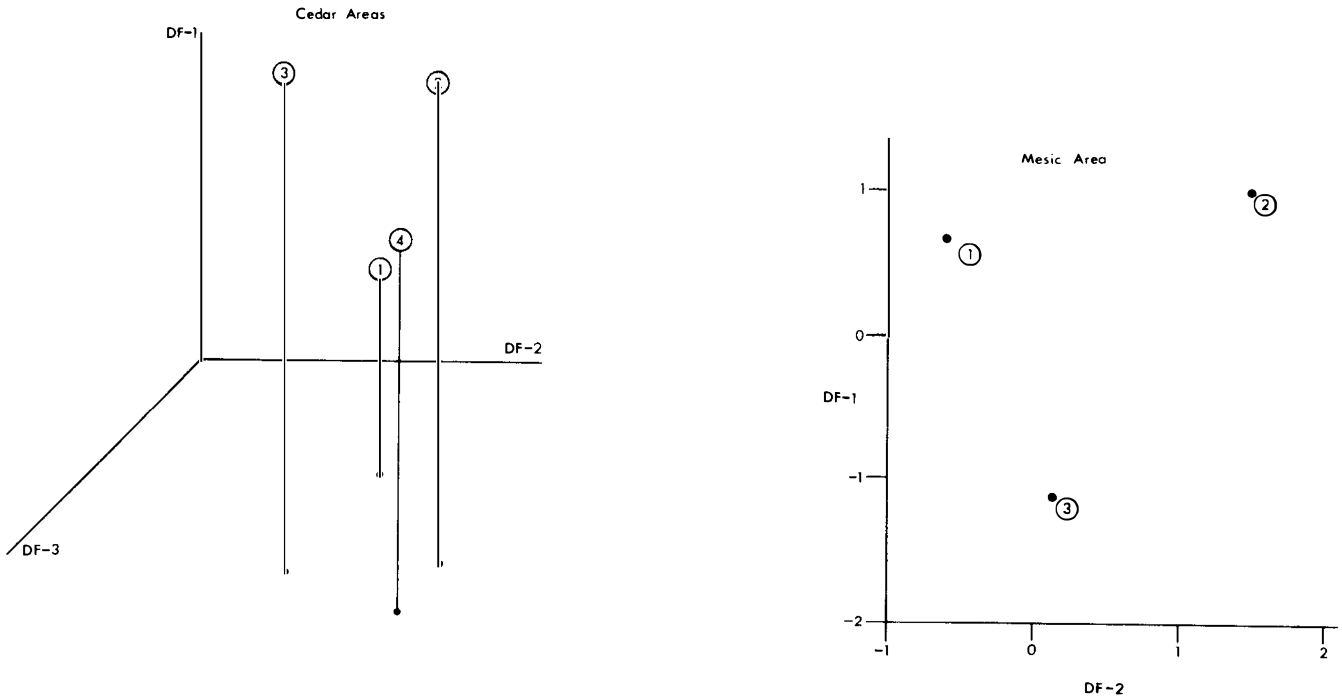

Figure 5. Positions of centroids of <u>Galium</u> species in multidimensional discriminant space. (Coding is as in Figure 4.)

The three discriminant function axes can be tentatively defined by using the factor pattern for each function. The factor pattern (Table 3) gives the relative contribution of each variable to that particular discriminant function or the relative correlation of the original variables with that function. In this analysis 81% of the variability in the original data is accounted for by the first discriminant function, with 12% remaining for the second and 6% for the third. The major environmental influence suggested by the first axis is related to overstory development including total basal area, canopy closure and a concurrent increase in litter depth (Table 3). This function discriminates between the four species separating them into two groups with *Galium aparine* and *G. pilosum* at one extreme and *G. circaezans* and *G. triflorum* in the other.

The second discriminant function has the highest correlation with percent moss cover, pine basal area and plot position on the slope. Since aspect and steepness of slope also are correlated with this axis, it may be interpreted as a moisture axis combined with an acidity axis. The effects of pine litter on soil acidity have been discussed previously and the occurrence of moss and lichen carpeting on acid soils with little accumulation of litter is common in this area. The effects of aspect and slope position on soil moisture in relation to species distribution has also been discussed. The distribution of *Galium triflorum* is most strongly affected by this axis (Figures 4 and 5).

TABLE 3

FACTOR PATTERNS (CORRELATIONS OF DISCRIMINANT FUNCTIONS WITH ORIGINAL VARIABLES) AND PERCENT TRACE ATTRIBUTABLE TO EACH FUNCTION FOR FOUR SPECIES OF *GALIUM* IN TWO LOCATIONS

Cedar Areas

Variable \ Discriminant Function	Factors 1	2	3
Ridge Height	0.197	0.174	-0.039
Plot Position	0.115	-0.601	0.377
Litter Depth	0.804	0.102	-0.209
Percent Oak Litter	0.596	0.356	-0.313
Percent Cedar Litter	-0.177	0.171	0.637
Percent Other Litter	0.080	0.246	0.319
Percent Moss Ground Cover	0.217	-0.664	-0.007
Percent Canopy Closure	0.782	-0.142	0.449
Aspect	0.461	-0.454	-0.023
Percent Slope	0.214	0.410	-0.007
Cedar Basal Area	-0.106	0.023	0.450
Percent Pine Litter	0.451	-0.606	0.207
Total Basal Area	0.854	-0.092	0.202
Percent Trace	81	12	6

Mesic Area

Variable \ Discriminant Function	Factors 1	2
Ridge Height	0.277	0.091
Litter Depth	-0.547	0.298
Percent Oak Litter	0.114	0.855
Percent Beech Litter	-0.277	0.001
Percent Canopy Closure	0.458	0.179
Aspect	0.085	-0.439
Percent Slope	-0.215	0.445
Percent Pine Litter	-0.324	0.766
Total Basal Area	-0.623	-0.104
Percent Trace	83	17

The 3rd discriminant function is most highly correlated with those variables that can be related to high pH or calcium content of soils, to differences in resistance to allelopathic substances from *Juniperis virginiana*, or as a dryness or high calcium axis since *J. virginiana* is known to be abundant on droughty limestone soils. The three variables most strongly correlated with this function are *Juniperus* basal area, percent *Juniperus* litter and canopy closure. The distribution of *Galium aparine* in most strongly affected by this axis (Figures 4 and 5).

Although the centroids define the centers of distribution of the four species in the three dimensional space defined by the three discriminant functions, the relationship of species positions to the values of the variables incorporated into all of the three functions is immediately clear (Figure 5). Basal area, litter depth and canopy closure for *G. triflorum* and *G. circaezans* was greater than for *G. aparine* and *G. pilosum* (Table 2). Similarly, *Juniperus* basal area, *Juniperus* percent litter and percent canopy closure were less for optimum occurrence of *G. aparine* than for the other three species. The sign of the second discriminant function, however, is reversed for "acidity." *G. triflorum* is associated with greater pine basal area and percent moss litter rather than less as the sign on that discriminant function might imply. By multiplying the sign of the factor (Table 3) associated with each discriminant function variable by the sign of the centroid value for that function, the direction of change of the variables in relation to the species centroids may be obtained. For example, *G. triflorum* is at the negative end of discriminant function

two. The variables moss litter, pine basal area, plot position and aspect all have negative factors for discriminant function two. This means that the mean occurrence of this species is associated with larger values of those variables. The reverse is true of percent slope.

To return to the original hypothesis of distribution these species, G. aparine does indeed appear to occur in more open areas (discriminant function one) as does G. pilosum. If discriminant function three is interpreted as a moisture axis, G. pilosum has a mean occurrence at the xeric end. It is less clear what factors separate the niches of G. circaezans and G. triflorum since these are best discriminated with function two which is the least interpretable. It appears that G. triflorum occurs on more acid, flatter, more northerly in terms of aspect, sites than G. circaezans which also fits the original hypothesis. It should be noted that no pattern of distribution in relation to any of the variables measured was apparent during the data collection with the possible exception of total basal area in relation to G. pilosum.

In the mesic area, the variables used in the analysis were slightly different. Because of the importance of pine in discriminating between groups in the other location, that variable was included even though it had a mean of zero for G. circaezans. The results of the discriminant analysis indicate that as in the cedar areas, basal area, litter depth and canopy closure were most highly correlated with the first discriminant function (Figures 4 and 5). However, separation of species on this axis are slightly different: G. aparine and G. circaezans occurring in

slightly more open areas than G. triflorum. It is surprising that this axis accounted for 83% (Table 3) of the variability in species occurrance since the area appears fairly uniform in these variables on casual inspection and differences in means (Appendix C) is slight. As in the cedar areas, the second discriminant axis is difficult to interpret. It is most highly correlated with percent oak litter and pine basal area which at first glance seems contradictory. However, oak litter also results in somewhat acid soil and both may result in slightly lowered fertility following leaching of bases. If this is the case, G. circaezans and G. aparine have reversed their positions in relation to this axis compared to the cedar areas.

It is obvious from the above discussion that while differentiation among species using discriminant analysis is possible, interpretation of the variables correlated with the axes may prove difficult. Differences in species distribution in relation to different variables in the two areas studied may be due to differences in variables not under consideration. As Whittaker has hypothesized (1965), presence of one favorable factor (such as moisture in cove forests) allows a greater diversity of herbs whose distribution is then dependent on other factors. It is apparent that direct measurement of such factors as available water and soil and litter nutrients would be valuable in analyses of species distributions, but such measures were outside the scope of this study.

Distribution of Seventeen Species

After establishing that discriminant analysis could be used to identify niche axes for closely related species, an attempt was made to use the same approach on pattern of distribution of seventeen species of herbs in the mesic area described previously. The term "herb" in this case includes Chimaphila maculata, several geophytes and hemicryptophytes and two species of ferns. Species selected were those that occurred on seven or more of the 99 plots and totaled at least thirteen individuals regardless of the number of plots in which they occurred.

Of the species under consideration, most occur in rich woods (Fernald, 1950; Oxendine, 1971), the others being Galium triflorum and Geranium maculatum, occurring in woods and thickets, Phlox divaricata and Polygonatum biflorum in damp to dry, rocky woods and thickets, Polystichum acrostichoides in woods and on rocky slopes, Smilacina racemosa in woods, clearings and bluffs, Chimaphila maculata in dry woods and Hexastylis arifolia in woodlands. One could conclude from these descriptions that Actaea pachypoda, Arisaema triphyllum, Botrichium virginianum, Dentaria diphylla, Dentaria lacinata, Galium aparine, Tiarella cordifolia, Trillum luteum and T. vaseyi would occur randomly together in rich woods and that the other species might occur in slightly dryer or more open situations. Discriminant analysis should give an indication as to what habitat variables, if any, contribute to niche separation among those species described as occurring in similar areas as well as those that probably are centered in dryer or more open areas.

In addition to variables measured respective to the Galium species (discussed previously), soil texture, soil loss on ignition and soil pH were included in the analysis. All variables under consideration (Appendix D) showed significant differences in species means at the 0.0001% level. Due to the limitations on number of variables allowed in discriminant analysis (13 observations - 1 = 12 in this case) all variables which had a mean of zero for any species were eliminated. Variables (SAS 76, Barr et al., 1976) with a correlation >0.6 were also eliminated. Percent silt content in soil samples was also eliminated since the value of this variable is directly dependent on sand and clay percentages resulting in a singular matrix which cannot be inverted in the discriminant function calculations.

As in the Galium analyses, the condition of equality of dispersion matrixes could not be met, although the F ratio for overall discrimination was 8.64, significant at the < 0.001 level. The factor pattern and percent of variability accounted for by each discriminant function are shown in Table 4. Chi square values were significant for the first 9 discriminate functions. The first three discriminant functions are much easier to interpret in this case than was the case for the Galium data since each has only one variable highly correlated with it.

The first discriminant function is most highly correlated with beech litter. The relationship of this variable to species distribution may be interpreted in at least two ways: it may represent a causative agent in the sense of having allelopathic effects on some or all species or it may represent a complex gradient of other unmeasured

TABLE 4

FACTOR PATTERN AND PERCENT TRACE FOR SEVENTEEN SPECIES

	Factors										
Discriminant Functions / Variables	1	2	3	4	5	6	7	8	9	10	11
Total Basal Area	-0.51	0.21	0.23	0.24	-0.18	-0.17	-0.29	0.07	-0.66	-0.05	-0.10
Plot Position	-0.22	-0.77	0.27	0.35	0.23	-0.23	-0.05	0.07	-0.02	-0.19	0.15
Litter Depth	-0.04	-0.07	0.29	0.19	-0.14	-0.13	-0.38	0.11	0.16	0.09	-0.81
Aspect	0.25	0.09	0.06	-0.18	-0.29	0.17	0.09	0.36	0.41	-0.66	0.21
Percent Canopy Closure	0.38	-0.03	0.16	0.21	0.46	0.59	0.36	0.10	-0.14	-0.14	-0.14
Percent Slope	-0.03	-0.14	0.67	0.02	0.54	-0.21	0.18	-0.11	0.16	-0.10	0.35
PH	0.52	0.35	-0.43	0.23	0.19	-0.50	-0.02	0.23	0.07	0.05	-0.18
Percent Sand	-0.14	-0.37	0.09	-0.49	-0.45	-0.21	0.26	0.49	0.08	0.21	-0.04
Percent Clay	0.04	0.22	-0.13	0.59	0.29	0.32	-0.19	0.12	0.33	0.19	0.47
Loss on Ignition	0.52	0.03	-0.04	0.23	-0.30	-0.34	0.49	0.18	0.40	0.17	-0.10
Percent Beech Litter	0.91	0.02	0.27	0.17	-0.17	-0.06	-0.16	-0.01	0.13	0.08	-0.04
Percent Trace	35.07	29.13	12.43	8.20	5.81	3.46	2.68	1.17	1.00		

variables (such as moisture) which are effecting distribution of beech in the same way as it is affecting the herbaceous species. Occurrence of most of the species identified as occurring in dryer or more open habitats on the negative end of this function is evidence for the latter. Loss on ignition (organic matter) and pH of soil were also fairly highly correlated (0.52) with this axis. The negative correlation of total basal area with this axis may reflect the tendency of fewer seedling trees occurring under beech trees. Since all of these variables occur together on this axis it can be best interpreted as a nutrient-moisture axis or a "rich woods" axis. This function accounts for only 35% of the variability in the data.

The second discriminant function, which accounted for 29% of the variability, was most highly correlated with plot position on the slope and was not correlated with any other variables. This function undoubtedly is related to moisture.

The third discriminant function is most correlated with percent slope (0.66) and soil pH (0.43) with higher pH values accompanying more level slopes. This may reflect the tendency of less steep slopes to allow greater accumulations of litter. The fact that litter depth was not highly correlated with this axis implies that such litter accumulations must be rapidly decomposing types (e.g., tulip poplar) which may also be relatively high in calcium and other bases (Chandler, 1941). More level slopes may also have higher available moisture levels, implying that this axis may also represent a moisture-nutrient axis.

The fourth discriminant function which together with the first three accounts for 84% of the variability in the data also appears to be related to moisture and possibly nutrients. The highest correlations with this function were for clay (0.58) and sand (-0.48). Higher clay content and lower sand content in soils would be related to greater water holding capacity while clay content may be related to base saturation and nutrient availability.

That the first four discriminant functions seem to represent the same limiting factors for the species involved and yet are orthogonal to one another may at first seem contradictory. Although data are not available from this study, inferences may be made based on other research on the effect of other variables on those measured. Soil texture affects water holding capacity of the soil or how much of the incident rainfall is retained and remains available for plants. Slope position is related to moisture in the soil since moisture moves by gravity down slope. Temperature differences (higher and more variable on upper slopes) affect evapotranspiration resulting in more rapid removal of moisture from upper slopes regardless of the amount of water available. Steep slopes allow less water to percolate into the soil during heavy rains and lose more moisture by gravity than more level slopes. Level slopes have a greater potential for becoming saturated during heavy rains resulting in poor aeration. If the second, third, and fourth discriminant functions (Figures 6 and 7) are interpreted in these terms it becomes apparent that extremes in moisture fluctuations may be important in competition among these species. If this interpretation is correct, one might expect to find *Polystichum acrostichoides*

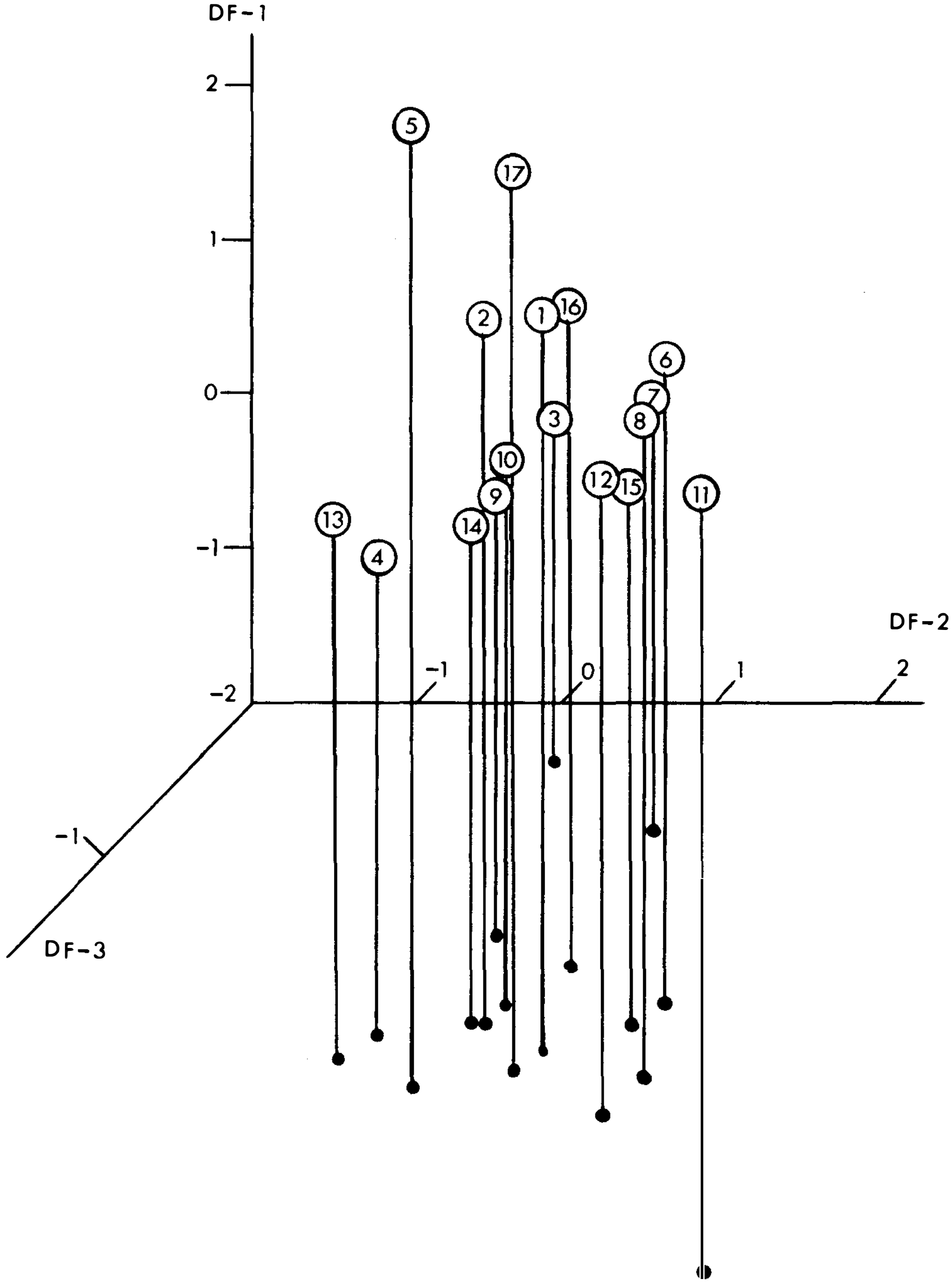

Figure 6. Distributions of centroids of 17 species from the mesic area as distributed in the three dimensional space described by the first three discriminant functions. (1 = Actaea pachypoda, 2 = Arisaema triphyllum, 3 = Botrichium virginianum, 4 = Chimaphila maculata, 5 = Dentaria diphylla, 6 = D. Lacinata, 7 = Galium aparine, 8 = G. triflorum, 9 = Geranium maculatum, 10 = Hexastylis arifolia, 11 = Phlox divaricata, 12 = Polystichum acrostichoides, 13 = Polygonatum biflorum, 14 = Smilacina racemosa, 15 = Tiarella cordifolia, 16 = Trillilum luteum, and 17 = Trillium vaseyi.)

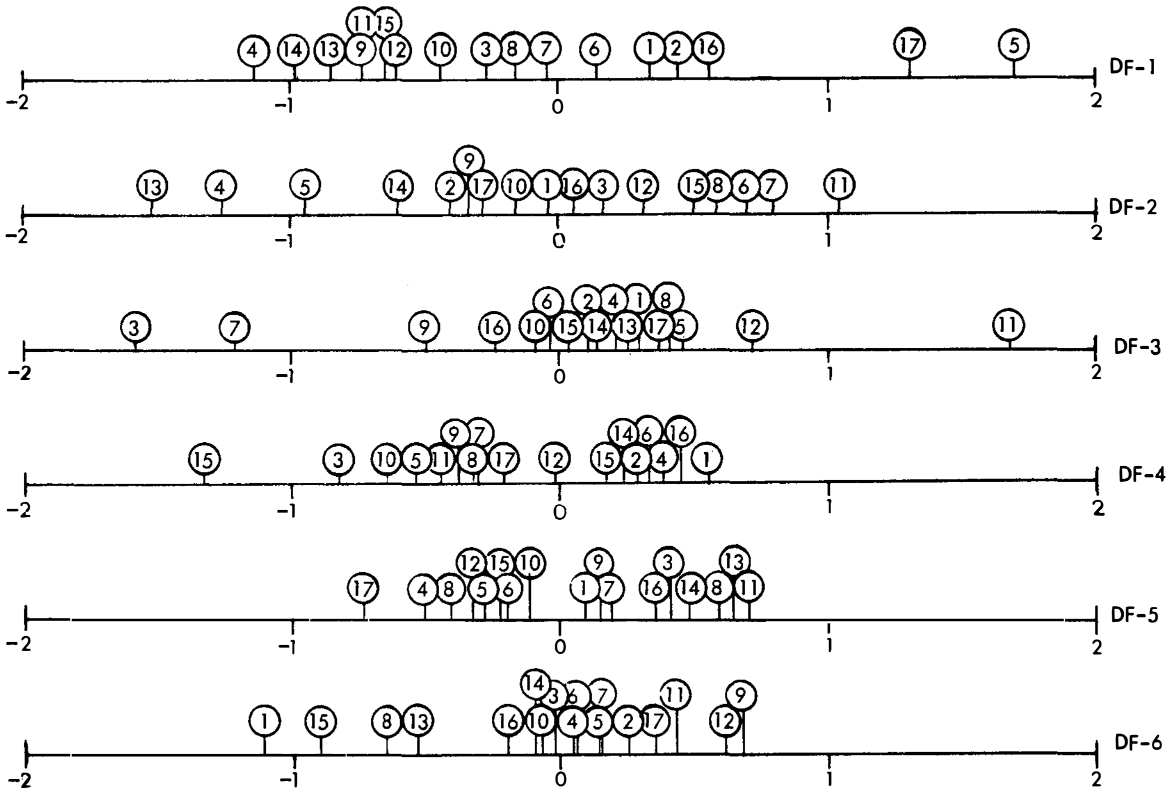

Figure 7. Positions of centroids of 17 species from the mesic area on the first 6 discriminant functions. (Functions 7, 8 and 9, although contributing significantly to separation of species centroids, are not shown since their contributions are not apparent in one dimension. 1 = *Actaea pachypoda*, 2 = *Arisaema triphyllum*, 3 = *Dentaria diphylla*, 6 = *D. laciniata*, 7 = *Galium aparine*, 8 = *G. triflorum*, 9 = *Geranium maculatum*, 10 = *Hexastylis arifolia*, 11 = *Phlox divaricata*, 12 = *Polystichum acrostichoides*, 13 = *Polygonatum biflorum*, 14 = *Smilacina racemosa*, 15 = *Tiarella cordifolia*, 16 = *Trillilum luteum* and 17 = *Trillium vaseyi*.)

and Phlox divaricata, two species described as occurring on rocky slopes, on relatively steep slopes, both conditions allowing good drainage. These two species are isolated on the steep end of discriminant function 3. These species may be poor competitors in wet situations but slightly more tolerant of drought than other species.

To return to my original hypothesis concerning likely niche segregation among the seventeen species based on general habitat descriptions, the following conclusions can be reached based on the discriminant analysis. Of the 8 species not described as occurring in rich woods all occur on the negative end of the first discriminant function (rich woods) and five occur on the upper slope end of the second discriminant function implying that in this case, as was true of the Galium analyses, it was possible to differentiate among species using discriminant functions as moderately interpretable niche axes. Interestingly, many of the species described as occurring in rich woods are more widely separated from one another in the discriminant hyperspace than are the other species.

To better visualize the spatial pattern among species centroids in the eleven dimensional discriminant space, distances between centroids of species were calculated (Table 5). Two species pairs, Trillium luteum and Arisaema triphyllum ($D^2 = 1.456$) and Trillium vaseyi and Dentaria diphylla ($D^2 = 1.818$) were closer than any other pairs in the hyperspace. To examine the effect of factors other than competition among species on their distributions, analysis of variance was

TABLE 5

DISCRIMINANT ANALYSIS : PAIRWISE SQUARED GENERALIZED DISTANCES BETWEEN GROUPS

$$D^2(I|J) = (\bar{X}_I - \bar{X}_J)' \, COV^{-1} (\bar{X}_I - \bar{X}_J)$$

GENERALIZED SQUARED DISTANCE TO :

FROM :	Actaea pachypoda	Arisaema triphyllum	Botrichium virginianum	Chimaphila maculata	Dentaria diphylla	Dentaria laciniata
ACPA[†]	0.00000000	3.03385474	12.45799716	11.30368575	8.36100263	3.51396167
ARTR	3.03385474	0.00000000	9.05497964	10.57269377	6.07079474	3.98326240
BOVI	12.45799716	9.05497964	0.00000000	18.30498208	18.82912214	10.92663578
CHMA	11.30368575	10.57269377	18.30498208	0.00000000	19.24722436	11.20121654
DEDI	8.36100263	6.07079474	18.82912214	19.24722436	0.00000000	10.55991349
DELA	3.51396167	3.98326240	10.92663578	11.20121654	10.55991349	0.00000000
GAAP	8.76160514	7.63242585	1.84680252	18.30466715	17.59946209	6.48525717
GATR	5.68645786	5.65007702	8.89367666	12.96734979	13.49710183	4.08342932
GEMA	10.75220911	7.97684977	12.70634385	5.62923862	16.07381525	6.12608973
HEAR	6.31655321	4.67390908	6.55229448	5.91407749	12.11925118	4.27964126
PHDI	12.09845928	11.91617056	17.93739497	18.74213944	23.26994170	9.41136156
POAC	7.53454132	6.60557323	11.66242416	8.58097048	14.92889634	3.90009032
POBI	10.98436066	11.50746983	17.52835064	4.90295699	19.75920912	15.69387036
SMRA	6.68276779	6.67880356	13.03335434	4.88225886	17.23013392	6.76352731
TICO	9.38564809	9.88771739	7.31277399	14.29401771	19.20126257	8.00242136
TRLU	2.37796409	1.45635808	7.42127190	12.60132937	7.25165780	2.47206541
TRVA	5.83638919	5.77040152	15.58794948	16.92529724	1.81802747	6.61457424

FROM :	Galium aparine	Galium triflorum	Geranium maculatum	Hexastylis arifolia	Phlox divaricata	Polystichum acrostichoides
ACPA	8.76160514	5.68645786	10.75220911	6.31655321	12.09845928	7.53454132
ARTR	7.63242585	5.65007702	7.97684977	4.67390908	11.91617056	6.60557323
BOVI	1.84680252	8.89367666	12.70634385	6.55229448	17.93739497	11.66242416
CHMA	18.30466715	12.96734979	5.62923862	5.91407749	18.74213944	8.58097048
DEDI	17.59946209	13.49710183	16.07381525	12.11925118	23.26994170	14.92889634
DELA	6.48525717	4.08342932	6.12608973	4.27964126	9.41136156	3.90009032
GAAP	0.00000000	6.70400336	12.38772523	6.27799611	13.90074773	9.84540904
GATR	6.70400336	0.00000000	10.46924384	3.00259563	6.43804468	4.28128987
GEMA	12.38772523	10.46924384	0.00000000	5.27211452	15.30221833	6.74046433
HEAR	6.27799611	3.00259563	5.27211452	0.00000000	9.59394518	3.54329787
PHDI	13.90074773	6.43804468	15.30221833	9.59394518	0.00000000	5.46426612
POAC	9.84540904	4.28128987	6.74046433	3.54329787	5.46426612	0.00000000
POBI	19.52558650	17.08971024	10.85922972	8.79518599	20.26325989	12.30740927
SMRA	12.48363173	8.61049982	3.56846691	5.40949487	11.60688427	4.90323291
TICO	6.94376034	2.03485276	11.08730153	3.68217543	8.46679658	7.04218606
TRLU	5.08866134	5.15456853	8.78815059	5.18384835	11.91167776	6.14042539
TRVA	12.29538542	10.52647867	14.12203109	9.48740448	18.53522614	10.79814471

FROM :	Polygonatum biflarum	Smilacina racemosa	Tiarella cordifolia	Trillium luteum	Trillium vaseyii
ACPA	10.98436066	6.68276779	9.38564809	2.37796409	5.83638919
ARTR	11.50746983	6.67880356	9.88771739	1.45635808	5.77040152
BOVI	17.52835064	13.03335434	7.31277399	7.42127190	15.58794948
CHMA	4.90295699	4.88225886	14.29401771	12.60132937	16.92529724
DEDI	19.75920912	17.23013392	19.20126257	7.25165780	1.81802747
DELA	15.69387036	6.76352731	8.00242136	2.47206541	6.61457424
GAAP	19.52558650	12.48363173	6.94376034	5.08866134	12.29538542
GATR	17.08971024	8.61049982	2.03485276	5.15456853	10.52647867
GEMA	10.85922972	3.56846691	11.08730153	8.78815059	14.12203109
HEAR	8.79518599	5.40949487	3.68217543	5.18384835	9.48740448
PHDI	20.26325989	11.60688427	8.46679658	11.91167776	18.53522614
POAC	12.30740927	4.90323291	7.04218606	6.14042539	10.79814471
POBI	0.00000000	7.26057207	16.23675300	13.26203251	19.01821351
SMRA	7.26057207	0.00000000	10.30055558	7.73168118	14.63924393
TICO	16.23675300	10.30055558	0.00000000	8.86659445	15.86951260
TRLU	13.26203251	7.73168118	8.86659445	0.00000000	5.36478585
TRVA	19.01821351	14.63924393	15.86951260	5.36478585	0.00000000

[†]Species names in left hand column are abbreviated to the first two letters of genus and species.

calculated testing significance of species presence versus species absence in relation to several of the variables studied.

Species included in the presence vs absence evaluation included both species of Dentaria, both species of Trillium, Arisaema triphyllum, Geranium maculatium and Phlox divaricata. The other species were not included since they occurred on fewer than seven plots. Due to the limitations on discriminant analysis discussed previously, only six variables could be used in the analysis. This meant arbitrairly eliminating some variables. Based on the result of the discriminant analysis of all 17 species, plot position, canopy closure, slope angle, pH, percent sand and percent clay were selected for this part of the analysis. Beech litter was eliminated since it had a value of zero for a number of the species absence data. Table 6 contains F ratios and significance levels for univariate and discriminant functions. For five of the seven species, mean pH was significantly different in plots where species were present vs plots where species were absent. In all of these cases, pH values were higher where species occurred than where they did not occur. Plot position on the slope was also significant for four species with all of the four occurring on lower slopes. Steepness of slope was only significant in the distribution of Dentaria laciniata which was found on slopes less steep than where it was absent, and soil texture was only significant for Trillium luteum which was found in less sandy soils.

Discriminant analysis using all six variables did not result in an increase in ability to discriminate among groups on the basis of habitat

TABLE 6

ANALYSIS OF VARIANCE SUMMARIES FOR PRESENCE VERSUS ABSENCE DATA

Species	Plot Position	Canopy Closure	Percent Slope	pH	Percent Sand	Percent Clay	F-ratio for Overall Discrimination
Dentaria laciniata	15.0***	0.19	4.80*	19.9***	5.24	2.95	5.96***
Arisaema triphyllum	1.37	1.70	0.18	29.5***	5.74	1.77	6.00***
Dentaria diphylla	0.60	1.65	0.01	6.11*	0.86	0.01	1.42
Geranium maculatum	1.64	0.52	1.80	0.83	0.30	0.39	0.60
Phlox divaricata	6.80*	1.17	1.17	0.74	0.91	0.37	2.44*
Trillium luteum	5.91*	1.30	3.14	36.2***	7.60**	1.36	7.83***
Trillium vaseyii	4.08*	1.16	1.92	7.80**	0.09	0.11	1.81

*Significant at the 0.05 level.

**Significant at the 0.01 level.

***Significant at the 0.001 level.

variables. In fact two species, Trillium vaseyi and Dentaria diphylla whose presence/absence was distinguishable in the univariate case on the basis of pH were no longer separable using discriminant analysis.

Of the seven species included, only Geranium remained inseparable as to presence/absence on the basis of the included variables. Univariate analysis of variance of all the original variables (except for separate species of trees) discloses that only one variable, beech litter ($p < 0.001$) was significantly different in the presence or absence of Geranium with individuals only occurring on plots where beech litter is present. This is further evidence that the presence of beech litter reflects other variables not included in the present study such as humidity, nutrients, and temperature, rather than exerting an allelopathic effect.

It is apparent from the above analyses that some habitat variables (e.g., soil pH) may draw boundaries to species occurrence; that, is they can be limiting factors in the fundamental niche of a plant species. The fact that those same variables or limiting factors do not provide a basis for discriminating among species (e.g., pH was only weakly correlated with discriminant function 3) implies that competition among species (perhaps along moisture gradients) is more important in determining species distribution (realized niche) within that fundamental niche.

CHAPTER IV

CONCLUSIONS

From the preceding discussion I conclude that discriminant analysis can be used to analyze niche relationships among vascular plant species. The greatest percentage of variability in the data as explained by the first few significant discriminant functions was interpretable as discriminating among species in a manner compatible with available habitat descriptions even though habitat differences were not all superficially obvious during the data collection. Although interpretation of some of the discriminant axes is ambiguous in some cases, especially for those most highly correlated with variables of a biological nature (e.g., percent beech litter), their relationship to species distribution is apparently real at least for the species discussed here. When this study was initiated, plot position on the slope, slope angle and aspect were selected as variables thought most likely to be correlated with moisture. If this had been the case, these three variables were expected to be highly correlated on one discriminant function. Each of these variables does have an effect on soil moisture, but, as mentioned previously, other facets of water relations of plants are apparently more important in pattern or niche relations among species.

Unfortunately most interpretation of the axes found to discriminate among groups is conjectural. This is especially so since most of the variables used in this analysis were selected on the presumption that they were related to other variables known to affect plants. Canopy closure and basal area were presumed to be correlated with available light, litter depth with a buffering of soil moisture, pine basal area and moss lichen cover with acidity and consequent lower soil base status, aspect with temperature, pH with base status and nutrient availability, and the above mentioned moisture relations. Beech litter was included because of its likely allelopathic effects. It is apparent from the analyses that, while the selected variables do serve to differentiate among species, they do not represent simple niche axes as was intended. To create niche hypervolumes with "real" variables as axes would apparently involve sophisticated microclimate measurements as well as soil moisture maxima and minima, nutrient status, etc. There is precedent for using vaguely defined environmental axes to array species including Whittaker's classic niche segregation among tree species along an altitudinal gradient (Whittaker, 1975). Foresters commonly use such variables in attempts to identify environments most suitable for growth of particular species. In that case the emphasis is on identification of environmental phenomena that can be used in a predictive manner. Presumably, the discriminant functions derived from this analysis could be used to predict occurrance of species in other areas or to assess suitability of habitat for their occurrance in areas where past land use (including environmental insults) has eliminated

them. However, it must be emphasized that this particular study is probably site specific for two reasons: the areas under consideration were selected because of the occurrance of species unusual on the Oak Ridge Reservation or because of species richness in the area and it is assumed that the relationships among species would differ if some of the species were absent.

The fact that the analyses appear to work for these vascular species allows the possibility of using discriminant analysis to assess habitat variables of certain rare or endangered species and their potential niche spaces.

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APPENDIXES

APPENDIX A

ABUNDANCE AND COVER DATA

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1	2	1	2	GALIUM	CIRCAEZANS	1	1
2	2	1	2	GERANIUM	MACULATUM	1	1
3	2	1	3	PHLOX	DIVARICATA	1	1
4	2	1	3	STELLARIA	PUBERA	1	1
5	3	1	1	IRIS	CRISTATA	3	3
6	3	1	1	MEDEOLA	VIRGINIANA	2	1
7	3	1	1	POLYSTICHUM	ACROSTICHOIDES	3	25
8	3	1	2	CHAMAELIRIUM	LUTEUM	5	5
9	3	1	2	CHIMAPHILA	MACULATA	8	2
10	3	1	2	COLLINSONIA	CANADENSIS	1	2
11	3	1	2	EPIGAEA	REPENS	9	11
12	3	1	2	HEXASTYLIS	ARIFOLIA	3	1
13	3	1	2	IRIS	CRISTATA	3	2
14	3	1	2	LUZULA	CAMPESTRIS	1	2
15	3	1	2	MEDEOLA	VIRGINIANA	11	6
16	3	1	3	DESMODIUM	NUDIFLORUM	3	1
17	3	1	3	HEXASTYLIS	ARIFOLIA	2	2
18	3	1	3	IRIS	CRISTATA	1	1
19	3	1	3	MEDEOLA	VIRGINIANA	4	1
20	3	2	1	CHIMAPHILA	MACULATA	2	1
21	3	2	1	GAULTHERIA	PROCUMBENS	9	5
22	3	2	1	POLYGONATUM	BIFLORUM	1	[illegible]
23	3	2	2	CHIMAPHILA	MACULATA	2	1
24	3	2	2	GAULTHERIA	PROCUMBENS	8	2
25	3	2	2	POLYGONATUM	BIFLORUM	1	[illegible]
26	4	1	1	AMPHICARPA	BRACTEATA	1	1
27	4	1	1	ASTER	CORDIFOLIUS	1	1
28	4	1	1	CHIMAPHILA	MACULATA	1	1
29	4	1	1	COLLINSONIA	CANADENSIS	9	6[illegible]
30	4	1	1	GALIUM	TRIFLORUM	5	6
31	4	1	1	IMPATIENS	CAPENSIS	2	1
32	4	1	1	MUHLENBERGIA	CAPILLARIS	2	1
33	4	1	1	PRENANTHES	ALTISSIMA	5	2
34	4	1	1	RANUNCULUS	CAROLINIANUS	1	1
35	4	1	1	SOLIDAGO	CURTISII	4	2
36	4	1	1	TIARELLA	CORDIFOLIA	11	22
37	4	1	1	VIOLA	HIRSUTULA	1	1
38	4	1	2	AMPHICARPA	BRACTEATA	2	1
39	4	1	2	ANEMONELLA	THALICTROIDES	4	1
40	4	1	2	CHIMAPHILA	MACULATA	5	1
41	4	1	2	GALIUM	TRIFLORUM	3	1
42	4	1	2	HEXASTYLIS	ARIFOLIA	2	1
43	4	1	2	HOUSTONIA	PURPUREA	1	1
44	4	1	2	LUZULA	CAMPESTRIS	1	1
45	4	1	2	MUHLENBERGIA	CAPILLARIS	9	2
46	4	1	2	PANICUM	COMMUTATUM	7	2

Appendix A (continued)

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
47	4	1	2	POLYSTICHUM	ACROSTICHOIDES	2	1
48	4	1	2	RANUNCULUS	CAROLINIANUS	1	1
49	4	1	2	SOLIDAGO	CURTISII	1	1
50	4	1	2	SPIGELIA	MARILANDICA	1	1
51	4	1	2	TIARELLA	CORDIFOLIA	6	7
52	4	1	2	VIOLA	HIRSUTULA	10	3
53	4	1	3	CAREX	DIGITALIS	5	5
54	4	1	3	HEXASTYLIS	ARIFOLIA	2	2
55	4	1	3	PHLOX	DIVARICATA	1	1
56	4	1	3	POLYGONATUM	BIFLORUM	5	2
57	4	1	3	SMILACINA	RACEMOSA	4	1
58	4	1	3	TIARELLA	CORDIFOLIA	5	6
59	4	2	1	CHIMAPHILA	MACULATA	4	1
60	4	2	2	CHIMAPHILA	MACULATA	3	1
61	4	2	3	CHIMAPHILA	MACULATA	4	2
62	4	2	3	POLYGONATUM	BIFLORUM	2	1
63	4	3	1	CHIMAPHILA	MACULATA	4	3
64	4	3	1	GAULTHERIA	PROCUMBENS	4	3
65	4	3	1	POLYGONATUM	BIFLORUM	5	3
66	4	3	2	HIERACIUM	VENOSUM	10	4
67	4	3	2	MEDEOLA	VIRGINIANA	1	1
68	4	3	2	PANICUM	COMMUTATUM	14	3
69	4	3	3	CHIMAPHILA	MACULATA	1	1
70	4	3	3	GAULTHERIA	PROCUMBENS	1	1
71	4	3	3	HIERACIUM	VENOSUM	1	1
72	4	3	3	PANICUM	COMMUTATUM	3	0
73	5	1	1	CAREX	DIGITALIS	3	2
74	5	1	1	CAREX	RETROFLEXA	1	1
75	5	1	1	HEXASTYLIS	ARIFOLIA	4	1
76	5	1	1	HOUSTONIA	CAERULEA	2	1
77	5	1	1	IRIS	CRISTATA	8	6
78	5	1	1	OXALIS	VIOLACEA	15	3
79	5	1	1	PANICUM	FLEXILE	2	1
80	5	1	1	POLYSTICHUM	ACROSTICHOIDES	1	10
81	5	1	1	POTENTILLA	CANADENSIS	6	3
82	5	1	1	SCUTELLARIA	INCANA	4	2
83	5	1	1	SCUTELLARIA	PARVULA	2	2
84	5	1	1	VIOLA	HIRSUTULA	5	2
85	5	1	2	ATHYRIUM	FILIX-FEMINA	3	48
86	5	1	2	CAREX	DIGITALIS	2	1
87	5	1	2	CHIMAPHILA	MACULATA	1	1
88	5	1	2	GOODYERA	PUBESCENS	1	1
89	5	1	2	PANICUM	FLEXILE	3	1
90	5	1	2	POTENTILLA	CANADENSIS	1	1
91	5	1	2	PRENANTHES	ALTISSIMA	1	1
92	5	1	2	VIOLA	HIRSUTULA	13	1

Appendix A (continued)

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
93	5	1	3	CAREX	DIGITALIS	1	1
94	5	1	3	CHIMAPHILA	MACULATA	1	16
95	5	1	3	OXALIS	VIOLACEA	3	0
96	5	1	3	POLYSTICHUM	ACROSTICHOIDES	4	40
97	5	2	1	AMPHICARPA	BRACTEATA	3	2
98	5	2	1	CAREX	DIGITALIS	[illegible]	9
99	5	2	1	DENTARIA	LACINIATA	52	12
100	5	2	1	GERANIUM	MACULATUM	7	5
101	5	2	1	GOODYERA	PUBESCENS	2	2
102	5	2	1	OXALIS	VIOLACEA	2	1
103	5	2	1	POTENTILLA	CANADENSIS	4	2
104	5	2	1	SPIGELIA	MARILANDICA	7	5
105	5	2	1	THELYPTERIS	HEXAGONOPTERA	20	23
106	5	2	1	UVULARIA	PERFOLIATA	3	1
107	5	2	1	VIOLA	HASTATA	8	3
108	5	2	2	CAREX	DIGITALIS	3	5
109	5	2	2	CHIMAPHILA	MACULATA	3	2
110	5	2	2	DENTARIA	LACINIATA	34	8
111	5	2	2	GERANIUM	MACULATUM	7	5
112	5	2	2	POLYSTICHUM	ACROSTICHOIDES	3	6
113	5	2	2	POTENTILLA	CANADENSIS	1	1
114	5	2	2	SMILACINA	RACEMOSA	2	3
115	5	2	2	THELYPTERIS	HEXAGONOPTERA	7	3
116	5	2	2	TIARELLA	CORDIFOLIA	3	5
117	5	2	2	VIOLA	HASTATA	2	1
118	5	2	3	BOTRYCHIUM	VIRGINIANUM	2	1
119	5	2	3	CAREX	DIGITALIS	1	0
120	5	2	3	DENTARIA	LACINIATA	15	4
121	5	2	3	GALIUM	CIRCAEZANS	1	1
122	5	2	3	GERANIUM	MACULATUM	10	7
123	5	2	3	MEDEOLA	VIRGINIANA	1	1
124	5	2	3	OXALIS	VIOLACEA	1	1
125	5	2	3	PHLOX	DIVARICATA	2	3
126	5	2	3	POTENTILLA	CANADENSIS	5	5
127	5	2	3	SPIGELIA	MARILANDICA	3	3
128	5	2	3	THELYPTERIS	HEXAGONOPTERA	19	27
129	5	2	3	VIOLA	HASTATA	5	3
130	5	3	1	CHIMAPHILA	MACULATA	1	0
131	5	3	1	SMILACINA	RACEMOSA	1	1
132	5	3	3	CHIMAPHILA	MACULATA	5	4
133	5	3	3	POLYGONATUM	BIFLORUM	1	1
134	5	3	3	POLYSTICHUM	ACROSTICHOIDES	1	4
135	5	3	3	SMILACINA	RACEMOSA	1	1
136	5	3	3	VIOLA	HIRSUTULA	1	1
137	6	0	1	PHLOX	DIVARICATA	6	5
138	6	0	3	DESMODIUM	NUDIFLORUM	10	5

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
139	6	0	3	PHLOX	DIVARICATA	9	5
140	6	1	1	CHIMAPHILA	MACULATA	2	3
141	6	2	1	GERANIUM	MACULATUM	11	5
142	6	2	1	HEXASTYLIS	ARIFOLIA	4	3
143	6	2	2	ANEMONELLA	THALICTROIDES	3	2
144	6	2	2	GERANIUM	MACULATUM	1[illegible]	10
145	6	2	2	HEXASTYLIS	ARIFOLIA	4	5
146	6	2	2	VIOLA	HASTATA	9	9
147	6	2	3	GERANIUM	MACULATUM	12	8
148	6	2	3	HEXASTYLIS	ARIFOLIA	1	2
149	6	2	3	OXALIS	VIOLACEA	5	6
150	6	2	3	POTENTILLA	CANADENSIS	1	1
151	6	3	2	CHIMAPHILA	MACULATA	1	1
152	6	3	2	HEXASTYLIS	ARIFOLIA	1	1
153	7	1	1	ARISAEMA	TRIPHYLLUM	4	3
154	7	1	1	CHIMAPHILA	MACULATA	1	1
155	7	1	1	DENTARIA	LACINIATA	47	5
156	7	1	1	GALIUM	TRIFLORUM	6	36
157	7	1	1	HEXASTYLIS	ARIFOLIA	1	1
158	7	1	1	TRILLIUM	LUTEUM	2	4
159	7	1	2	ARISAEMA	TRIPHYLLUM	22	8
160	7	1	2	AUREOLARIA	VIRGINICA	1	1
161	7	1	2	CHIMAPHILA	MACULATA	2	[illegible]
162	7	1	2	CUNILA	ORIGANOIDES	1	[illegible]
163	7	1	2	DENTARIA	LACINIATA	55	10
164	7	1	2	HEXASTYLIS	ARIFOLIA	1	2
165	7	1	2	TRILLIUM	LUTEUM	[illegible]	4
166	7	1	3	ACTAEA	PACHYPODA	5	6
167	7	1	3	ARISAEMA	TRIPHYLLUM	17	6
168	7	1	3	DENTARIA	LACINIATA	5[illegible]	3
169	7	1	3	GALIUM	TRIFLORUM	4	5
170	7	1	3	HEXASTYLIS	ARIFOLIA	1	5
171	7	1	3	ORCHIS	SPECTABILIS	1	3
172	7	1	3	TIARELLA	CORDIFOLIA	1	1
173	7	1	3	TRILLIUM	LUTEUM	1	2
174	7	2	1	CHIMAPHILA	MACULATA	2	1
175	7	2	2	AUREOLARIA	VIRGINICA	1	1
176	7	2	2	CHIMAPHILA	MACULATA	2	1
177	7	2	2	CUNILA	ORIGANOIDES	1	[illegible]
178	7	3	1	CHIMAPHILA	MACULATA	4	3
179	7	3	1	GALIUM	CIRCAEZANS	1	1
180	7	3	1	POTENTILLA	CANADENSIS	1	3
181	7	3	2	CHIMAPHILA	MACULATA	1	1
182	7	3	3	CAREX	NIGROMARGINATA	3	4
183	7	3	3	CAREX	PLATYPHYLLA	[illegible]	1
184	7	3	3	CHIMAPHILA	MACULATA	2	2

Appendix A (continued)

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
185	7	3	3	DESMODIUM	NUDIFLORUM	1	2
186	7	3	3	PANICUM	DICHOTOMUM	7	2
187	7	3	3	POTENTILLA	CANADENSIS	2	2
188	7	3	3	SCUTELLARIA	INCANA	1	0
189	7	4	3	SMILACINA	RACEMOSA	1	1
190	8	1	1	CAREX	DIGITALIS	2	4
191	8	1	1	DENTARIA	LACINIATA	1[illegible]	1
192	8	1	1	HEUCHERA	AMERICANA	1	2
193	8	1	1	PHLOX	DIVARICATA	3	1
194	8	1	1	POLYSTICHUM	ACROSTICHOIDES	1	3
195	8	1	1	TIARELLA	CORDIFOLIA	2	5
196	8	1	1	TRILLIUM	LUTEUM	1	2
197	8	1	2	CAREX	DIGITALIS	1	1
198	8	1	2	GALIUM	TRIFLORUM	4	1
199	8	1	2	SEDUM	TERNATUM	53	36
200	8	1	2	TIARELLA	CORDIFOLIA	2	7
201	8	1	3	ANEMONELLA	THALICTROIDES	3	2
202	8	1	3	ARISAEMA	TRIPHYLLUM	3	1
203	8	1	3	CAREX	DIGITALIS	1	2
204	8	1	3	TIARELLA	CORDIFOLIA	3	4
205	8	1	3	VIOLA	HIRSUTULA	1	1
206	8	2	1	ANTENNARIA	PLANTAGINIFOLIA	13	7
207	8	2	1	ASPLENIUM	PLATYNEURON	1	2
208	8	2	1	CAREX	NIGROMARGINATA	4	4
209	8	2	1	CAREX	PLATYPHYLLA	10	12
210	8	2	1	CUNILA	ORIGANOIDES	2	3
211	8	2	1	HEUCHERA	AMERICANA	2	3
212	8	2	1	HOUSTONIA	PURPUREA	1	2
213	8	2	1	POLYGONATUM	BIFLORUM	5	3
214	8	2	2	ANTENNARIA	PLANTAGINIFOLIA	4	4
215	8	2	2	CAREX	NIGROMARGINATA	3	2
216	8	2	2	CHIMAPHILA	MACULATA	1	1
217	8	2	2	CUNILA	ORIGANOIDES	1	1
218	8	2	2	DESMODIUM	VIRIDIFLORUM	1	1
219	8	2	2	HOUSTONIA	PURPUREA	1	2
220	8	2	2	SEDUM	TERNATUM	6	3
221	8	2	3	ANTENNARIA	PLANTAGINIFOLIA	34	15
222	8	2	3	CUNILA	ORIGANOIDES	4	5
223	8	2	3	DESMODIUM	VIRIDIFLORUM	1	2
224	8	2	3	HEUCHERA	AMERICANA	2	4
225	8	2	3	SEDUM	TERNATUM	4	3
226	8	3	1	CAREX	NIGROMARGINATA	4	5
227	8	3	1	CHIMAPHILA	MACULATA	2	2
228	8	3	1	DESMODIUM	VIRIDIFLORUM	8	30
229	8	3	2	AMPHICARPA	BRACTEATA	8	2
230	8	3	2	CHIMAPHILA	MACULATA	7	5

Appendix A (continued)

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
231	8	3	2	LESPEDEZA	PROCUMBENS	1	2
232	8	3	2	PANICUM	COMMUTATUM	10	2
233	8	3	3	AMPHICARPA	BRACTEATA	1	3
234	8	3	3	CHIMAPHILA	MACULATA	6	3
235	9	1	1	BOTRYCHIUM	VIRGINIANUM	1	3
236	9	1	1	SANICULA	CANADENSIS	1	1
237	9	1	3	SANICULA	CANADENSIS	2	3
238	9	2	1	ACTAEA	PACHYPODA	1	4
239	9	2	1	CAREX	DIGITALIS	1	1
240	9	2	1	CAULOPHYLLUM	THALICTROIDES	1	6
241	9	2	1	DENTARIA	LACINIATA	15	1
242	9	2	1	ERYTHRONIUM	AMERICANUM	1	5
243	9	2	1	GALIUM	TRIFLORUM	1	1
244	9	2	1	HEXASTYLIS	ARIFOLIA	1	2
245	9	2	1	PHLOX	DIVARICATA	8	1
246	9	2	1	POLYSTICHUM	ACROSTICHOIDES	3	30
247	9	2	1	TRILLIUM	VASEYII	1	3
248	9	2	2	CAREX	DIGITALIS	10	8
249	9	2	2	DENTARIA	LACINIATA	10	1
250	9	2	2	GALIUM	TRIFLORUM	1	1
251	9	2	2	HEXASTYLIS	ARIFOLIA	1	1
252	9	2	2	PHLOX	DIVARICATA	14	4
253	9	2	2	POLYSTICHUM	ACROSTICHOIDES	4	40
254	9	2	2	STELLARIA	PUBERA	10	6
255	9	2	2	TIARELLA	CORDIFOLIA	2	4
256	9	2	2	TRILLIUM	LUTEUM	3	2
257	9	2	3	CAREX	DIGITALIS	3	5
258	9	2	3	DENTARIA	LACINIATA	29	1
259	9	2	3	GALIUM	TRIFLORUM	4	3
260	9	2	3	HEXASTYLIS	ARIFOLIA	2	1
261	9	2	3	PHLOX	DIVARICATA	9	3
262	9	2	3	PODOPHYLLUM	PELTATUM	1	5
263	9	2	3	POLYSTICHUM	ACROSTICHOIDES	1	3
264	9	2	3	STELLARIA	PUBERA	11	3
265	9	2	3	TIARELLA	CORDIFOLIA	3	6
266	9	2	3	TRILLIUM	LUTEUM	1	1
267	9	3	1	GERANIUM	MACULATUM	1	3
268	9	3	1	POLYGONATUM	BIFLORUM	2	4
269	9	3	1	SEDUM	TERNATUM	26	10
270	9	3	1	SMILACINA	RACEMOSA	2	3
271	9	3	2	ACTAEA	PACHYPODA	1	5
272	9	3	2	GERANIUM	MACULATUM	1	1
273	9	3	2	POLYGONATUM	BIFLORUM	3	5
274	9	3	2	SEDUM	TERNATUM	25	13
275	9	3	3	SEDUM	TERNATUM	5	4
276	9	3	3	SMILACINA	RACEMOSA	2	4

Appendix A (continued)

------------------------------------ LOC=1 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
277	9	4	1	CHIMAPHILA	MACULATA	7	4
278	9	4	2	CHIMAPHILA	MACULATA	5	1
279	10	1	1	BOTRYCHIUM	VIRGINIANUM	9	8
280	10	1	1	FRAGARIA	VIRGINIANA	4	2
281	10	1	1	GALIUM	APARINE	2	2
282	10	1	1	GALIUM	TRIFLORUM	2	3
283	10	1	1	PRUNELLA	VULGARIS	3	1
284	10	1	1	TRILLIUM	LUTEUM	2	3
285	10	1	1	VIOLA	HIRSUTULA	11	4
286	10	1	2	ASPLENIUM	PLATYNEURON	4	5
287	10	1	2	BOTRYCHIUM	VIRGINIANUM	7	2
288	10	1	2	CAREX	RETROFLEXA	10	5
289	10	1	2	EUPATORIUM	RUGOSUM	1	2
290	10	1	2	FRAGARIA	VIRGINIANA	3	2
291	10	1	2	GALIUM	APARINE	3	3
292	10	1	2	GEUM	CANADENSE	3	1
293	10	1	2	TRILLIUM	LUTEUM	2	2
294	10	1	2	VIOLA	HIRSUTULA	3	1
295	10	1	3	ASPLENIUM	PLATYNEURON	7	10
296	10	1	3	BOTRYCHIUM	VIRGINIANUM	11	6
297	10	1	3	FRAGARIA	VIRGINIANA	3	2
298	10	1	3	GALIUM	APARINE	6	4
299	10	1	3	GEUM	CANADENSE	1	1
300	10	2	1	ARISAEMA	TRIPHYLLUM	7	7
301	10	2	1	DENTARIA	DIPHYLLA	3	2
302	10	2	1	GALIUM	CIRCAEZANS	7	7
303	10	2	1	POLYSTICHUM	ACROSTICHOIDES	1	5
304	10	2	1	SANGUINARIA	CANADENSIS	13	10
305	10	2	1	STELLARIA	PUBERA	3	2
306	10	2	1	TRILLIUM	LUTEUM	4	7
307	10	2	2	ARISAEMA	TRIPHYLLUM	16	6
308	10	2	2	DENTARIA	DIPHYLLA	8	2
309	10	2	2	THELYPTERIS	HEXAGONOPTERA	6	6
310	10	2	2	TRILLIUM	LUTEUM	5	6
311	10	2	3	ARISAEMA	TRIPHYLLUM	21	7
312	10	2	3	TRILLIUM	LUTEUM	1	2
313	10	3	1	ACTAEA	PACHYPODA	6	14
314	10	3	1	ARISAEMA	TRIPHYLLUM	12	5
315	10	3	1	BOTRYCHIUM	VIRGINIANUM	1	4
316	10	3	1	TRILLIUM	LUTEUM	1	2
317	10	3	2	ARISAEMA	TRIPHYLLUM	23	7
318	10	3	2	HEXASTYLIS	ARIFOLIA	2	3
319	10	3	3	ARISAEMA	TRIPHYLLUM	4	4
320	10	3	3	DENTARIA	DIPHYLLA	6	2
321	10	3	3	TRILLIUM	LUTEUM	3	2
322	11	1	2	CHIMAPHILA	MACULATA	5	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
323	11	1	3	CHIMAPHILA	MACULATA	10	1
324	11	2	1	ASPLENIUM	PLATYNEURON	1	3
325	11	2	1	BOTRYCHIUM	VIRGINIANUM	1	1
326	11	2	1	CAREX	RETROFLEXA	17	5
327	11	2	1	DENTARIA	LACINIATA	1	1
328	11	2	1	EUPATORIUM	RUGOSUM	4	2
329	11	2	1	GALIUM	APARINE	1	1
330	11	2	1	HEXASTYLIS	ARIFOLIA	2	2
331	11	2	1	SEDUM	TERNATUM	8	3
332	11	2	2	ASPLENIUM	PLATYNEURON	1	1
333	11	2	2	GALIUM	APARINE	7	3
334	11	2	2	HEXASTYLIS	ARIFOLIA	3	4
335	11	2	2	MICROSTEGEUM	VIMINEUM	4	0
336	11	2	2	RANUNCULUS	RECURVATUS	1	1
337	11	2	2	TRILLIUM	LUTEUM	1	1
338	11	2	2	TRILLIUM	VASEYII	1	1
339	11	2	3	ASPLENIUM	PLATYNEURON	5	8
340	11	2	3	BOTRYCHIUM	VIRGINIANUM	3	2
341	11	2	3	CAREX	DIGITALIS	2	1
342	11	2	3	CAREX	RETROFLEXA	2	2
343	11	2	3	DENTARIA	LACINIATA	7	1
344	11	2	3	EUPATORIUM	RUGOSUM	1	1
345	11	2	3	GALIUM	APARINE	4	2
346	11	2	3	GEUM	CANADENSE	2	1
347	11	2	3	LAPORTEA	CANADENSIS	5	2
348	11	2	3	MICROSTEGEUM	VIMINEUM	6	2
349	11	2	3	RANUNCULUS	RECURVATUS	1	1
350	11	2	3	TIARELLA	CORDIFOLIA	1	1
351	11	2	3	TRILLIUM	LUTEUM	3	3
352	11	3	1	ACTAEA	PACHYPODA	1	2
353	11	3	1	ARISAEMA	TRIPHYLLUM	5	3
354	11	3	1	DENTARIA	DIPHYLLA	22	10
355	11	3	1	GALIUM	APARINE	1	2
356	11	3	1	LAPORTEA	CANADENSIS	6	17
357	11	3	1	SANGUINARIA	CANADENSIS	7	4
358	11	3	1	TRILLIUM	LUTEUM	1	1
359	11	3	1	TRILLIUM	VASEYII	3	4
360	11	3	2	ACTAEA	PACHYPODA	1	4
361	11	3	2	ARISAEMA	TRIPHYLLUM	3	2
362	11	3	2	DENTARIA	DIPHYLLA	17	6
363	11	3	2	SANGUINARIA	CANADENSIS	1	1
364	11	3	2	TRILLIUM	VASEYII	1	2
365	11	3	3	ACTAEA	PACHYPODA	1	2
366	11	3	3	ANEMONELLA	THALICTROIDES	1	0
367	11	3	3	ARISAEMA	TRIPHYLLUM	4	2
368	11	3	3	DENTARIA	DIPHYLLA	31	13

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
369	11	3	3	STELLARIA	PUBERA	1	1
370	11	3	3	THELYPTERIS	HEXAGONOPTERA	4	5
371	11	3	3	TRILLIUM	LUTEUM	1	3
372	11	3	3	TRILLIUM	VASEYII	4	2
373	11	4	1	POLYSTICHUM	ACROSTICHOIDES	1	4
374	11	4	1	TRILLIUM	LUTEUM	1	1
375	11	4	2	ANEMONELLA	THALICTROIDES	2	2
376	11	4	2	BOTRYCHIUM	VIRGINIANUM	1	1
377	11	4	2	DISPORUM	LANUGINOSUM	2	2
378	11	4	2	LAPORTEA	CANADENSIS	3	2
379	11	4	2	SMILACINA	RACEMOSA	1	2
380	11	4	3	ANEMONELLA	THALICTROIDES	1	2
381	11	4	3	BOTRYCHIUM	VIRGINIANUM	1	2
382	11	4	3	DISPORUM	LANUGINOSUM	1	5
383	11	4	3	SMILACINA	RACEMOSA	1	1
384	12	1	1	ACTAEA	PACHYPODA	3	6
385	12	1	1	DENTARIA	LACINIATA	24	2
386	12	1	1	ERYTHRONIUM	AMERICANUM	5	30
387	12	1	1	GALIUM	APARINE	2	2
388	12	1	1	GEUM	CANADENSE	2	3
389	12	1	1	HYDROPHYLLUM	MACROPHYLLUM	7	20
390	12	1	1	JEFFERSONIA	DIPHYLLA	1	2
391	12	1	1	TRILLIUM	LUTEUM	11	10
392	12	1	1	TRILLIUM	VASEYII	1	2
393	12	1	2	ARISAEMA	TRIPHYLLUM	5	2
394	12	1	2	BOTRYCHIUM	VIRGINIANUM	1	2
395	12	1	2	DENTARIA	DIPHYLLA	11	10
396	12	1	2	DENTARIA	LACINIATA	1	1
397	12	1	2	GALIUM	APARINE	2	2
398	12	1	2	HYDROPHYLLUM	MACROPHYLLUM	12	45
399	12	1	2	JEFFERSONIA	DIPHYLLA	1	1
400	12	1	2	LAPORTEA	CANADENSIS	10	7
401	12	1	2	RANUNCULUS	ABORTIVUS	1	1
402	12	1	2	TRILLIUM	LUTEUM	8	8
403	12	1	3	ARISAEMA	TRIPHYLLUM	6	4
404	12	1	3	CAULOPHYLLUM	THALICTROIDES	1	1
405	12	1	3	DENTARIA	LACINIATA	51	10
406	12	1	3	GALIUM	APARINE	3	3
407	12	1	3	HYDROPHYLLUM	MACROPHYLLUM	11	33
408	12	1	3	LAPORTEA	CANADENSIS	5	3
409	12	1	3	TRILLIUM	LUTEUM	5	4
410	12	1	3	TRILLIUM	VASEYII	2	4

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
411	1	1	1	AMPHICARPA	BRACTEATA	1	1
412	1	1	1	DANTHONIA	SPICATA	1	0
413	1	1	1	GALIUM	TRIFLORUM	3	1
414	1	1	1	GEUM	VIRGINIANUM	1	1
415	1	1	1	SENECIO	SMALLII	2	1
416	1	1	1	SILPHIUM	TRIFOLIATUM	2	2
417	1	1	1	VERBESINA	OCCIDENTALIS	1	2
418	1	1	1	VIOLA	HIRSUTULA	3	2
419	1	1	2	FRAGARIA	VIRGINIANA	4	2
420	1	1	2	GALIUM	APARINE	2	1
421	1	1	2	PRUNELLA	VULGARIS	3	1
422	1	1	2	SANICULA	CANADENSIS	2	1
423	1	1	2	VERBESINA	OCCIDENTALIS	1	0
424	1	1	2	VIOLA	HIRSUTULA	3	2
425	1	1	3	AMPHICARPA	BRACTEATA	2	1
426	1	1	3	FRAGARIA	VIRGINIANA	3	2
427	1	1	3	PANICUM	LANUGINOSUM	1	1
428	1	1	3	SENECIO	SMALLII	13	6
429	1	1	3	SILPHIUM	TRIFOLIATUM	2	1
430	1	2	1	AMPHICARPA	BRACTEATA	6	1
431	1	2	1	EUPHORBIA	COROLLATA	2	1
432	1	2	1	LESPEDEZA	PROCUMBENS	1	1
433	1	2	2	LESPEDEZA	PROCUMBENS	1	3
434	1	2	2	PANICUM	LAXIFLORUM	9	3
435	1	2	2	SILPHIUM	TRIFOLIATUM	2	2
436	1	2	3	ASTER	PILOSUS	1	0
437	1	2	3	DANTHONIA	SPICATA	1	1
438	1	2	3	SANICULA	CANADENSIS	1	1
439	1	2	3	VERBESINA	OCCIDENTALIS	1	1
440	1	2	3	VIOLA	HIRSUTULA	2	1
441	2	1	1	FRAGARIA	VIRGINIANA	1	1
442	2	1	1	PANICUM	LAXIFLORUM	1	1
443	2	1	1	POLYGONATUM	BIFLORUM	1	0
444	2	1	1	SMILACINA	RACEMOSA	4	2
445	2	1	2	GALIUM	CIRCAEZANS	2	1
446	2	1	2	PANICUM	LAXIFLORUM	1	1
447	2	1	2	POLYGONATUM	BIFLORUM	1	1
448	2	1	2	UVULARIA	PERFOLIATA	7	2
449	2	1	3	PANICUM	LAXIFLORUM	5	3
450	2	1	3	POLYGONATUM	BIFLORUM	1	1
451	2	1	3	UVULARIA	PERFOLIATA	22	10
452	2	2	1	DESMODIUM	VIRIDIFLORUM	1	2
453	2	2	1	GALIUM	TRIFLORUM	1	1
454	2	2	1	PHRYMA	LEPTOSTACHYA	1	1
455	2	2	1	SANICULA	CANADENSIS	1	1
456	2	2	1	VIOLA	HIRSUTULA	4	2

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
457	2	2	2	GALIUM	CIRCAEZANS	1	0
458	2	2	2	PANICUM	LAXIFLORUM	1	1
459	2	2	3	AMPHICARPA	BRACTEATA	1	1
460	2	2	3	ASTER	CORDIFOLIUS	2	1
461	2	2	3	GERANIUM	CAROLINIANUM	3	1
462	2	2	3	PANICUM	LAXIFLORUM	2	1
463	2	2	3	SMILACINA	RACEMOSA	1	1
464	2	2	3	VIOLA	HIRSUTULA	2	1
465	2	3	1	ANEMONE	VIRGINIANA	3	1
466	2	3	1	ANEMONELLA	THALICTROIDES	3	1
467	2	3	1	ASTER	CORDIFOLIUS	5	5
468	2	3	1	CAREX	NIGROMARGINATA	4	1
469	2	3	1	DESMODIUM	PANICULATUM	1	1
470	2	3	1	GALIUM	CIRCAEZANS	2	1
471	2	3	1	PANICUM	LAXIFLORUM	4	1
472	2	3	1	POLYGONATUM	BIFLORUM	1	0
473	2	3	1	SANICULA	CANADENSIS	3	1
474	2	3	1	SCUTELLARIA	PARVULA	5	1
475	2	3	1	SMILACINA	RACEMOSA	1	1
476	2	3	2	AMPHICARPA	BRACTEATA	1	0
477	2	3	2	ARABIS	LAEVIGATA	1	1
478	2	3	2	ASPLENIUM	PLATYNEURON	1	0
479	2	3	2	ASTER	CORDIFOLIUS	1	1
480	2	3	2	CAREX	NIGROMARGINATA	3	4
481	2	3	2	GALIUM	CIRCAEZANS	2	0
482	2	3	2	PANICUM	LAXIFLORUM	4	2
483	2	3	2	SILPHIUM	TRIFOLIATUM	3	1
484	2	3	3	ANEMONE	VIRGINIANA	7	2
485	2	3	3	ANEMONELLA	THALICTROIDES	4	1
486	2	3	3	ASTER	CORDIFOLIUS	5	3
487	2	3	3	CAREX	NIGROMARGINATA	4	2
488	2	3	3	DESMODIUM	VIRIDIFLORUM	6	9
489	2	3	3	GERANIUM	MACULATUM	1	1
490	2	3	3	OXALIS	VIOLACEA	1	0
491	2	3	3	PANICUM	LAXIFLORUM	2	0
492	2	3	3	POLYGONATUM	BIFLORUM	3	1
493	2	3	3	SMILACINA	RACEMOSA	1	1
494	2	4	1	AGRIMONIA	PUBESCENS	3	2
495	2	4	1	AMPHICARPA	BRACTEATA	4	2
496	2	4	1	ANEMONE	VIRGINIANA	6	2
497	2	4	1	ASTER	CORDIFOLIUS	2	1
498	2	4	1	GALIUM	CIRCAEZANS	5	1
499	2	4	1	PANICUM	LAXIFLORUM	1	2
500	2	4	1	PHRYMA	LEPTOSTACHYA	1	1
501	2	4	1	SANICULA	CANADENSIS	3	1
502	2	4	1	UVULARIA	PERFOLIATA	6	2

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
503	2	4	1	VIOLA	HIRSUTULA	4	1
504	2	4	2	ASTER	CORDIFOLIUS	2	1
505	2	4	2	BOTRYCHIUM	VIRGINIANUM	2	1
506	2	4	2	GALIUM	CIRCAEZANS	2	1
507	2	4	2	SANICULA	CANADENSIS	3	2
508	2	4	2	VIOLA	HIRSUTULA	1	1
509	2	4	3	AGRIMONIA	PUBESCENS	1	1
510	2	4	3	ARABIS	LAEVIGATA	1	2
511	2	4	3	ASTER	CORDIFOLIUS	1	1
512	2	4	3	GALIUM	CIRCAEZANS	3	1
513	2	4	3	POLYGONATUM	BIFLORUM	2	1
514	2	4	3	SALVIA	LYRATA	1	1
515	2	4	3	SANICULA	CANADENSIS	2	1
516	2	5	1	AMPHICARPA	BRACTEATA	5	3
517	2	5	1	ANEMONE	VIRGINIANA	1	1
518	2	5	1	ASTER	CORDIFOLIUS	4	3
519	2	5	1	GALIUM	CIRCAEZANS	5	1
520	2	5	1	HEPATICA	AMERICANA	23	20
521	2	5	1	PRENANTHES	ALTISSIMA	1	1
522	2	5	1	SANICULA	CANADENSIS	2	1
523	2	5	1	SMILACINA	RACEMOSA	1	3
524	2	5	1	UVULARIA	PERFOLIATA	62	42
525	2	5	2	ASPLENIUM	PLATYNEURON	1	1
526	2	5	2	CAREX	DIGITALIS	1	2
527	2	5	2	GALIUM	CIRCAEZANS	2	1
528	2	5	2	HEPATICA	AMERICANA	2	3
529	2	5	2	HEXASTYLIS	ARIFOLIA	1	1
530	2	5	2	MELICA	MUTICA	1	2
531	2	5	2	PHLOX	DIVARICATA	1	3
532	2	5	2	PHRYMA	LEPTOSTACHYA	1	1
533	2	5	2	PRENANTHES	SERPENTARIA	1	1
534	2	5	2	SMILACINA	RACEMOSA	2	2
535	2	5	2	UVULARIA	PERFOLIATA	58	40
536	2	5	2	VIBURNUM	CASSINOIDES	1	1
537	2	5	2	VICIA	CAROLINIANA	1	1
538	2	5	3	AMPHICARPA	BRACTEATA	3	1
539	2	5	3	ASTER	CORDIFOLIUS	4	3
540	2	5	3	CAREX	DIGITALIS	1	1
541	2	5	3	GALIUM	CIRCAEZANS	1	0
542	2	5	3	GERANIUM	MACULATUM	1	1
543	2	5	3	HEPATICA	AMERICANA	17	10
544	2	5	3	PANICUM	LAXIFLORUM	2	1
545	2	5	3	PHRYMA	LEPTOSTACHYA	1	0
546	2	5	3	POLYGONATUM	BIFLORUM	1	2
547	2	5	3	SMILACINA	RACEMOSA	2	3
548	2	5	3	UVULARIA	PERFOLIATA	51	37

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
549	2	5	3	VIOLA	HIRSUTULA	1	1
550	2	6	1	AMPHICARPA	BRACTEATA	1	1
551	2	6	1	ANEMONE	VIRGINIANA	3	1
552	2	6	1	CHRYSANTHEMUM	LEUCANTHEMUM	2	1
553	2	6	1	FRAGARIA	VIRGINIANA	4	1
554	2	6	1	HEXASTYLIS	ARIFOLIA	1	0
555	2	6	1	LESPEDEZA	PROCUMBENS	6	4
556	2	6	1	PANICUM	LANUGINOSUM	1	1
557	2	6	1	PANICUM	LAXIFLORUM	5	3
558	2	6	1	PHRYMA	LEPTOSTACHYA	1	1
559	2	6	1	SCLERIA	TRIGLOMERATA	2	1
560	2	6	1	SPIGELIA	MARILANDICA	1	1
561	2	6	2	AMPHICARPA	BRACTEATA	12	4
562	2	6	2	ANEMONE	VIRGINIANA	2	1
563	2	6	2	CAREX	DIGITALIS	2	3
564	2	6	2	DANTHONIA	SPICATA	12	2
565	2	6	2	FRAGARIA	VIRGINIANA	1	1
566	2	6	2	HEPATICA	AMERICANA	2	2
567	2	6	2	HEXASTYLIS	ARIFOLIA	1	1
568	2	6	2	LOBELIA	SPICATA	2	0
569	2	6	2	MELICA	MUTICA	5	2
570	2	6	2	PANICUM	LANUGINOSUM	1	1
571	2	6	2	PANICUM	LAXIFLORUM	2	1
572	2	6	2	POTENTILLA	CANADENSIS	2	1
573	2	6	2	SANICULA	CANADENSIS	3	1
574	2	6	2	SCLERIA	TRIGLOMERATA	1	1
575	2	6	3	ANEMONE	VIRGINIANA	1	1
576	2	6	3	ASTER	CORDIFOLIUS	1	1
577	2	6	3	GALIUM	CIRCAEZANS	1	0
578	2	6	3	MELICA	MUTICA	4	1
579	2	6	3	PANICUM	LAXIFLORUM	2	2
580	2	6	3	POTENTILLA	CANADENSIS	2	1
581	2	6	3	UVULARIA	PERFOLIATA	4	2
582	2	6	3	VICIA	CAROLINIANA	1	3
583	3	1	1	ALLIUM	CERNUUM	8	5
584	3	1	1	AMPHICARPA	BRACTEATA	5	2
585	3	1	1	ANEMONELLA	THALICTROIDES	9	2
586	3	1	1	ASTER	CORDIFOLIUS	6	4
587	3	1	1	BOTRYCHIUM	VIRGINIANUM	1	0
588	3	1	1	GERANIUM	MACULATUM	2	1
589	3	1	1	MELICA	MUTICA	2	4
590	3	1	1	PANICUM	LAXIFLORUM	1	2
591	3	1	2	AGRIMONIA	PUBESCENS	1	1
592	3	1	2	ASTER	CORDIFOLIUS	10	6
593	3	1	2	BOTRYCHIUM	VIRGINIANUM	1	0
594	3	1	2	CAREX	PLATYPHYLLA	1	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
595	3	1	2	GALIUM	CIRCAEZANS	1	1
596	3	1	2	GALIUM	TRIFLORUM	2	0
597	3	1	2	GERANIUM	MACULATUM	1	1
598	3	1	2	MELICA	MUTICA	6	2
599	3	1	2	SMILACINA	RACEMOSA	2	1
600	3	1	2	UVULARIA	PERFOLIATA	8	4
601	3	1	2	VIOLA	HIRSUTULA	1	1
602	3	1	3	AMPHICARPA	BRACTEATA	5	1
603	3	1	3	ASTER	CORDIFOLIUS	2	2
604	3	1	3	BOTRYCHIUM	VIRGINIANUM	4	1
605	3	1	3	CAREX	DIGITALIS	1	0
606	3	1	3	GERANIUM	MACULATUM	3	1
607	3	1	3	PANICUM	LAXIFLORUM	2	1
608	3	2	1	ASTER	CORDIFOLIUS	5	2
609	3	2	1	BOTRYCHIUM	VIRGINIANUM	2	0
610	3	2	1	PANICUM	LAXIFLORUM	3	2
611	3	2	1	PHRYMA	LEPTOSTACHYA	1	1
612	3	2	1	SCUTELLARIA	INCANA	1	1
613	3	2	1	SMILACINA	RACEMOSA	1	1
614	3	2	1	THALICTRUM	DIOICUM	6	6
615	3	2	2	CONOPHOLIS	AMERICANA	1	1
616	3	2	2	PANICUM	LAXIFLORUM	1	1
617	3	2	3	BOTRYCHIUM	VIRGINIANUM	1	1
618	3	2	3	PHLOX	DIVARICATA	2	2
619	3	2	3	SMILACINA	RACEMOSA	6	1
620	3	2	3	UVULARIA	PERFOLIATA	3	1
621	3	3	1	ASTER	CORDIFOLIUS	6	4
622	3	3	1	GALIUM	CIRCAEZANS	1	0
623	3	3	1	HEPATICA	AMERICANA	5	4
624	3	3	1	PANICUM	LAXIFLORUM	2	1
625	3	3	1	POTENTILLA	CANADENSIS	1	1
626	3	3	1	UVULARIA	PERFOLIATA	45	21
627	3	3	1	VERBESINA	OCCIDENTALIS	1	1
628	3	3	2	HEPATICA	AMERICANA	2	2
629	3	3	2	UVULARIA	PERFOLIATA	33	10
630	3	3	3	ASTER	CORDIFOLIUS	1	1
631	3	3	3	ASTER	SIMPLEX	1	0
632	3	3	3	SMILACINA	RACEMOSA	1	1
633	3	3	3	UVULARIA	PERFOLIATA	29	12
634	3	4	1	ASPLENIUM	PLATYNEURON	1	2
635	3	4	1	BOTRYCHIUM	VIRGINIANUM	6	2
636	3	4	1	GALIUM	CIRCAEZANS	1	1
637	3	4	1	PANICUM	LAXIFLORUM	3	1
638	3	4	1	PHRYMA	LEPTOSTACHYA	2	1
639	3	4	1	POLYGONATUM	BIFLORUM	3	2
640	3	4	1	POTENTILLA	CANADENSIS	10	6

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
641	3	4	1	UVULARIA	PERFOLIATA	3	3
642	3	4	2	BOTRYCHIUM	VIRGINIANUM	3	1
643	3	4	2	PANICUM	LAXIFLORUM	3	1
644	3	4	2	PHRYMA	LEPTOSTACHYA	1	1
645	3	4	2	PODOPHYLLUM	PELTATUM	1	2
646	3	4	2	POLYGONATUM	BIFLORUM	9	3
647	3	4	2	POTENTILLA	CANADENSIS	8	4
648	3	4	2	SANICULA	CANADENSIS	7	1
649	3	4	2	SMILACINA	RACEMOSA	1	2
650	3	4	2	UVULARIA	PERFOLIATA	9	3
651	3	4	3	ALLIUM	CERNUUM	3	3
652	3	4	3	ASTER	CORDIFOLIUS	1	1
653	3	4	3	PANICUM	LAXIFLORUM	1	1
654	3	4	3	POTENTILLA	CANADENSIS	10	4
655	3	4	3	SMILACINA	RACEMOSA	1	2
656	3	4	3	UVULARIA	PERFOLIATA	15	4
657	4	1	1	AMPHICARPA	BRACTEATA	4	2
658	4	1	1	ANEMONE	VIRGINIANA	1	1
659	4	1	1	BOTRYCHIUM	VIRGINIANUM	3	2
660	4	1	1	GALIUM	CIRCAEZANS	2	1
661	4	1	1	HEXASTYLIS	ARIFOLIA	2	2
662	4	1	1	PANICUM	LAXIFLORUM	1	1
663	4	1	1	PHLOX	DIVARICATA	4	2
664	4	1	1	PHRYMA	LEPTOSTACHYA	1	1
665	4	1	1	SANICULA	CANADENSIS	2	0
666	4	1	1	SMILACINA	RACEMOSA	1	1
667	4	1	1	THALICTRUM	DIOICUM	2	1
668	4	1	1	UVULARIA	PERFOLIATA	8	2
669	4	1	1	VERBESINA	VIRGINICA	1	1
670	4	1	2	ASTER	CORDIFOLIUS	1	1
671	4	1	2	HEPATICA	AMERICANA	1	2
672	4	1	2	PHLOX	DIVARICATA	2	1
673	4	1	2	SMILACINA	RACEMOSA	1	1
674	4	1	2	TRILLIUM	LUTEUM	1	1
675	4	1	2	VIOLA	HIRSUTULA	1	1
676	4	1	3	BOTRYCHIUM	VIRGINIANUM	1	1
677	4	1	3	GALIUM	CIRCAEZANS	1	0
678	4	1	3	PHLOX	DIVARICATA	6	3
679	4	1	3	PHRYMA	LEPTOSTACHYA	2	1
680	4	1	3	SMILACINA	RACEMOSA	3	4
681	4	1	3	THALICTRUM	DIOICUM	1	1
682	4	1	3	UVULARIA	PERFOLIATA	9	3
683	4	2	1	AGRIMONIA	PUBESCENS	2	1
684	4	2	1	CHIMAPHILA	MACULATA	3	2
685	4	2	1	OXALIS	VIOLACEA	2	0
686	4	2	1	PANICUM	LAXIFLORUM	1	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
687	4	2	1	PODOPHYLLUM	PELTATUM	2	5
688	4	2	1	SMILACINA	RACEMOSA	3	2
689	4	2	1	UVULARIA	PERFOLIATA	1	1
690	4	2	2	ASTER	CORDIFOLIUS	1	1
691	4	2	2	CHIMAPHILA	MACULATA	1	1
692	4	2	2	OXALIS	VIOLACEA	2	0
693	4	2	2	PODOPHYLLUM	PELTATUM	5	18
694	4	2	2	SMILACINA	RACEMOSA	1	1
695	4	2	2	UVULARIA	PERFOLIATA	6	3
696	4	2	3	ASTER	CORDIFOLIUS	1	1
697	4	2	3	ASTER	SIMPLEX	2	2
698	4	2	3	BOTRYCHIUM	VIRGINIANUM	1	1
699	4	2	3	CHIMAPHILA	MACULATA	2	1
700	4	2	3	GALIUM	CIRCAEZANS	2	0
701	4	2	3	PHRYMA	LEPTOSTACHYA	1	1
702	4	2	3	PODOPHYLLUM	PELTATUM	3	8
703	4	3	1	AMPHICARPA	BRACTEATA	1	1
704	4	3	1	PODOPHYLLUM	PELTATUM	3	10
705	4	3	1	VERBESINA	OCCIDENTALIS	1	1
706	4	3	2	GALIUM	CIRCAEZANS	3	1
707	4	3	2	PODOPHYLLUM	PELTATUM	1	4
708	4	3	2	POLYGONATUM	BIFLORUM	1	0
709	4	3	2	UVULARIA	PERFOLIATA	4	2
710	4	3	2	VERBESINA	OCCIDENTALIS	2	1
711	4	3	2	VIOLA	HIRSUTULA	1	1
712	4	3	3	BOTRYCHIUM	VIRGINIANUM	1	1
713	4	3	3	PHRYMA	LEPTOSTACHYA	2	1
714	4	3	3	SMILACINA	RACEMOSA	2	2
715	4	3	3	UVULARIA	PERFOLIATA	1	1
716	4	4	1	AMPHICARPA	BRACTEATA	5	1
717	4	4	1	ANEMONE	VIRGINIANA	4	3
718	4	4	1	ASTER	CORDIFOLIUS	14	10
719	4	4	1	CAREX	DIGITALIS	1	1
720	4	4	1	CAREX	NIGROMARGINATA	3	1
721	4	4	1	FRAGARIA	VIRGINIANA	1	1
722	4	4	1	GALIUM	CIRCAEZANS	2	0
723	4	4	1	LESPEDEZA	PROCUMBENS	4	1
724	4	4	1	PANICUM	LAXIFLORUM	15	5
725	4	4	1	RUDBECKIA	HIRTA	1	0
726	4	4	1	SCLERIA	TRIGLOMERATA	3	1
727	4	4	1	VIOLA	HIRSUTULA	1	1
728	4	4	2	AMPHICARPA	BRACTEATA	2	2
729	4	4	2	ANEMONE	VIRGINIANA	3	1
730	4	4	2	ASTER	CORDIFOLIUS	18	11
731	4	4	2	BOTRYCHIUM	VIRGINIANUM	3	1
732	4	4	2	FRAGARIA	VIRGINIANA	2	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
733	4	4	2	GALIUM	CIRCAEZANS	4	1
734	4	4	2	GALIUM	TRIFLORUM	16	2
735	4	4	2	HELIANTHUS	HIRSUTUS	1	1
736	4	4	2	RUDBECKIA	HIRTA	1	0
737	4	4	2	SANICULA	CANADENSIS	2	1
738	4	4	2	SENECIO	SMALLII	1	1
739	4	4	2	VIOLA	HIRSUTULA	3	1
740	4	4	3	AMPHICARPA	BRACTEATA	5	3
741	4	4	3	ANEMONE	VIRGINIANA	5	2
742	4	4	3	ASTER	CORDIFOLIUS	7	3
743	4	4	3	BOTRYCHIUM	VIRGINIANUM	2	1
744	4	4	3	FRAGARIA	VIRGINIANA	2	1
745	4	4	3	GALIUM	CIRCAEZANS	1	0
746	4	4	3	LESPEDEZA	PROCUMBENS	3	2
747	4	4	3	POTENTILLA	CANADENSIS	1	1
748	4	4	3	RUDBECKIA	HIRTA	1	0
749	4	4	3	SANICULA	CANADENSIS	5	1
750	4	4	3	SMILACINA	RACEMOSA	2	1
751	4	4	3	VIOLA	HIRSUTULA	1	1
752	5	1	1	GALIUM	CIRCAEZANS	2	1
753	5	1	1	GOODYERA	PUBESCENS	2	1
754	5	1	1	PENSTEMON	LAEVIGATUS	1	1
755	5	1	1	POLYGONATUM	BIFLORUM	1	1
756	5	1	1	VIOLA	HIRSUTULA	3	1
757	5	1	2	AMPHICARPA	BRACTEATA	5	2
758	5	1	2	GALIUM	CIRCAEZANS	1	0
759	5	1	2	POLYGONATUM	BIFLORUM	2	1
760	5	1	3	AMPHICARPA	BRACTEATA	2	1
761	5	1	3	ASTER	SIMPLEX	2	1
762	5	1	3	DELPHINIUM	TRICORNE	1	1
763	5	1	3	GOODYERA	PUBESCENS	1	1
764	5	1	3	PHRYMA	LEPTOSTACHYA	1	1
765	5	1	3	SPIGELIA	MARILANDICA	1	1
766	5	2	1	ALLIUM	CERNUUM	28	12
767	5	2	1	AMPHICARPA	BRACTEATA	8	3
768	5	2	1	ASTER	CORDIFOLIUS	2	1
769	5	2	1	PANICUM	LAXIFLORUM	2	1
770	5	2	2	ANEMONE	VIRGINIANA	2	1
771	5	2	2	ASTER	CORDIFOLIUS	2	1
772	5	2	2	BOTRYCHIUM	VIRGINIANUM	6	1
773	5	2	2	DESMODIUM	PANICULATUM	1	1
774	5	2	2	GALIUM	CIRCAEZANS	1	0
775	5	2	2	HELIANTHUS	HIRSUTUS	1	1
776	5	2	2	PANICUM	LAXIFLORUM	2	1
777	5	2	2	POLYGONATUM	BIFLORUM	1	1
778	5	2	2	SANICULA	CANADENSIS	1	0

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
779	5	2	2	VIOLA	HIRSUTULA	6	3
780	5	2	3	ANEMONE	VIRGINIANA	4	1
781	5	2	3	ASTER	CORDIFOLIUS	2	1
782	5	2	3	DESMODIUM	VIRIDIFLORUM	3	2
783	5	2	3	FRAGARIA	VIRGINIANA	1	1
784	5	2	3	HELIANTHUS	HIRSUTUS	5	6
785	5	2	3	PANICUM	LAXIFLORUM	6	2
786	5	2	3	SANICULA	CANADENSIS	3	2
787	5	2	3	VERBESINA	OCCIDENTALIS	1	1
788	5	2	3	VIOLA	HIRSUTULA	4	1
789	5	3	1	AMPHICARPA	BRACTEATA	5	2
790	5	3	1	ANEMONE	VIRGINIANA	1	1
791	5	3	1	ASTER	CORDIFOLIUS	3	2
792	5	3	1	CHIMAPHILA	MACULATA	1	1
793	5	3	1	HELIANTHUS	HIRSUTUS	1	1
794	5	3	1	POLYGONATUM	BIFLORUM	1	0
795	5	3	1	SCLERIA	TRIGLOMERATA	2	1
796	5	3	1	SMILACINA	RACEMOSA	1	1
797	5	3	1	UVULARIA	PERFOLIATA	3	1
798	5	3	1	VERBESINA	OCCIDENTALIS	2	1
799	5	3	2	AMPHICARPA	BRACTEATA	6	2
800	5	3	2	FRAGARIA	VIRGINIANA	2	2
801	5	3	2	HELIANTHUS	HIRSUTUS	2	1
802	5	3	2	OXALIS	VIOLACEA	4	1
803	5	3	2	SANICULA	CANADENSIS	6	1
804	5	3	2	VERBESINA	OCCIDENTALIS	3	2
805	5	3	2	VIOLA	HIRSUTULA	1	1
806	5	3	3	AMPHICARPA	BRACTEATA	1	1
807	5	3	3	ASTER	CORDIFOLIUS	19	12
808	5	3	3	GALIUM	CIRCAEZANS	5	1
809	5	3	3	HELIANTHUS	HIRSUTUS	2	1
810	5	3	3	PHRYMA	LEPTOSTACHYA	1	1
811	5	3	3	VERBESINA	OCCIDENTALIS	1	1
812	5	4	1	ANEMONE	VIRGINIANA	1	1
813	5	4	1	ASTER	CORDIFOLIUS	29	13
814	5	4	1	CHRYSANTHEMUM	LEUCANTHEMUM	3	1
815	5	4	1	DANTHONIA	SPICATA	1	1
816	5	4	1	FRAGARIA	VIRGINIANA	1	2
817	5	4	1	LESPEDEZA	PROCUMBENS	6	10
818	5	4	1	LITHOSPERMUM	CANESCENS	2	2
819	5	4	1	OXALIS	STRICTA	1	0
820	5	4	1	RUDBECKIA	HIRTA	[illegible]	1
821	5	4	1	SALVIA	LYRATA	2	2
822	5	4	1	SANICULA	CANADENSIS	2	2
823	5	4	1	SOLIDAGO	NEMORALIS	1	1
824	5	4	1	VIOLA	HIRSUTULA	2	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
825	5	4	2	ANEMONE	VIRGINIANA	1	1
826	5	4	2	ASTER	CORDIFOLIUS	15	5
827	5	4	2	CHRYSANTHEMUM	LEUCANTHEMUM	1	0
828	5	4	2	DANTHONIA	SPICATA	.	.
829	5	4	2	FRAGARIA	VIRGINIANA	2	1
830	5	4	2	GALIUM	PILOSUM	4	1
831	5	4	2	LITHOSPERMUM	CANESCENS	4	1
832	5	4	2	LOBELIA	SPICATA	5	1
833	5	4	2	SALVIA	LYRATA	1	1
834	5	4	2	SCLERIA	TRIGLOMERATA	1	1
835	5	4	2	SCUTELLARIA	PARVULA	2	0
836	5	4	2	SOLIDAGO	NEMORALIS	5	2
837	5	4	3	AMPHICARPA	BRACTEATA	6	3
838	5	4	3	ASTER	CORDIFOLIUS	14	6
839	5	4	3	CHRYSANTHEMUM	LEUCANTHEMUM	2	1
840	5	4	3	DANTHONIA	SPICATA	4	1
841	5	4	3	FRAGARIA	VIRGINIANA	1	1
842	5	4	3	GALIUM	CIRCAEZANS	2	0
843	5	4	3	LESPEDEZA	PROCUMBENS	3	4
844	5	4	3	LITHOSPERMUM	CANESCENS	8	2
845	5	4	3	RUDBECKIA	HIRTA	1	1
846	5	4	3	SALVIA	LYRATA	5	2
847	5	4	3	SANICULA	CANADENSIS	1	1
848	5	4	3	SOLIDAGO	NEMORALIS	4	2
849	5	4	3	VIOLA	HIRSUTULA	1	1
850	6	1	1	ANEMONE	VIRGINIANA	3	1
851	6	1	1	ANEMONELLA	THALICTROIDES	20	6
852	6	1	1	ASTER	CORDIFOLIUS	4	2
853	6	1	1	DELPHINIUM	TRICORNE	3	2
854	6	1	1	LOBELIA	SPICATA	1	1
855	6	1	1	POLYGONATUM	BIFLORUM	3	1
856	6	1	1	SCLERIA	TRIGLOMERATA	1	0
857	6	1	1	SILPHIUM	TRIFOLIATUM	1	1
858	6	1	1	SPIGELIA	MARILANDICA	1	1
859	6	1	2	AMPHICARPA	BRACTEATA	3	1
860	6	1	2	ASTER	CORDIFOLIUS	4	2
861	6	1	2	ASTER	SIMPLEX	1	0
862	6	1	2	BOTRYCHIUM	VIRGINIANUM	2	1
863	6	1	2	GALIUM	CIRCAEZANS	1	0
864	6	1	2	SALVIA	LYRATA	2	2
865	6	1	2	SCLERIA	TRIGLOMERATA	3	2
866	6	1	3	ANEMONELLA	THALICTROIDES	12	2
867	6	1	3	ASTER	CORDIFOLIUS	6	2
868	6	1	3	BOTRYCHIUM	VIRGINIANUM	5	2
869	6	1	3	GALIUM	CIRCAEZANS	5	1
870	6	1	3	SCLERIA	TRIGLOMERATA	3	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
871	6	2	1	AMPHICARPA	BRACTEATA	9	6
872	6	2	1	ASTER	CORDIFOLIUS	2	1
873	6	2	1	DANTHONIA	SPICATA	20	30
874	6	2	1	FRAGARIA	VIRGINIANA	1	1
875	6	2	1	GALIUM	TRIFLORUM	1	0
876	6	2	1	LITHOSPERMUM	CANESCENS	2	2
877	6	2	1	SANICULA	CANADENSIS	1	1
878	6	2	1	SCLERIA	TRIGLOMERATA	1	1
879	6	2	2	AGAVE	VIRGINICA	3	2
880	6	2	2	AMPHICARPA	BRACTEATA	8	2
881	6	2	2	ASTER	CORDIFOLIUS	9	7
882	6	2	2	CASSIA	FASCICULATA	4	1
883	6	2	2	CHRYSANTHEMUM	LEUCANTHEMUM	1	0
884	6	2	2	DANTHONIA	SPICATA	2	1
885	6	2	2	DESMODIUM	CILIARE	2	1
886	6	2	2	DESMODIUM	VIRIDIFLORUM	9	2
887	6	2	2	FRAGARIA	VIRGINIANA	9	2
888	6	2	2	GALIUM	CIRCAEZANS	2	1
889	6	2	2	HOUSTONIA	TENUIFOLIA	1	0
890	6	2	2	LOBELIA	SPICATA	1	0
891	6	2	2	PENSTEMON	LAEVIGATUS	1	1
892	6	2	2	POTENTILLA	CANADENSIS	2	1
893	6	2	2	SALVIA	LYRATA	14	6
894	6	2	2	SANICULA	CANADENSIS	1	1
895	6	2	2	SCUTELLARIA	PARVULA	1	0
896	6	2	2	SENECIO	SMALLII	3	2
897	6	2	3	AMPHICARPA	BRACTEATA	11	4
898	6	2	3	BOTRYCHIUM	VIRGINIANUM	4	1
899	6	2	3	FRAGARIA	VIRGINIANA	7	3
900	6	2	3	HOUSTONIA	TENUIFOLIA	1	0
901	6	2	3	POTENTILLA	CANADENSIS	1	1
902	6	2	3	SCLERIA	TRIGLOMERATA	5	2
903	6	3	1	ANEMONE	VIRGINIANA	1	1
904	6	3	1	ASTER	CORDIFOLIUS	8	4
905	6	3	1	DESMODIUM	VIRIDIFLORUM	2	1
906	6	3	1	GALIUM	CIRCAEZANS	3	1
907	6	3	1	GALIUM	TRIFLORUM	2	0
908	6	3	1	LESPEDEZA	PROCUMBENS	1	0
909	6	3	1	PANICUM	COMMUTATUM	2	1
910	6	3	1	PENSTEMON	LAEVIGATUS	1	1
911	6	3	1	POTENTILLA	CANADENSIS	3	1
912	6	3	1	SALVIA	LYRATA	9	8
913	6	3	1	SANICULA	CANADENSIS	1	0
914	6	3	1	SCLERIA	TRIGLOMERATA	1	1
915	6	3	1	VIOLA	HIRSUTULA	2	1
916	6	3	2	ASTER	CORDIFOLIUS	9	4

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
917	6	3	2	BOTRYCHIUM	VIRGINIANUM	9	2
918	6	3	2	CASSIA	FASCICULATA	1	0
919	6	3	2	CHIMAPHILA	MACULATA	7	3
920	6	3	2	DANTHONIA	SPICATA	1	1
921	6	3	2	GALIUM	PILOSUM	1	0
922	6	3	2	LESPEDEZA	PROCUMBENS	2	3
923	6	3	2	PANICUM	COMMUTATUM	4	1
924	6	3	2	PANICUM	LAXIFLORUM	5	2
925	6	3	2	POTENTILLA	CANADENSIS	3	1
926	6	3	2	SALVIA	LYRATA	5	2
927	6	3	2	SANICULA	CANADENSIS	2	1
928	6	3	2	VIOLA	HIRSUTULA	1	1
929	6	3	3	ANEMONE	VIRGINIANA	1	1
930	6	3	3	ASTER	CORDIFOLIUS	3	2
931	6	3	3	DANTHONIA	SPICATA	5	3
932	6	3	3	EUPATORIUM	PURPUREUM	1	2
933	6	3	3	FRAGARIA	VIRGINIANA	2	1
934	6	3	3	GALIUM	CIRCAEZANS	4	2
935	6	3	3	LESPEDEZA	PROCUMBENS	3	4
936	6	3	3	PANICUM	COMMUTATUM	3	1
937	6	3	3	POLYGONATUM	BIFLORUM	1	2
938	6	3	3	POTENTILLA	CANADENSIS	1	1
939	6	3	3	SALVIA	LYRATA	5	3
940	6	3	3	SANICULA	CANADENSIS	3	1
941	6	3	3	SMILACINA	RACEMOSA	1	1
942	7	2	1	EUPHORBIA	COROLLATA	9	2
943	7	2	1	FRAGARIA	VIRGINIANA	2	1
944	7	2	1	GALIUM	CIRCAEZANS	2	1
945	7	2	1	LESPEDEZA	PROCUMBENS	13	45
946	7	2	2	ASTER	LATERIFLORUS	2	1
947	7	2	2	CHIMAPHILA	MACULATA	2	1
948	7	2	2	EUPHORBIA	COROLLATA	3	1
949	7	2	2	FRAGARIA	VIRGINIANA	2	1
950	7	2	2	LESPEDEZA	PROCUMBENS	3	3
951	7	2	2	PANICUM	COMMUTATUM	1	1
952	7	2	2	RUDBECKIA	HIRTA	1	1
953	7	2	2	SCLERIA	TRIGLOMERATA	4	1
954	7	2	2	SISYRINCHIUM	ALBIDUM	1	0
955	7	2	2	SMILACINA	RACEMOSA	1	1
956	7	2	3	ANEMONE	VIRGINIANA	2	1
957	7	2	3	ASTER	LATERIFLORUS	8	2
958	7	2	3	CHRYSANTHEMUM	LEUCANTHEMUM	2	1
959	7	2	3	DANTHONIA	SPICATA	1	0
960	7	2	3	DESMODIUM	VIRIDIFLORUM	1	2
961	7	2	3	EUPHORBIA	COROLLATA	3	1
962	7	2	3	FRAGARIA	VIRGINIANA	3	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
963	7	2	3	LESPEDEZA	PROCUMBENS	10	7
964	7	2	3	PENSTEMON	LAEVIGATUS	1	1
965	7	2	3	PRUNELLA	VULGARIS	1	1
966	7	2	3	RUDBECKIA	HIRTA	2	1
967	7	2	3	SANICULA	CANADENSIS	2	1
968	7	2	3	SCUTELLARIA	PARVULA	6	1
969	7	2	3	SENECIO	SMALLII	3	1
970	7	3	1	CHIMAPHILA	MACULATA	3	2
971	7	3	1	FRAGARIA	VIRGINIANA	3	3
972	7	3	1	GALIUM	PILOSUM	1	[illegible]
973	7	3	1	GOODYERA	PUBESCENS	1	1
974	7	3	1	HELIANTHUS	HIRSUTUS	1	1
975	7	3	1	POTENTILLA	CANADENSIS	5	2
976	7	3	1	RUDBECKIA	HIRTA	1	1
977	7	3	2	CHIMAPHILA	MACULATA	6	1
978	7	3	3	ASTER	CORDIFOLIUS	1	1
979	7	3	3	ASTER	SIMPLEX	3	1
980	7	3	3	BOTRYCHIUM	VIRGINIANUM	1	[illegible]
981	7	3	3	HELIANTHUS	HIRSUTUS	4	2
982	7	3	3	POTENTILLA	CANADENSIS	5	2
983	7	3	3	RUDBECKIA	HIRTA	1	1
984	7	3	3	SOLIDAGO	NEMORALIS	3	2

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
985	1	1	1	ACHILLEA	MILLEFOLIUM	9	3
986	1	1	1	ANDROPOGON	SCOPARIUS	1	1
987	1	1	1	CASSIA	FASCICULATA	4	2
988	1	1	1	CHRYSANTHEMUM	LEUCANTHEMUM	6	1
989	1	1	1	DANTHONIA	SPICATA	8	10
990	1	1	1	DAUCUS	CAROTA	1	1
991	1	1	1	FRAGARIA	VIRGINIANA	2	1
992	1	1	1	MEDICAGO	LUPULINA	5	2
993	1	1	1	PANICUM	SPHAEROCARPON	3	1
994	1	1	1	POTENTILLA	CANADENSIS	4	2
995	1	1	1	SCLERIA	TRIGLOMERATA	2	1
996	1	1	1	SENECIO	SMALLII	3	2
997	1	1	2	ANDROPOGON	SCOPARIUS	3	2
998	1	1	2	ANEMONE	VIRGINIANA	3	2
999	1	1	2	CASSIA	FASCICULATA	1	1
1000	1	1	2	DANTHONIA	SPICATA	3	1
1001	1	1	2	DESMODIUM	VIRIDIFLORUM	3	2
1002	1	1	2	MEDICAGO	LUPULINA	2	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFEC
1003	1	1	2	MELILOTUS	ALBA	1	0
1004	1	1	2	OXALIS	STRICTA	1	1
1005	1	1	2	PANICUM	SPHAEROCARPON	1	0
1006	1	1	2	POTENTILLA	CANADENSIS	1	1
1007	1	1	2	SENECIO	SMALLII	6	4
1008	1	1	3	ACHILLEA	MILLEFOLIUM	7	3
1009	1	1	3	ANEMONE	VIRGINIANA	1	1
1010	1	1	3	CASSIA	FASCICULATA	1	1
1011	1	1	3	CHRYSANTHEMUM	LEUCANTHEMUM	3	1
1012	1	1	3	CLITORIA	MARIANA	1	1
1013	1	1	3	DANTHONIA	SPICATA	3	1
1014	1	1	3	ERIGERON	STRIGOSUS	1	1
1015	1	1	3	FRAGARIA	VIRGINIANA	6	4
1016	1	1	3	MEDICAGO	LUPULINA	17	7
1017	1	1	3	MELILOTUS	ALBA	1	1
1018	1	1	3	PANICUM	SPHAEROCARPON	1	0
1019	1	1	3	POTENTILLA	CANADENSIS	2	1
1020	1	1	3	SENECIO	SMALLII	2	1
1021	1	1	3	VERBESINA	OCCIDENTALIS	1	1
1022	1	2	1	ANDROPOGON	SCOPARIUS	30	95
1023	1	2	1	CLITORIA	MARIANA	6	1
1024	1	2	1	MELILOTUS	ALBA	10	1
1025	1	2	1	SENECIO	SMALLII	3	1
1026	1	2	2	ANDROPOGON	SCOPARIUS	25	96
1027	1	2	2	BROMUS	JAPONICUS	1	0
1028	1	2	2	CLITORIA	MARIANA	1	1
1029	1	2	2	ERIGERON	STRIGOSUS	2	2
1030	1	2	2	FRAGARIA	VIRGINIANA	3	2
1031	1	2	2	MELILOTUS	ALBA	9	3
1032	1	2	3	ANDROPOGON	SCOPARIUS	15	76
1033	1	2	3	BROMUS	JAPONICUS	3	1
1034	1	2	3	CARDAMINE	HIRSUTA	2	1
1035	1	2	3	CLITORIA	MARIANA	1	1
1036	1	2	3	DESMODIUM	VIRIDIFLORUM	2	2
1037	1	2	3	FRAGARIA	VIRGINIANA	5	2
1038	1	2	3	GALIUM	APARINE	17	7
1039	1	2	3	LESPEDEZA	PROCUMBENS	2	1
1040	1	2	3	MELILOTUS	ALBA	3	1
1041	1	2	3	SENECIO	SMALLII	2	1
1042	1	2	3	TRIDENS	FLAVUS	1	1
1043	2	1	1	AGAVE	VIRGINICA	3	2
1044	2	1	1	AMPHICARPA	BRACTEATA	1	1
1045	2	1	1	ANDROPOGON	SCOPARIUS	17	35
1046	2	1	1	ANEMONE	VIRGINIANA	5	2
1047	2	1	1	ASCLEPIAS	VERTICILLATA	2	1
1048	2	1	1	CHRYSANTHEMUM	LEUCANTHEMUM	12	2

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1049	2	1	1	DESMODIUM	CILIARE	7	6
1050	2	1	1	HOUSTONIA	TENUIFOLIA	1	1
1051	2	1	1	LOBELIA	SPICATA	7	1
1052	2	1	1	SALVIA	LYRATA	1	1
1053	2	1	1	SPOROBOLUS	NEGLECTUS	33	23
1054	2	1	2	AMPHICARPA	BRACTEATA	2	1
1055	2	1	2	ANDROPOGON	SCOPARIUS	20	70
1056	2	1	2	ANEMONE	VIRGINIANA	6	1
1057	2	1	2	CLITORIA	MARIANA	1	1
1058	2	1	2	DESMODIUM	CILIARE	13	4
1059	2	1	2	FRAGARIA	VIRGINIANA	2	1
1060	2	1	2	VIOLA	SAGITTATA	1	1
1061	2	1	3	AMPHICARPA	BRACTEATA	4	1
1062	2	1	3	ANDROPOGON	SCOPARIUS	22	62
1063	2	1	3	ASCLEPIAS	VERTICILLATA	1	1
1064	2	1	3	ASTER	PATENS	1	1
1065	2	1	3	DESMODIUM	CILIARE	1	1
1066	2	1	3	GALIUM	PILOSUM	16	6
1067	2	1	3	KUHNIA	EUPATORIOIDES	2	1
1068	2	1	3	LESPEDEZA	PROCUMBENS	2	1
1069	2	1	3	LOBELIA	SPICATA	1	0
1070	2	1	3	POTENTILLA	CANADENSIS	5	1
1071	2	1	3	SALVIA	LYRATA	3	2
1072	2	2	1	ANDROPOGON	SCOPARIUS	16	95
1073	2	2	1	ANEMONE	VIRGINIANA	1	0
1074	2	2	1	CASSIA	FASCICULATA	1	1
1075	2	2	1	CLITORIA	MARIANA	6	2
1076	2	2	1	HYPERICUM	DOLABRIFORME	2	1
1077	2	2	1	KUHNIA	EUPATORIOIDES	3	2
1078	2	2	1	POTENTILLA	CANADENSIS	2	1
1079	2	2	1	SALVIA	LYRATA	1	1
1080	2	2	1	SENECIO	SMALLII	2	1
1081	2	2	2	ANDROPOGON	SCOPARIUS	14	30
1082	2	2	2	ASCLEPIAS	VERTICILLATA	1	0
1083	2	2	2	CLITORIA	MARIANA	1	1
1084	2	2	2	LESPEDEZA	PROCUMBENS	14	28
1085	2	2	2	MEDICAGO	LUPULINA	4	1
1086	2	2	2	POTENTILLA	CANADENSIS	6	3
1087	2	2	3	AMPHICARPA	BRACTEATA	3	1
1088	2	2	3	ANDROPOGON	SCOPARIUS	24	94
1089	2	2	3	CHRYSANTHEMUM	LEUCANTHEMUM	2	2
1090	2	2	3	HOUSTONIA	TENUIFOLIA	2	1
1091	2	2	3	LESPEDEZA	PROCUMBENS	3	2
1092	2	2	3	LOBELIA	SPICATA	3	1
1093	2	2	3	POA	COMPRESSA	3	1
1094	2	3	1	AMPHICARPA	BRACTEATA	6	3

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1095	2	3	1	ANDROPOGON	SCOPARIUS	26	65
1096	2	3	1	ANEMONE	VIRGINIANA	5	1
1097	2	3	1	ASCLEPIAS	VERTICILLATA	1	1
1098	2	3	1	CHRYSANTHEMUM	LEUCANTHEMUM	2	1
1099	2	3	1	DAUCUS	CAROTA	2	1
1100	2	3	1	HOUSTONIA	TENUIFOLIA	1	0
1101	2	3	1	POTENTILLA	CANADENSIS	1	1
1102	2	3	1	SANICULA	CANADENSIS	4	1
1103	2	3	2	ANDROPOGON	SCOPARIUS	30	70
1104	2	3	2	ASCLEPIAS	VERTICILLATA	1	0
1105	2	3	2	HOUSTONIA	TENUIFOLIA	1	0
1106	2	3	2	POTENTILLA	CANADENSIS	4	1
1107	2	3	2	SOLIDAGO	ERECTA	1	0
1108	2	3	2	SOLIDAGO	NEMORALIS	2	1
1109	2	3	3	ANDROPOGON	SCOPARIUS	30	93
1110	2	3	3	ANEMONE	VIRGINIANA	5	1
1111	2	3	3	ASCLEPIAS	VERTICILLATA	1	0
1112	2	3	3	CHRYSANTHEMUM	LEUCANTHEMUM	3	0
1113	2	3	3	PANICUM	CAPILLARE	1	0
1114	2	3	3	POTENTILLA	CANADENSIS	2	1
1115	2	3	3	SOLIDAGO	NEMORALIS	1	1
1116	2	4	1	ANDROPOGON	VIRGINICUS	1	1
1117	2	4	1	ANEMONE	VIRGINIANA	4	2
1118	2	4	1	CAREX	COMPLANATA	2	4
1119	2	4	1	CASSIA	FASCICULATA	1	0
1120	2	4	1	FRAGARIA	VIRGINIANA	4	3
1121	2	4	1	GALIUM	PILOSUM	1	0
1122	2	4	1	GERANIUM	CAROLINIANUM	3	2
1123	2	4	1	MEDICAGO	LUPULINA	75	20
1124	2	4	1	MELILOTUS	ALBA	1	1
1125	2	4	1	PANICUM	SPHAEROCARPON	4	1
1126	2	4	1	SANICULA	CANADENSIS	3	1
1127	2	4	1	TRIDENS	FLAVUS	1	1
1128	2	4	2	ANEMONE	VIRGINIANA	7	2
1129	2	4	2	BOTRYCHIUM	VIRGINIANUM	1	0
1130	2	4	2	CAREX	RETROFLEXA	1	1
1131	2	4	2	GALIUM	PILOSUM	1	0
1132	2	4	2	GERANIUM	MACULATUM	1	1
1133	2	4	2	OXALIS	STRICTA	1	0
1134	2	4	3	ANEMONE	VIRGINIANA	3	1
1135	2	4	3	BOTRYCHIUM	VIRGINIANUM	3	1
1136	2	4	3	DIANTHUS	ARMERIA	1	1
1137	2	4	3	FRAGARIA	VIRGINIANA	6	4
1138	2	4	3	GALIUM	APARINE	1	0
1139	2	4	3	GALIUM	PILOSUM	8	1
1140	2	4	3	GEUM	VIRGINIANUM	2	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1141	2	4	3	MEDICAGO	LUPULINA	12	4
1142	2	4	3	PANICUM	SPHAEROCARPON	1	0
1143	2	4	3	PASPALUM	LAEVE	2	1
1144	2	4	3	SCLERIA	TRIGLOMERATA	1	1
1145	2	4	3	SENECIO	SMALLII	3	3
1146	2	4	3	TRIFOLIUM	CAMPESTRE	3	1
1147	2	5	2	ASPLENIUM	PLATYNEURON	3	1
1148	2	5	2	CAREX	RETROFLEXA	3	1
1149	2	5	2	CHRYSANTHEMUM	LEUCANTHEMUM	6	2
1150	2	5	2	DRABA	VERNA	2	0
1151	2	5	2	POLYSTICHUM	ACROSTICHOIDES	1	0
1152	3	4	1	ANDROPOGON	SCOPARIUS	16	84
1153	3	4	1	CASSIA	FASCICULATA	1	0
1154	3	4	1	EUPATORIUM	HYSSOPIFOLIUM	1	1
1155	3	4	1	LESPEDEZA	PROCUMBENS	1	1
1156	3	4	1	SENECIO	SMALLII	3	2
1157	3	4	2	ANDROPOGON	SCOPARIUS	12	72
1158	3	4	2	CASSIA	FASCICULATA	1	1
1159	3	4	2	CINNA	ARUNDINACEA	1	1
1160	3	4	2	LESPEDEZA	PROCUMBENS	1	1
1161	3	4	3	ANDROPOGON	SCOPARIUS	17	73
1162	3	4	3	CASSIA	FASCICULATA	3	1
1163	3	5	1	ANDROPOGON	SCOPARIUS	24	89
1164	3	5	1	CINNA	ARUNDINACEA	1	1
1165	3	5	1	LESPEDEZA	PROCUMBENS	2	1
1166	3	5	1	LOBELIA	SPICATA	1	0
1167	3	5	2	ANDROPOGON	SCOPARIUS	25	87
1168	3	5	2	ASCLEPIAS	VERTICILLATA	1	0
1169	3	5	2	DAUCUS	CAROTA	1	1
1170	3	5	2	HOUSTONIA	TENUIFOLIA	2	1
1171	3	5	2	HYPERICUM	DOLABRIFORME	7	3
1172	3	5	2	POTENTILLA	CANADENSIS	2	3
1173	3	5	2	SALVIA	LYRATA	1	3
1174	3	5	2	SCUTELLARIA	PARVULA	5	1
1175	3	5	2	SOLIDAGO	NEMORALIS	2	1
1176	3	5	3	ANDROPOGON	SCOPARIUS	10	15
1177	3	5	3	EUPATORIUM	HYSSOPIFOLIUM	2	1
1178	3	5	3	LESPEDEZA	PROCUMBENS	2	2
1179	3	6	1	ANDROPOGON	SCOPARIUS	19	64
1180	3	6	1	ANEMONE	VIRGINIANA	3	2
1181	3	6	1	ASPLENIUM	PLATYNEURON	1	3
1182	3	6	1	CHRYSANTHEMUM	LEUCANTHEMUM	6	2
1183	3	6	1	CLITORIA	MARIANA	1	1
1184	3	6	1	GALIUM	CIRCAEZANS	2	1
1185	3	6	1	HOUSTONIA	TENUIFOLIA	1	[illegible]
1186	3	6	1	SALVIA	LYRATA	1	1

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1187	3	6	1	SENECIO	SMALLII	6	2
1188	3	6	1	TRIFOLIUM	PRATENSE	2	1
1189	3	6	1	TRIFOLIUM	REPENS	3	3
1190	3	6	1	VERBESINA	VIRGINICA	3	2
1191	3	6	2	AGRIMONIA	PUBESCENS	5	3
1192	3	6	2	AMPHICARPA	BRACTEATA	1	1
1193	3	6	2	ANDROPOGON	SCOPARIUS	13	32
1194	3	6	2	ANEMONE	VIRGINIANA	5	2
1195	3	6	2	CHRYSANTHEMUM	LEUCANTHEMUM	7	2
1196	3	6	2	CINNA	ARUNDINACEA	2	2
1197	3	6	2	CLITORIA	MARIANA	2	3
1198	3	6	2	GEUM	VIRGINIANUM	5	1
1199	3	6	2	PANICUM	CAPILLARE	18	2
1200	3	6	2	SANICULA	CANADENSIS	1	1
1201	3	6	2	SENECIO	SMALLII	3	2
1202	3	6	2	SOLIDAGO	NEMORALIS	1	1
1203	3	6	2	TRIDENS	FLAVUS	2	1
1204	3	6	2	TRIOSTEUM	ANGUSTIFOLIUM	1	1
1205	3	6	2	VERBESINA	VIRGINICA	4	9
1206	3	6	3	AGRIMONIA	PUBESCENS	2	2
1207	3	6	3	ANDROPOGON	SCOPARIUS	14	48
1208	3	6	3	ANEMONE	VIRGINIANA	3	2
1209	3	6	3	ASTER	PILOSUS	1	1
1210	3	6	3	CASSIA	FASCICULATA	1	0
1211	3	6	3	CINNA	ARUNDINACEA	8	9
1212	3	6	3	CLITORIA	MARIANA	1	1
1213	3	6	3	GALIUM	CIRCAEZANS	3	1
1214	3	6	3	GEUM	VIRGINIANUM	2	1
1215	3	6	3	LESPEDEZA	PROCUMBENS	1	0
1216	3	6	3	VERBESINA	VIRGINICA	9	8
1217	3	7	1	ANDROPOGON	SCOPARIUS	23	80
1218	3	7	1	ASCLEPIAS	VERTICILLATA	1	1
1219	3	7	1	GALIUM	PILOSUM	2	1
1220	3	7	1	LESPEDEZA	PROCUMBENS	23	27
1221	3	7	1	POTENTILLA	CANADENSIS	1	1
1222	3	7	2	ANDROPOGON	SCOPARIUS	24	86
1223	3	7	2	ANEMONE	VIRGINIANA	1	1
1224	3	7	2	ASCLEPIAS	VERTICILLATA	1	1
1225	3	7	2	HOUSTONIA	TENUIFOLIA	1	0
1226	3	7	2	LESPEDEZA	PROCUMBENS	8	14
1227	3	7	3	ANDROPOGON	SCOPARIUS	23	75
1228	3	7	3	ASCLEPIAS	VERTICILLATA	1	0
1229	3	7	3	LESPEDEZA	PROCUMBENS	20	20
1230	3	7	3	POTENTILLA	CANADENSIS	1	1
1231	3	7	3	VIOLA	HIRSUTULA	1	1
1232	3	8	1	ANDROPOGON	SCOPARIUS	2	2

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1233	3	8	1	BOTRYCHIUM	VIRGINIANUM	2	1
1234	3	8	1	CASSIA	FASCICULATA	1	0
1235	3	8	1	ERIANTHUS	ALOPECUROIDES	3	1
1236	3	8	1	FRAGARIA	VIRGINIANA	6	2
1237	3	8	1	GALIUM	PILOSUM	7	1
1238	3	8	1	GEUM	VIRGINIANUM	1	1
1239	3	8	1	LESPEDEZA	PROCUMBENS	5	2
1240	3	8	1	MELILOTUS	ALBA	1	1
1241	3	8	1	MICROSTEGEUM	VIMINEUM	12	2
1242	3	8	1	OXALIS	VIOLACEA	1	1
1243	3	8	1	PANICUM	SPHAEROCARPON	3	1
1244	3	8	1	SANICULA	CANADENSIS	7	3
1245	3	8	1	SCUTELLARIA	PARVULA	2	0
1246	3	8	1	VIOLA	HIRSUTULA	2	1
1247	3	8	2	ANDROPOGON	SCOPARIUS	16	53
1248	3	8	2	ASTER	PATENS	1	1
1249	3	8	2	BOTRYCHIUM	VIRGINIANUM	1	0
1250	3	8	2	FRAGARIA	VIRGINIANA	7	3
1251	3	8	2	GALIUM	PILOSUM	3	1
1252	3	8	2	PANICUM	SPHAEROCARPON	11	2
1253	3	8	2	POTENTILLA	CANADENSIS	4	2
1254	3	8	2	SANICULA	CANADENSIS	10	2
1255	3	8	2	SCUTELLARIA	PARVULA	1	0
1256	3	8	2	SENECIO	SMALLII	1	1
1257	3	8	2	SISYRINCHIUM	ALBIDUM	4	2
1258	3	8	3	AGRIMONIA	PUBESCENS	2	1
1259	3	8	3	ANDROPOGON	SCOPARIUS	11	15
1260	3	8	3	ANEMONE	VIRGINIANA	3	1
1261	3	8	3	ASTER	PATENS	2	1
1262	3	8	3	ASTER	PATENS	2	1
1263	3	8	3	FRAGARIA	VIRGINIANA	12	3
1264	3	8	3	GALIUM	PILOSUM	4	1
1265	3	8	3	LESPEDEZA	PROCUMBENS	5	5
1266	3	8	3	POLYPODIUM	POLYPODIOIDES	2	1
1267	3	8	3	POTENTILLA	CANADENSIS	2	1
1268	3	8	3	SANICULA	CANADENSIS	1	1
1269	3	8	3	SENECIO	SMALLII	1	1
1270	4	1	1	ANEMONE	VIRGINIANA	1	[illegible]
1271	4	1	1	CHIMAPHILA	MACULATA	10	4
1272	4	1	1	FRAGARIA	VIRGINIANA	2	1
1273	4	1	1	POTENTILLA	CANADENSIS	3	2
1274	4	1	2	ANEMONE	VIRGINIANA	2	1
1275	4	1	2	CHIMAPHILA	MACULATA	6	3
1276	4	1	2	POTENTILLA	CANADENSIS	2	1
1277	4	1	3	CHIMAPHILA	MACULATA	8	4
1278	4	1	3	FRAGARIA	VIRGINIANA	9	3

Appendix A (continued)

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OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1279	4	2	1	ANEMONE	VIRGINIANA	1	0
1280	4	2	1	SALVIA	LYRATA	2	2
1281	4	2	1	SANICULA	CANADENSIS	1	1
1282	4	2	1	TRIOSTEUM	ANGUSTIFOLIUM	2	1
1283	4	2	1	VERBESINA	OCCIDENTALIS	1	1
1284	4	2	1	VIOLA	HIRSUTULA	4	1
1285	4	2	1	VIOLA	PAPILIONACEA	1	2
1286	4	2	2	GALIUM	TRIFLORUM	2	0
1287	4	2	2	SALVIA	LYRATA	1	1
1288	4	2	2	SANICULA	CANADENSIS	3	1
1289	4	2	2	VIOLA	PAPILIONACEA	5	2
1290	4	2	3	ANEMONE	VIRGINIANA	1	1
1291	4	2	3	GALIUM	TRIFLORUM	1	0
1292	4	2	3	POTENTILLA	CANADENSIS	2	1
1293	4	2	3	SALVIA	LYRATA	1	1
1294	4	2	3	SCUTELLARIA	INCANA	2	0
1295	4	2	3	TRIOSTEUM	ANGUSTIFOLIUM	3	2
1296	4	2	3	VERBESINA	OCCIDENTALIS	1	1
1297	4	2	3	VIOLA	HIRSUTULA	1	1
1298	4	3	1	CHIMAPHILA	MACULATA	9	2
1299	4	3	1	GALIUM	CIRCAEZANS	2	1
1300	4	3	1	LESPEDEZA	REPENS	21	22
1301	4	3	1	POTENTILLA	CANADENSIS	2	1
1302	4	3	1	PRUNELLA	VULGARIS	12	3
1303	4	3	2	CHIMAPHILA	MACULATA	7	3
1304	4	3	2	LESPEDEZA	REPENS	12	16
1305	4	3	2	POTENTILLA	CANADENSIS	1	1
1306	4	3	3	CHIMAPHILA	MACULATA	4	2
1307	4	3	3	DANTHONIA	SPICATA	1	1
1308	4	3	3	LESPEDEZA	REPENS	22	27
1309	4	3	3	PRUNELLA	VULGARIS	3	1
1310	4	3	3	SENECIO	SMALLII	1	1
1311	4	3	3	TRIOSTEUM	ANGUSTIFOLIUM	1	1

------------------------------------- LOC=4 -------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1312	1	1	2	ASPLENIUM	PLATYNEURON	1	1
1313	1	1	2	CHIMAPHILA	MACULATA	2	1
1314	1	2	2	HEPATICA	AMERICANA	2	2
1315	1	2	2	HEUCHERA	AMERICANA	1	1
1316	1	2	2	SOLIDAGO	FLACCIDIFOLIA	1	1
1317	2	1	1	HEXASTYLIS	ARIFOLIA	1	1
1318	2	1	2	HEXASTYLIS	ARIFOLIA	1	2

Appendix A (continued)

------------------------------------ LOC=4 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1319	2	1	3	HEXASTYLIS	ARIFOLIA	2	1
1320	3	1	1	SMILACINA	RACEMOSA	2	2
1321	3	2	3	CHIMAPHILA	MACULATA	1	1
1322	3	2	3	GALIUM	TRIFLORUM	2	1
1323	3	2	3	HEXASTYLIS	ARIFOLIA	2	4
1324	3	2	3	MICROSTEGEUM	VIMINEUM	125	40
1325	3	2	3	OXALIS	STRICTA	4	1
1326	3	2	3	PANICUM	LAXIFLORUM	1	10
1327	3	2	3	POLYSTICHUM	ACROSTICHOIDES	2	0
1328	3	2	3	SILENE	VIRGINICA	1	1
1329	4	1	1	AMPHICARPA	BRACTEATA	6	2
1330	4	1	1	ASPLENIUM	PLATYNEURON	3	3
1331	4	1	1	CAREX	NIGROMARGINATA	3	4
1332	4	1	1	GALIUM	CIRCAEZANS	4	1
1333	4	1	1	HEXASTYLIS	ARIFOLIA	13	5
1334	4	1	1	PANICUM	LAXIFLORUM	6	3
1335	4	1	2	CAREX	NIGROMARGINATA	4	2
1336	4	1	2	CHIMAPHILA	MACULATA	2	2
1337	4	1	2	GALIUM	CIRCAEZANS	2	0
1338	4	1	2	GALIUM	PILOSUM	1	0
1339	4	1	2	HEXASTYLIS	ARIFOLIA	1	2
1340	4	1	2	SMILACINA	RACEMOSA	11	3
1341	4	1	3	AMPHICARPA	BRACTEATA	1	1
1342	4	1	3	CHIMAPHILA	MACULATA	4	1
1343	4	1	3	DESMODIUM	NUDIFLORUM	4	13
1344	4	1	3	HEXASTYLIS	ARIFOLIA	3	2
1345	4	1	3	PANICUM	LAXIFLORUM	7	5
1346	4	1	3	SMILACINA	RACEMOSA	12	5
1347	4	2	1	HEXASTYLIS	ARIFOLIA	2	2
1348	4	2	1	RANUNCULUS	RECURVATUS	1	1
1349	4	2	1	SMILACINA	RACEMOSA	2	1
1350	4	2	2	MICROSTEGEUM	VIMINEUM	132	26
1351	4	2	2	OXALIS	STRICTA	4	2
1352	4	2	2	PANICUM	LAXIFLORUM	2	3
1353	4	2	2	VIOLA	HIRSUTULA	1	1
1354	4	2	3	HEXASTYLIS	ARIFOLIA	1	2
1355	4	2	3	MICROSTEGEUM	VIMINEUM	6	1
1356	4	2	3	POLYSTICHUM	ACROSTICHOIDES	2	1
1357	4	2	3	SILENE	VIRGINICA	1	1

Appendix A (continued)

------------------------------------ LOC=5 ------------------------------------

OBS	LINE	PLOT	SUB	GENUS	SPECIES	MAXNUM	MAXFAC
1358	1	1	1	EPIFAGUS	VIRGINIANA	10	6
1359	1	1	2	CHIMAPHILA	MACULATA	1	1
1360	1	1	2	EPIFAGUS	VIRGINIANA	7	5
1361	1	1	3	EPIFAGUS	VIRGINIANA	11	7
1362	2	1	1	COREOPSIS	MAJOR	1	1
1363	2	1	2	CAREX	NIGROMARGINATA	1	1
1364	2	1	2	CHIMAPHILA	MACULATA	1	0
1365	2	1	3	DESMODIUM	NUDIFLORUM	1	1
1366	2	4	2	SOLIDAGO	CAESIA	2	2
1367	3	1	1	HEXASTYLIS	ARIFOLIA	1	1
1368	3	1	1	LUZULA	CAMPESTRIS	1	1
1369	3	1	2	HEXASTYLIS	ARIFOLIA	1	1
1370	3	1	2	LUZULA	CAMPESTRIS	1	1
1371	3	3	1	CHAMAELIRIUM	LUTEUM	1	3
1372	3	3	1	HEXASTYLIS	ARIFOLIA	1	1
1373	4	1	1	CHIMAPHILA	MACULATA	1	1
1374	4	1	3	CHIMAPHILA	MACULATA	3	1
1375	4	2	2	DESMODIUM	NUDIFLORUM	4	3

APPENDIX B

HABITAT DATA

LOC=1

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
1	1	1	1	0.8589	22	4.5	0.140461	0.35183	0.000000	1.42926	0.00000	0	0.000000	0.01100	0
2	1	1	2	-1.3319	30	2.5	0.140461	0.35183	0.000000	1.37046	0.00000	0	0.020001	0.00000	0
3	1	1	3	-1.3319	37	7.0	0.160691	0.35183	0.000000	1.57080	0.00000	0	0.000000	0.00000	0
4	2	1	1	-1.4117	35	6.5	0.150568	0.09562	0.927295	0.20136	0.00000	0	0.000000	0.00000	0
5	2	1	2	-1.3791	23	4.5	0.160691	0.09562	0.466765	0.58236	0.00000	0	0.000000	0.05002	0
6	2	1	3	-0.8338	20	6.5	0.160691	0.09562	0.252680	0.84806	0.00000	0	0.000000	0.00000	0
7	3	1	1	1.2211	25	3.5	0.160691	0.32148	0.848062	0.10017	0.10017	0	0.000000	0.05002	0
8	3	1	2	0.1405	27	1.5	0.150568	0.32148	0.775397	0.05002	0.15057	0	0.000000	0.10017	0
9	3	1	3	-1.1423	20	3.5	0.020001	0.32148	0.050021	0.02000	0.92730	0	0.100167	0.03000	0
10	3	2	1	1.2485	31	4.5	0.140461	1.02354	0.000000	0.25268	0.77540	0	0.050021	0.00000	0
11	3	2	2	-1.3869	33	7.5	0.160691	1.02354	0.000000	0.25268	0.52360	0	0.252680	0.00000	0
12	3	2	3	1.3777	28	8.0	0.160691	1.02354	0.000000	0.64350	0.25268	0	0.150568	0.00000	0
13	4	1	1	0.3317	3	3.2	0.090122	0.06330	0.000000	0.15057	0.00000	0	0.000000	1.01599	0
14	4	1	2	0.3801	12	2.5	0.140461	0.06330	0.000000	0.10017	0.00000	0	0.020001	1.07586	0
15	4	1	3	-1.1082	3	2.0	0.150568	0.06330	0.000000	0.02000	0.00000	0	0.000000	1.37046	0
16	4	2	1	-1.1236	24	4.0	0.160691	0.47672	0.000000	1.25324	0.00000	0	0.000000	0.05002	0
17	4	2	2	-1.1236	20	5.5	0.160691	0.47672	0.000000	1.57080	0.00000	0	0.000000	0.00000	0
18	4	2	3	-1.0088	9	4.5	0.150568	0.47672	0.000000	1.01599	0.00000	0	0.000000	0.15057	0
19	4	3	1	-1.1082	22	3.0	0.160691	0.65360	0.000000	0.77540	0.30469	0	0.000000	0.00000	0
20	4	3	2	1.2601	20	2.5	0.140461	0.65360	0.000000	0.58236	0.25268	0	0.201358	0.00000	0
21	4	3	3	1.1640	18	4.5	0.150568	0.65360	0.000000	0.10017	1.01599	0	0.000000	0.00000	0
22	5	1	1	1.1780	2	2.5	0.140461	0.14839	0.020001	0.52360	0.00000	0	0.000000	0.52360	0
23	5	1	2	1.4134	1	1.5	0.160691	0.14839	0.000000	0.92730	0.00000	0	0.000000	0.20136	0
24	5	1	3	-1.2115	7	3.0	0.150568	0.14839	0.030035	0.77540	0.00000	0	0.000000	0.17083	0
25	5	2	1	1.0000	5	2.0	0.150568	0.06386	0.000000	0.92730	0.00000	0	0.000000	0.20136	0
26	5	2	2	-1.0000	3	3.0	0.150568	0.06386	0.070057	0.92730	0.00000	0	0.000000	0.13037	0
27	5	2	3	-0.4931	13	2.5	0.150568	0.06386	0.090122	1.07586	0.00000	0	0.000000	0.03000	0
28	5	3	1	-1.1236	35	4.5	0.160691	0.60136	0.000000	1.57080	0.00000	0	0.000000	0.00000	0
29	5	3	2	-1.2543	22	6.0	0.150568	0.60136	0.000000	1.57080	0.00000	0	0.000000	0.00000	0
30	5	3	3	0.6971	10	2.5	0.140461	0.60136	0.000000	1.57080	0.00000	0	0.000000	0.00000	0
31	6	0	1	0.3317	37	5.0	0.150568	0.18030	0.000000	0.52360	0.00000	0	0.000000	0.46677	0
32	6	0	2	0.4696	32	4.0	0.140461	0.18030	0.000000	1.11977	0.00000	0	0.000000	0.10017	0
33	6	0	3	0.4696	35	3.5	0.160691	0.18030	0.000000	0.64350	0.00000	0	0.000000	0.41152	0
34	6	1	1	1.0517	24	2.5	0.150568	0.37216	0.000000	1.16808	0.00000	0	0.000000	0.08009	0
35	6	1	2	0.7824	24	3.0	0.160691	0.37216	0.000000	1.37046	0.00000	0	0.000000	0.02000	0
36	6	1	3	-0.1841	20	4.5	0.160691	0.37216	0.000000	1.11977	0.00000	0	0.000000	0.10017	0
37	6	2	1	-0.6309	8	3.0	0.150568	0.47300	0.000000	0.77540	0.00000	0	0.000000	0.30469	0
38	6	2	2	0.5571	12	3.5	0.140461	0.47300	0.080086	1.07586	0.00000	0	0.000000	0.03000	0
39	6	2	3	-0.7349	6	3.5	0.150568	0.47300	0.000000	1.11977	0.00000	0	0.000000	0.10017	0
40	6	3	1	-0.2767	24	3.5	0.140461	1.08586	0.000000	1.25324	0.00000	0	0.000000	0.05002	0
41	6	3	2	1.3210	18	3.0	0.140461	1.08586	0.000000	1.11977	0.00000	0	0.000000	0.10017	0
42	6	3	3	-1.4084	24	4.0	0.150568	1.08586	0.000000	1.11977	0.00000	0	0.010000	0.09012	0
43	7	1	1	0.4696	3	5.5	0.140461	0.20336	0.927295	0.00000	0.00000	0	0.000000	0.20136	0
44	7	1	2	-1.1197	5	4.0	0.150568	0.20336	0.643501	0.10017	0.00000	0	0.000000	0.10017	0
45	7	1	3	-0.3195	1	4.5	0.140461	0.20336	0.775397	0.00000	0.00000	0	0.000000	0.30469	0
46	7	2	1	1.1121	20	3.0	0.140461	[illegible]	0.000000	0.92730	0.00000	0	0.000000	0.20136	0

Appendix B (continued)

LOC=1

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
47	7	2	2	0.8236	23	4.0	0.160691	0.60809	0.00000	1.01599	0.000000	0.0000000	0.0000000	0.15057	0.000000
48	7	2	3	1.1121	19	3.5	0.160691	0.60809	0.00000	1.25324	0.000000	0.0000000	0.0000000	0.05002	0.000000
49	7	3	1	0.5970	15	4.0	0.150568	0.60218	0.00000	1.57080	0.000000	0.0000000	0.0000000	0.01000	0.000000
50	7	3	2	-1.0600	15	2.5	0.160691	0.60218	0.00000	1.57080	0.000000	0.0000000	0.0000000	0.01000	0.000000
51	7	3	3	1.2924	12	1.5	0.160691	0.60218	0.00000	0.77540	0.000000	0.0000000	0.0000000	0.15057	0.000000
52	7	4	1	-1.4084	33	1.0	0.150568	0.86435	0.00000	1.11977	0.000000	0.0000000	0.0000000	0.01000	0.000000
53	7	4	2	-0.0657	35	2.5	0.140461	0.86435	0.00000	1.32523	0.000000	0.0000000	0.0000000	0.01000	0.000000
54	7	4	3	1.1121	32	5.0	0.160691	0.86435	0.00000	1.28700	0.000000	0.0000000	0.0000000	0.01000	0.000000
55	8	1	1	-1.2366	30	3.0	0.150568	0.44786	0.00000	0.52360	0.000000	0.0000000	0.0000000	0.52360	0.000000
56	8	1	2	0.3073	34	4.0	0.150568	0.44786	0.10017	0.52360	0.000000	0.0000000	0.0000000	0.41152	0.000000
57	8	1	3	1.1386	38	2.5	0.140461	0.44786	0.02000	0.89467	0.000000	0.0000000	0.0000000	0.10017	0.000000
58	8	2	1	-0.8489	43	0.5	0.140461	1.30554	0.00000	0.52360	0.000000	0.0000000	0.0000000	0.01000	0.000000
59	8	2	2	-1.2426	32	0.5	0.120290	1.30554	0.00000	0.77540	0.000000	0.0000000	0.0000000	0.01000	0.000000
60	8	2	3	-1.3818	40	1.0	0.150568	1.30554	0.00000	0.80389	0.000000	0.0000000	0.0000000	0.01000	0.000000
61	8	3	1	-0.5686	18	4.0	0.140461	0.84928	0.00000	1.42926	0.000000	0.0000000	0.0000000	0.01000	0.000000
62	8	3	2	-0.3681	22	2.5	0.060036	0.84928	0.00000	1.11977	0.000000	0.0000000	0.0000000	0.10017	0.000000
63	8	3	3	0.4221	8	9.5	0.140461	0.84928	0.00000	1.57080	0.000000	0.0000000	0.0000000	0.01000	0.000000
64	9	1	1	0.4519	4	2.5	0.140461	0.21841	0.00000	0.03000	0.100167	0.0000000	0.0000000	0.96141	0.050021
65	9	1	2	-0.1530	7	3.5	0.140461	0.21841	0.00000	0.00000	0.130369	0.0000000	0.0000000	0.96141	0.020001
66	9	1	3	-0.8835	12	5.5	0.150568	0.21841	0.00000	0.00000	0.336304	0.0000000	0.0000000	0.61651	0.100167
67	9	2	1	1.4120	16	1.5	0.150568	0.28240	0.35757	0.00000	0.000000	0.0000000	0.0000000	0.52360	0.150568
68	9	2	2	-0.0970	25	4.0	0.160691	0.28240	0.25268	0.00000	0.000000	0.0000000	0.0000000	0.35757	0.411517
69	9	2	3	-0.3133	30	3.0	0.150568	0.28240	0.77540	0.03000	0.000000	0.0000000	0.0000000	0.27339	0.000000
70	9	3	1	0.8489	28	4.5	0.160691	0.75095	0.00000	1.01599	0.000000	0.0000000	0.0500209	0.10017	0.000000
71	9	3	2	-1.0000	32	3.0	0.150568	0.75095	0.00000	1.11977	0.000000	0.0000000	0.0000000	0.10017	0.000000
72	9	3	3	1.3210	26	5.5	0.150568	0.75095	0.00000	1.37046	0.000000	0.0000000	0.0000000	0.02000	0.000000
73	9	4	1	-1.3818	7	4.0	0.140461	1.31578	0.00000	1.01599	0.150568	0.0000000	0.0000000	0.01000	0.000000
74	9	4	2	0.0845	5	4.0	0.150568	1.31578	0.00000	0.92730	0.201358	0.0000000	0.0000000	0.01000	0.000000
75	9	4	3	-1.3818	13	4.0	0.150568	1.31578	0.00000	1.32523	0.030035	0.0000000	0.0000000	0.01000	0.000000
76	10	1	1	-1.0390	1	1.5	0.150568	0.03807	0.00000	0.00000	0.020001	0.0000000	0.0000000	1.19441	0.050021
77	10	1	2	0.3741	1	2.5	0.150568	0.03807	0.00000	0.00000	0.000000	0.0000000	0.0000050	0.89467	0.020001
78	10	1	3	1.1004	3	2.0	0.150568	0.03807	0.00000	0.00000	0.000000	0.0000000	0.0000000	1.11977	0.100167
79	10	2	1	-0.0970	15	2.5	0.160691	0.46236	0.20136	0.25268	0.000000	0.0000000	0.0000000	0.58236	0.000000
80	10	2	2	-0.4931	20	3.0	0.150568	0.46236	0.77540	0.20136	0.000000	0.0000000	0.0000000	0.10017	0.000000
81	10	2	3	1.0000	12	5.0	0.160691	0.46236	0.52360	0.30469	0.000000	0.0000000	0.0000000	0.20136	0.000000
82	10	3	1	-0.3133	28	3.0	0.150568	0.74998	0.20136	0.20136	0.000000	0.0000000	0.0000000	0.01000	0.000000
83	10	3	2	-0.6862	32	1.0	0.160691	0.74998	0.35757	0.20136	0.000000	0.0000000	0.0000000	0.10017	0.000000
84	10	3	3	-0.4873	34	1.5	0.150568	0.74998	0.35757	0.30469	0.000000	0.0000000	0.0000000	0.35757	0.000000
85	11	1	1	1.3948	45	3.5	0.160691	0.35942	0.00000	0.04001	0.150568	0.0000000	0.0200013	0.87884	0.000000
86	11	1	2	-0.1778	10	3.0	0.100167	0.35942	0.00000	0.10017	0.201358	0.0200013	0.0901219	0.63106	0.000000
87	11	1	3	0.2213	4	2.5	0.150568	0.35942	0.01000	0.07006	0.100167	0.0000000	0.0100002	0.94415	0.000000
88	11	2	1	0.6808	5	3.5	0.150568	0.04319	0.00000	0.00000	0.000000	0.0000000	0.0200013	1.25324	0.030025
89	11	2	2	0.6698	4	3.0	0.150568	0.04319	0.00000	0.00000	0.000000	0.0000000	0.0000000	1.42926	0.000000
90	11	2	3	-0.4873	3	1.5	0.120290	0.04319	0.00000	0.00000	0.000000	0.0000000	0.0100002	1.32523	0.010000
91	11	3	1	0.4932	12	3.5	0.160691	0.30497	1.25324	0.00000	0.000000	0.0000000	0.0100002	0.01000	0.000000
92	11	3	2	1.0000	15	4.0	0.150568	0.30497	1.37046	0.01000	0.000000	0.0000000	0.0000000	0.01000	0.000000

Appendix B (continued)

LOC=1

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
93	11	3	3	1.4109	12	3	0.160691	0.30497	1.14328	0.00000	0	0	0.0000000	0.020001	0
94	11	4	1	-0.0657	25	4	0.150568	1.13491	0.00000	1.11977	0	0	0.0000000	0.100167	0
95	11	4	2	0.4696	30	3	0.150568	1.13491	0.10017	0.64350	0	0	0.0500209	0.201358	0
96	11	4	3	0.7026	30	3	0.140461	1.13491	0.02000	1.14328	0	0	0.0000000	0.050021	0
97	12	1	1	1.0682	18	3	0.150568	0.21822	0.92730	0.00000	0	0	0.0000000	0.100167	0
98	12	1	2	-1.0764	18	3	0.160691	0.21822	0.92730	0.00000	0	0	0.0000000	0.201358	0
99	12	1	3	1.2820	18	1	0.160691	0.21822	0.77540	0.00000	0	0	0.0000000	0.100167	0

LOC=2

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
100	1	1	1	-0.3195	8	1.5	0.150568	0.30763	0	0.64350	0.000000	0.304693	0.000000	0.080086	0.020001
101	1	1	2	1.4095	10	1.0	0.160691	0.30763	0	0.84806	0.000000	0.080086	0.050021	0.080086	0.040011
102	1	1	3	-1.3791	11	3.0	0.070057	0.30763	0	0.92730	0.000000	0.000000	0.060036	0.130369	0.010000
103	1	2	1	-0.3195	10	1.5	0.150568	0.56359	0	1.25324	0.050021	0.000000	0.000000	0.000000	0.000000
104	1	2	2	0.8439	15	3.0	0.020001	0.56359	0	1.32523	0.020001	0.000000	0.000000	0.010000	0.000000
105	1	2	3	1.3119	11	2.0	0.160691	0.56359	0	0.91081	0.030005	0.010000	0.020001	0.000000	0.000000
106	2	1	1	1.0132	6	3.5	0.000000	0.48639	0	1.32523	0.000000	0.030005	0.000000	0.000000	0.000000
107	2	1	2	-1.4113	8	2.5	0.130369	0.48639	0	1.32523	0.020001	0.010000	0.000000	0.000000	0.000000
108	2	1	3	-0.7080	7	2.5	0.140461	0.48639	0	1.14328	0.030005	0.000000	0.000000	0.010000	0.000000
109	2	2	1	-1.3095	8	3.0	0.160691	0.35612	0	1.01599	0.000000	0.100167	0.000000	0.000000	0.050021
110	2	2	2	1.2335	9	3.5	0.130369	0.35612	0	0.91081	0.000000	0.201358	0.000000	0.010000	0.000000
111	2	2	3	-0.0720	7	5.5	0.160691	0.35612	0	1.07586	0.000000	0.100167	0.000000	0.020001	0.000000
112	2	3	1	0.8737	9	3.5	0.140461	0.29972	0	0.77540	0.000000	0.050021	0.252680	0.000000	0.000000
113	2	3	2	-1.2657	9	2.0	0.150568	0.29972	0	1.25324	0.000000	0.000000	0.050021	0.000000	0.000000
114	2	3	3	-1.4066	6	3.0	0.150568	0.29972	0	1.16808	0.000000	0.050021	0.030005	0.000000	0.000000
115	2	4	1	0.6253	6	1.5	0.130369	0.21447	0	0.70758	0.000000	0.150568	0.000000	0.201358	0.000000
116	2	4	2	-0.5397	7	2.0	0.160691	0.21447	0	0.58236	0.000000	0.050021	0.030005	0.379009	0.000000
117	2	4	3	1.3893	13	2.0	0.160691	0.21447	0	1.01599	0.000000	0.080086	0.020001	0.050021	0.000000
118	2	5	1	-0.8389	16	3.0	0.150568	0.57810	0	0.92730	0.000000	0.201358	0.000000	0.000000	0.000000
119	2	5	2	-0.0970	14	3.0	0.160691	0.57810	0	1.05520	0.000000	0.100167	0.020001	0.010000	0.000000
120	2	5	3	1.3844	15	2.5	0.160691	0.57810	0	1.19441	0.000000	0.020001	0.050021	0.000000	0.000000
121	2	6	1	-1.1236	6	3.5	0.140461	0.12531	0	0.10017	0.201358	0.000000	0.707584	0.050021	0.000000
122	2	6	2	-0.8835	25	3.0	0.020001	0.12531	0	0.10017	0.020001	0.020001	0.466765	0.100167	0.315193
123	2	6	3	-0.6862	13	3.5	0.150568	0.12531	0	0.46677	0.466765	0.000000	0.080086	0.020001	0.000000
124	3	1	1	-0.3133	11	2.0	0.160691	0.35899	0	0.64350	0.000000	0.304693	0.000000	0.100167	0.000000
125	3	1	2	-0.3133	23	4.0	0.160691	0.35899	0	0.70758	0.000000	0.273393	0.030005	0.050021	0.000000
126	3	1	3	0.9911	24	4.0	0.160691	0.35899	0	0.30469	0.000000	0.304693	0.100167	0.304693	0.000000
127	3	2	1	-0.8638	6	1.5	0.150568	0.71777	0	1.57080	0.000000	0.000000	0.000000	0.000000	0.000000
128	3	2	2	1.2485	3	3.0	0.160691	0.71777	0	1.57080	0.000000	0.000000	0.000000	0.000000	0.000000
129	3	2	3	-1.4127	10	3.0	0.160691	0.71777	0	1.37046	0.000000	0.020001	0.000000	0.000000	0.000000
130	3	3	1	0.9866	7	1.0	0.160691	0.21386	0	0.64350	0.304693	0.100167	0.000000	0.000000	0.000000
131	3	3	2	-0.0907	5	3.0	0.160691	0.21386	0	1.11977	0.100167	0.000000	0.000000	0.000000	0.000000
132	3	3	3	0.6642	6	4.0	0.140461	0.21386	0	0.70758	0.304693	0.050021	0.000000	0.000000	0.000000

Appendix B (continued)

-- LCC=2 --

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
133	3	4	1	0.7824	4	2.5	0.140461	0.29211	0	1.11977	0.03000	0.010000	0.02000	0.040011	0
134	3	4	2	-0.0156	4	1.5	0.070057	0.29211	0	1.22263	0.01000	0.010000	0.00000	0.040011	0
135	3	4	3	-0.2274	15	3.0	0.160691	0.29211	0	0.70758	0.05002	0.252680	0.00000	0.050021	0
136	4	1	1	-0.3133	13	1.5	0.070057	0.67943	0	0.46677	0.00000	0.050021	0.00000	0.523599	0
137	4	1	2	1.4100	19	2.5	0.140461	0.67943	0	0.52360	0.00000	0.030005	0.00000	0.489291	0
138	4	1	3	-1.4113	11	2.0	0.150568	0.67943	0	0.64350	0.00000	0.010000	0.00000	0.400632	0
139	4	2	1	0.9685	5	1.5	0.150568	1.22132	0	1.32523	0.03000	0.000000	0.00000	0.000000	0
140	4	2	2	-0.9776	5	2.0	0.160691	1.22132	0	1.37046	0.02000	0.000000	0.00000	0.000000	0
141	4	2	3	-0.8688	3	3.0	0.130369	1.22132	0	1.14328	0.08009	0.010002	0.00000	0.000000	0
142	4	3	1	1.2050	9	7.0	0.150568	0.84701	0	0.52360	0.00000	0.523599	0.00000	0.000000	0
143	4	3	2	-1.1043	5	3.0	0.160691	0.84701	0	1.42926	0.01000	0.000003	0.00000	0.000000	0
144	4	3	3	-1.1746	5	4.0	0.160691	0.84701	0	0.00000	0.00000	0.000000	0.00000	0.000000	0
145	4	4	1	0.1717	5	1.0	0.150568	1.01416	0	0.01000	0.19116	0.000000	0.64350	0.201358	0
146	4	4	2	1.3702	3	2.0	0.160691	1.01416	0	0.00000	0.25268	0.000000	0.77540	0.050021	0
147	4	4	3	1.3948	4	1.0	0.160691	1.01416	0	0.00000	0.89467	0.000000	0.02000	0.201358	0
148	5	1	1	1.4100	15	5.0	0.160691	0.14355	0	1.57080	0.00000	0.000000	0.00000	0.000000	0
149	5	1	2	-1.0044	23	3.5	0.150568	0.14355	0	1.25324	0.00000	0.000000	0.05002	0.000000	0
150	5	1	3	0.4755	14	2.0	0.150568	0.14355	0	0.64350	0.00000	0.010000	0.00000	0.400632	0
151	5	2	1	-0.8489	2	2.0	0.100167	0.79327	0	1.14328	0.00000	0.010000	0.00000	0.000000	0
152	5	2	2	1.0517	6	2.5	0.150568	0.79327	0	1.25324	0.00000	0.000000	0.00000	0.050021	0
153	5	2	3	-1.2685	3	1.5	0.120290	0.79327	0	1.28700	0.00000	0.020001	0.00000	0.020001	0
154	5	3	1	-1.3479	5	2.5	0.140461	0.58857	0	1.25324	0.05002	0.000000	0.00000	0.000000	0
155	5	3	2	-1.3968	7	2.5	0.150568	0.58857	0	1.25324	0.00000	0.020001	0.00000	0.000000	0
156	5	3	3	1.3948	4	2.5	0.090122	0.58857	0	0.20136	0.04001	0.010000	0.52360	0.252680	0
157	5	4	1	1.3948	3	0.5	0.080086	0.29974	0	0.05002	1.11977	0.050021	0.00000	0.000000	0
158	5	4	2	-0.9077	6	0.5	0.030005	0.29974	0	0.10017	0.52360	0.232078	0.07006	0.000000	0
159	5	4	3	-1.2974	8	1.0	0.140461	0.29974	0	0.05002	0.92730	0.040011	0.01000	0.000000	0
160	6	1	1	0.5048	28	1.5	0.100167	0.08702	0	0.91081	0.00000	0.060036	0.15057	0.000000	0
161	6	1	2	-1.2426	8	3.0	0.160691	0.08702	0	1.19441	0.00000	0.010000	0.06004	0.000000	0
162	6	1	3	-0.4931	30	1.5	0.140461	0.08702	0	0.70759	0.00000	0.201358	0.15057	0.000000	0
163	6	2	1	-1.3671	3	2.5	0.130369	1.17706	0	1.11977	0.10017	0.000000	0.00000	0.000000	0
164	6	2	2	-0.8884	5	2.0	0.080086	1.17706	0	0.02000	1.11977	0.000000	0.02000	0.000000	0
165	6	2	3	-1.0433	4	1.0	0.090122	1.17706	0	0.20136	0.10017	0.000000	0.77540	0.000000	0
166	6	3	1	1.4045	6	2.5	0.110223	0.56363	0	0.15057	0.64350	0.100167	0.25268	0.000000	0
167	6	3	2	-0.7720	10	1.5	0.150568	0.56363	0	0.00000	1.01599	0.000000	0.00000	0.150568	0
168	6	3	3	0.0281	4	3.0	0.140461	0.56363	0	0.30469	0.20136	0.523599	0.00000	0.000000	0
169	7	2	1	-1.4030	4	7.0	0.120290	0.25522	0	0.00000	0.05002	0.000000	1.25324	0.000000	0
170	7	2	2	0.1717	4	4.0	0.140461	0.25522	0	0.00000	0.04001	0.010000	1.25324	0.000000	0
171	7	2	3	1.1676	5	6.5	0.080086	0.25522	0	0.00000	0.10017	0.000000	1.11977	0.000000	0
172	7	3	1	0.8981	7	2.5	0.100167	0.74983	0	0.77540	0.10017	0.000000	0.05002	0.150568	0
173	7	3	2	-1.3479	5	3.0	0.160691	0.74983	0	0.00000	0.52360	0.000000	0.00000	0.523599	0
174	7	3	3	-1.3605	3	4.5	0.110223	0.74983	0	0.05002	1.11977	0.000000	0.00000	0.050021	0

Appendix B (continued)

LOC=3

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
175	1	1	1	1.4014	5	1.00	0.070057	0.41934	0	0.00000	0.000000	0.52360	0.304693	0.000000	0.20136
176	1	1	2	-0.7562	8	0.50	0.110223	0.41934	0	0.00000	0.000000	0.00000	0.201358	0.000000	0.92730
177	1	1	3	-0.1778	3	1.00	0.030005	0.41934	0	0.00000	0.000000	0.41152	0.466765	0.000000	0.15057
178	1	2	1	-1.2974	5	0.50	0.000000	0.46551	0	0.00000	0.000000	0.00000	0.000000	0.000000	1.57080
179	1	2	2	1.0804	6	0.50	0.000000	0.46551	0	0.00000	0.000000	0.05002	0.000000	0.000000	1.25324
180	1	2	3	-0.9408	5	0.50	0.000000	0.46551	0	0.00000	0.000000	0.03000	0.130369	0.000000	0.99728
181	2	1	1	-0.1841	2	0.25	0.000000	0.27710	0	0.05002	0.000000	0.00000	0.000000	0.000000	1.14328
182	2	1	2	-0.9408	10	0.50	0.000000	0.27710	0	0.00000	0.000000	0.00000	0.020001	0.000000	1.37046
183	2	1	3	-1.3968	8	0.25	0.000000	0.27710	0	0.01000	0.000000	0.00000	0.000000	0.000000	1.28700
184	2	2	1	1.4134	5	0.25	0.000000	0.47715	0	0.00000	0.000000	0.02000	0.000000	0.000000	1.37046
185	2	2	2	1.3023	4	0.25	0.000000	0.47715	0	0.00000	0.000000	0.00000	0.000000	0.000000	1.01599
186	2	2	3	-1.3927	5	0.50	0.000000	0.47715	0	0.00000	0.000000	0.00000	0.000000	0.000000	1.57080
187	2	3	1	1.2846	8	0.25	0.000000	0.74520	0	0.00000	0.000000	0.00000	0.000000	0.000000	0.84806
188	2	3	2	0.1717	8	0.25	0.000000	0.74520	0	0.00000	0.000000	0.00000	0.020001	0.000000	0.68155
189	2	3	3	-0.2227	8	0.25	0.000000	0.74520	0	0.00000	0.000000	0.00000	0.030005	0.000000	1.28700
190	2	4	1	0.9315	5	0.50	0.150568	0.77307	0	0.00000	0.000000	0.25268	0.000000	0.000000	0.84806
191	2	4	2	-0.4101	5	0.50	0.150568	0.77307	0	0.00000	0.304693	0.41152	0.000000	0.100167	0.20136
192	2	4	3	0.9173	7	0.50	0.110223	0.77307	0	0.00000	0.000000	0.02000	0.643501	0.160691	0.22181
193	3	4	1	-0.1592	9	3.00	0.110223	1.04764	0	0.10017	0.010000	0.03000	0.020001	0.000000	0.99728
194	3	4	2	-0.7720	3	0.50	0.070057	1.04764	0	0.20136	0.010000	0.04001	0.000000	0.000000	0.84806
195	3	4	3	-1.2572	7	1.00	0.000000	1.04764	0	0.44449	0.020001	0.01000	0.020001	0.000000	0.54685
196	3	5	1	-1.2872	5	0.50	0.000000	0.87786	0	0.05002	0.010000	0.00000	0.000000	0.000000	1.22263
197	3	5	2	1.0804	5	1.00	0.000000	0.87786	0	0.10017	0.000000	0.00000	0.000000	0.000000	1.01599
198	3	5	3	-0.4162	9	0.10	0.000000	0.87786	0	0.01000	0.010000	0.00000	0.010000	0.010000	0.12029
199	3	6	1	-1.2872	1	1.00	0.010000	0.78539	0	0.00000	0.000000	0.15057	0.030005	0.000000	0.96141
200	3	6	2	-1.3401	1	0.50	0.000000	0.78539	0	0.00000	0.000000	0.10017	0.325729	0.000000	0.58236
201	3	6	3	1.3937	1	0.50	0.100167	0.78539	0	0.00000	0.000000	0.46677	0.050021	0.000000	0.46677
202	3	7	1	1.1273	3	3.00	0.140461	0.58414	0	0.00000	0.304693	0.10017	0.000000	0.000000	0.64350
203	3	7	2	0.7026	4	1.50	0.000000	0.58414	0	0.00000	0.000000	0.05002	0.000000	0.000000	1.25324
204	3	7	3	-1.1197	4	3.00	0.100167	0.58414	0	0.00000	0.100167	0.10017	0.000000	0.000000	0.92730
205	3	8	1	-1.4005	6	0.25	0.140461	0.90306	0	0.00000	0.000000	1.25324	0.000000	0.030015	0.02000
206	3	8	2	-0.2089	3	1.00	0.080086	0.90306	0	0.00000	0.100167	0.52360	0.100167	0.150568	0.15057
207	3	8	3	-0.3861	6	0.50	0.140461	0.90306	0	0.00000	0.010000	0.10017	0.000000	0.252680	0.20136
208	4	2	1	1.3893	6	1.00	0.130369	0.84123	0	1.57080	0.000000	0.00000	0.000000	0.000000	0.00000
209	4	2	2	1.1159	8	2.00	0.140461	0.84123	0	1.32523	0.000000	0.02000	0.010000	0.000000	0.00000
210	4	2	3	1.4100	6	2.50	0.120290	0.84123	0	1.32523	0.000000	0.02000	0.010000	0.000000	0.00000

Appendix B (continued)

LOC=4

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
212	1	1	1	1.4132	23	3.5	0.160691	0.08106	0.000000	1.25324	0.0000000	0	0.000000	0.05002	0
213	1	1	2	-0.8835	25	3.0	0.140461	0.08106	0.000000	1.37046	0.0000000	0	0.000000	0.02000	0
214	1	1	3	0.7188	32	2.5	0.140461	0.08106	0.000000	1.37046	0.0000000	0	0.000000	0.02000	0
215	1	2	1	-1.2147	43	2.0	0.150568	0.17069	0.535185	0.47800	0.0300045	0	0.000000	0.00000	0
216	1	2	2	0.6476	48	3.0	0.160691	0.17069	0.000000	0.52360	0.0000000	0	0.000000	0.52360	0
217	1	2	3	1.3048	44	2.5	0.150568	0.17069	0.000000	0.15057	0.0200013	0	0.000000	0.97911	0
218	2	1	1	0.3255	25	3.5	0.090122	0.96708	0.000000	0.92730	0.0000000	0	0.000000	0.20136	0
219	2	1	2	1.2712	8	7.5	0.040011	0.96708	0.000000	1.25324	0.0000000	0	0.000000	0.05002	0
220	2	1	3	1.1159	25	5.0	0.150568	0.96708	0.000000	1.57080	0.0000000	0	0.000000	0.00000	0
221	3	1	1	0.4755	22	5.0	0.160691	1.57080	0.000000	1.11977	0.0000000	0	0.000000	0.10017	0
222	3	1	2	0.0845	18	6.5	0.150568	1.57080	0.000000	1.11977	0.0000000	0	0.000000	0.10017	0
223	3	1	3	0.0845	18	7.0	0.160691	1.57080	0.000000	1.11977	0.0000000	0	0.000000	0.10017	0
224	3	2	1	-0.3620	8	3.5	0.120290	0.73071	0.000000	1.57080	0.0000000	0	0.000000	0.00000	0
225	3	2	2	-0.7080	8	2.5	0.150568	0.73071	0.000000	1.57080	0.0000000	0	0.000000	0.00000	0
226	3	2	3	-1.4038	8	4.0	0.150568	0.73071	0.000000	1.57080	0.0000000	0	0.000000	0.00000	0
227	4	1	1	-1.4142	28	5.5	0.130369	0.21944	0.000000	0.10017	0.0000000	0	0.000000	1.01599	0
228	4	1	2	0.0031	25	0.5	0.160691	0.21944	0.000000	0.05002	0.0000000	0	0.000000	1.25324	0
229	4	1	3	1.0682	25	4.5	0.140461	0.21944	0.000000	1.11977	0.0000000	0	0.000000	0.10017	0
230	4	2	1	-0.1778	22	2.5	0.160691	0.15894	0.000000	0.52360	0.0000000	0	0.000000	0.52360	0
231	4	2	2	-0.4637	35	4.5	0.110223	0.15894	0.000000	0.10017	0.0000000	0	0.201358	0.72758	0
232	4	2	3	1.1780	12	6.0	0.100167	0.15894	0.000000	0.64350	0.0000000	0	0.201358	0.20136	0

LOC=5

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
233	1	1	1	-1.2999	41	4.0	0.150568	0.158659	1.01599	0.15057	0.000000	0	0.000000	0.000000	0
234	1	1	2	-1.0925	38	2.5	0.150568	0.158659	0.20136	0.15057	0.000000	0	0.010000	0.150568	0
235	1	1	3	0.1405	35	1.0	0.150568	0.158659	0.30469	0.30469	0.000000	0	0.000000	0.050021	0
236	1	2	1	-1.4038	18	7.5	0.140461	0.339517	0.05002	0.41152	0.150568	0	0.000000	0.411517	0
237	1	2	2	0.7402	22	6.5	0.140461	0.339517	0.00000	0.00000	0.201358	0	0.000000	0.927295	0
238	1	2	3	-0.4162	22	4.0	0.160691	0.339517	0.00000	0.52360	0.150568	0	0.000000	0.357571	0
239	1	3	1	-0.7772	20	4.5	0.140461	0.339398	0.00000	1.15520	0.030005	0	0.000000	0.100167	0
240	1	3	2	0.7668	22	3.0	0.130369	0.339398	0.00000	1.01599	0.100167	0	0.000000	0.050021	0
241	1	3	3	-1.2898	22	5.5	0.160691	0.339398	0.01000	1.11977	0.050021	0	0.000000	0.040011	0
242	2	1	1	0.4042	18	2.5	0.130369	0.754211	0.00000	0.20136	0.357571	0	0.000000	0.466765	0
243	2	1	2	1.3570	24	2.5	0.160691	0.754211	0.00000	0.10017	0.643501	0	0.000000	0.304693	0
244	2	1	3	-0.3861	20	5.5	0.160691	0.754211	0.00000	0.05002	0.643501	0	0.000000	0.357571	0
245	2	2	1	0.9548	27	4.0	0.140461	0.652677	0.52360	0.46677	0.050021	0	0.000000	0.000000	0
246	2	2	2	1.2712	27	5.0	0.030005	0.652677	0.20136	0.52360	0.030005	0	0.000000	0.273393	0
247	2	2	3	-1.2657	27	3.5	0.150568	0.652677	0.13037	0.84806	0.020001	0	0.000000	0.000000	0
248	2	3	1	-0.7980	28	3.5	0.160691	0.417944	0.00000	0.20136	0.643501	0	0.000000	0.201358	0
249	2	3	2	-0.7295	34	4.5	0.160691	0.417944	0.10017	0.30469	0.643501	0	0.000000	0.000000	0
250	2	3	3	-0.7295	32	7.0	0.160691	0.417944	0.00000	0.84806	0.201358	0	0.000000	0.050021	0
251	2	4	1	-0.0720	60	0.5	0.160691	0.146492	0.01000	0.00000	0.000000	0	0.523599	0.010000	0

Appendix B (continued)

LOC=5

OBS	LINE	PLOT	SUB	ASP	SLOPE	DEP	CAN	PLOTLOC	BCH	OAK	PIN	CED	MOS	OTH	GRAS
252	2	4	2	0.0595	40	4.5	0.160691	0.146492	0.150568	0.00000	0.000000	0	0.050021	0.848062	0
253	2	4	3	1.3893	50	3.0	0.160691	0.146492	0.304693	0.05002	0.000000	0	0.100167	0.050021	0
254	3	1	1	0.3499	22	2.5	0.150568	0.545906	0.000000	1.11977	0.000000	0	0.000000	0.100167	0
255	3	1	2	1.3893	22	4.5	0.150568	0.545906	0.000000	1.01599	0.100167	0	0.000000	0.050021	0
256	3	1	3	-0.7080	25	2.0	0.150568	0.545906	0.010000	0.83307	0.100167	0	0.000000	0.150568	0
257	3	3	1	1.3233	34	4.0	0.160691	0.504056	0.000000	1.11977	0.050021	0	0.000000	0.050021	0
258	3	3	2	-0.8389	36	5.0	0.160691	0.504056	0.000000	1.11977	0.000000	0	0.000000	0.100167	0
259	3	3	3	0.5048	34	5.5	0.160691	0.504056	0.100167	1.11977	0.000000	0	0.000000	0.000000	0
260	3	4	1	-1.0219	42	4.5	0.160691	0.122312	0.050021	0.64350	0.000000	0	0.050021	0.050021	0
261	3	4	2	-1.0219	42	2.5	0.160691	0.122312	0.000000	1.11977	0.000000	0	0.000000	0.100167	0
262	3	4	3	0.3255	40	4.0	0.150568	0.122312	0.000000	1.11977	0.000000	0	0.000000	0.100167	0
263	4	1	1	-1.0219	30	3.0	0.160691	0.066996	0.000000	0.92730	0.000000	0	0.000000	0.201358	0
264	4	1	2	1.3142	34	6.0	0.160691	0.066996	0.050021	1.01599	0.050021	0	0.000000	0.050021	0
265	4	1	3	1.3142	25	6.5	0.160691	0.066996	0.100167	1.11977	0.000000	0	0.000000	0.000000	0

APPENDIX C

GALIUM DATA SUMMARY

Cedar Areas

VARIABLE	*Galium aparine* MEAN	*Galium aparine* STANDARD DEVIATION	*Galium circaezans* MEAN	*Galium circaezans* STANDARD DEVIATION	*Galium pilosum* MEAN	*Galium pilosum* STANDARD DEVIATION	*Galium triflorum* MEAN	*Galium triflorum* STANDARD DEVIATION	F - RATIOS	
OAK BASAL AREA	0.14480000	0.44568500	4.83063291	4.45090904	0.32683333	0.98324503	1.49777143	2.74766423	25.0	***
PINE BASAL AREA	0.09895000	0.26271106	3.44654430	4.44025036	1.47966667	2.63457910	7.59303571	5.17394285	19.0	***
TOTAL BASAL AREA	6.70380000	3.75355629	18.07858228	4.45990529	10.30260417	3.66239531	19.05014286	2.63239859	79.0	***
PLOT POSITION	0.46509928	0.08719096	0.52511582	0.31858064	0.59349891	0.27815853	0.82327272	0.29129362	9.0	***
LITTER DEPTH	0.55000000	0.15389675	2.39610390	1.19851241	0.57812500	0.64237808	2.19642857	0.59844375	53.0	***
ASPECT	-0.61290451	0.80621835	0.08605854	1.05751796	-0.57737435	0.97500631	0.86117535	0.59826955	15.0	***
CANOPY CLOSURE	0.02158022	0.05354682	0.13304789	0.03225116	0.07541520	0.06215383	0.15203054	0.01571916	53.0	***
PERCENT SLOPE	5.60000000	1.56944509	9.31168831	7.36145677	6.58333333	1.59565012	5.82142857	5.28487409	5.0	**
PERCENT CEDAR LITTER	0.03451245	0.01574444	0.10907026	0.14567929	0.26452022	0.43686743	0.06504894	0.11235243	6.2	***
PERCENT "OTHER" LITTER	0.01604309	0.04199077	0.07299137	0.12846751	0.06998514	0.08709868	0.04073656	0.02568533	3.3	*
PERCENT PINE LITTER	0.00000000	0.00000000	0.13570789	0.27341280	0.09302351	0.20795528	0.19393049	0.17285456	11.0	***
PERCENT MOSS COVER	0.14799077	0.11920916	0.16064419	0.28622692	0.12039086	0.23831296	0.46434750	0.37080168	49.0	***
PERCENT GRASS LITTER	0.86278253	0.33025385	0.04315738	0.17617332	0.54375249	0.55590712	0.00392946	0.01100489	15.0	***
SUGAR MAPLE BASAL AREA	0.00000000	0.00000000	0.35275949	0.51645595	0.00000000	0.00000000	0.14860714	0.48940995	2.6	
BUCKEYE BASAL AREA	0.00000000	0.00000000	0.07239241	0.24283367	0.00000000	0.00000000	0.00892857	0.03278316	5.7	***
HICKORY BASAL AREA	0.00000000	0.00000000	0.07350633	0.17287374	0.00000000	0.00000000	0.00000000	0.00000000	19.0	***
ASH BASAL AREA	0.03260000	0.10034068	1.10859241	1.30961541	0.00470833	0.02275320	0.25796429	0.37968374	2.0	
WALNUT BASAL AREA	0.02760000	0.08455101	0.08122785	0.25653330	0.00356250	0.02468172	0.04178571	0.09391105	2.6	
JUNIPER BASAL AREA	6.12190000	2.30004160	6.55862025	3.07710081	7.79795833	2.96727444	6.71571429	1.58936763	1.6	
SWEETGUM BASAL AREA	0.00000000	0.00000000	0.21522785	0.68434269	0.15775000	0.52705834	0.00000000	0.00000000	25.0	***
WHITE PINE BASAL AREA	0.01465000	0.06551679	0.00077215	0.00686304	0.46325000	0.59943450	0.00000000	0.00000000	8.5	***
HORNBEAM BASAL AREA	0.00000000	0.00000000	0.19392405	0.37512602	0.00000000	0.00000000	0.00000000	0.00000000	3.1	*
SHORTLEAF PINE BASAL AREA	0.00000000	0.00000000	0.69121519	1.21368102	0.35831250	0.65138642	0.36253571	1.11712165	7.6	***
LOBLOLLY PINE BASAL AREA	0.05780000	0.17790465	0.44143038	0.86018633	0.09585417	0.33806653	0.78714286	0.82427956	23.0	***
VIRGINIA PINE BASAL AREA	0.02650000	0.08156528	2.31307595	3.46309587	0.56916667	2.15745998	6.44335714	4.31904368	4.0	**
CHERRY BASAL AREA	0.02325000	0.10397716	0.03362025	0.11306298	0.09687500	0.19084255	0.00000000	0.00000000	3.4	*
WHITE OAK BASAL AREA	0.00000000	0.00000000	0.33827848	0.92820697	0.00000000	0.00000000	0.11039286	0.38839550	7.1	***
SCARLET OAK BASAL AREA	0.00000000	0.00000000	0.50682278	1.06760173	0.00000000	0.00000000	0.00000000	0.00000000	1.5	
SOUTHERN RED OAK BASAL AREA	0.00000000	0.00000000	0.18645570	0.85317572	0.00000000	0.00000000	0.00000000	0.00000000	0.4	
BLACK JACK OAK BASAL AREA	0.00000000	0.00000000	0.00731646	0.06503008	0.00000000	0.00000000	0.00000000	0.00000000	22.0	***
CHINQUAPIN OAK BASAL AREA	0.04230000	0.13019665	1.44379747	1.53715063	0.14933333	0.50052387	0.09339286	0.17461669	0.8	
CHESTNUT OAK BASAL AREA	0.00000000	0.00000000	0.00346835	0.02165809	0.00000000	0.00000000	0.00000000	0.00000000	25.0	***
NORTHERN RED OAK BASAL AREA	0.10240000	0.31518055	2.00177215	1.85123341	0.17950000	0.54158528	0.43421429	0.96384955	4.2	**
POST OAK BASAL AREA	0.00000000	0.00000000	0.24962025	0.58236620	0.00000000	0.00000000	0.85885714	2.52480268	2.8	*
BLACK OAK BASAL AREA	0.00000000	0.00000000	0.09327848	0.31453633	0.00000000	0.00000000	0.00000000	0.00000000	5.3	**
ELM BASAL AREA	0.07570000	0.23299968	0.02567089	0.08253402	0.06008333	0.09462397	0.17828571	0.34944886	2.3	

*** P<0.001
** P<0.01
* P<0.05

Appendix C (continued)

Mesic Area

VARIABLE	*Galium aparine* MEAN	*Galium aparine* STANDARD DEVIATION	*Galium circoezans* MEAN	*Galium circoezans* STANDARD DEVIATION	*Galium triflorum* MEAN	*Galium triflorum* STANDARD DEVIATION	F - RATIOS	
OAK BASAL AREA	0.38535484	0.95304633	5.61190000	3.10723845	4.12673333	3.44415966	23.0	***
PINE BASAL AREA	1.40445161	1.92506614	0.00000000	0.00000000	1.24306667	1.78927608	2.4	
TOTAL BASAL AREA	24.00822581	4.37654005	22.08710000	2.38146353	28.33346667	2.59921269	17.0	***
PLOT POSITION	0.08934150	0.08579488	0.39981864	0.17439769	0.20332066	0.12983315	26.0	***
LITTER DEPTH	2.30645161	0.77111844	2.85000000	0.74721706	3.70000000	1.23874241	15.0	***
ASPECT	0.43191290	0.78269789	-0.19538464	0.49277445	0.11837563	0.49921894	4.2	*
CANOPY CLOSURE	0.14862055	0.01178176	0.15866618	0.00426797	0.13645166	0.02175159	9.4	***
PERCENT SLOPE	6.64516129	6.51944981	15.60000000	2.67498702	13.60000000	12.44186481	5.8	**
PERCENT PINE LITTER	0.00129041	0.00499495	0.00000000	0.00000000	0.00133342	0.00507450	0.3	
PERCENT BEECH LITTER	0.23511643	0.41231695	0.19663927	0.11696956	0.42592908	0.40507810	2.4	
PERCENT "OTHER" LITTER	0.94399640	0.52214416	0.41565750	0.26868559	0.55813554	0.37757609	8.5	***
PERCENT MOSS COVER	0.00225813	0.00497325	0.00000000	0.00000000	0.00200013	0.00610298	0.8	
PERCENT GRASS LITTER	0.02680624	0.03891296	0.00000000	0.00000000	0.02207089	0.07930895	0.8	
RED MAPLE BASAL AREA	0.00000000	0.00000000	0.25120000	0.50275326	0.25626667	0.43223516	5.0	**
SUGAR MAPLE BASAL AREA	1.22945161	2.02933785	4.24620000	2.93015638	3.60200000	2.71979614	9.4	***
BUCKEYE BASAL AREA	0.28319355	0.52114025	0.03920000	0.12396128	0.56880000	0.95937316	2.4	
HICKORY BASAL AREA	0.82012903	1.54368615	2.60720000	0.66654729	2.82200000	0.90962425	23.0	***
BEECH BASAL AREA	0.31212903	1.73786090	4.98730000	2.24528756	5.66766667	5.01590225	18.0	***
ASH BASAL AREA	0.89977419	0.84035710	0.08430000	0.26658001	0.66106667	0.70279152	4.8	*
BUTTERNUT BASAL AREA	0.96812903	1.23833926	0.00000000	0.00000000	0.17120000	0.34825342	8.6	***
CEDAR BASAL AREA	0.51309677	0.70329602	0.00000000	0.00000000	0.09640000	0.36686196	6.3	**
SWEETGUM BASAL AREA	0.00000000	0.00000000	0.26370000	0.64090319	0.21280000	0.35892160	4.1	*
TULIP POPLAR BASAL AREA	12.18483871	6.60640748	1.16070000	2.34328677	4.92600000	2.77641376	27.0	***
BLACK GUM BASAL AREA	0.00000000	0.00000000	0.16830000	0.50472876	0.00000000	0.00000000	3.6	*
WHITE PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.63840000	1.07676481	7.1	**
HORNBEAM BASAL AREA	0.00525806	0.02927566	0.00000000	0.00000000	0.00000000	0.00000000	0.6	
SOURWOOD BASAL AREA	0.00000000	0.00000000	0.07470000	0.18415455	0.07680000	0.12953562	4.4	*
VIRGINIA PINE BASAL AREA	1.40445161	1.92506614	0.00000000	0.00000000	0.60493333	1.07382535	4.4	*
CHERRY BASAL AREA	0.03051613	0.16990662	0.00000000	0.00000000	0.00000000	0.00000000	0.6	
WHITE OAK BASAL AREA	0.22422581	0.42204855	4.25530000	1.89742141	1.53013333	1.66845511	36.0	***
SCARLET OAK BASAL AREA	0.00000000	0.00000000	0.06000000	0.18973666	0.00000000	0.00000000	3.3	*
CHINQUAPIN OAK BASAL AREA	0.05164516	0.28754809	0.00000000	0.00000000	0.00000000	0.00000000	0.6	
CHESTNUT OAK BASAL AREA	0.00000000	0.00000000	0.87700000	1.84997327	1.84800000	2.52934622	8.2	***
NORTHERN RED OAK BASAL AREA	0.10948387	0.60958040	0.41950000	0.35410835	0.74860000	0.58196952	9.6	***
BASSWOOD BASAL AREA	0.48016129	0.89762231	1.61420000	1.03209580	1.35600000	1.44932993	5.7	**
ELM BASAL AREA	0.66858065	0.35835176	0.00000000	0.00000000	0.04726667	0.17987907	50.0	***

*** $P < 0.001$
** $P < 0.01$
* $P < 0.05$

APPENDIX D

SEVENTEEN SPECIES DATA SUMMARY

VARIABLE	*Actaea pachypoda* MEAN	*Actaea pachypoda* STANDARD DEVIATION	*Arisaema triphyllum* MEAN	*Arisaema triphyllum* STANDARD DEVIATION	*Botrichium virginianum* MEAN	*Botrichium virginianum* STANDARD DEVIATION	*Chimaphila maculata* MEAN	*Chimaphila maculata* STANDARD DEVIATION
OAK BASAL AREA	4.65005263	3.60181973	4.21834211	2.66734390	1.37500000	3.31618449	13.76275238	10.72375791
PINE BASAL AREA	.00000000	0.00000000	0.00000000	0.00000000	2.95991176	2.16402584	5.44471905	6.44696331
TOTAL BASAL AREA	25.98705263	4.28581191	25.44698026	3.62136205	23.67014706	3.29270979	24.22924762	5.37527406
PLOT POSITION	0.42734851	0.25574163	0.43750921	0.21401143	0.13625051	0.28346306	0.60919721	0.36356803
LITTER DEPTH	3.39473684	0.80930264	3.23684211	1.39172979	2.07352941	0.56505083	3.59238095	1.87261105
ASPECT	0.16017287	0.75510192	-0.13429356	0.60138717	0.06889085	0.90672059	-0.12797087	0.21756696
CANOPY CLOSURE	0.14397409	0.00609907	0.15370067	0.00738488	0.14759945	0.00914116	0.14021285	0.02569308
PERCENT SLOPE	18.89473684	8.11647664	17.38157895	9.90480130	5.73529412	8.36047274	14.33333333	8.96431673
PH	5.68947368	0.69812824	5.26250000	0.83906921	5.27205882	0.48713622	4.18571429	0.53072493
PERCENT SAND	21.36842105	5.05756338	16.40131579	5.37502178	19.26470588	3.57843038	24.44761905	10.62107932
PERCENT CLAY	15.00000000	3.01846171	20.44078947	4.46136253	17.73529412	5.41775322	16.01904762	7.67032029
LOSS ON IGNITION	0.13342105	0.14100043	0.08355000	0.04315627	0.07014706	0.02358111	0.07068571	0.03342768
PERCENT SILT	63.63157895	3.38641939	63.15789474	4.03517093	63.00000000	5.18739732	57.53333333	12.40875245
PERCENT CEDAR LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00095244	0.00427989
PERCENT PINE LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.00824057	0.01852529	0.09625263	0.17061648
PERCENT BEECH LITTER	0.63113545	0.41706594	0.60677423	0.29377222	.04223135	0.16209176	0.09834624	0.23593272
PERCENT MOSS COVER	0.00052632	0.00229420	0.00032895	0.00178954	0.00294184	0.00938713	0.01196210	0.03928033
PERCENT GRASS LITTER	0.00792465	0.03454273	0.00000000	0.00000000	0.05064886	0.03914608	0.00000000	0.00000000
PERCENT "OTHER" LITTER	0.13040761	0.15914076	0.15763337	0.13213125	0.95453714	0.42296986	0.22616471	0.35330294
RED MAPLE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.14088235	0.40581081	0.28759048	0.51927486
SUGAR MAPLE BASAL AREA	3.58557895	2.05212712	4.45571711	1.98490311	0.62594117	1.47690759	0.87586667	1.67699521
BUCKEYE BASAL AREA	.21994737	0.45372866	0.10187500	0.31941964	0.05926471	0.22716772	0.13308571	0.49903162
HICKORY BASAL AREA	4.93436842	4.08491737	4.52953947	3.63149851	1.26017647	3.01857976	1.49285714	1.81719667
BEECH BASAL AREA	5.98736842	3.88951031	6.31795395	2.59222673	0.25444118	0.91348932	0.52443810	1.58907437
ASH BASAL AREA	0.64700000	0.59639743	0.53657237	0.61481218	1.42108824	0.79617686	0.27090476	0.49390342
BUTTERNUT BASAL AREA	0.04505263	0.19637987	0.00000000	0.00000000	0.29423529	0.81791446	0.00000000	0.00000000
CEDAR BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.97817647	0.68664478	0.11009524	0.26058992
SWEETGUM BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.11735294	0.47647098	0.11243810	0.37847650
TULIP POPLAR BASAL AREA	3.46400000	1.37587394	2.47971053	1.75530754	11.12244118	4.24251631	1.77829524	2.55364250
BLACK GUM BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00414706	0.02418130	0.61797143	1.08989987
WHITE PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.65840000	1.87034714
HORNBEAM BASAL AREA	0.02573684	0.06106539	0.01286842	0.04409933	0.00000000	0.00000000	0.00000000	0.00000000
SOURWOOD BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.06682353	0.20911856	0.51340000	0.74520206
SHORTLEAF PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	1.03150476	1.20927942
VIRGINIA PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	2.95991176	2.16482584	3.75433333	5.95097035
	0.17000000	0.35662866	0.07468421	0.25593843	0.00000000	0.00000000	0.04564762	0.16519673
WHITE OAK BASAL AREA	1.33542105	0.82797426	1.20748684	1.67633027	0.58350000	2.01815946	2.34945714	2.92581096
SCARLET OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.08537143	0.26726274
CHINQUAPIN OAK BASAL AREA	0.25278947	0.59978955	0.12839474	0.43314739	0.00000000	0.00000000	0.00000000	0.00000000
CHESTNUT OAK BASAL AREA	1.97947368	2.77908281	1.38157895	2.26095023	0.51841176	1.70553392	7.91140952	8.82469326
NORTHERN RED OAK BASAL AREA	2.08268421	1.47006183	1.49313816	1.14091674	0.27305882	0.89342002	1.32923810	1.38355724
POST OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.33700000	0.82943719
BLACK OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	1.75012381	3.34565156
BASSWOOD BASAL AREA	1.37094737	1.45986573	1.76940132	1.34328921	0.06220588	0.36271951	0.09474286	0.55519065
ELM BASAL AREA	0.19468421	0.46192412	0.08923026	0.32052264	0.55800000	0.30192473	0.02860952	0.20629667

Appendix D (continued)

VARIABLE	*Dentaria diphylla* MEAN	*Dentaria diphylla* STANDARD DEVIATION	*Dentaria laciniata* MEAN	*Dentaria laciniata* STANDARD DEVIATION	*Galium aparine* MEAN	*Galium aparine* STANDARD DEVIATION	*Galium triflorum* MEAN	*Galium triflorum* STANDARD DEVIATION
	4.59091837	1.48478155	3.61305237	3.29914563	0.38535484	0.95304633	4.12673333	3.44415966
OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	1.40445161	1.92506614	1.24306667	1.78927608
PINE BASAL AREA	21.51743878	1.90753181	26.98251372	4.19799890	24.00822581	4.37654005	28.33346667	2.59921269
TOTAL BASAL AREA	0.34014522	0.12108764	0.18458712	0.08633116	0.08934150	0.78509488	0.20332066	0.12983315
PLOT POSITION	3.17857143	0.58876947	3.15835411	1.38806926	2.30645161	0.77111844	3.70000000	1.23874241
LITTER DEPTH	0.53659906	0.86145837	0.10245670	0.91173012	0.43191290	0.78249789	0.11837563	0.49921894
ASPECT	0.15744566	0.00473153	0.14915999	0.00739650	0.14862055	0.01178176	0.13645166	0.02175159
CANOPY CLOSURE	15.28571429	5.49976569	11.28927681	8.62153912	6.64516129	6.51944981	13.60000000	12.44186481
PERCENT SLOPE	5.13265306	0.70674466	5.33054863	0.74601990	15.61290323	0.37192467	5.03166667	0.74827196
PH	23.89795918	10.08570469	17.37655865	4.17496696	18.35483871	4.84113201	21.36666667	10.43364364
PERCENT SAND	15.42857143	6.24417254	20.16209476	4.95137957	21.03225806	5.32593573	15.13333333	5.27671092
PERCENT CLAY	0.12288776	0.04156007	0.09892768	0.14396842	0.09390323	0.14167282	0.07920000	0.03241477
LOSS ON IGNITION	60.67346939	6.75151836	62.46134663	4.87792242	60.61290323	3.28306178	63.50000000	7.01107498
PERCENT SILT	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
PERCENT CEDAR LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.00129041	0.00499495	0.00133342	0.00517450
PERCENT PINE LITTER	1.07616090	0.29885382	0.53512129	0.35659634	0.23511643	0.41231695	0.42592908	0.40507810
PERCENT BEECH LITTER	0.00224494	0.00419398	0.00022445	0.00164307	0.00225813	0.00497325	0.00200013	0.00610298
PERCENT MOSS COVER	0.00000000	0.00000000	0.01614389	0.06947325	0.02680824	0.03891296	0.02207089	0.07930895
PERCENT GRASS LITTER	0.07906980	0.13298056	0.22044572	0.19537960	0.94399840	0.52214416	0.55813554	0.37757609
PERCENT "OTHER" LITTER	0.00000000	0.00000000	0.37856110	0.65324804	0.00000000	0.00000000	0.25626667	0.43223516
RED MAPLE BASAL AREA	1.69300000	2.11640486	3.80858853	2.42214427	1.22945161	2.02933785	3.60200000	2.71979614
SUGAR MAPLE BASAL AREA	0.25388776	0.35448627	0.33203990	0.46496519	0.28319355	0.52114025	0.56880000	0.95937316
BUCKEYE BASAL AREA	1.33681633	2.70040397	3.41705237	0.83801541	0.82012903	1.54368615	2.82200000	0.90962425
HICKORY BASAL AREA	7.89747959	3.21125855	5.55456359	4.48163971	0.31212903	1.73786090	5.66766667	5.01590225
BEECH BASAL AREA	0.79865306	0.37115765	0.90254115	0.46212384	0.89977419	0.84035710	0.66106667	0.70279152
ASH BASAL AREA	0.00000000	0.00000000	0.16516708	0.44347606	0.96812903	1.23833926	0.17120000	0.34825342
BUTTERNUT BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.51309677	0.70329602	0.09640000	0.36686196
CEDAR BASAL AREA	0.00000000	0.00000000	0.50248130	0.86708572	0.00000000	0.00000000	0.21280000	0.35892160
SWEET GUM BASAL AREA	3.16357143	1.21457121	5.07525187	2.69392620	12.18483871	6.60640748	4.92600000	2.77641376
TULIP POPLAR BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
BLACK GUM BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.63840000	1.07676481
WHITE PINE BASAL AREA	0.11642857	0.27401449	0.00000000	0.00000000	0.00525806	0.02927566	0.00000000	0.00000000
HORNBEAM BASAL AREA	0.00000000	0.00000000	0.04306983	0.07432163	0.00000000	0.00000000	0.07680000	0.12953562
SOURWOOD BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
SHORTLEAF PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	1.40445161	1.92506614	0.60493333	1.07382535
VIRGINIA PINE BASAL AREA	0.67571429	0.42955647	0.00000000	0.00000000	0.03051613	0.16990662	0.00000000	0.00000000
WHITE OAK BASAL AREA	0.51913265	1.15562867	2.88252868	3.45545079	0.22422581	0.42204855	1.53013333	1.66845511
SCARLET OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
CHINQUAPIN OAK BASAL AREA	1.14357143	0.72697665	0.00000000	0.00000000	0.05164516	0.28754809	0.00000000	0.00000000
CHESTNUT OAK BASAL AREA	0.29706122	1.16920705	0.17266833	1.08104371	0.00000000	0.00000000	1.84800000	2.52934622
NORTHERN RED OAK BASAL AREA	2.63121429	1.34520932	0.55785536	0.69684273	0.10948387	0.60958040	0.74860000	0.58196952
POST OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
BLACK OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
BASSWOOD BASAL AREA	0.54731633	0.88564505	1.76068828	1.41108501	0.48016129	0.89762231	1.35600000	1.44932993
ELM BASAL AREA	0.13839796	0.39121918	0.24082793	0.48298561	0.66858065	0.35835176	0.04726667	0.17987907

Appendix D (continued)

VARIABLE	*Geranium maculatum* MEAN	*Geranium maculatum* STANDARD DEVIATION	*Hexastylis arifolia* MEAN	*Hexastylis arifolia* STANDARD DEVIATION	*Phlox divaricata* MEAN	*Phlox divaricata* STANDARD DEVIATION	*Polystichum acrostichoides* MEAN	*Polystichum acrostichoides* STANDARD DEVIATION
OAK BASAL AREA	11.73831667	2.86259227	7.30286456	5.56048549	5.17726415	2.39245263	7.79524000	5.33[illegible]7298
PINE BASAL AREA	0.00000000	0.00000000	1.53521622	2.98823663	1.06928302	0.59438799	1.30452000	2.86693539
TOTAL BASAL AREA	26.58733333	0.97149273	27.50570270	3.67149040	28.45947170	4.35594725	25.94444000	4.21337812
PLOT POSITION	0.31231849	0.21649181	0.30409110	0.23387993	0.24709882	0.78197784	0.27718471	0.22560221
LITTER DEPTH	3.33333333	0.57391509	2.87837838	0.95310462	3.37735849	1.11331824	2.98000000	0.75663730
ASPECT	-0.27748966	0.70587028	0.09192611	0.79514660	0.12636767	0.70365872	0.02353563	0.98220364
CANOPY CLOSURE	0.14922121	0.00435216	0.14078028	0.02990076	0.15515199	0.00518684	0.15219034	0.00695976
PERCENT SLOPE	9.15000000	5.55046188	12.64864865	9.91972282	26.86792453	7.99528163	15.84000000	9.43256770
PH	4.56916667	0.367[illegible]8791	4.66216216	0.68398398	4.33396226	0.28212340	4.17800000	0.36602596
PERCENT SAND	21.75000000	7.41419847	21.67567568	7.68857036	18.20754717	7.55329396	17.72000000	5.71926569
PERCENT CLAY	18.66666667	4.46707984	16.13513514	4.21084685	19.43396226	2.40599759	17.20000000	4.35889894
LOSS ON IGNITION	0.05698333	0.01715581	0.06113514	0.02431753	0.05833962	0.02316242	0.06096000	0.03139237
PERCENT SILT	59.58333333	6.01492964	62.18918919	6.48433085	62.35849057	7.94958717	65.08000000	4.88978527
PERCENT CEDAR LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
PERCENT PINE LITTER	0.00000000	0.00000000	0.06233230	0.21369816	0.00000000	0.00000000	0.01202009	0.03322178
PERCENT BEECH LITTER	0.04432069	0.06885545	0.21753957	0.31667225	0.26055838	0.27067496	0.23818269	0.29146362
PERCENT MOSS COVER	0.00083363	0.00645766	0.00757676	0.02329948	0.00000000	0.00000000	0.00160011	0.00553812
PERCENT GRASS LITTER	0.00000000	0.00000000	0.01681335	0.07136720	0.13142985	0.17741197	0.08391089	0.15402529
PERCENT "OTHER" LITTER	0.12876937	0.10010720	0.48420077	0.49734506	0.39926101	0.18297800	0.33521662	0.28773990
RED MAPLE BASAL AREA	0.88898333	0.51481481	0.41740541	0.51585083	0.08932075	0.32836962	0.46332000	0.64879046
SUGAR MAPLE BASAL AREA	0.37476667	1.05819590	1.15005405	1.86263562	3.77352830	1.27921814	1.99084000	2.32346590
BUCKEYE BASAL AREA	0.15680000	0.19366062	0.23059459	0.67146860	0.05503774	0.30052748	0.21768000	0.59075359
HICKORY BASAL AREA	4.11366667	0.45916160	2.84754054	2.56446847	5.52145283	2.85317975	2.96404000	2.03101804
BEECH BASAL AREA	2.54168333	0.70484128	3.36316216	3.95682609	7.39318868	5.77931789	4.80804000	5.32011010
ASH BASAL AREA	0.33720000	0.41646913	0.19500000	0.42916178	0.25545283	0.33375559	0.35476000	0.49441222
BUTTERNUT BASAL AREA	0.00000000	0.00000000	0.43051351	0.87159336	0.50067925	0.42582028	0.27392000	0.40753752
CEDAR BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
SWEETGUM BASAL AREA	0.96325000	0.85238893	0.19389189	0.25922178	0.10245283	0.40317726	0.34524000	0.66000052
TULIP POPLAR BASAL AREA	3.34135000	2.63427166	5.93702703	6.16801284	4.64952830	3.40385802	5.91744000	3.60550255
BLACK GUM BASAL AREA	0.12838333	0.11485999	0.08154054	0.17591706	0.05245283	0.08163958	0.02652000	0.13260000
WHITE PINE BASAL AREA	0.00000000	0.00000000	1.18394595	2.38862808	0.04516981	0.32884119	1.01304000	2.29500698
HORNBEAM BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
SOURWOOD BASAL AREA	1.54605000	0.34547822	0.28367568	0.35121575	0.08218868	0.12221420	0.15816000	0.20876037
SHORTLEAF PINE BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
VIRGINIA PINE BASAL AREA	0.00000000	0.00000000	0.35137838	0.63266936	0.02413208	0.17568416	0.29156000	0.59886310
	0.01306667	0.07095997	0.12389189	0.36076091	0.00000000	0.00000000	0.22920000	0.46785254
WHITE OAK BASAL AREA	11.19243333	3.68930741	5.48072973	6.14546892	2.60160377	1.96540670	5.24632000	4.20132407
SCARLET OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
CHINQUAPIN OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
CHESTNUT OAK BASAL AREA	0.35410000	1.62068880	1.15516216	1.87121294	2.28773585	3.00689822	1.79428000	3.83444826
NORTHERN RED OAK BASAL AREA	0.19148333	0.98932445	0.56313514	0.79134408	0.28792453	0.38659559	0.56240000	0.95941571
POST OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
BLACK OAK BASAL AREA	0.00000000	0.00000000	0.10389189	0.30252289	0.00000000	0.00000000	0.19220000	0.39232661
BASSWOOD BASAL AREA	0.08320000	0.41928203	0.33113514	0.91678188	0.40154717	0.30943438	0.31504000	0.51139975
ELM BASAL AREA	0.20075000	0.18311760	0.29954054	0.45777400	0.00000000	0.00000000	0.30040000	0.61318893

Appendix D (continued)

VARIABLE	*Polygonatum biflorum* MEAN	*Polygonatum biflorum* STANDARD DEVIATION	*Smilacina racemosa* MEAN	*Smilacina racemosa* STANDARD DEVIATION	*Tiarella cordifolia* MEAN	*Tiarella cordifolia* STANDARD DEVIATION	*Trillium luteum* MEAN	*Trillium luteum* STANDARD DEVIATION
OAK BASAL AREA	14.85432000	7.11898732	12.32700000	6.54474296	6.20810256	2.97650945	2.39389231	2.52110781
PINE BASAL AREA	2.66484000	3.60924146	0.97920000	1.680[illegible]1286	2.07138462	1.84465168	0.24356923	0.95857045
TOTAL BASAL AREA	26.71980000	2.02833704	27.90426667	2.17144226	27.88046154	1.74451762	23.66790769	4.751[illegible]8317
PLOT POSITION	0.69869289	0.41856337	0.51469507	0.42991867	0.1633652[illegible]	0.15430147	0.28838645	0.2[illegible]1[illegible]3142
LITTER DEPTH	2.76000000	1.66533289	3.46666667	1.31565663	2.91538462	0.647[illegible]7376	2.93846154	1.04771959
ASPECT	-0.72350202	0.74281746	-0.01568066	1.05355249	-0.07680921	0.70293926	-0.06987598	0.89139410
CANOPY CLOSURE	0.15097751	0.00798580	0.15191999	0.00647379	0.13067055	0.02660315	0.15228610	0.009[illegible]3259
PERCENT SLOPE	23.36000000	14.46224971	17.53333333	13.39438404	13.43589744	13.07628402	15.24615385	8.76432893
PH	4.44800000	0.72722074	4.67000000	0.72427303	4.91282051	0.55532328	5.48000000	0.76734119
PERCENT SAND	24.52000000	7.47283971	19.93333333	4.54291704	26.20512821	10.83167744	16.12307692	5.86437255
PERCENT CLAY	15.72000000	4.04680944	16.66666667	4.80575052	13.43589744	5.95948987	20.67692308	5.48893117
LOSS ON IGNITION	0.08384000	0.04164701	0.06966667	0.02670063	0.07346154	0.02265049	0.11106154	0.05477621
PERCENT SILT	59.76000000	8.82364248	63.40000000	5.61630280	63.35897436	6.54332597	63.20000000	5.406[illegible]1517
PERCENT CEDAR LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
PERCENT PINE LITTER	0.11289838	0.20624964	0.00000000	0.00000000	0.00000000	0.00000000	0.00061543	0.00348095
PERCENT BEECH LITTER	0.00000000	0.00000000	0.01735222	0.03352304	0.10455029	0.23743981	0.61051755	0.35984335
PERCENT MOSS COVER	0.01610971	0.05198778	0.01000417	0.02071060	0.00333354	0.00737516	0.00361539	0.00242190
PERCENT GRASS LITTER	0.00000000	0.00000000	0.00000000	0.00000000	0.02135984	0.09190939	0.02160916	0.08694381
PERCENT "OTHER" LITTER	0.30617124	0.54554299	0.41562001	0.59877644	0.77462575	0.44678804	0.31399440	0.368[illegible]6174
RED MAPLE BASAL AREA	0.28188000	0.46298302	0.57560000	0.58759191	0.65771795	0.51868675	0.01372308	0.11063898
SUGAR MAPLE BASAL AREA	1.75132000	2.48958108	2.47926667	2.79912414	1.85146154	2.76932161	4.31824615	2.00765078
BUCKEYE BASAL AREA	0.42660000	0.87079360	0.62106667	0.95319864	1.23338462	1.04158133	0.45950769	0.59551155
HICKORY BASAL AREA	1.32080000	1.07306609	3.42660000	2.78057676	2.99394872	0.77218044	3.27398462	2.41985930
BEECH BASAL AREA	0.06760000	0.10912264	0.36760000	0.67360160	2.31294872	4.14559083	3.82686154	4.28343723
ASH BASAL AREA	0.07516000	0.37580000	0.37693333	0.67588561	0.20333333	0.35228975	0.69475385	0.59568377
BUTTERNUT BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.17387179	0.47957372	0.20658462	0.62720772
CEDAR BASAL AREA	0.01600000	0.03265986	0.00000000	0.00000000	0.00000000	0.00000000	0.08898462	0.35020032
SWEETGUM BASAL AREA	0.15960000	0.32578214	0.47880000	0.71055936	0.60361538	0.55583160	0.00000000	0.00000000
TULIP POPLAR BASAL AREA	1.06708000	1.97115867	2.94820000	2.31889238	4.71469231	3.25638922	4.30053846	4.71169590
BLACK GUM BASAL AREA	0.91996000	1.64430655	0.13520000	0.28001995	0.00000000	0.00000000	0.00000000	0.00000000
WHITE PINE BASAL AREA	0.47880000	0.97734641	0.63840000	1.09582407	1.35046154	1.20264056	0.00000000	0.00000000
HORNBEAM BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00501538	0.02836784
SOURWOOD BASAL AREA	0.38492000	0.62153137	0.25293333	0.27896863	0.17561538	0.13666144	0.01330769	0.10729005
SHORTLEAF PINE BASAL AREA	0.73388000	1.36082850	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
VIRGINIA PINE BASAL AREA	1.45256000	2.36482202	0.34106667	0.58544653	0.72148718	0.64251348	0.24356923	0.95857045
WHITE OAK BASAL AREA	0.07840000	0.16033333	0.11460000	0.17737362	0.00000000	0.00000000	0.02910769	0.16463787
SCARLET OAK BASAL AREA	1.83388000	2.38066829	1.84906667	2.79077771	2.44894872	2.23965970	1.21476923	1.39692694
CHINQUAPIN OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
CHESTNUT OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.04926154	0.27863132
NORTHERN RED OAK BASAL AREA	10.16832000	6.16606407	7.74253333	6.28579833	3.19907692	2.30021353	0.50336923	1.61261348
POST OAK BASAL AREA	2.85220000	1.86628941	2.73533333	2.13912434	0.56007692	0.36338340	0.62653846	0.99433692
BLACK OAK BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
BASSWOOD BASAL AREA	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000	0.00000000
ELM BASAL AREA	0.46140000	0.94182881	0.61520000	1.05600089	0.34123077	0.63534965	1.74209231	1.14653998
	0.00000000	0.00000000	0.00000000	0.00000000	0.00917949	0.05732588	0.52092308	0.57787137

Appendix D (continued)

Trillium vaseyi

VARIABLE	MEAN	STANDARD DEVIATION
OAK BASAL AREA	3.56407692	2.01955455
PINE BASAL AREA	0.00000000	0.00000000
TOTAL BASAL AREA	22.13423077	3.92576931
PLOT POSITION	0.26307799	0.07571853
LITTER DEPTH	2.76923077	0.97072534
ASPECT	1.06439146	0.39110600
CANOPY CLOSURE	0.15757607	0.00426263
PERCENT SLOPE	13.30769231	3.81629435
PH	5.13076923	0.67962565
PERCENT SAND	24.15384615	9.55550586
PERCENT CLAY	17.53846154	7.17188242
LOSS ON IGNITION	0.13376923	0.04304291
PERCENT SILT	58.30769231	5.36010907
	0.00000000	0.00000000
PERCENT CEDAR LITTER	0.00000000	0.00000000
PERCENT PINE LITTER	0.96453590	0.39940493
PERCENT BEECH LITTER	0.00230773	0.00438536
PERCENT MOSS COVER	0.01158217	0.04176013
PERCENT GRASS LITTER	0.18179721	0.39992485
PERCENT "OTHER" LITTER	0.00000000	0.00000000
RED MAPLE BASAL AREA	1.71653846	2.05470536
SUGAR MAPLE BASAL AREA	0.38376923	0.48660476
BUCKEYE BASAL AREA	1.13330769	1.77011814
HICKORY BASAL AREA	6.89100000	4.82971687
BEECH BASAL AREA	0.79907692	0.36114320
ASH BASAL AREA	0.25823077	0.71419280
BUTTERNUT BASAL AREA	0.00000000	0.00000000
CEDAR BASAL AREA	0.00000000	0.00000000
SWEETGUM BASAL AREA	4.91107692	4.42104723
TULIP POPLAR BASAL AREA	0.00000000	0.00000000
BLACK GUM BASAL AREA	0.00000000	0.00000000
WHITE PINE BASAL AREA	0.10030769	0.08253826
HORNBEAM BASAL AREA	0.00000000	0.00000000
SOURWOOD BASAL AREA	0.00000000	0.00000000
SHORTLEAF PINE BASAL AREA	0.00000000	0.00000000
VIRGINIA PINE BASAL AREA	0.58215385	0.47912572
WHITE OAK BASAL AREA	0.49023077	0.97267425
SCARLET OAK BASAL AREA	0.00000000	0.00000000
CHINQUAPIN OAK BASAL AREA	0.98523077	0.81069786
CHESTNUT OAK BASAL AREA	0.00000000	0.00000000
NORTHERN RED OAK BASAL AREA	2.08861538	1.71861871
POST OAK BASAL AREA	0.00000000	0.00000000
BLACK OAK BASAL AREA	0.00000000	0.00000000
BASSWOOD BASAL AREA	0.58161538	0.88529925
ELM BASAL AREA	0.31207692	0.53408293

VITA

Linda Kathleen Mann was born in Montclair, New Jersey, on December 8, 1945. She attended elementary school in Oak Ridge, Tennessee, and graduated from Oak Ridge High School in June, 1964. The following September she entered the University of Tennessee and in December, 1967, received a Bachelor of Science degree *summa cum laude* with a major in botany. She was employed at the University of Tennessee Herbarium until June, 1968, when she was employed by the Biology Division of Oak Ridge National Laboratory. In July, 1970, she transferred to the Environmental Sciences Division of the same company where she has been employed since.

In April, 1971, she enrolled in graduate school at the University of Tennessee, Knoxville, and, after a four year leave of absence, received the Master of Science degree with a major in Ecology in 1977.

The author is a member of Phi Beta Kappa and the Farm Bureau.