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Plant Species of the Virginia Coastal Plain Flora that Are Disjunct from the Mountains: their Distribution, Abundance and Substrate Selectivity

Leah E. McDonald
College of William & Mary - Arts & Sciences

Plant Species of the Virginia Coastal Plain Flora that are Disjunct from the Mountains: their Distribution, Abundance and Substrate Selectivity

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APPROVAL SHEET

This thesis is submitted in partial fulfillment

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Author

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Stewart A. Ware

Stewart A. Ware

Martha A. Case

Martha A. Case

Donna M. E. Ware

Donna M. E. Ware

Dedicated to my grandfather, Felix Maiorana, and my mother, Kathleen McDonald

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ABSTRACT

A group of species within the Virginia flora, known as mountain disjuncts, have their primary range in the mountains, are absent or sparse in the Piedmont and then reappear in the Coastal Plain. These species are often found in the steep ravines that cut into the calcareous Yorktown Formation and that dissect much of Virginia's Coastal Plain. The objectives of this study were to 1) examine the distribution patterns of mountain disjunct species whose status was in question by mapping their collection locations in the state, 2) investigate the composition of the vegetation where mountain disjuncts occur, and 3) determine how crucial calcareous substrates are to the growth and survival of mountain disjunct species.

County-based maps of individual collection locations were made for disjunct species whose distributions across the Piedmont were somewhat filled in (they are considered less disjunct). Data on the distribution and abundance of herbaceous and woody mountain disjunct species that occurred in calcareous ravines in the Coastal Plain were collected and analyzed using an ordination program(CANOCO). These data were compared to the vegetation of non-calcareous ravines nearby in the Coastal Plain. Soil tolerance experiments were set up to test whether or not populations of disjunct species in the Coastal Plain grew better on calcareous or non-calcareous soil.

Maps of individual collection locations for less disjunct species revealed that some of these species were more disjunct than previously thought. The spatial extent to which the actual disjunctions were revealed by the maps was one to two counties wide for most less disjunct species. Some less disjunct species occurred in a corridor across the Piedmont, connecting the mountains and Coastal Plain.

The distribution and abundance of disjunct species within ravines in the Coastal Plain was patchy for most species; however, some were found in large colonies. The presence of disjunct species was not a good predictor of which, if any, disjunct species were located in neighboring ravines. The herbaceous vegetation on the upland edges of calcareous ravines differed from the vegetation on the slopes of calcareous ravines. This vegetational difference is probably due to pH and calcium differentials that exist between the upland edges and slopes of calcareous ravines. The vegetation of the uplands associated with these calcareous ravines was more similar to that of non-calcareous ravines.

The soil tolerance experiments indicated that Coastal Plain and mountain populations of *Solidago flexicaulis* and *Desmodium glutinosum* grew better on calcareous soil. *Collinsonia canadensis* from the mountains also grew significantly better on calcareous soil than on non-calcareous soil. These species that grew better on calcareous soil may not require high levels of soil calcium to germinate and persist, but grow to be more robust when it is present. *Aralia racemosa* from the Coastal Plain grew better on calcareous soil than non-calcareous soil, but the difference was not significant, suggesting that this species may not be an obligate calciphile in the Coastal Plain.

PLANT SPECIES OF THE VIRGINIA COASTAL PLAIN FLORA THAT ARE DISJUNCT FROM THE MOUNTAINS: THEIR DISTRIBUTION, ABUNDANCE AND SUBSTRATE SELECTIVITY

INTRODUCTION

Within the flora of Virginia there is a suite of species that have their primary ranges in the mountains, are absent or sparse in the Piedmont, and reappear, sometimes in local abundance, in the Coastal Plain. These species are often called "mountain disjunct plants". Though they may be more generally distributed in the mountains, within the Coastal Plain most of these species are found in steep-sided ravines, most of which cut into calcareous substrates.

Disjunctions in geographical ranges of plants and animals have attracted much attention from biogeographers. However, most studies of disjunctions focus on large intercontinental separations in ranges of a taxon, such as the east Asia--eastern North American disjunction (Thorne 1972 and Pielou 1979), and studies of regional disjunctions (Marquis and Voss 1981, Downing et al. 1991, Jackson and Singer 1997) in plants are somewhat rare. Regional disjunctions are on a smaller scale with subranges separated by gaps on the order of one hundred to a few hundred kilometers (Pielou 1979). The Virginia mountain disjuncts are good examples of the kind of small scale or regional disjunctions that have been largely neglected.

Although considerable attention has been paid to the presence of mountain disjunct species in various floristic studies of the Coastal Plain, there is no comprehensive list of all species showing the mountain disjunct distribution pattern. Further, nothing is known of the structure of the vegetation of the ravines in which these mountain disjuncts occur, nor of the role of the disjuncts in that vegetation; that is, whether they are among the dominants, are of moderate structural importance, or are only of minor components of the vegetation. Neither is anything known about how crucial calcareous soil is in the growth and survival of the mountain disjuncts. This study addresses these issues by a) compiling a complete list of all species appearing to show a gap in their distribution between the mountains of Virginia and the Coastal Plain; b) reexamining the distribution pattern in some of those species in which the width of the gap in distribution has been called into question as too narrow to be significant; c) quantitatively describing both the herbaceous and woody vegetation patterns in ravines in the Coastal Plain using ordination techniques, and d) comparing the ability of mountain disjunct species to grow on calcareous soils of ravines versus the prevailing non-calcareous soils of the Coastal Plain.

Geology and Topography of the Coastal Plain

The geology and topography of the Coastal Plain of Virginia is defined in part by the major rivers that flow across it, dividing it into three peninsulas (Fig. 1). The Rappahannock, York and James Rivers flow southeastward into the Chesapeake Bay. The small side tributaries that flow into these rivers often have eroded out steep ravines and valleys (Bick and Coch, 1969). Most of the ravines where the mountain disjunct plants have been found are cut into the Yorktown

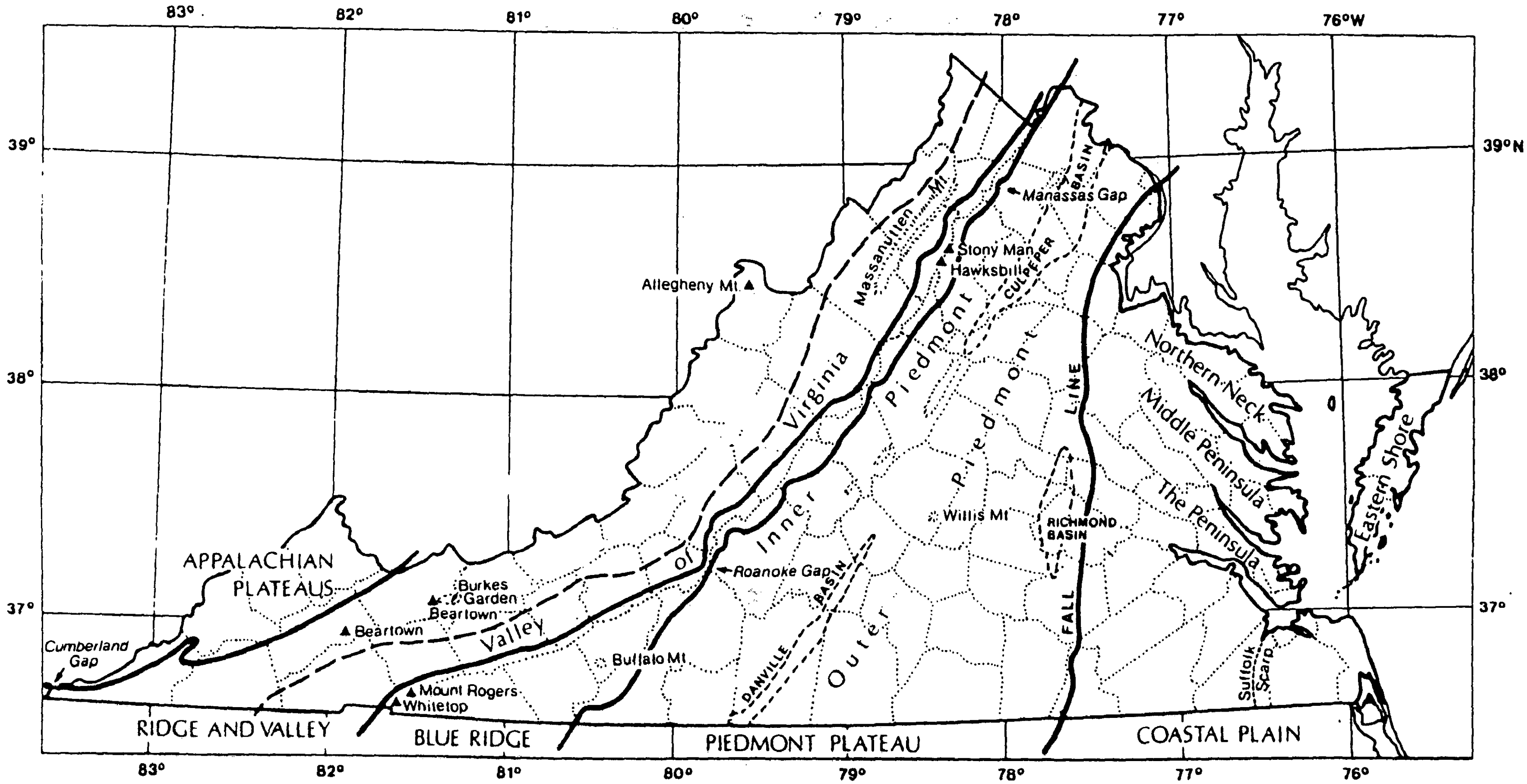


Fig. 1. The physiographic provinces of Virginia. This map is modified from Terwilliger (1991). The Rappahannock River separates the Northern Neck peninsula and the Middle Peninsula, the York River separates the Middle Peninsula and the Peninsula, and the James River is just south of the Peninsula. The fall line separates the Coastal Plain and the Piedmont.

Formation of Pliocene age (Dowsett and Wiggs 1992). This formation is composed of marine and littoral deposits with sand, gravel and clay (Bick and Coch, 1969). The scallop shells *Chesapectan jeffersonius* and *Chesapectan madisonius* are the most conspicuous fossil element of the Yorktown. Several layers of these shells, which can be dinner plate size, can be found in ravines that cut into the Yorktown. The St. Mary's Formation, now referred to as the Eastover Formation, is located below the Yorktown Formation. This formation, like the Yorktown, is composed of sand with large amounts of marine fossils and is difficult to distinguish from the Yorktown. Both the Yorktown and Eastover Formations belong to the Chesapeake group and are rich in calcium carbonate due to their shelly composition. Marl, a calcareous cement-like substance, is composed almost entirely of calcium carbonate that precipitated into the soil from shells and is often found in thick lenses in ravines. The presence of high calcium carbonate greatly influences the chemistry of ravine soils. With increased soil pH caused by high calcium, it is known that various soil ions needed by plants, including crucial soil nitrogen, become more soluble and readily available to plants (Adams and Adams 1983, Bailey 1995). On the other hand, many plants are adapted to much more acid soil, and may have difficulty growing in high pH soils. The geology and resulting soil chemistry reactions may have much to do with why mountain disjunct species occur where they do.

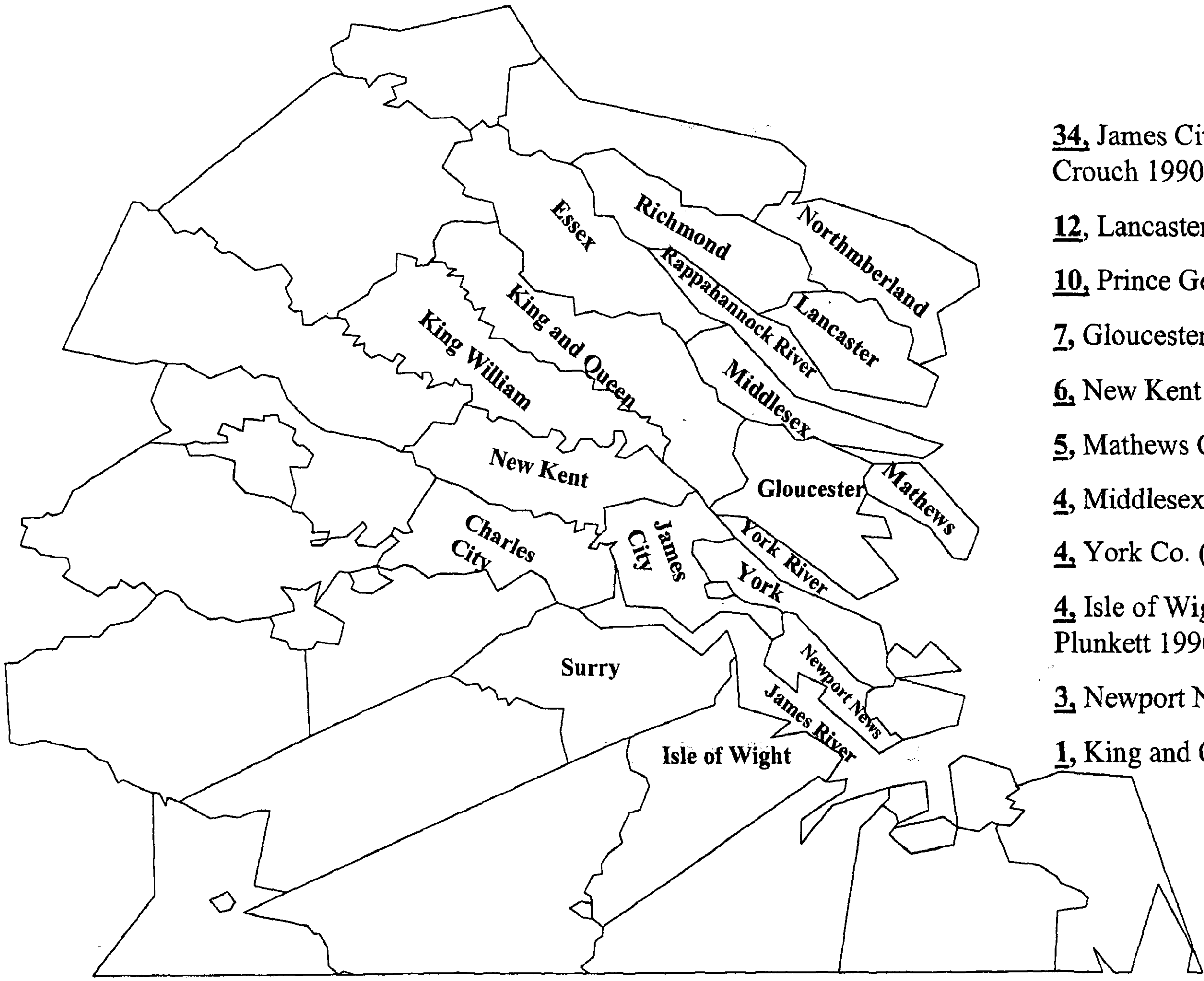
The Coastal Plain's topography may also play an important role in the distribution of these plants. Narrow steep-sided ravines are formed by tributary streams that cut down through the surface sediments. Soil moisture and humidity are significantly greater in ravines than on the associated uplands. After rains, surface water runs down from the uplands along the slopes of the ravines and finally is deposited in the ravine floor. In addition to water washing down slope, water on the uplands percolates through the surface soil, and seeps out at the bottom of ravine slopes over time (Quarterman and Keever 1962). In fact, springs typically occur at the contact between the top of the Yorktown Formation and the overlaying (sand/gravel) formations (C. R. Berquist pers. comm.). Furthermore, high soil moisture in the ravines results in high humidity.

Temperature is another environmental factor that makes ravines different from their associated uplands. Cold air drainage occurs when ambient cool air, which has a greater density than the surrounding warm air, is present and sinks into the ravine, thereby making the temperature of the ravine cooler than the associated uplands. The high soil moisture, high humidity and lower temperatures are environmental factors that make ravines climatically different from surrounding uplands and may be requirements for mountain disjuncts.

Botanical History of Mountain Disjuncts

The Rev. John Clayton (late 1600s), John Banister (late 1600s) and John Clayton (early to mid 1700s) were the first to do any significant botanical work in Virginia's Coastal Plain, but whether they collected mountain disjunct species in the Coastal Plain is not clear. The works of the Rev. John Clayton were lost. The major publications based on the works of Bannister and the later John Clayton list many species now considered mountain disjuncts, but little collection information is given for species listed, so it is not apparent if the species they record are from the mountains or Coastal Plain (Ewan and Ewan 1970, Gronovius 1739). It was not until the early 1920s that E. J. Grimes of the College of William and Mary, doing botanical work on the Peninsula of Virginia, recorded species now understood to be mountain disjuncts (Erlanson 1924). Some of the disjunct species he found included *Monotropsis odorata, Actaea pachypoda,* and *Caltha palustris.* About seven years after Grimes did his work, M. L. Fernald from Harvard's Gray Herbarium came to southeastern Virginia and began a series of floristic studies, mostly in the southern Coastal Plain south of the James River. His extensive works about the Coastal Plain discuss at some length the flora that occurs on calcareous substrates and how it "commingles" with the surrounding pine barrens (Fernald 1937). Examples of mountain disjunct species he found during his studies included *Amianthium muscaetoxicum, Hexalectris spicata* and *Monotropsis odorata.* It was not until the mid 1960s that the first paper was published on mountain disjuncts as a group. This work was by A. M. Harvill of the Longwood College herbarium and identified 18 species north of the James River and mentions that other species found south of the James River have disjunct distributions, but were not included in the study (Harvill 1965).

From 1969 through the mid 1990s a series of floristic studies by students at the College of William and Mary documented the presence of mountain disjunct species up and down the Coastal Plain, though rarely were as many as ten disjuncts found in any one study. These studies are summarized in Fig. 2 and



<u>34,</u> James City Co. (Barans 1969, Crouch 1990, Ware and Ware 1992)

<u>12</u>, Lancaster Co. (Weldy 1995)

<u>10,</u> Prince George Co. (Mort 1994)

<u>7</u>, Gloucester Co., (Greaves 1982)

<u>6</u>, New Kent Co. (Gillespie 1970)

<u>5</u>, Mathews Co. (van Montfrans 1980)

<u>4</u>, Middlesex Co. (North 1983)

<u>4</u>, York Co. (Salle 1972)

<u>4</u>, Isle of Wight (Whitmarsh 1980, Plunkett 1990)

<u>3</u>, Newport News Co. (Appler 1974)

<u>1</u>, King and Queen Co., (Vascott 1985)

Fig. 2 The Coastal Plain of Virginia with number of mountain disjuncts reported from floristic studies. Underlined numbers indicate the number of disjuncts located in the studies listed to the right. These numbers only represent the number of disjuncts recorded by those studies indicated and there may be other disjuncts for those counties in herbarium collections. Some counties indicated on the map do not have published floristic work.

Table 1. The northernmost of these was on the Northern Neck, where Weldy (1995) reported 12 mountain disjunct species from the Corrotoman watershed in Lancaster Co. Four studies took place on the Middle Peninsula. These were by van Montfrans (1980) in Mathews Co.; by Greaves (1982) in Gloucester Co.; by North (1983) in Middlesex Co.; and by Vascott (1985) in southeastern King and Queen Co. Three studies took place south of the James River. These were by Whitmarsh (1980) at Burwell Bay in Isle of Wight Co.; by Plunkett in western Isle of Wight Co.; and by Mort (1994) at Tar Bay and Powell Creek watersheds in Prince George Co., where he recorded 10 mountain disjunct species. On the Peninsula the studies were by Barans (1969) in James City Co., by Gillespie (1970) in New Kent Co., by Appler (1974) in the City of Newport News, by Salle (1972) in York Co., and by Crouch (1990) in James City Co.

The floristic study by Allene Barans (1969) of the College Woods adjacent to the campus of the College of William and Mary in James City Co. produced more mountain disjuncts than any of the other floristic studies mentioned (Table 1), and a further floristic reconnaissance of the College Woods by Virginia Crouch (1990) yielded six other mountain disjuncts not found by Barans, bringing the total number of disjuncts for the College Woods to 18.

The greatest number of disjunct species found in any one place in the Coastal Plain was in the Grove Creek watershed in James City Co., where Donna M. E. Ware found 27 mountain disjuncts (Ware and Ware 1992). This study is the most recent work that focuses on mountain disjunct species as a group. Ware and Ware (1992) divided the 27 species into the "strongly disjunct"

Table 1. Mountain disjunct species recorded in floristic studies in the Coastal Plain counties of Virginia by students at the College of William and Mary The county, author, and specific watershed, if available, are listed for each study. The species listed represent only those recorded by the studies indicated and there may be other disjuncts for those counties in herbarium collections. Ware and Ware (1992), listed for James City Co., is not a student study.

Lancaster Co.: Corrotoman Watershed (Weldy 1995)
Veratrum viride, Athyrium pycnocarpon, Caltha palustris, Cornus alternifolia, Aralia nudicaulis, Stewartia ovata, Carex bromoides, Juglans cinerea, Tilia americana, Viola conspersa, Myosotis laxa, Anemone quinquefolius

Mathews Co. (van Montfrans 1980)
Chelone cuthbertii, Desmodium glutinosum, Quercus muehlenbergii, Agrimonia pubescens, Veronica anagallis-aquatica

Gloucester Co.: Beaverdam Swamp (Greaves 1982)
Anemone quinquefolia, Caltha palustris, Ranunculus septentrionalis, Desmodium glutinosum, Viola conspersa, Mysotis laxa, Veronica anagallis-aquatica

Eastern Middlesex Co. (North 1983)
Galax urceolata, Caltha palustris, Ranunculus septentrionalis, Veronica anagallis-aquatica

Southeastern King and Queen Co. (Vascott 1985)
Agrimonia pubescens

Isle of Wight Co.: Burwell Bay (Whitmarsh 1980), Western Isle of Wight Co. (Plunkett 1990)

Burwell Bay: Whitmarsh (1980): *Campanula americana, Quercus muehlenbergii, Veronica anagallis-aquatica*

Western Isle of Wight Co.: Plunkett (1990)
Galax urceolata

Prince George Co.: Tar Bay and Powell Creek Watersheds (Mort 1994)
Campanula americana, Ranunculus septentrionalis, Carex bromoides, Cornus alternifolia, Quercus muehlenbergii, Elymus villosus, Tilia americana, Scutellaria ovata, Eleocharis erythropoda, Solidago flexicaulis

Table 1 (continued)

<u>James City Co.</u>: College of William and Mary, the College Woods (Barans 1969 and Crouch 1990); Grove Creek Watershed (Ware and Ware 1992)

College Woods: Barans (1969): *Muhlenbergia tenuiflora, Carex bromoides, Amianthium muscaetoxicum, Quercus muehlenbergii, Caltha palustris, Desmodium glutinosum, Aralia nudicaulis, Cornus alternifolia, Monotropsis odorata, Galax urceolata, Pedicularis lanceolata, Triosteum perfoliatum*

Crouch (1990): Found the species above, except for *Caltha palustris.* Additional disjuncts she found: *Actaea pachypoda, Euonymus atropurpureus, Panax quinquefolius, Hexalectris spicata, Aruncus dioicus, Aralia racemosa*

Grove Creek: Ware and Ware (1992): *Aralia racemosa, Athyrium pycnocarpon, Caltha palustris, Carex bromoides, Campanula americana, Cornus alternifolia, Desmodium glutinosum, Magnolia tripetala, Mitella diphylla, Quercus muehlenbergii, Ranunculus septentrionalis, Sanicula marilandica, Solidago flexicaulis, Stewartia ovata, Thalictrum dioicum, Triosteum perfoliatum, Aruncus dioicus, Athyrium thelypteroides, Celastrus scandens, Collinsonia canadensis, Dirca palustris, Elymus villosus, Hexalectis spicata, Juglans cinerea, Panax quinquefolius, Scutellaria ovata, Taenidia integerrima, Tilia americana*

<u>New Kent Co</u>. (Gillespie 1970)
Pellea atropurpurea, Carex bromoides, Arabis lyrata, Agrimonia pubescens, Galax urceolata, Veronica anagallis-aquatica

<u>York Co.</u>: Yorktown Colonial Parkway between Brackens Pond and Kings Creek (Salle 1972)
Elymus villosus, Quercus muehlenbergii, Agrimonia pubescens, Veronica anagallis-aquatica

<u>City of Newport News</u> Fort Eustis (Appler 1974)
Agrimonia pubescens, Galax urceolata, Veronica anagallis-aquatica

and "less strongly disjunct" categories that will be examined further in this thesis.

Harvill (1965) tried to address the origin of the pattern of distribution of mountain disjuncts. He proposed that the Coastal Plain and mountains provided suitable habitats and refugia during the climatically stressful post-Pleistocene xerothermic period (hypsithermal) and that these refugia were not available in the Piedmont. Furthermore, Harvill (1965) suggests that these isolated Coastal Plain populations developed narrow edaphic tolerances and hence soil selectivity in locations where they persisted, thereby making them poor competitors outside their limited habitat. Some mountain disjunct species are known to be calciphiles in both the mountains and Coastal Plain. One such species is *Pellea atropurpurea,* the cliff-break fern. However, many mountain disjunct species are not regarded as calciphiles in the mountains, but suspected to be calciphiles in the Coastal Plain, (Ware and Ware 1992); and if this is the case this would be consistent with Harvill's (1965) notion that mountain species isolated in the Coastal Plain have become narrow in their habitat tolerances.

METHODS AND MATERIALS

Determination of Mountain Disjunct Species

While various studies of the Coastal Plain's flora have reported mountain disjunct species, no comprehensive list of disjunct species exists. For this study mountain disjunct species are defined as species whose usual range is in the mountains of Virginia, which appear sparsely or not at all through the Piedmont, and then reappear in the Coastal Plain, sometimes in significant numbers. These mountain disjunct species were then identified in relation to whether they fit that definition. Specifically, a species was considered a mountain disjunct if there was at least a one or two county break between its area of distribution in the mountains to its area of occurrence in the Coastal Plain. Such breaks usually lay in the Piedmont and/or adjacent inner Coastal Plain. A list of these disjunct species was compiled using Harvill (1965), Ware and Ware (1992), D.M.E. Ware (pers. comm.) and G.P. Fleming (pers. comm.) (Table 2). The maps in Harvill et al. (1992) were used to identify additional species that possess a disjunct distribution but that were not mentioned by the above sources.

The list of disjunct species was then grouped, using Harvill et al.'s (1992) distribution maps, into several categories based on the size of the gap from

Table 2. Species identified as mountain disjuncts by this study. Groups of species are alphabetized first by family and then by genus.

Species	Family
Ferns	
Athyrium pycnocarpon (Spreng.) Tidestr.	Aspidicaeae
Athyrium thelypteroides (Michx.) Desv.	Aspidicaeae
Camptosorus rhizophyllus (L.) Link	Aspleniaceae
Osmunda claytoniana L.	Osmundaceae
Pellaea atropurpurea L. (Link)	Pteridaceae
Monocots	
Carex bromoides Willdenow	Cyperaceae
Carex hirtifolia Mackenzie	Cyperaceae
Carex oligocarpa Willdenow	Cyperaceae
Carex pellita (C. lasiocarpa) Ehrhart	Cyperaceae
Carex tetanica Schkuhr	Cyperaceae
Carex virescens Willdenow	Cyperaceae
Eleocharis erthyropoda Steudel	Cyperaceae
Scripus pendulinus Muhl.	Cyperaceae
Elodea canadensis Michaux	Hydrocharitaceae
Amianthium muscaetoxicum (Walter) Gray	Liliaceae
Ulvularia puberula Michaux	Liliaceae
Veratrum viride Aiton	Liliaceae
Calopogon tuberosus (L.) BSP.	Orchidaceae
Corallorhiza wisteriana Conrad	Orchidaceae
Habenaria ciliaris (L.) R. Br.	Orchidaceae
Hexalextris spicata (Walt.) Barnhart	Orchidaceae
Danthonia compressa Austin	Poaceae
Deschampsia flexuosa (L.) Beauvois	Poaceae
Dicanthelium latifolium (L.) Harvill	Poaceae
Dicanthelium linearifolium (Scribner) Gould	Poaceae
Elymus villosus Willdenow	Poaceae
Glyceria grandis Watson	Poaceae
Muhlenbergia sobolifera (Willdenow) Trinius	Poaceae
Muhlenbergia tenuiflora (Willdenow) BSP.	Poaceae
Dicots	
Sanicula gregaria Bicknell	Apiaceae
Sanicula marilandica L.	Apiaceae
Taenidia integerrima (L.) Drude	Apiaceae
Aralia nudicaulis	Araliaceae
Aralia racemosa L.	Araliaceae
Panax quinquefolium L.	Araliaceae

Table 2 (continued)

Species	Family
Dicots	
Aster laevis L.	Asteraceae
Bidens cernua L.	Asteraceae
Cirsium muticum Michaux	Asteraceae
Liatris spicata (L.) Willdenow	Asteraceae
Solidago flexicaulis L	Asteraceae
Solidago ulmifolia Willdenow	Asteraceae
Impatiens pallida Nuttall	Balsaminaceae
Myosotis laxa Lehmann	Borginaceae
Arabis lyrata L.	Brassicaceae
Campanula americana L.	Campanulaceae
Triosteum perfoliatum L.	Caprifoliaceae
Euonymous atropurpureus Jacquin	Celastraceae
Celastrus scadens L.	Celastraceae
Cornus alternifolia L. F.	Cornaceae
Cornus racemosa Lam.	Cornaceae
Galax urceolata Poir.	Diapensiaceae
Monotropsis odorata Schweinitz	Ericaceae
Astragalus canadensis L.	Fabaceae
Desmodium cuspidatum (Willd.) Loudon	Fabaceae
Desmodium glutinosum (Willd.) Wood	Fabaceae
Lathyrus venosus Muhl.	Fabaceae
Quercus muehlenbergii Engelm.	Fagaceae
Juglans cincerea L.	Juglandaceae
Blephilia ciliata (L.) Bentham	Lamiaceae
Collinsonia canadensis L.	Lamiaceae
Mentha arvensis L.	Lamiaceae
Monarda fistulosa L.	Lamiaceae
Pycnanthemum virginianum (L.) Durand & Jackson	Lamiaceae
Scutellaria ovata Hill	Lamiaceae
Magnolia tripetala L.	Magnoliaceae
Comptonia peregrina (L.) Coulter	Myricaceae
Polygala polygama Walter	Polygalaceae
Actaea pachypoda Elliot	Ranunculaceae
Anemone lancifolia Pursh	Ranunculaceae
Anemone quinquefolia L.	Ranunculaceae
Caltha palustris L.	Ranunculaceae
Delphinium tricorne Michaux	Ranunuculaceae
Ranunculus septentrionalis Poir.	Ranunculaceae
Thalictrum dioicum L.	Ranunculaceae
Agrimonia gryposepala Wallr.	Rosaceae
Agrimonia pubescens Wallr.	Rosaceae
Aruncus dioicus (Walt.) Fern.	Rosaceae
Ptelea trifoliata L.	Rutaceae

Table 2 (continued)

Species	Family
Dicots	
Salix sericea Marshall	Salicaeae
Mitella diphylla L.	Saxifragaceae
Parnassia asarifolia Vent.	Saxifragaceae
Saxifraga pensylvanica L.	Saxifragaceae
Aureolaria flava (L.) Farwell	Scrophulariaceae
Chelone cuthbertii Small.	Scrophulariaceae
Pedicularis lanceolata Michaux	Scrophulariaceae
Melampyrum lineare Desr.	Scrophulariaceae
Scrophularia lanceolata Pursh	Scrophulariaceae
Veronica anagllis-acquatica L.	Scrophulariaceae
Stewartia ovata (Cav.) Weatherby	Theaceae
Dirca palustris L.	Thymelaeaceae
Tilia americana L.	Tiliaceae
Parietaria pensylvanica Willdenow	Urticaceae
Hybanthus concolor (Forster)Sprengel	Violaceae
Viola conspersa Reichenbach	Violaceae

the mountains to the Coastal Plain. Species were considered "strongly disjunct" if the gap was at least 3 counties wide at any place in the distribution from the mountains and or Piedmont to the Coastal Plain (Fig. 3). Species were considered less strongly disjunct if the gap was only 1 or 2 counties wide (Fig. 3). Finally, a category of "miscellaneous disjuncts" included those species that have a limited or spotty distribution in the mountains and reappear in the Coastal Plain; those that occur in the mountains and Coastal Plain, but have a few isolated occurrences in the central Piedmont; and those that occur strongly in the mountains but reappear only in the southernmost portion of the Coastal Plain (Fig. 3).

Mapping of "Less Disjunct" Species

The various levels of disjunction of Ware and Ware (1992) are based on maps in Harvill et al.'s 1992 *Atlas of the Virginia Flora.* The Atlas records the presence of a species in a county by a single dot in the center of each county regardless of where or how often the species was collected in that county. Some species are called "less disjunct" because dots on the Atlas map bridge the gap between the mountains and the Coastal Plain, and whether they even show disjunction may be in questioned. Since it is unknown whether the Atlas map dots in counties bridging the gap in range represent rare or common occurrences, it is problematic to comment on the strength of their disjunction. Therefore, a map showing actual location of collections is needed to assess the actual degree of disjunction.

Strongly Disjunct Species

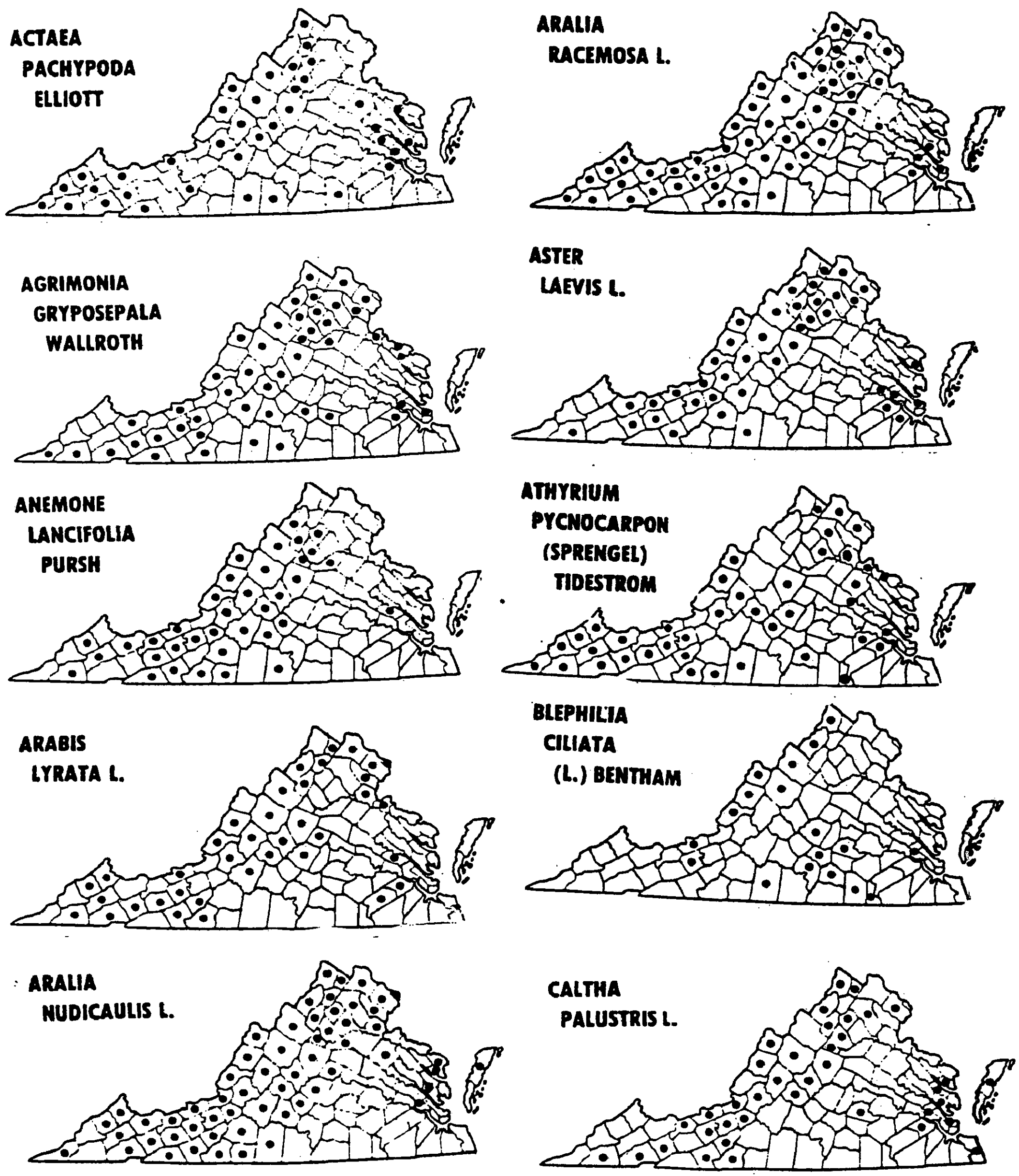


Fig. 3 Mountain disjunct species' distribution maps from the *Atlas of the Virginia Flora* (Harvill et al. 1992). Strongly disjunct species have at least a three county gap from the mountains to the Coastal Plain; less strongly disjunct species a one to two county gap; and miscellaneous disjuncts are spotty through the mountains and reappear in the Coastal Plain, or occur strongly in the mountains and reappear in the southern Coastal Plain. See addendum at the end of the figure for additional species in the strongly disjunct and less disjunct categories.

Strongly Disjunct Species

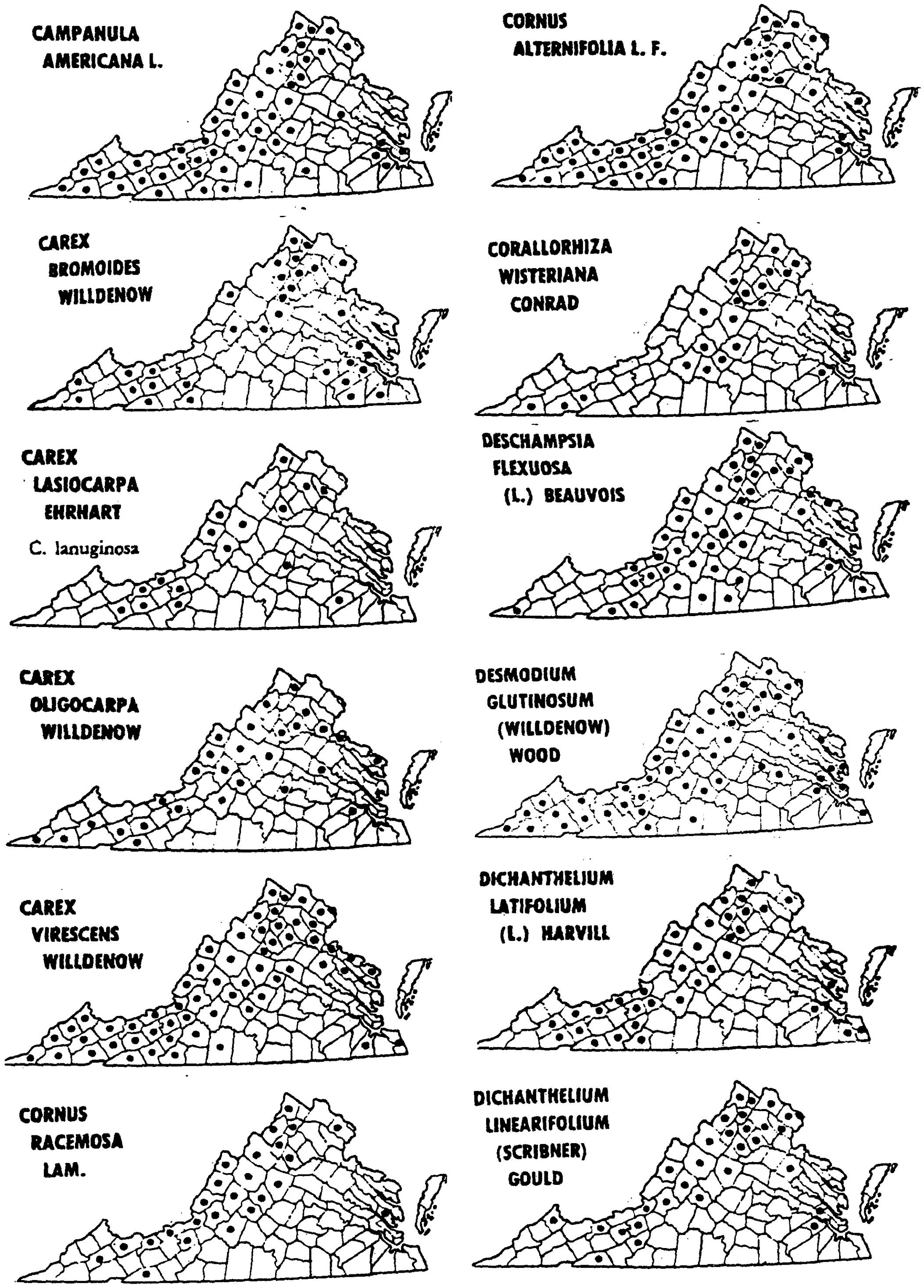
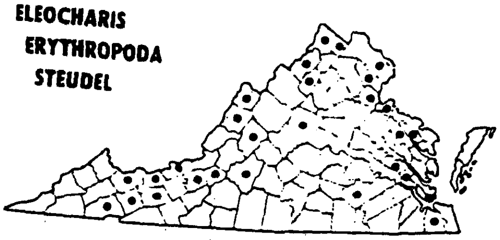


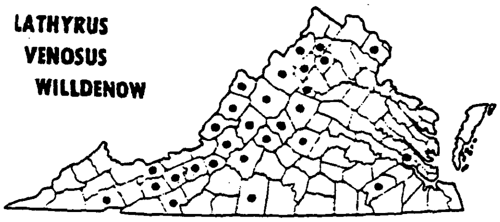
Fig. 3 (continued)

Strongly Disjunct Species

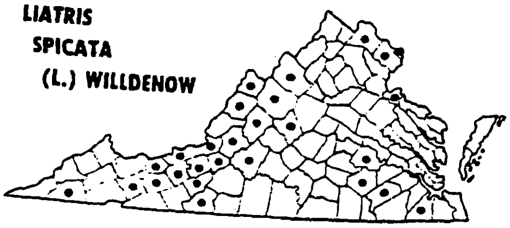
ELEOCHARIS ERYTHROPODA STEUDEL



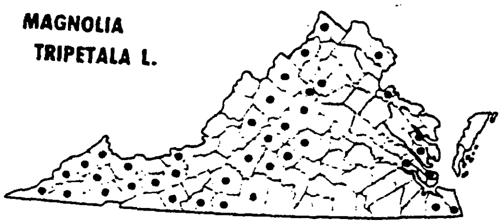
LATHYRUS VENOSUS WILLDENOW



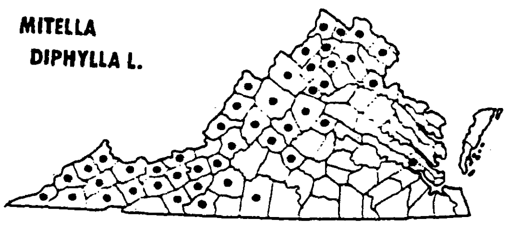
LIATRIS SPICATA (L.) WILLDENOW



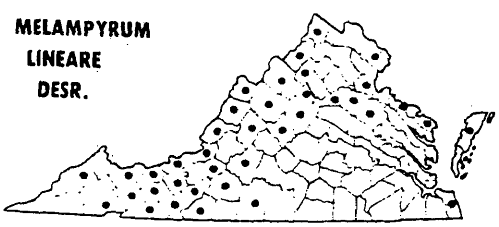
MAGNOLIA TRIPETALA L.



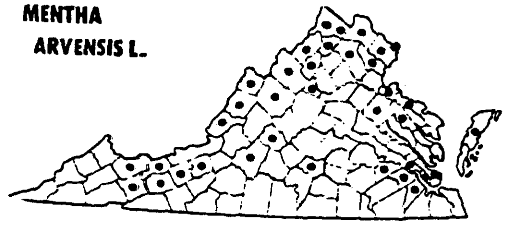
MITELLA DIPHYLLA L.



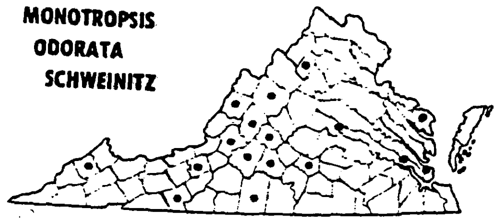
MELAMPYRUM LINEARE DESR.



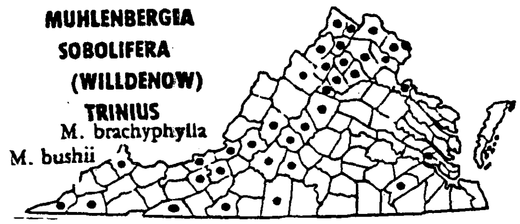
MENTHA ARVENSIS L.



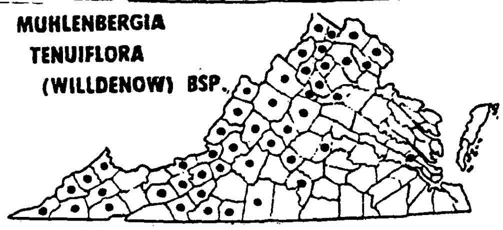
MONOTROPSIS ODORATA SCHWEINITZ



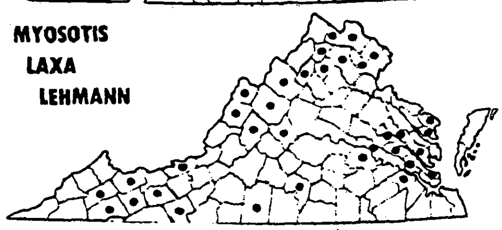
MUHLENBERGIA SOBOLIFERA (WILLDENOW) TRINIUS



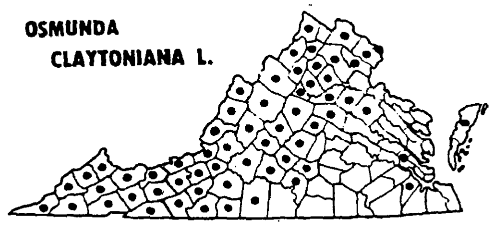
MUHLENBERGIA TENUIFLORA (WILLDENOW) BSP.



MYOSOTIS LAXA LEHMANN



OSMUNDA CLAYTONIANA L.



PARIETARIA PENSYLVANICA WILLDENOW

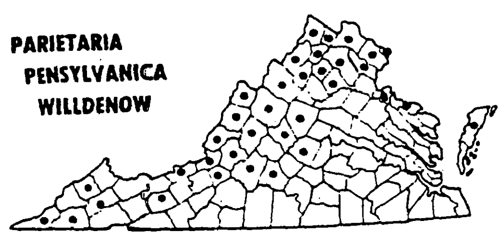


Fig. 3 (continued)

Strongly Disjunct Species

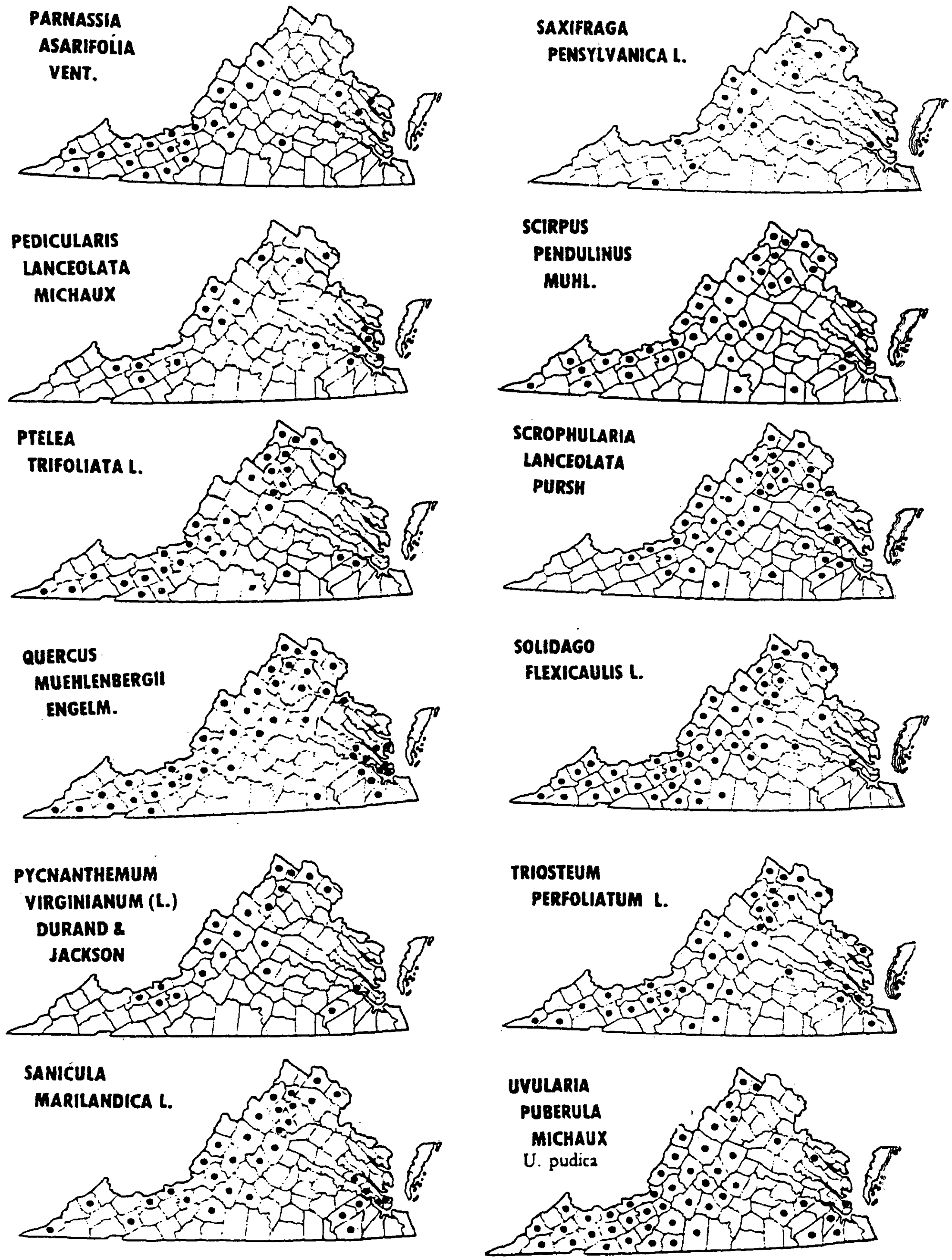
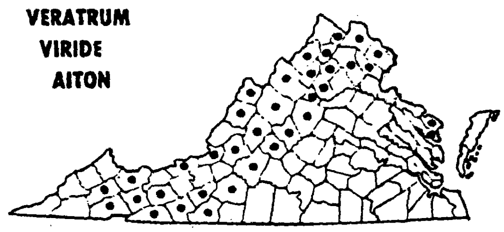


Fig. 3 (continued)

Strongly Disjunct Species



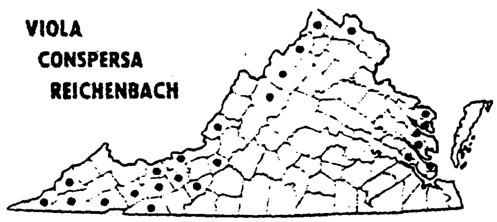


Fig. 3 (continued)

Less Disjunct Species

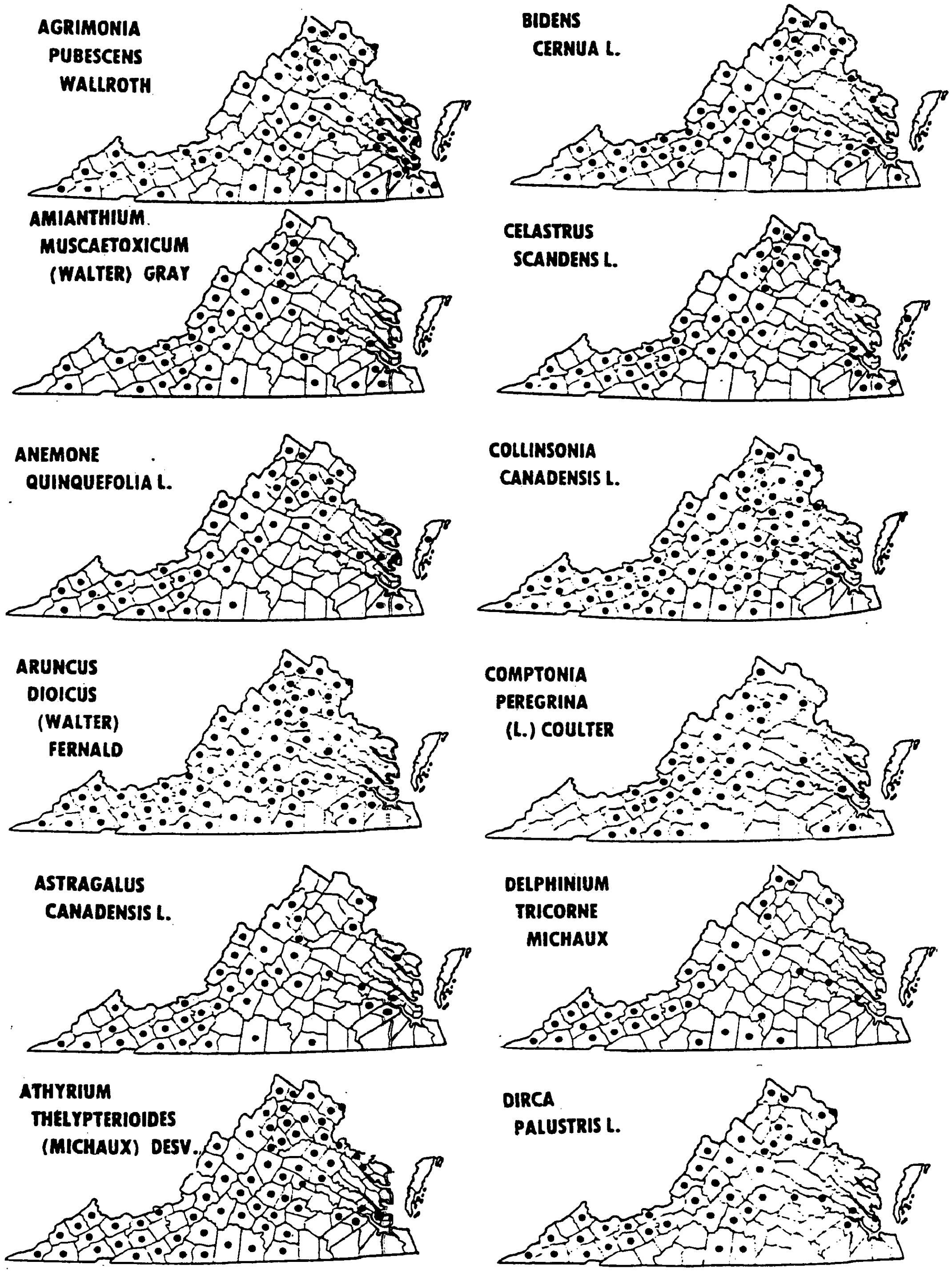


Fig. 3 (continued)

Less Disjunct Species

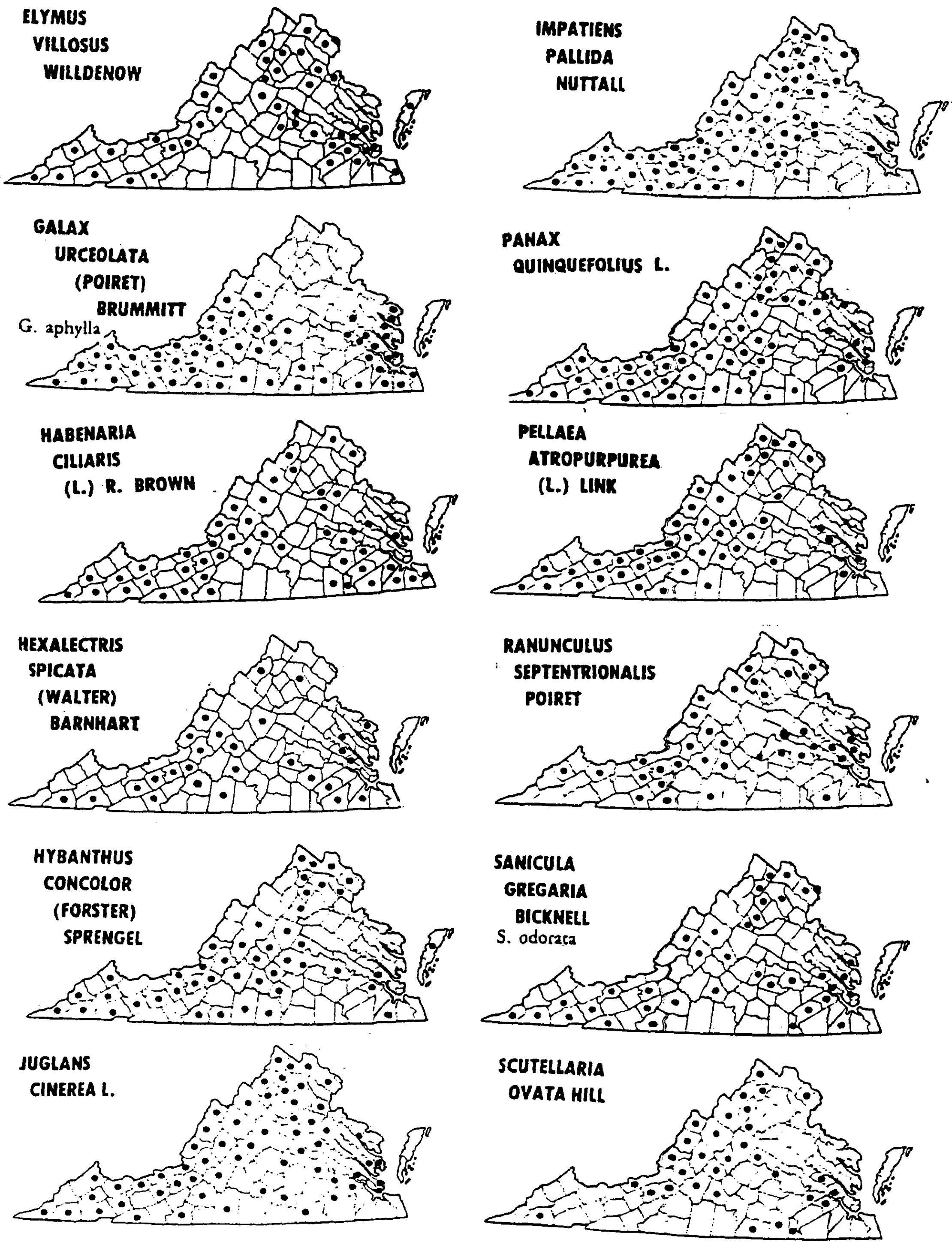


Fig. 3 (continued)

Less Disjunct Species

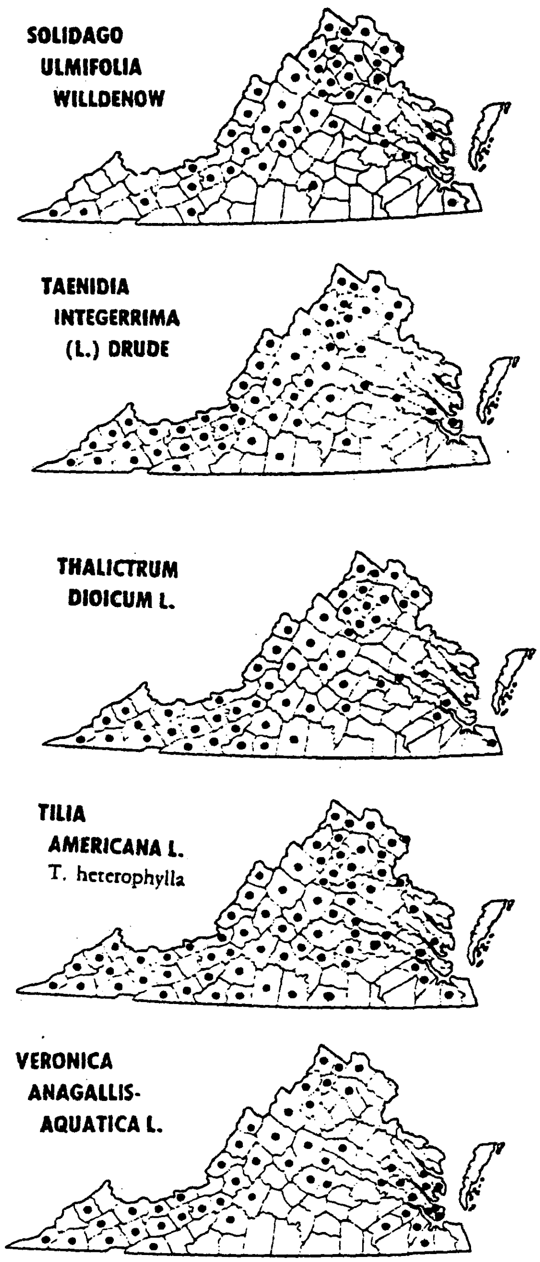


Fig. 3 (continued)

Miscellaneous Disjunct Species

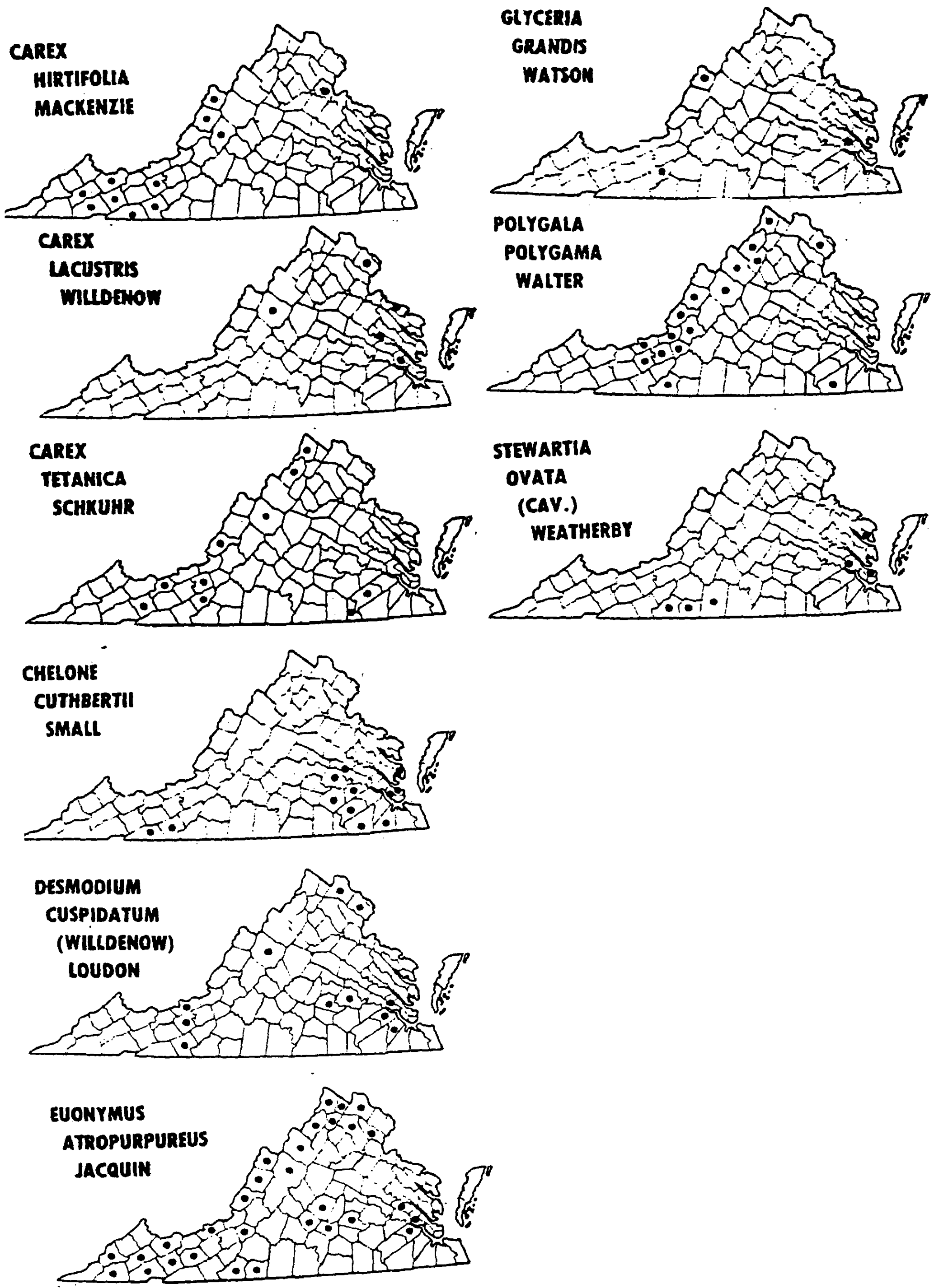
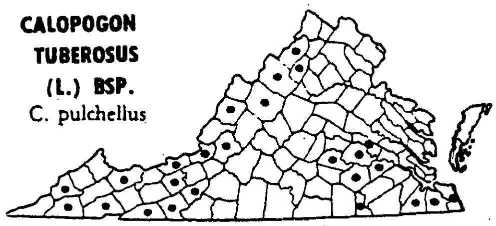
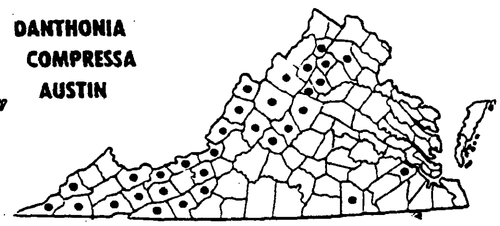


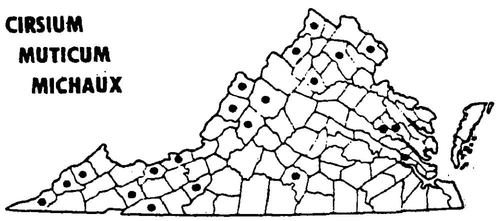
Fig. 3 (continued)

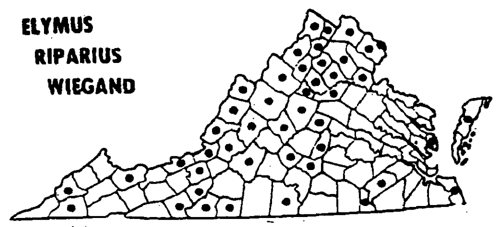
Addendum to Fig. 3

Strongly Disjunct Species

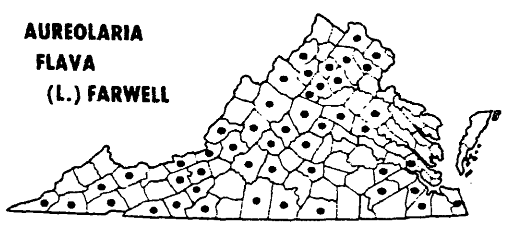


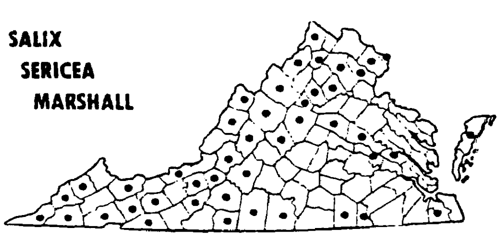






Less Disjunct Species





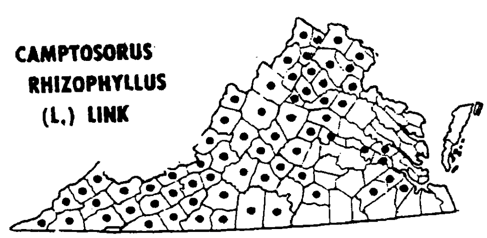


Fig. 3 (continued)

In order to better understand the distribution of these species previously designated "less strongly disjunct", maps were created in Arc View 3.2 (ESRI 1999) of individual collection locations in each county, based on herbarium data. The herbaria of The College of William and Mary (WILLI), Virginia Polytechnic Institute (MASSE), Longwood College (FARM), and George Mason (GMUF) were visited and specimens of mountain disjuncts examined. These herbaria were chosen because they hold the most collections from the Coastal Plain (WILLI), mountains (MASSE), and Piedmont (FARM & GMUF) of Virginia. Herbarium label data were collected for each species identified as a mountain disjunct. The following information was recorded for each specimen examined: collector, collector number, date, county where the plant was collected, collecting location, and any ecological information included. Only Virginia specimens were examined. The collection information from these herbaria could be used to map species' distributions across Virginia. The number of specimens of disjunct species examined are given in Appendix A. In some cases no specimen was found in these herbaria to document the Atlas dots for certain counties.

ArcView 3.2 (ESRI 1999) was used to map the individual collection locations for mountain disjuncts considered "less disjunct". Before any collections were mapped, duplicate specimens were removed from the data set. Herbarium label information was used to pinpoint the collection location of each specimen on the *Virginia Atlas and Gazetteer* (1995). The Gazetteer was used because it includes topographic features, has labeled landmarks, and has county route numbers identified. Once the collecting locations were identified on the

Gazetteer map, the approximate locations were then mapped in ArcView 3.2 (ESRI 1999) on a base map of Virginia. The base map includes the state boundaries and each county's delineation. This mapping of actual locations of collections allowed the assessment of the actual width of the distribution gaps.

Vegetation Studies

The herbaceous and woody vegetation of calcareous ravines in which mountain disjuncts occurred were quantitatively sampled. The vegetation of some non-calcareous ravines in the Coastal Plain was also quantitatively sampled and compared to the vegetation in calcareous ravines in order to examine any vegetational difference between ravines on different substrates.

Selection of Study Sites

Most disjunct species have been found almost entirely in and around ravines that cut into the Yorktown Formation. Therefore, ravines known to cut into that formation were explored in order to locate disjunct populations of plants. If a ravine in a system of ravines contained disjuncts, neighboring ravines were explored as well. The uplands just above the ravine slopes and the ravine floodplain, if present, were also explored before deciding whether a ravine should be sampled and where transects should be placed within it. Ultimately, fifteen calcareous ravines with disjuncts were chosen for sampling. Ravines that opened in several different directions were included. In addition, three ravines without disjuncts, none on the Yorktown Formation, were chosen for sampling and are called non-calcareous ravines.

Study sites were chosen in five counties in the Coastal Plain of Virginia: James City Co., York Co., Gloucester Co., Surry Co., and Lancaster Co. (Fig. 4). A total of 15 calcareous ravines and 3 non-calcareous ravines were sampled. In James City Co., a total of eight calcareous ravines and three non-calcareous ravines (not cutting into the Yorktown Formation) were selected. Seven ravines were studied in the College Woods, six calcareous and one non-calcareous. Two other non-calcareous ravines selected were on the Casey Tract, off Jester's Lane in Williamsburg. Two other calcareous ravines were in the Grove Creek Watershed, one near the Old Country Rd., Carter's Grove and the other off Rt. 60 near Busch Gardens.

In York Co., two calcareous ravines were sampled in the Cheatham Naval Annex Supply Center. In Gloucester Co., two calcareous ravines were selected off Hickory Fork Rd. across from the county Convenient Center #4, otherwise known as the Gum Fork dump. In Surry Co., two calcareous ravines were sampled along College Run in Chippokes Plantation St. Park. In Lancaster Co., one calcareous ravine was sampled in the portion of Cabin Swamp called Hickory Hollow. See topographic maps provided in the Appendix B for exact locations of ravines.

The topography of a ravine and the distribution of disjunct plants within it determined where transects were placed. In calcareous ravines transects were always positioned in order to intersect one or more groups of mountain disjunct plants. Transects consisted of a series of plots starting on the upland edge on one side of the ravine, extending down the slope, into the floodplain (if present), up

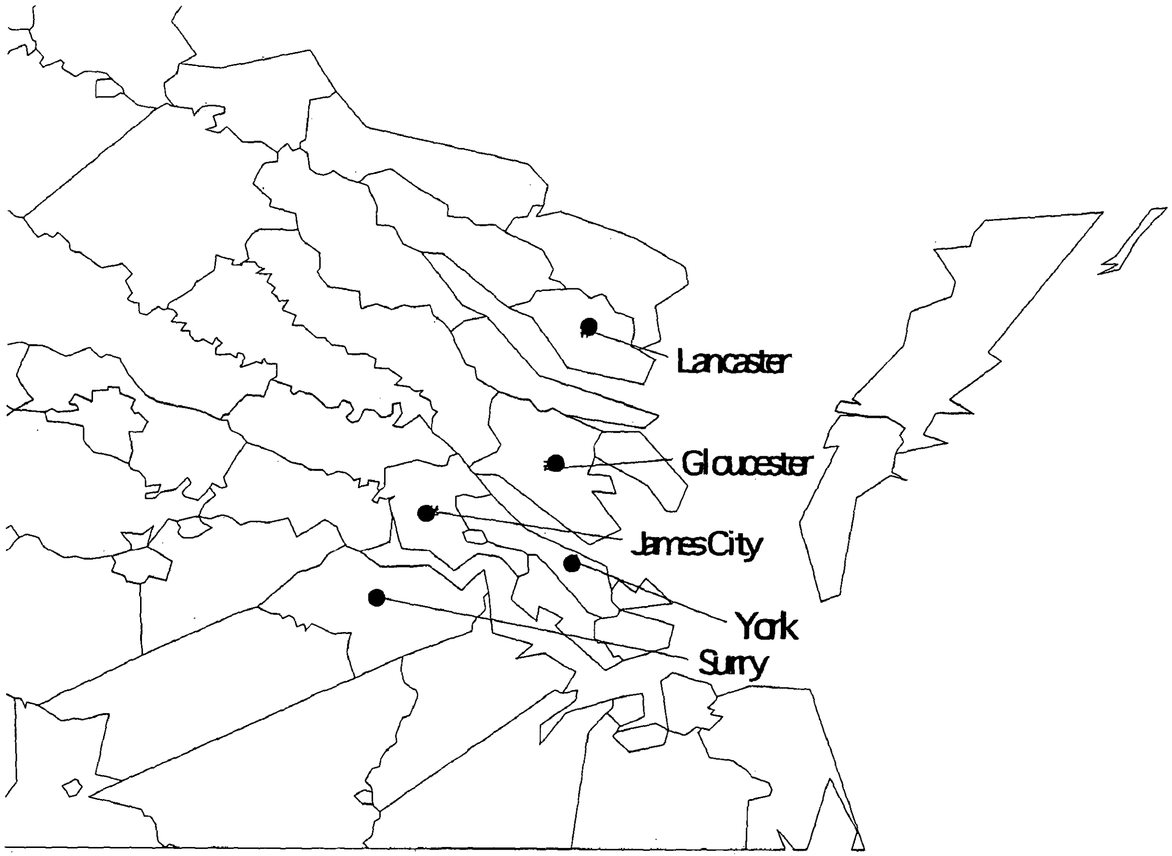


Fig. 4 Map of the Virginia Coastal Plain showing the five counties with study sites. In Lancaster Co., one ravine was studied; in Gloucester Co., two ravines were studied; in James City Co., eleven ravines were studied (eight calcareous and three non-calcareous); in York Co., two ravines were studied; and in Surry Co., two ravines were studied. A total of fifteen calcareous ravines and three non-calcareous ravines were sampled.

the other slope and ending on the upland edge of the other side (Fig. 5). In smaller ravines, the slopes converged to form a narrow crevice-like bottom with no real floodplain, and so no floodplain plots were established. The number of and distance between transects in each ravine varied depending on the overall size of the ravine and the distribution of populations of disjunct plants within the ravine. The first transect was placed at the head of a ravine, and then parallel transects were placed approximately every 15m until the ravine ended. Along each transect, plots were placed to insure inclusion of disjunct plants where possible, although disjunct species were rarely present on the upland. This methodology was chosen for this study to ensure that all disjunct species present in a ravine were represented in one or more plots. In non-calcareous ravines without disjunct species, transects and plots along transects were placed systematically without reference to presence or absence of species.

Sampling of Ground Layer Vegetation and Collection of Environmental Data

In the summer (June-August) of 1999 and spring (May) 2000, 1 x 1m plots were placed at intervals in each transect in the ravine, and permanent stakes were placed in each corner of the plot. Colored flagging was used to mark one corner of each plot to allow for easy relocation during later visits.

Once the plots were placed along the transects, the following ecological data for each plot were collected: coverage of each species present in the plot, density or number of stems, the angle of the slope, the direction of the slope, the percent canopy cover over the plot, a list of the canopy cover species and tall shrub cover over the plot. Coverage was estimated using a modification of

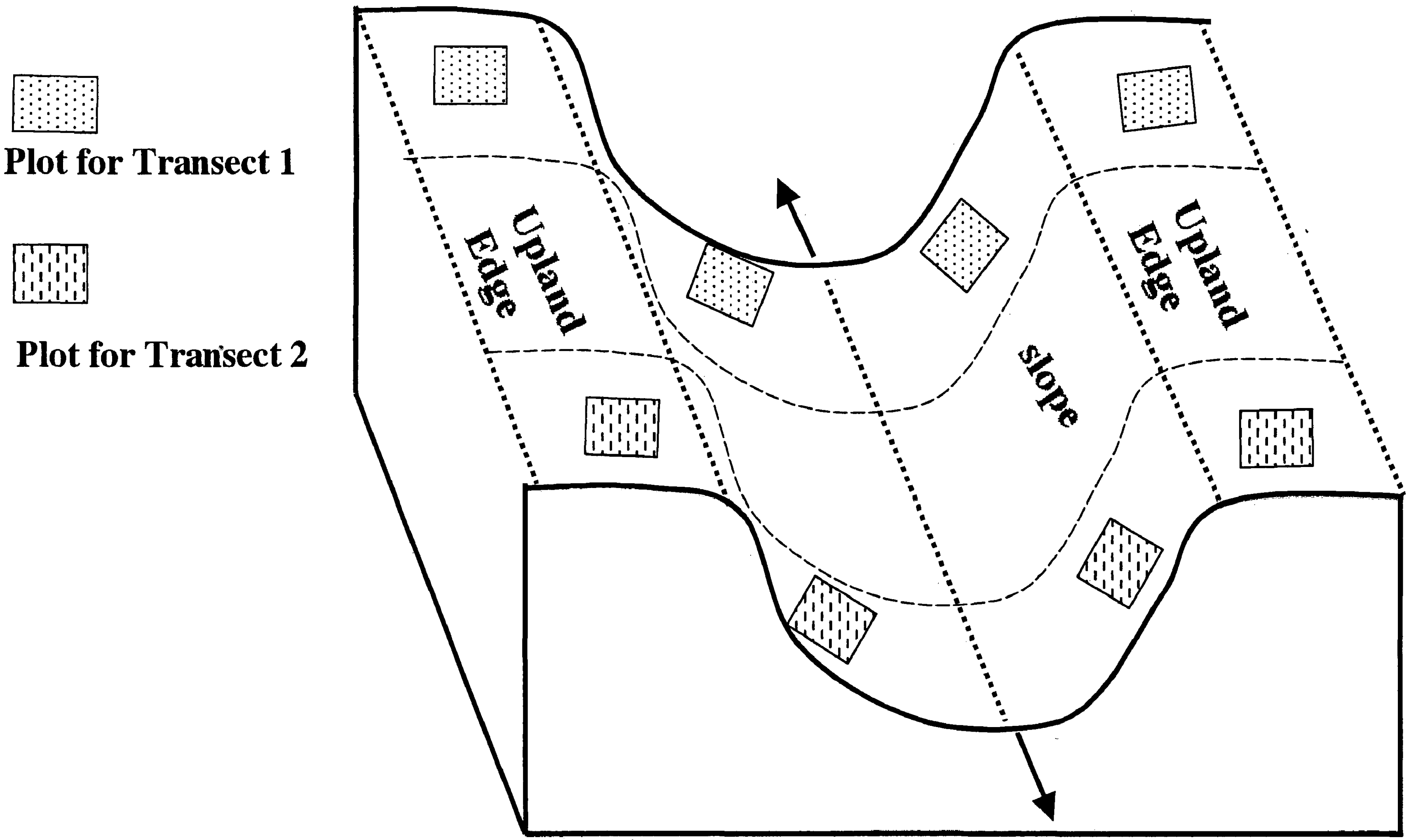


Fig. 5 Cross-section of a typical ravine with 1 x 1m plots set up in transects to sample the ground layer vegetation. Ravine plots are situated along the slopes and upland edges, but not the floodplain. Floodplain plots were placed in ravines when there was a distinct level floodplain between the two slopes.

Daubenmire's (1968) cover class system. Sterile dwarf ericads were combined as "*Vaccinium spp./ Gaylussacia spp*". Species were recorded into the coverage categories in Table 3. The coverage class "P" was used when a species was present in a plot but did not have a significant coverage in that plot. Species represented in a plot by a single- stemmed, juvenile usually fit into this category.

Density was recorded using Cain and Castro's (1959) estimation classes. These categories are S (Scarce) consisting of 1 to 4 stalks; I (Infrequent), 5-14 stalks; F (Frequent), 15-29 stalks; A (Abundant), 30-99 stalks; and V (Very Abundant), 100 or more stalks per square meter quadrat. For species that were several-stemmed such as ferns, grasses and sedges, individual stems were not counted, but the group of stems was counted as one stem. Multiple leaves of a fern were considered to be from one individual and it was fairly clear where one individual began and ended. However, in the grasses and sedges, it is more difficult to separate individuals; therefore to aid in data collection, tussocks were considered one stem. In species like *Asmina triloba* that produce many stems attached underground by rhizomes, individual stems were counted because it was impossible to discern where one individual began or ended.

Relative coverage and relative density were calculated for each species in a plot and then combined into an importance value (based on a 200% scale). The importance values for species in plots along the same topographic position (upland edge, slope and floodplain) in a ravine were averaged as were the environmental measurements for these same plots, and averaged values were used in the ordinations performed.

Table 3. Coverage classes for the ground layer vegetation. Appropriate classes were assigned to individual species in each plot. The mid-point value of each class was used to determine the relative coverage for each species in a plot. "P" was used in instances where a trace of the species occurred but was not used to calculate relative coverage or was too small to be placed in a coverage class.

Class	Range of Coverage
1	1-5%
2	5-10%
3	10-15%
4	15-20%
5	20-25%
6	25-30%
7	30-35%
8	35-50%
9	50-75%
10	75-95%
11	95-100%
P	Present

The direction of the slope was determined by using a compass. The angle of slope was determined by using a protractor with a weight tied by a string to the protractor's center. The flat side of the protractor was placed parallel to the slope and the angle of the slope was recorded as indicated by the string.

Canopy cover for a plot was estimated by standing over the plot on each of its sides and taking the average percentage of canopy cover as viewed from each of those sides. The tree species comprising the canopy cover were also recorded. Shrub cover was estimated as the area each species covered over the plot.

In addition to these data, as the plots were revisited during the summer and fall, evidence of herbivory in a plot was recorded. As the population size of white-tailed deer has increased in the Coastal Plain, the evidence of their presence has become more apparent. Any evidence that stems in a plot had been chewed on was noted, and which species were grazed upon was recorded.

Soil samples were collected in the fall of 1999 and the spring of 2000. Separate collections were made from the upland edge, slopes, and floodplain (if present) of each ravine examined. A minimum of 5 collections were made for each topographic type at approximately 20 pace intervals between each collection. Equal amounts of soils were taken from each collection site, and collections for an individual section of a ravine were placed in a Ziploc bag and then taken back to the lab. For longer ravines, more than one series of samples were gathered for each topographic feature, one near the head of the ravine and another down the ravine. Each soil sample was mixed well, spread out to dry, and then boxed and sent to the Virginia Tech Soil Testing Lab for analysis of pH, P, K, Ca, Mg, Zn, Cu, Fe, and B. The soil data were tested for correlation with the ordinated vegetation data.

Sampling of Woody Vegetation

Woody plant sampling was conducted in order to examine the forest communities at each of the study sites, and to collect data on the associates of disjunct woody plants. Sampling in each ravine was continued until the forest canopy vegetation over all herbaceous plots had been included and the woody disjuncts recorded. The combined Bitterlich-circular quadrat method was used and modified to fit the topography of the ravines. The height of ravine slopes from the ravine bottom to the level uplands was insufficient for placement of a full Bitterlich circle on one side of the ravine without sampling portions of the upland community. Therefore, I followed Mort (1994) in using half-circle plots, a modification of the Bitterlich-circular method he devised for such situations. Each sampling point was placed at the bottom of the slope, and half-circle rather than a full circle was surveyed upslope from that point. Basal area was determined by the Bitterlich method at each half-circle. Density was taken by counting separately large stems (>10.16 cm dbh), understory stems (> 2.5 cm, < 10cm dbh), and shrub-sapling stems (< 2.5 cm dbh) stems in a 10 m radius half circle. Relative basal area and relative density of large stems were averaged to give Importance Values (I.V.) for each species in each stand. Relative density alone was calculated for understory stems and shrub-sapling stems, since no measure of basal area was taken for these small stems. In rare situations where the ravine bottom was a wide floodplain, a full circle plot was used in sampling the woody vegetation, and all the above data calculated accordingly.

Ordination Analysis

The indirect ordination method Detrended Correspondence Analysis (DCA) performed by the program CANOCO was used to analyze the herbaceous and woody vegetation data collected (Ter Braak 1988). The program examines the similarity and differences in species composition among the plots and allows one to graphically display the plots in relation to one another based on that composition. Therefore, the importance values of species in each plot were the variables ordinated. Environmental variables were then tested for correlation with the first and second axes of the ordination. The occurrences of dominant species in plots and the presence of mountain disjunct species are indicated on the ordinations. Environmental variables that were significantly correlated with the first and second ordination axes at the $P < 0.05$ level are indicated on the DCA ordinations.

Soil Tolerance Experiments

The hypothesis that both Coastal Plain and mountain populations of disjunct species grew differently on calcareous and non-calcareous soil was tested. Seeds were collected from either the mountains, the Coastal Plain, or both for eight disjunct species, and sufficient seed germination for setting up experiments was obtained for five species (Table 4). The location of seed sources are included in Appendix C.

Table 4. Mountain disjunct species used in the soil tolerance experiments. The "X"s indicate the physiographic province(s) from which the seeds were collected. They were germinated and grown on basic high calcium soil and acidic low calcium soil. N/A indicates that seeds of a given species did not germinate or died soon after germination.

Mountain Disjunct Species	Coastal Plain Seed Collection	Mountain Seed Collection	Number of Blocks/ Replicates
Desmodium glutinosum	X	X	4
Aralia racemosa	X	X	9
Aruncus dioicus	X		4
Solidago flexicaulis	X	X	12
Actaea pachypoda	X	X	N/A
Collinsonia canadensis		X	12
Agrimonia gryposepala		X	3
Veronica anagallis-aquatica	X		N/A

The growth of newly germinated seedlings of these species on calcareous soil and non-calcareous soil was examined using a randomized block design. Both calcareous and non-calcareous soils were collected in the Coastal Plain, in James City Co. The calcareous soil had a pH of 5.9 and a calcium level of 1864.7 ppm, and non-calcareous soil had a pH of 4.3 and a calcium level of 120.0 ppm. Other data on soil minerals for the two soil types are recorded in Table 5.

The seeds of all species and populations were given a moist cold treatment in a dark refrigerator at approximately 5 ^{oC} for 12 weeks. Seeds were germinated on moist filter paper in petri plates in the greenhouse. When cotyledons and two permanent leaves were present, seedlings were transplanted to 10 cm diameter plastic pots containing calcareous soil or non-calcareous soil. Both soil types were collected in James City Co., the calcareous soil was collected in the College Woods in the *Actaea pachypoda* Ravine (Appendix B) and the non-calcareous soil was collected on the Casey Tract in Ravine #1 (Appendix B). Transplanted seedlings that died in the first week were replaced; however, those that died more than a week after transplanting were not. All pots were kept continuously moist, but not saturated. The number of blocks or replicates depended on the number of seeds that germinated and survived and therefore is different for each species; they varied from 3 to 12 (Table 4). For species with seeds from both the mountains and the Coastal Plain a block consisted of 4 pots: a pot with a mountain plant on high calcium soil, a pot with a mountain plant on acidic, low calcium soil, a pot with a Coastal Plain plant on calcareous soil and a pot with a Coastal Plain plant on non-calcareous soil. The blocks were rotated

Table 5. Soil chemistry data for the two types of soil (calcareous and non calcareous) used in the greenhouse experiment. The units for minerals are recorded in ppm.

Soil Type	**pH**	**P**	**K**	**Ca**	**Mg**	**Zn**	**Mn**	**Cu**	**Fe**	**B**
Non-calcareous soil	4.3	1.0	53.0	120.0	39.5	1.4	4.0	0.3	37.0	0.2
Calcareous soil	5.9	5.5	40.5	1864.7	38.5	1.8	10.4	0.3	22.6	0.5

every 2 days to minimize any position effects in the greenhouse that may have occurred.

The experiment was carried out through the spring and early summer growing seasons. After 12 weeks, all surviving plants were severed at the base of the stem, dried for 36h at 100 C, allowed to cool and then weighed to the nearest 0.1 mg. For species that had seeds from both the mountains and the Coastal Plain a two way ANOVA was performed to detect significance between the groups and a one way ANOVA was used for those species with seeds from just one physiographic province.

RESULTS

Maps of Individual Collection Locations for the Less Disjunct Species

The maps of individual collection locations were divided into categories based on whether or not the perceived disjunct distribution was more pronounced after mapping. The first category includes maps of species whose disjunction is more prominent than on their Atlas maps. This category is further divided into two subgroups: those species whose disjunction is 2-3 counties wide across the Piedmont, and those whose disjunction is only 1 county wide at some point in the Piedmont, but wider for most of its distribution. The second category is composed of those species whose individual collection locations maps did not elucidate new information about their disjunction. The third category consists of those that have a more filled in distribution, and whose disjunction is therefore probably no longer supportable. Although, the primary range of less disjunct species is centered in the mountains it sometimes includes the western Piedmont and western Coastal Plain and 6 of the 20 species mapped show this.

This first category singles out 8 of the 20 less disjunct species that when mapped showed a greater resolution of their disjunctions as compared to their Atlas maps. The first subgroup of the first category includes those species whose

Atlas maps show a 1 or 2 county gap, and when individual collection locations are mapped the gap is maintained or extended to 2 to 3 counties throughout most of the Piedmont. The members of the first subgroup are *Amianthium muscaetoxicum* (Fig. 6), *Comptonia peregrina* (Fig. 7), *Galax urceolata* (Fig. 8) and *Anemone quinquefolius* (Fig. 9). The gaps in the distribution of these species was widened, and mostly because the collection locations in the western Piedmont counties are often located in the western, not eastern part of the county. This is especially so for *Amianthium muscaetoxicum* (Fig. 6). In the case of *Galax urceolata* (Fig. 8), a non-calciphile, the collection locations in the Coastal Plain are in the eastern portion of Coastal Plain counties, thereby making the mountain-Coastal Plain gap even greater. *Comptonia peregrina* (Fig. 7), also a non-calciphile, has a few collections in the central Piedmont. These few collections do not necessarily weaken this species' disjunct status because they may represent a specific microhabitat site which may also be required in the mountains and the Coastal Plain. The map for *Amianthium muscaetoxicum* (Fig. 6) shows that many specimens of this species were collected along the Appalachain Trail in the Blue Ridge. This may represent a collecting artifact.

The second subgroup of the first category contains *Dirca palustris* (Fig. 10), *Bidens cernua* (Fig. 11) *Scutellaria ovata* (Fig. 12), and *Taenidia integerrima* (Fig. 13). The Atlas maps for species in this subgroup indicate a thin corridor of collections from the western Piedmont counties, through the central Piedmont to the Coastal Plain, and will be referred to as the Piedmont-Coastal Plain corridor. The collection locations along this Piedmont corridor determine the spatial extent of those disjunctions. The Atlas map for *Taenidia integerrima* (Fig. 13) and *Bidens*

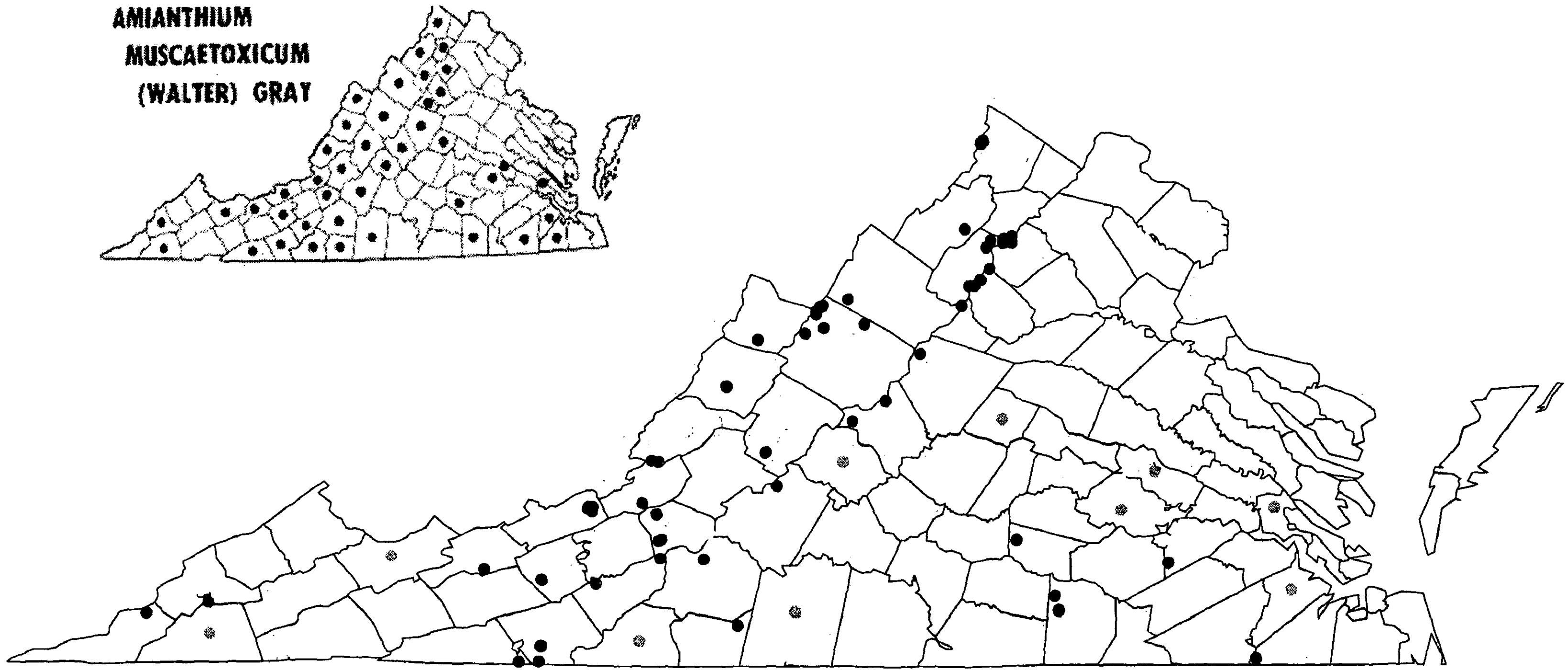
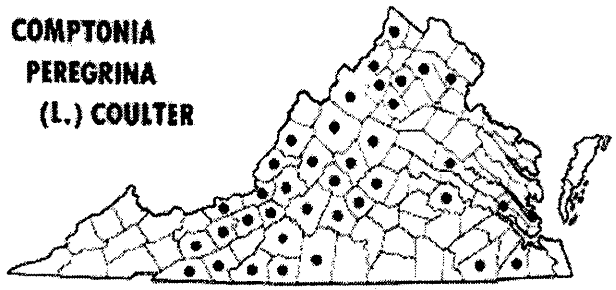


Fig. 6 Map of individual collection locations for *Amianthium mucaetoxicum.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 1 because many collections found in the Piedmont counties were found in the western part of the county, thereby increasing its disjunction.



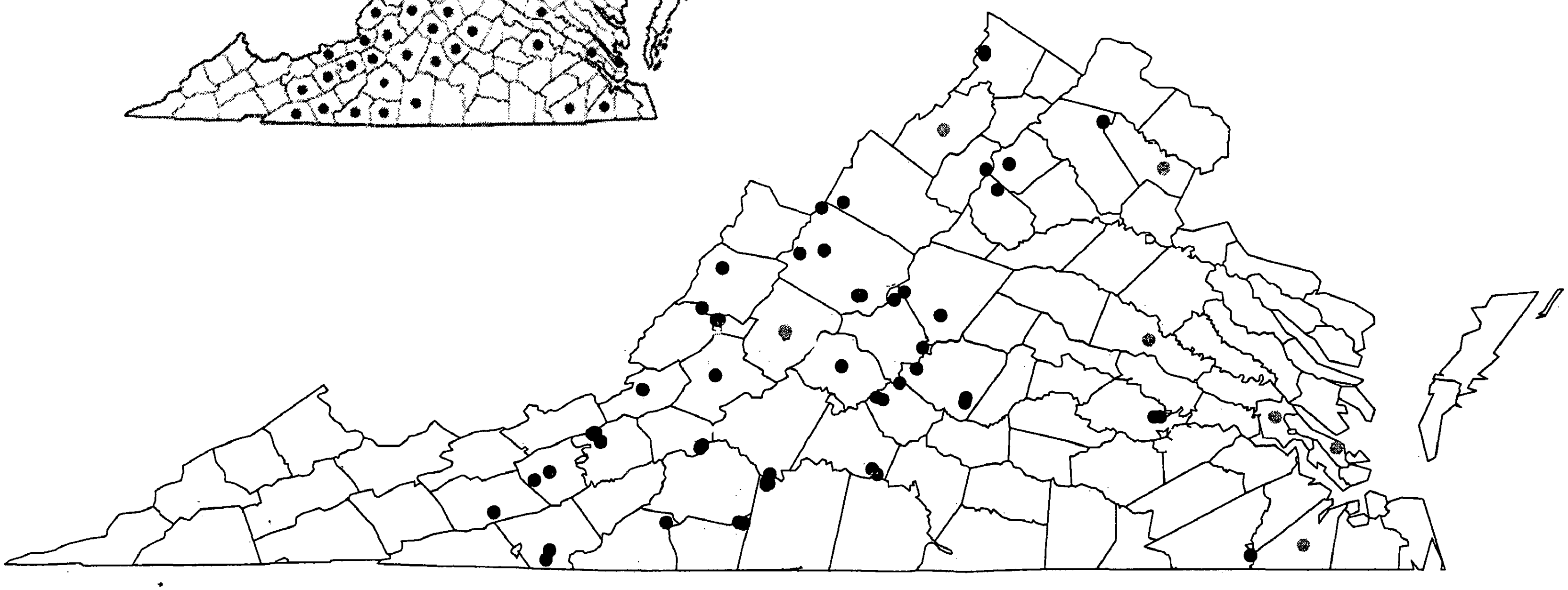


Fig. 7 Map of individual collection locations for *Comptonia peregrina.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 1 because its disjunction extends to more than two counties wide once mapped.

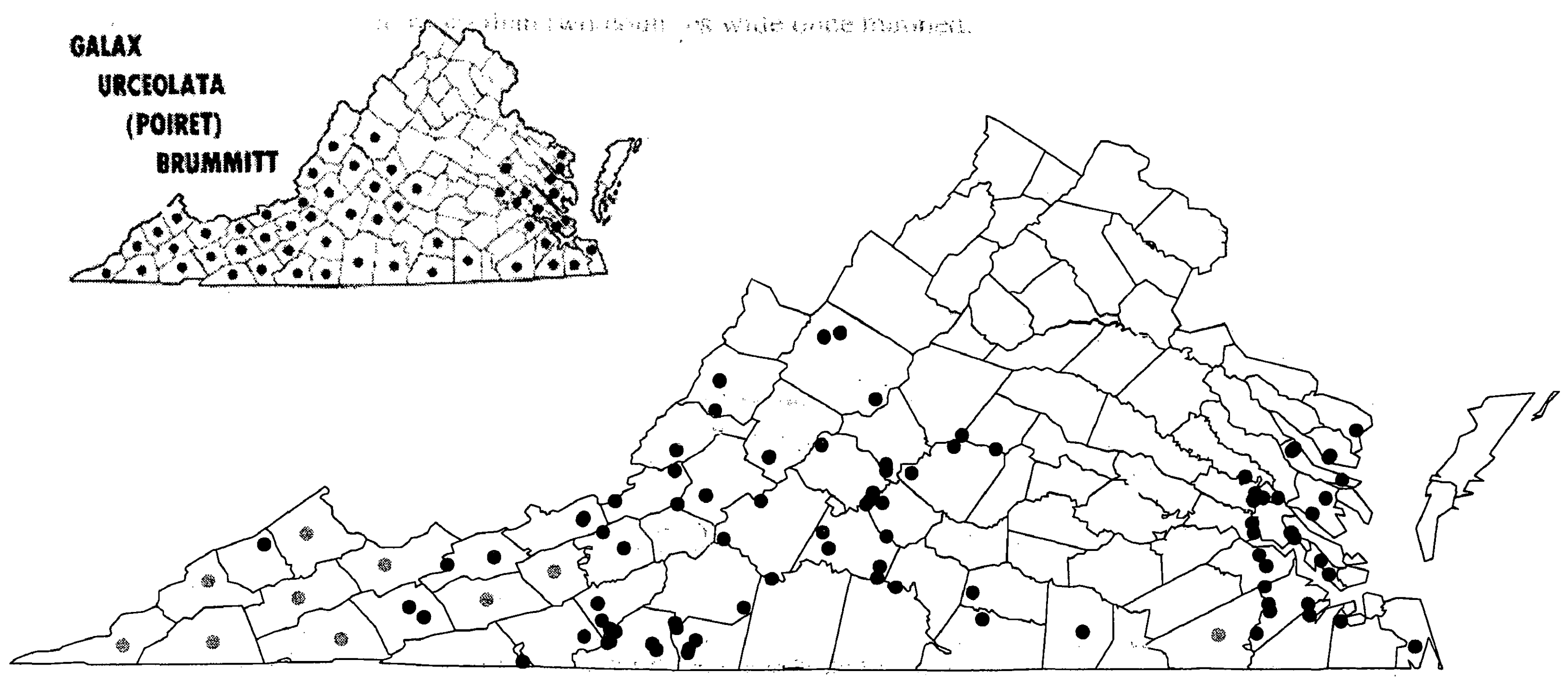


Fig. 8 Map of individual collection locations for *Galax urceolata.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 1 because its disjunction extends to more than two counties wide once mapped.

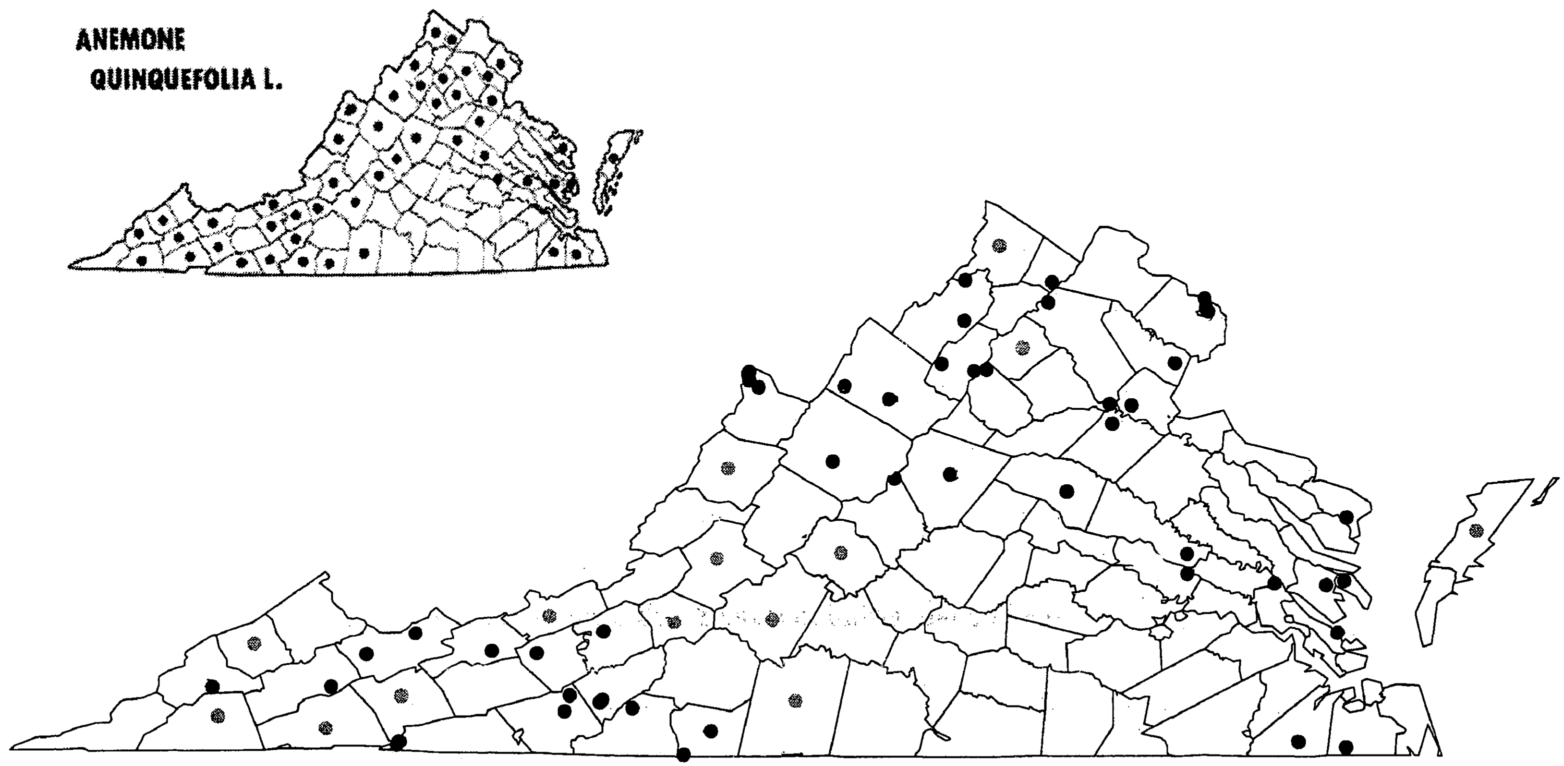


Fig. 9 Map of individual collection locations for *Anemone quinquefolia.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 1 because its disjunction is extended once mapped.

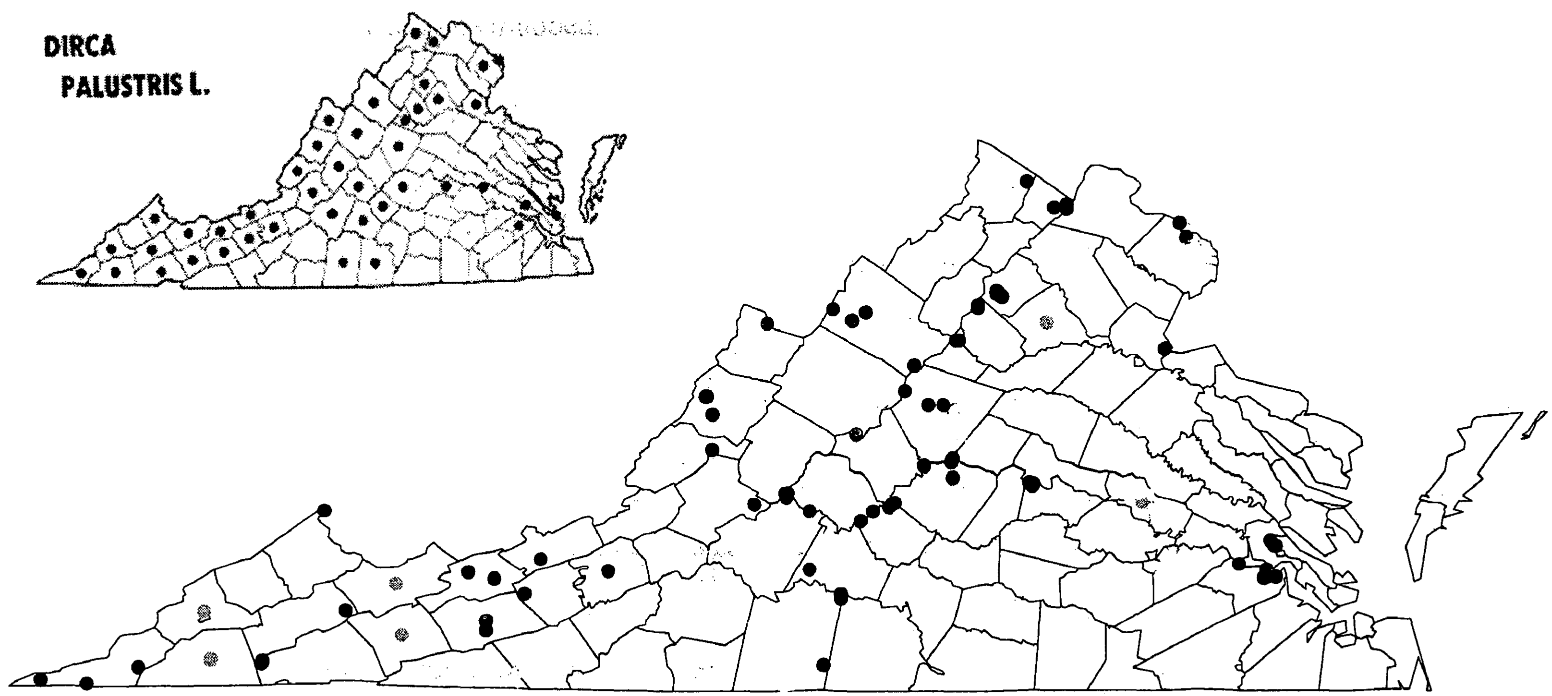


Fig. 10 Map of individual collection locations for *Dirca palustris*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 2 because a corridor of collections exists from the Piedmont to the Coastal Plain.

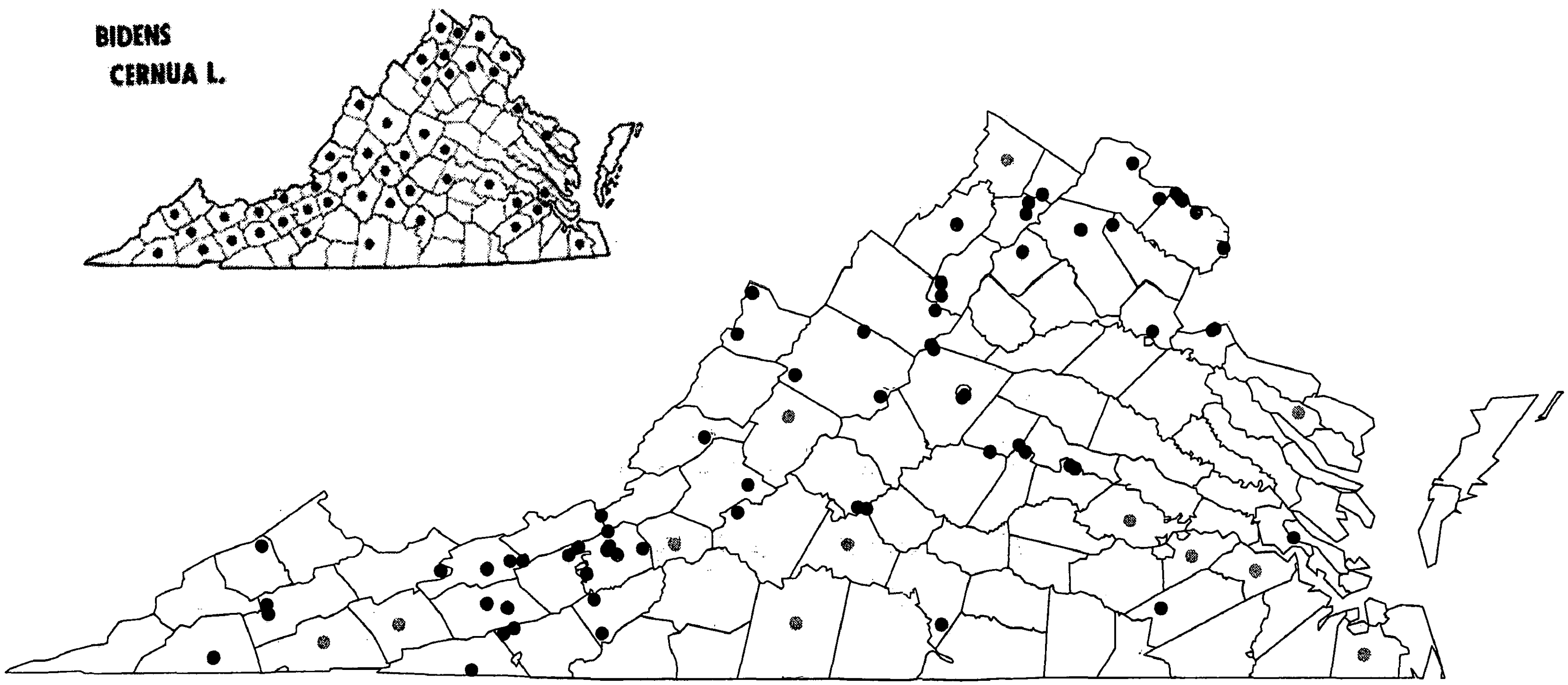


Fig. 11 Map of individual collection locations for *Bidens cernua.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 2 because a corridor of collections exists from the Piedmont to the Coastal Plain.

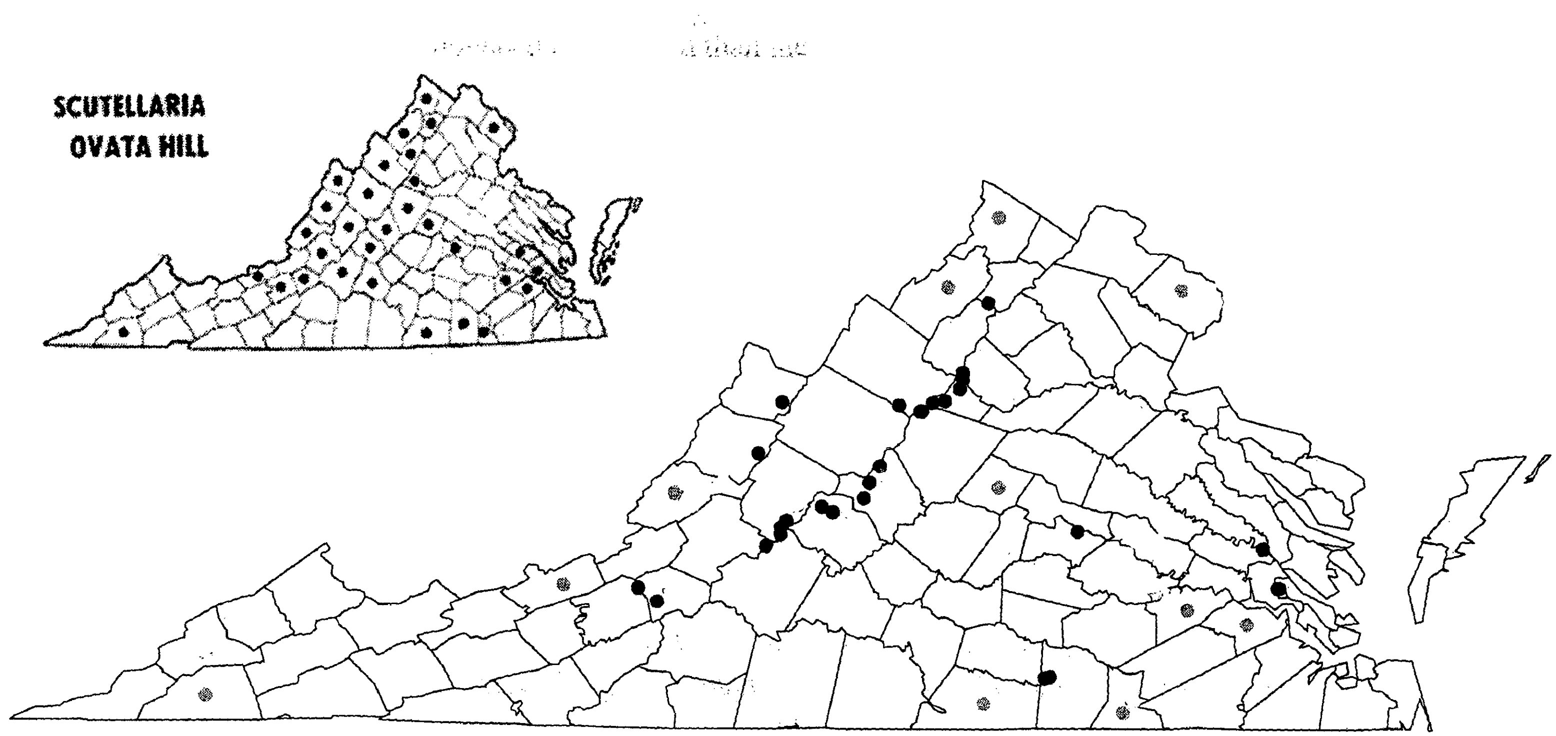


Fig. 12 Map of individual collection locations for *Scutellaria ovata*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 2 because a corridor of collections exists from the Piedmont to the Coastal Plain.

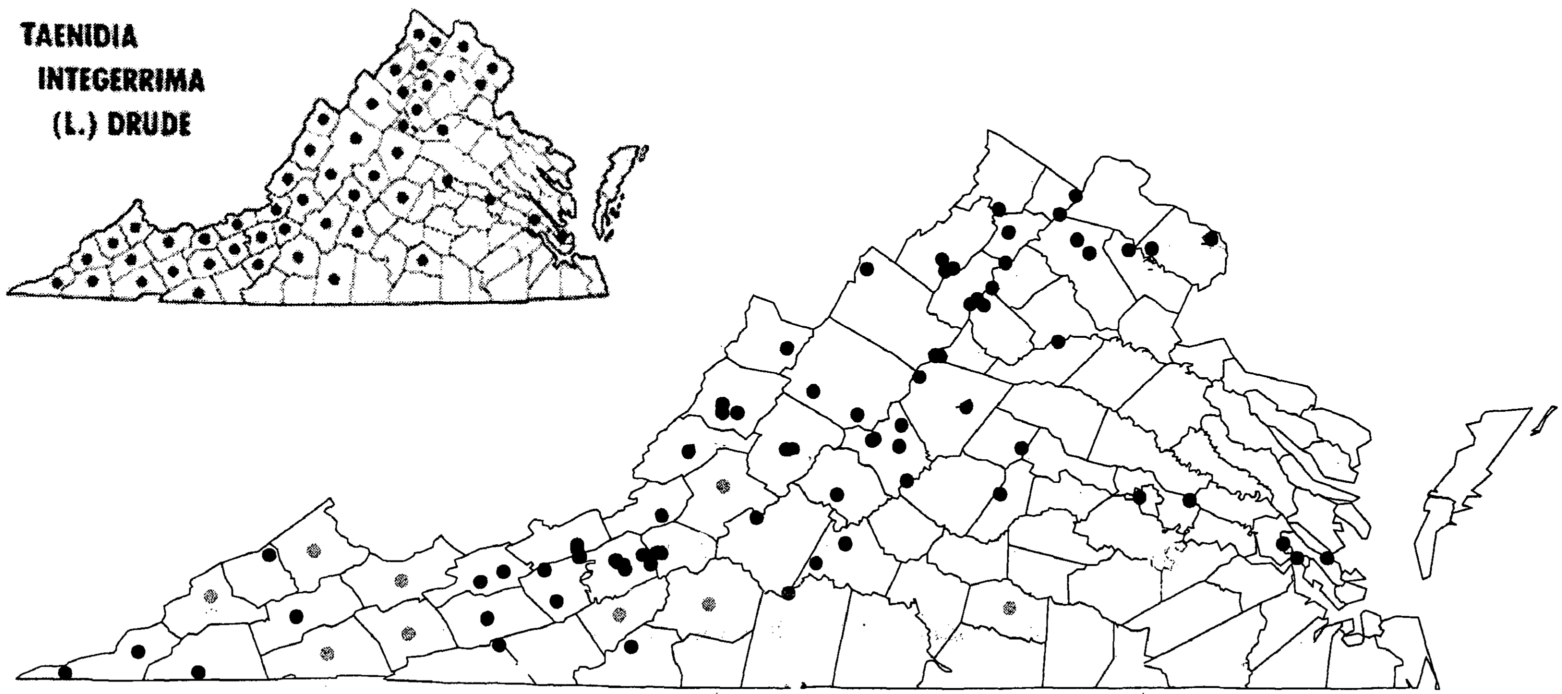


Fig. 13 Map of individual collection locations for *Taenidia integerrima.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map shows a more pronounced disjunction than the Atlas map, and belongs to category 1, subgroup 2 because a corridor of collections exists from the Piedmont to the Coastal Plain.

cernua (Fig. 11) have the most apparent Piedmont-Coastal Plain corridors and disjunctions. The individual collection locations maps for these species show that the collections along the corridor are located in the western part of the western and central Piedmont counties and the eastern part of the outer Coastal Plain counties, thereby creating a small disjunction of one county wide or less. The Piedmont-Coastal Plain corridor for *Taenidia integerrima* (Fig. 12) appears to be located along the James River. For *Scutellaria ovata* (Fig. 11) the individual collections map shows that it was collected along the Appalachian Trail in the Blue Ridge, and may represent a collecting artifact.

The second category consisting of 9 species *Tilia americana* (Fig. 14), *Veronica anagallis-aquatica* (Fig. 15), *Athyrium thelypteroides* (Fig. 16), *Collinsonia canadensis* (Fig. 17), *Panax quinquefolius* (Fig. 18), *Celastrus scandens* (Fig. 19), *Pellea atropurpurea* (Fig. 20), *Aruncus dioicus* (Fig. 21) and *Ranunculus septentrionalis* (Fig. 22) for which maps of individual collection locations did not make their disjunction more clear cut as they did for species in category 1. Atlas maps for *Athyrium thelypteroides* (Fig. 16) and *Collinsonia canadensis* (Fig. 17) are nearly filled in across the state with only a 1 county gap. For these two species the gap is in the inner Coastal Plain and instead of the Piedmont. *Ranunculus septentrionalis* (Fig. 22) and *Veronica anagallis-aquatica* (Fig. 15) follow very much the same pattern as those species in category 1 subgroup 2, that is, there is a central Piedmont-Coastal Plain corridor of collected specimens. These species are placed in this second group because their individual collections map do not elucidate anything new that their Atlas maps does not show. Overall, the species in this category can still be considered disjunct because at some point in both

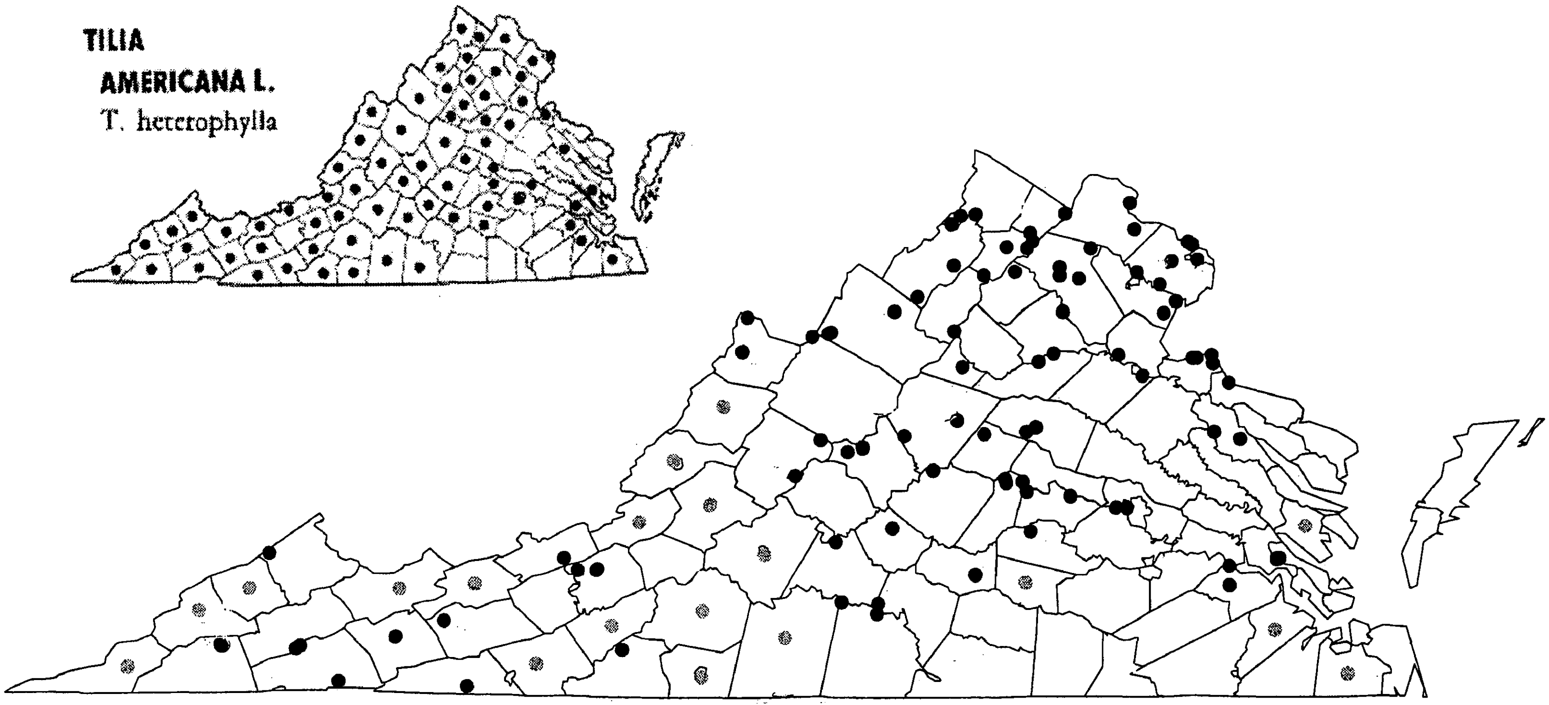


Fig. 14 Map of individual collection locations for *Tilia americana*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

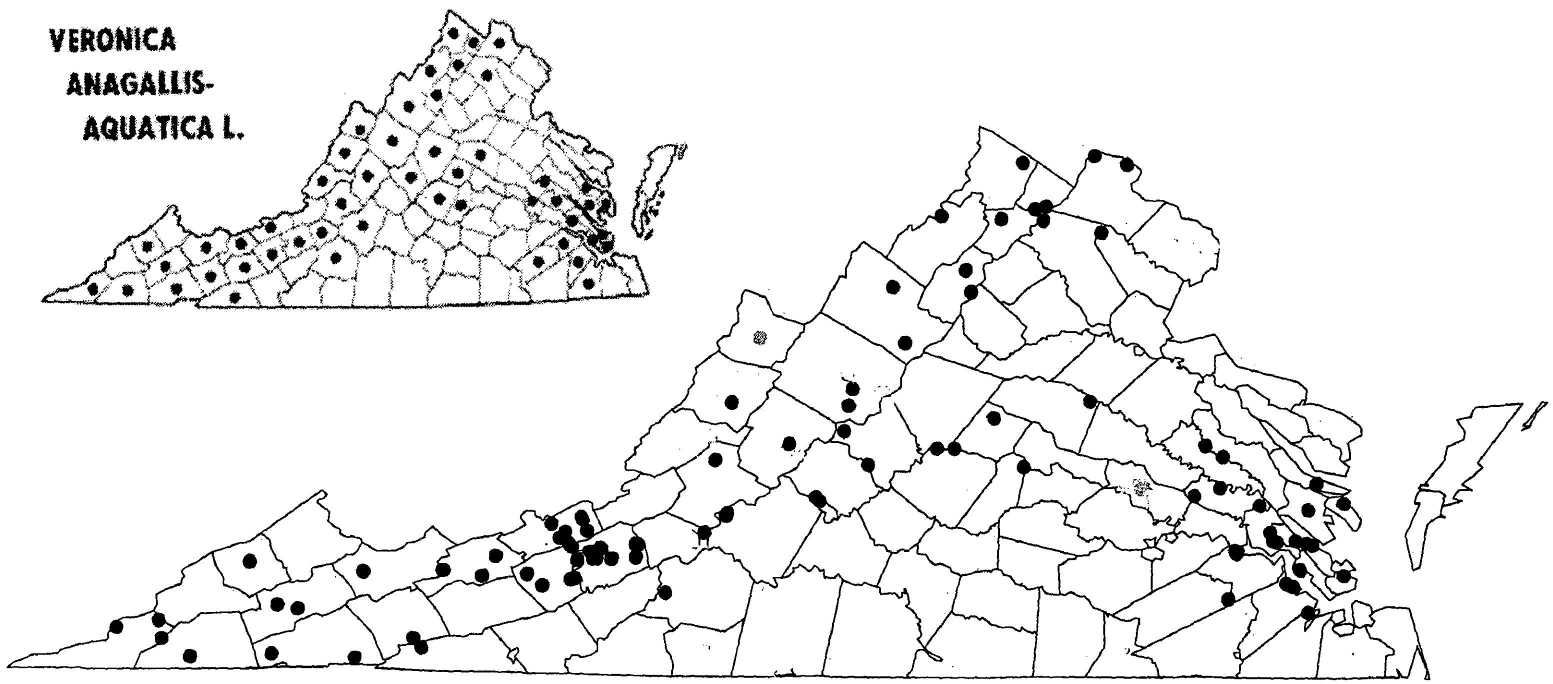


Fig. 15 Map of individual collection locations for *Veronica anagallis-aquatica.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

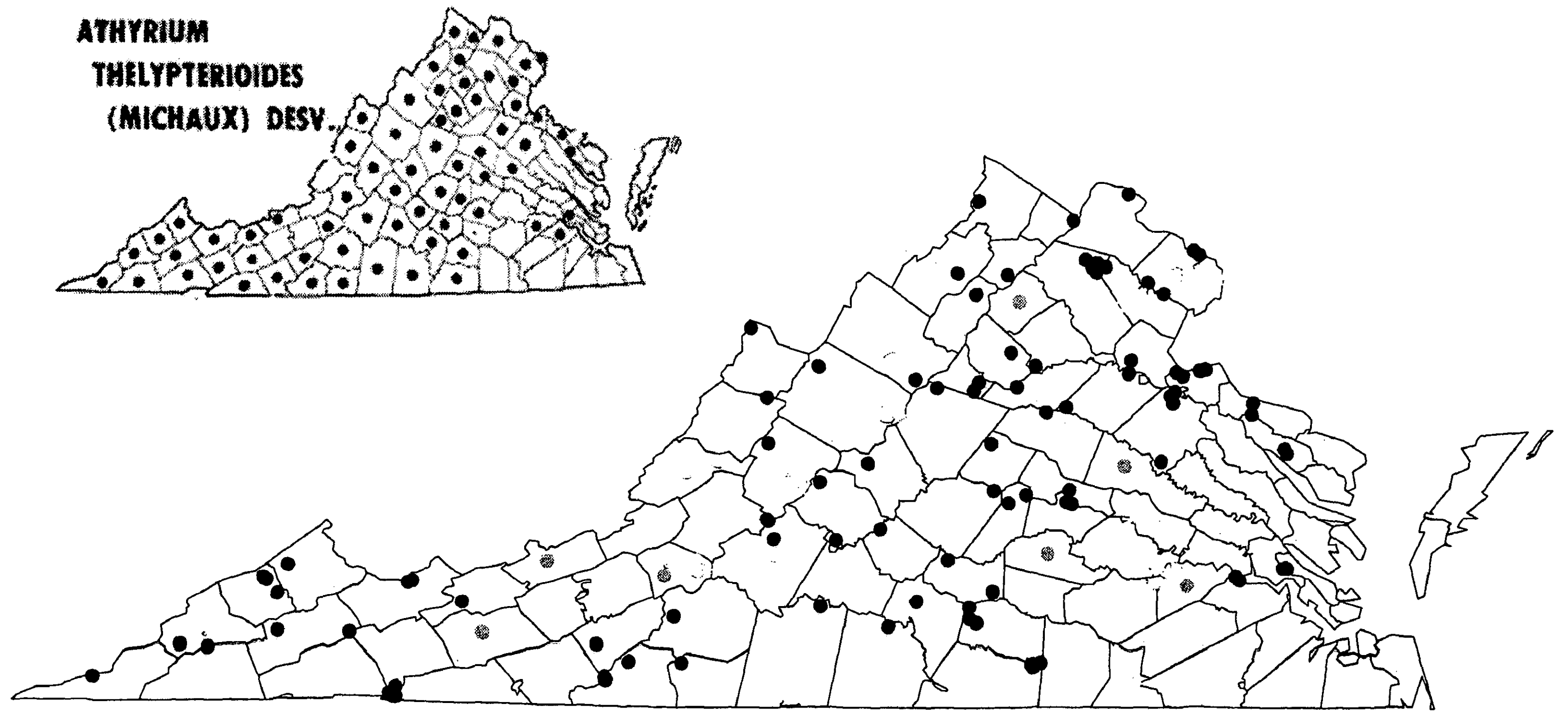


Fig. 16 Map of individual collection locations for *Athyrium thelypterioides*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

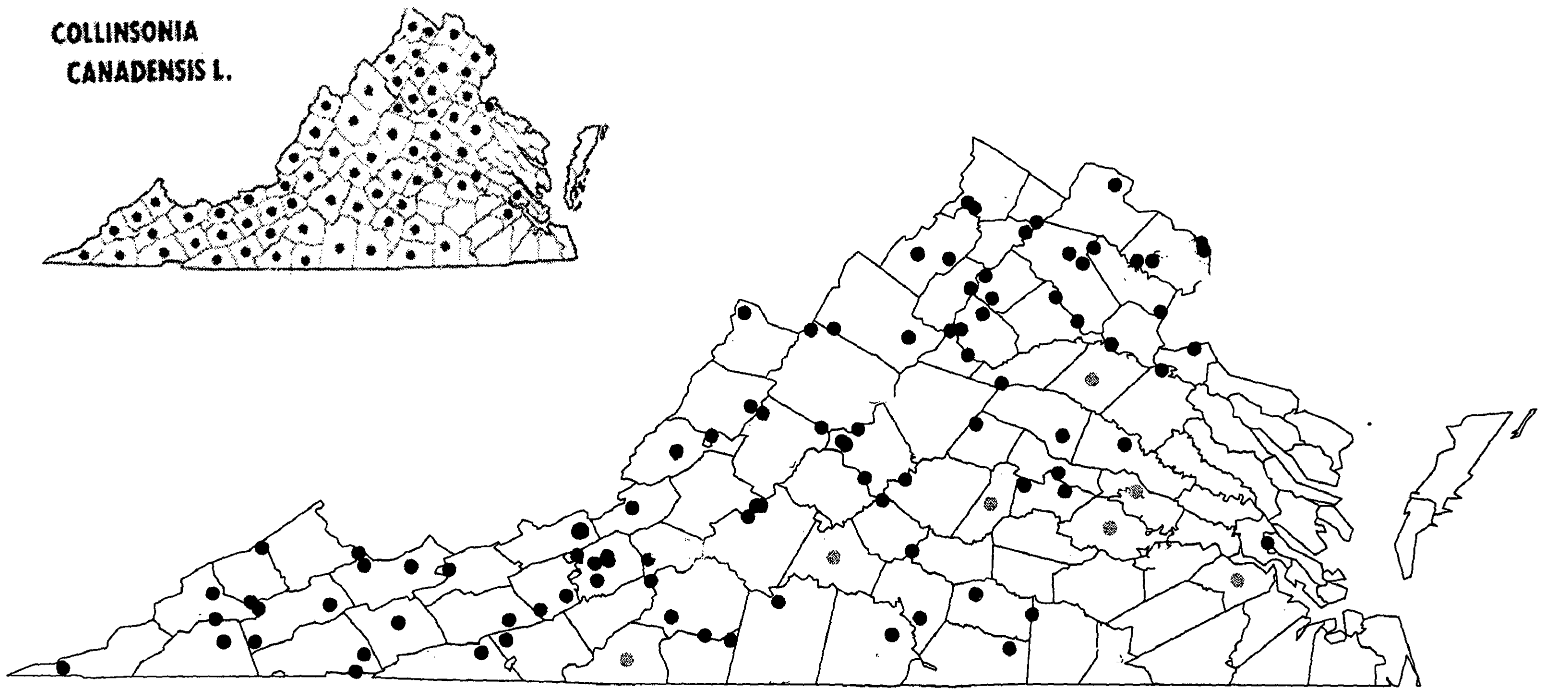


Fig. 17 Map of individual collection locations for *Collinsonia canadensis*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

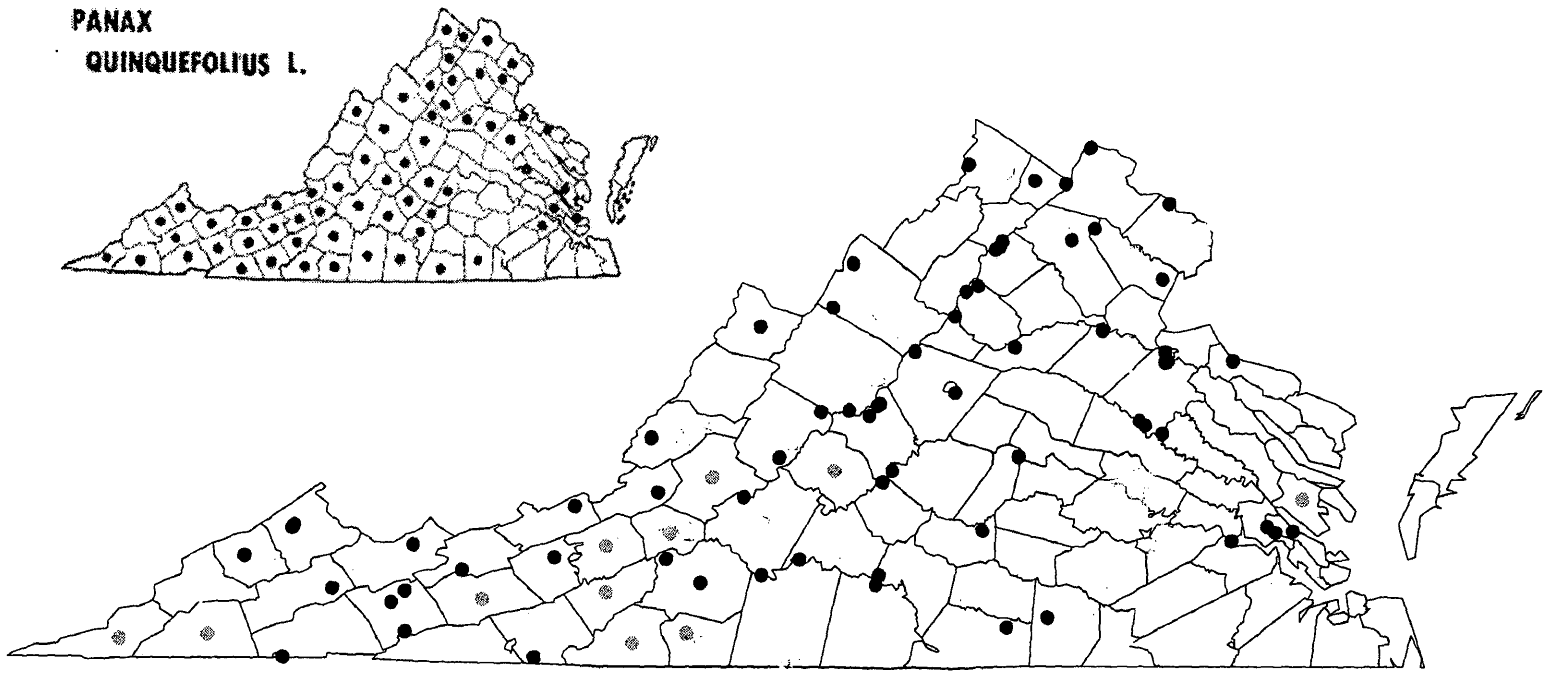


Fig. 18 Map of individual collection locations for *Panax quinquefolius*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

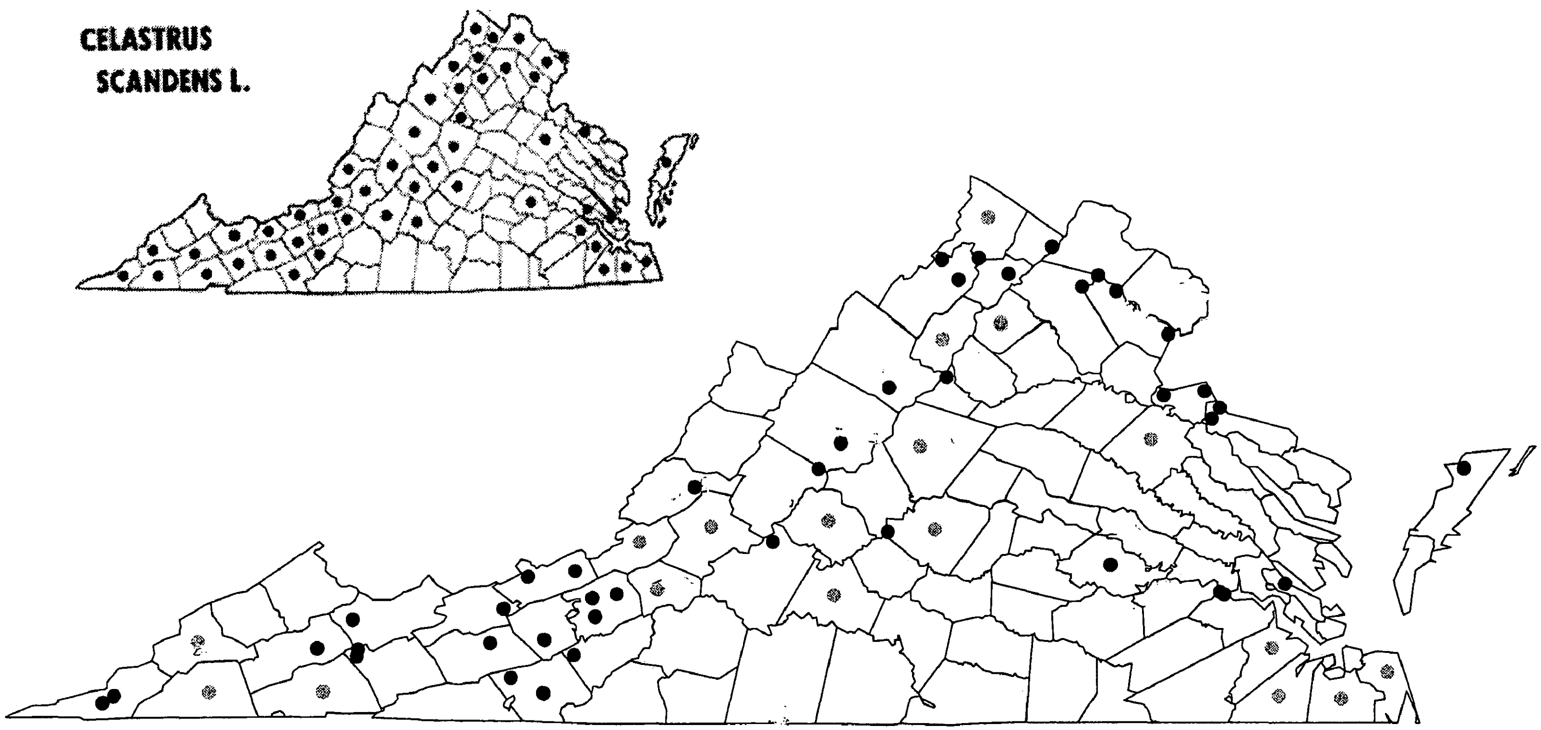


Fig. 19 Map of individual collection locations for *Celastrus scandens.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

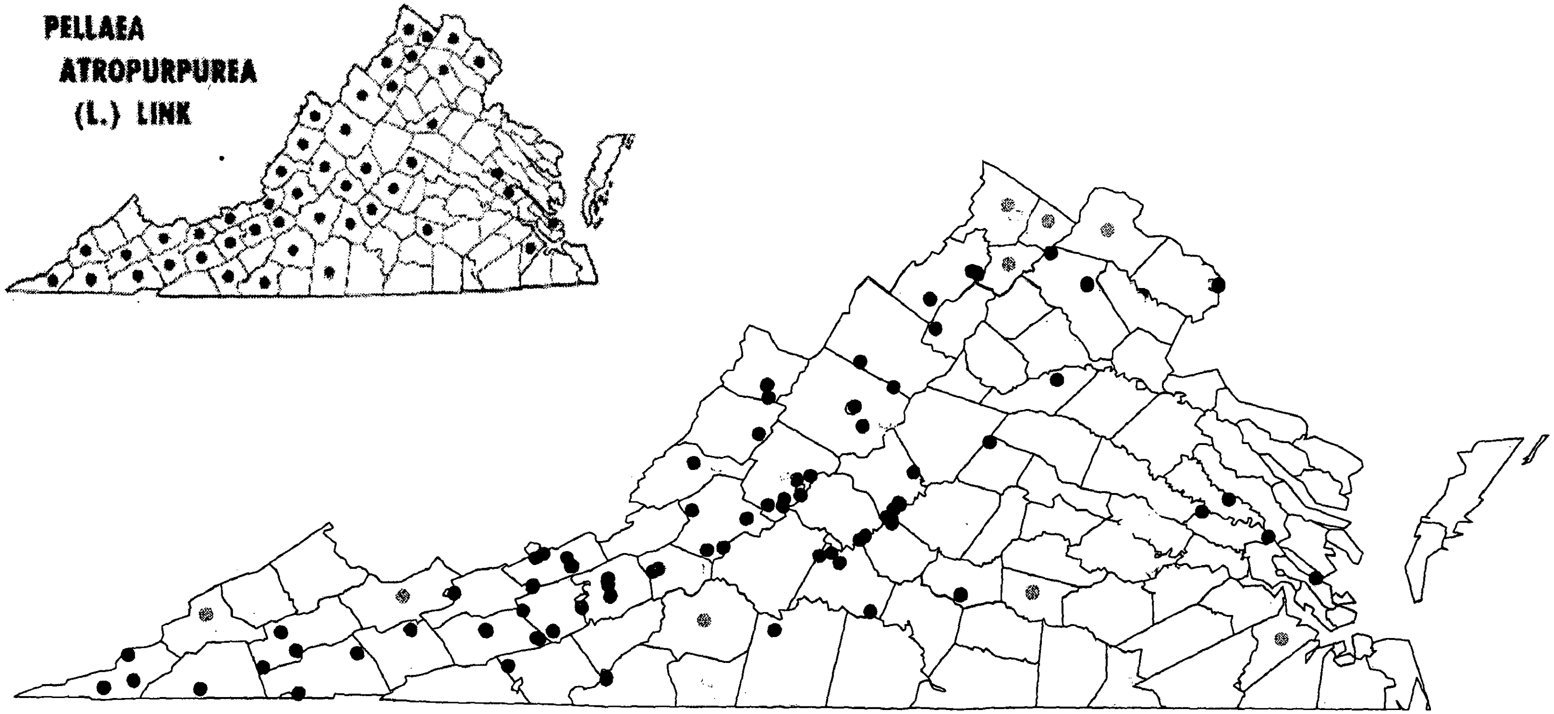


Fig. 20 Map of individual collection locations for *Pellaea atropurpurea.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

do over

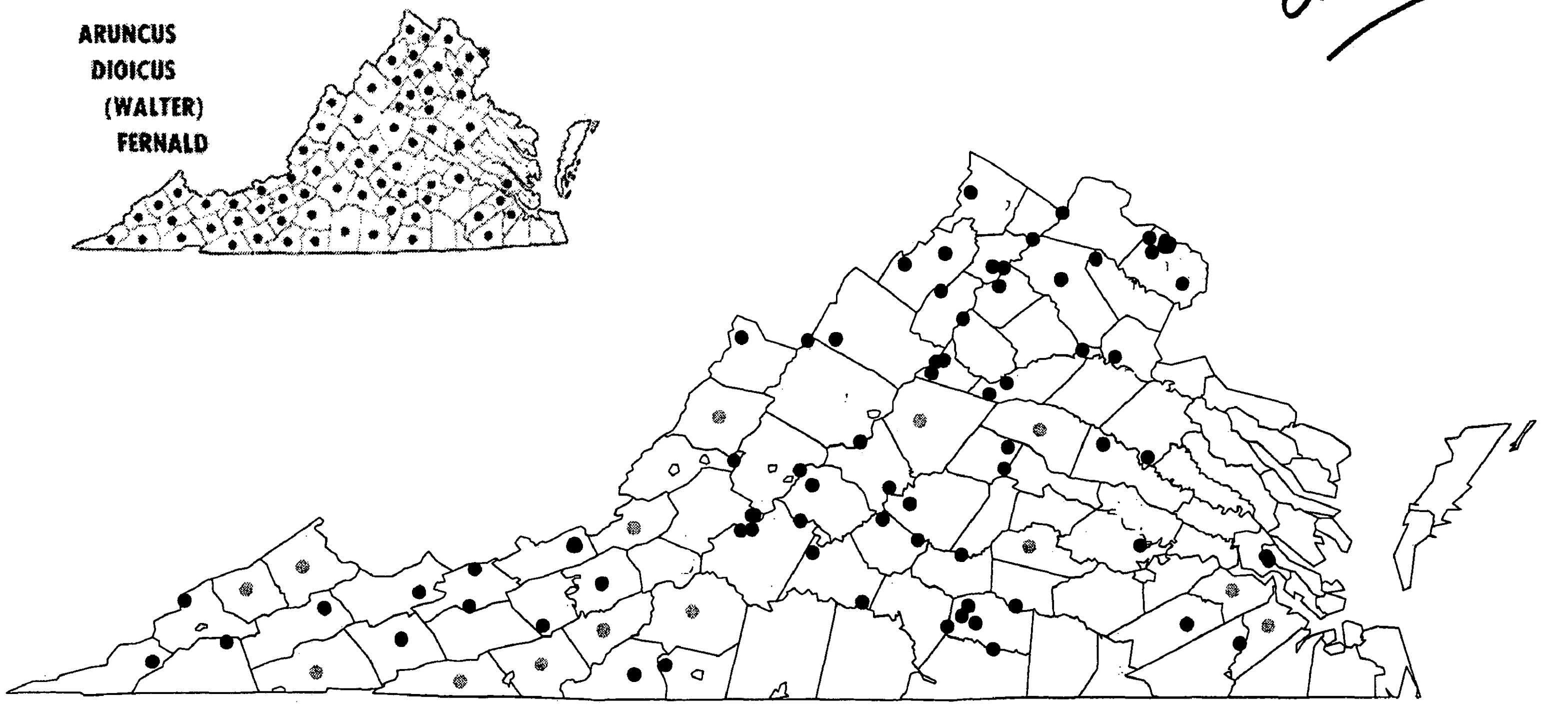


Fig. 21 Map of individual collection locations for *Aruncus dioicus.* The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

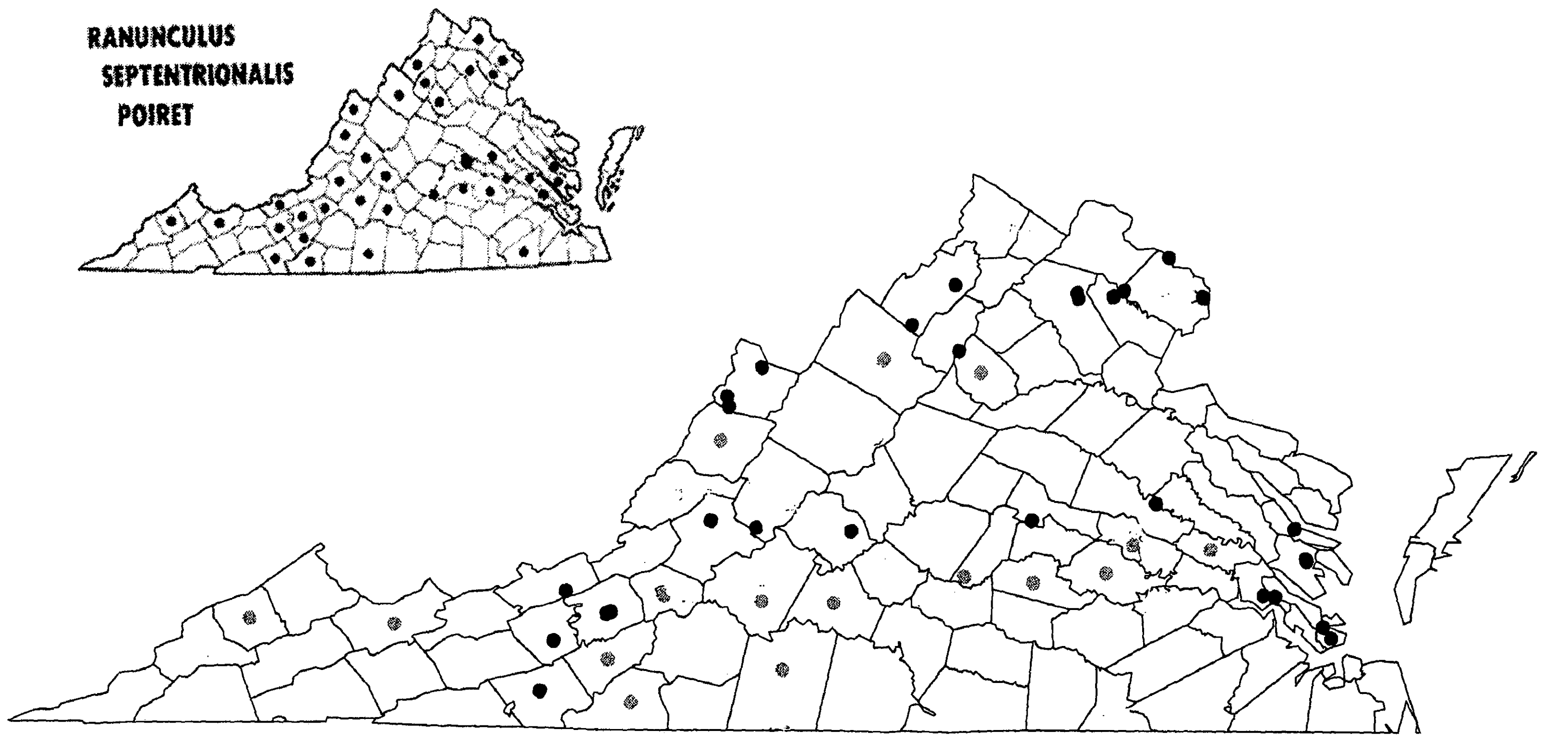


Fig. 22 Map of individual collection locations for *Ranunculus septentrionalis*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map does not show a more pronounced disjunction than the Atlas map and therefore belongs to category 2.

map types there is a significant gap from the mountains or Piedmont to the Coastal Plain, usually only 1 or 2 counties wide, but sometimes 3-4 counties wide.

The third category is the smallest, with three less disjunct species whose distributions are filled in across the state or are patchy throughout the Piedmont and Coastal Plain. The map of *Agrimonia pubescens* (Fig. 23) illustrates the first case and the of maps of *Hexalectris spicata* (Fig. 24) and *Juglans cinerea* (Fig. 25) illustrate the second case. Collections of *Hexalectris spicata* in the central Piedmont have been added since the publication of the *Atlas of Virginia Flora* (Harvill et al. 1992), somewhat filling in its distribution throughout the state. Still, there are places in the central Piedmont and Coastal Plain where there are 2 and 3 county wide gaps in their distribution. *Juglans cinerea* (Fig. 25) on the other hand, appears to be fairly evenly spread across the state, even if that distribution is sporadic.

Results from the Ground Layer Sampling

Phytogeographical and Floristic Considerations

Disjunct Species and their Occurrence

All species that occurred in the plots within the ravines studied, both calcareous and non-calcareous, are recorded in Table 6. The mountain disjunct species encountered were a mix of woody and herbaceous species and their occurrences are recorded in Table 7. All disjunct species occurred in calcareous ravines, except for the acidophile *Galax urceolata*, present only in one non-

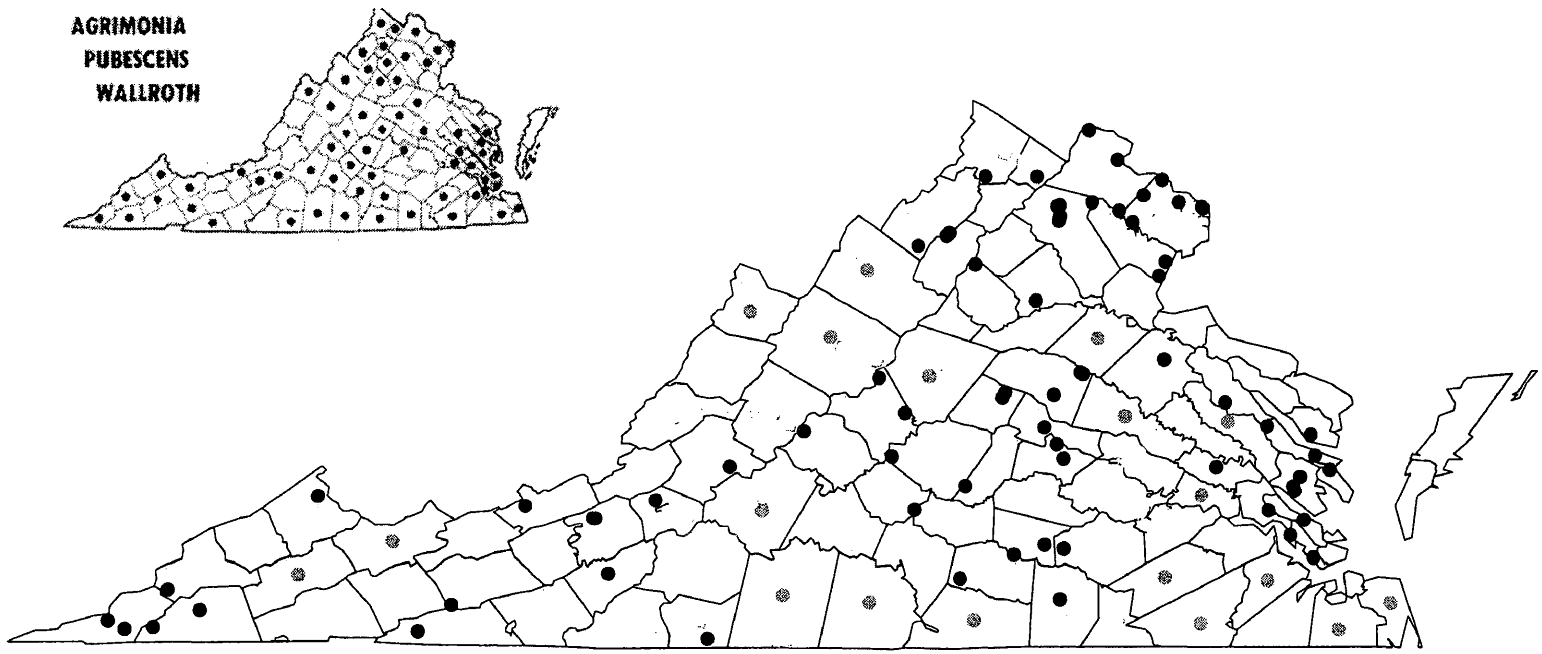


Fig. 23 Map of individual collection locations for *Agrimonia pubescens*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' map is nearly filled in across the state and it's disjunct status is in question and; therefore it belongs to category 3.

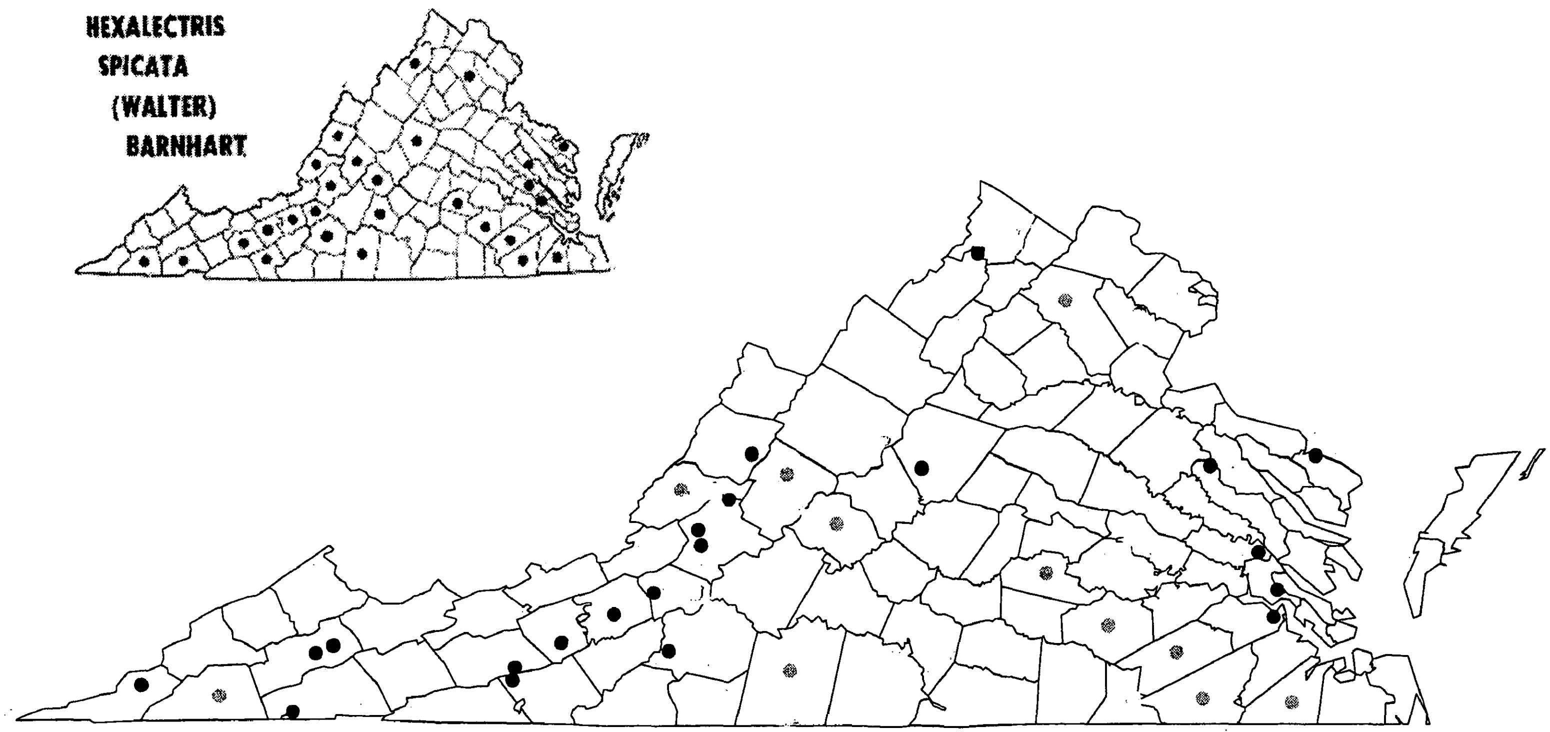


Fig. 24 Map of individual collection locations for *Hexalectris spicata*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' distribution is patchy throughout the state and does not follow the typical disjucnt distribution. Throughout the Piedmont there are places where there are 2 and 3 county gaps. For this reason this species may still be considered disjunct.

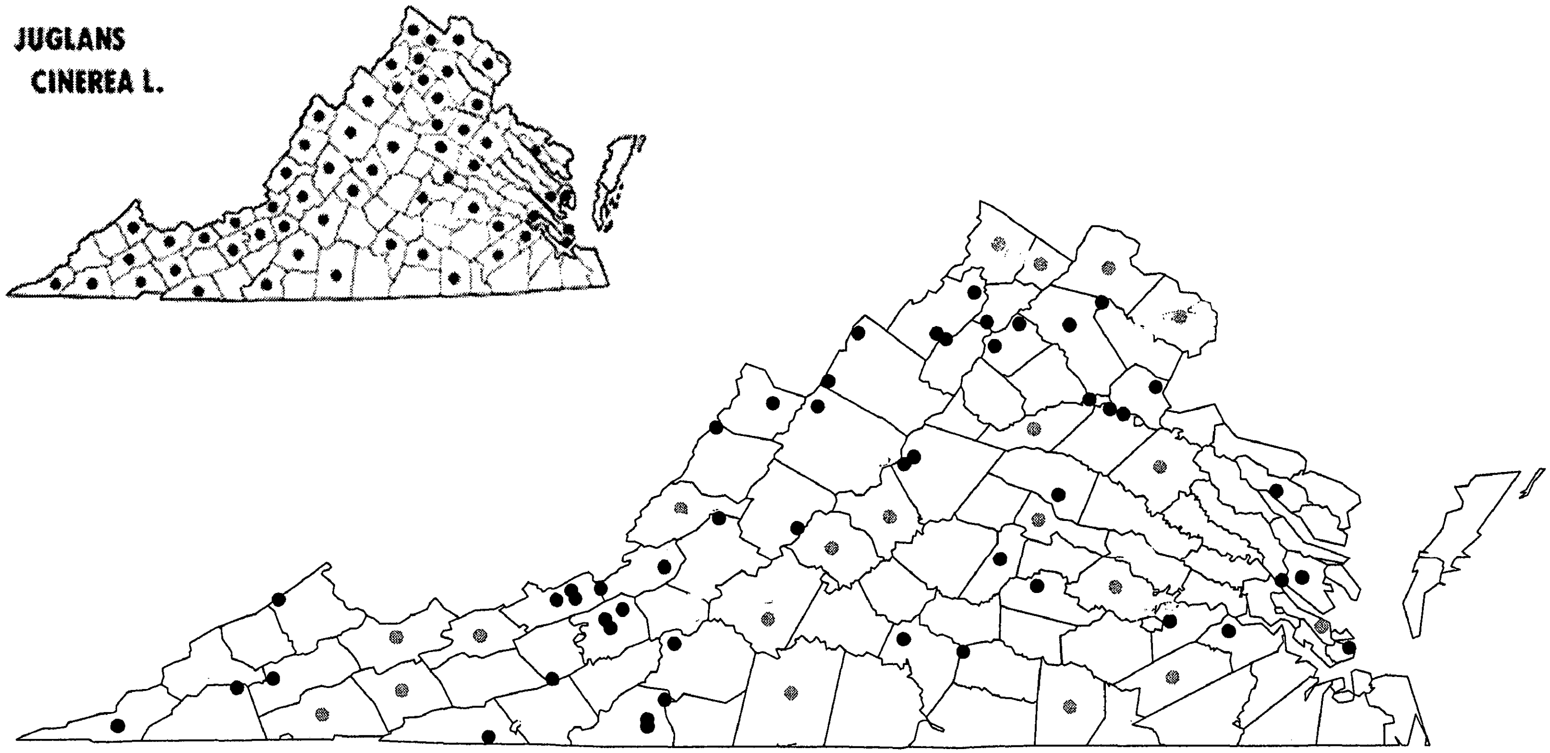


Fig. 25 Map of individual collection locations for *Juglans cinerea*. The map in the upper left is from the *Atlas of the Virginia Flora* (Harvill et al. 1992). The solid black dots represent individual collection locations and the gray dots indicate counties where collections are recorded in the Atlas, but were not found in the herbarium specimens examined. This species' distribution is patchy throughout the state and does not follow the typical disjunct distribution. Throughout the Piedmont there are places where there are 2 and 3 county gaps. For this reason this species may still be considered disjunct.

Table 6. Herbaceous and woody seedling species identified in study plots of the calcareous and non-calcareous ravines. The two and three letters indicate the site and the number indicates the ravine; these codes are referred to as ravine codes. Disjunct species are underlined. The species found in the upland edge plots of calcareous ravines are also included. The following are the sites used in the study and the counties in which they are found: College Woods, James City Co.; Grove Creek, James City Co; Hickory Fork Rd., Gloucester Co.; Cheatham Naval Annex, York Co.; Chippokes Plantation St. Park, Surry Co.; Hickory Hollow in Cabin Swamp, Lancaster Co. and the Casey Tract, James City Co. Species for Hickory Fork Rd. ravines HF-9 and HF-10 are listed under one heading in this table because of their close proximity to one another.

Calcareous Ravines

CW-1, College Woods, *Actaea pachypoda* Ravine

Acer rubrum, Actaea pachypoda, Adiantum pedatum, Asarum canadense, Aster sp. Brachyelytrum erectum, Carex sp., Circaea lutetiana, Cornus florida, Dicanthelium boscii, Euonymus americanus, Fagus grandifolia, Galium triflorum, Lindera benzoin, Liriodendron tulipifera, Lonicera japonica, Lycopus americana, Pinus taeda, Polygonatum biflorum, Polystichum acrostichoides, Prunus serotina, Quercus alba, Quercus rubra, Quercus velutina, Toxicodendron radicans, Vaccinium spp., Viburnum acerifolium, Viola sp., Vitis rotundifolia

CW-2, College Woods, *Ponthieva racemosa* Ravine

Acer rubrum, Aruncus dioicus, Asarum canadense, Brachyelytrum erectum, Carpinus caroliana, Carya cordiformis, Cornus florida, Desmodium glutinosum, Dicanthelium boscii, Fraxinus pennsylvanica, Liriodendron tulipifera, Luzula acuminata, Nyssa sylvatica, Parthenocissus quinquefolia, Polystichum acrostichoides, Quercus alba, Sanguinaria canadensis, Solidago flexicaulis, Solidago caesia, Vaccinium spp., Viburnum acerifolium, Viola sp., Vitis aestivilus

CW-3, College Woods, *Aruncus dioicus* "Gorge"

Acer rubrum, Agrimonia sp., Arisaema triphyllum, Aristolochia serpentaria, Aruncus dioicus, Asarum canadense, Asimina triloba, Brachyelytrum erectum, Carpinus caroliniana, Carya cordiformis, Cimicifuga racemosa, Cornus florida, Desmodium glutinosum, Desmodium nudiflorum, Euonymus americanus, Fagus grandifolia, Galium circaezans, Hepatica americana, Hieracium gronovii, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Mitchella repens, Parthenocissus quinquefolia, Polygonatum biflorum, Polystichum acrostichoides, Prunus serotina, Prynanthes spp., Senecio aureus, Solidago caesia, Toxicodendron radicans
Vaccinium spp.

CW-4, College Woods, *Aralia nudicaulis* Ravine

Acer rubrum, Amphicarpa bracteata, Aralia nudicaulis, Aristolochia serpentaria, Boehmeria cylindrica, Cercis canadensis, Cicuta maculata, Cornus florida, Desmodium nudiflorum, Dicanthelium commutatum, Dioscorea villosa, Euonymus americanus, Fagus grandifolia, Galium circaezans, Glyceria striata, Hexastylis virginiana, Impatiens capensis, Lonicera japonica, Luzula acuminata, Lycopus virginiana, Mitchella repens, Parthenocissus quinquefolia, Prunus serotina, Quercus alba, Sanicula sp. , Saururus cernuus, Senecio aureus, Toxicodendron radicans, Vaccinium spp., Virburnum acerifolium

Table 6. (continued)

CW-5, College Woods, *Hexalectris spicata* Ravine
Agrimonia pubescens, Amphicarpa bracteata, Anemone virginiana, Aristolochia serpentaria, Cercis canadensis, Cornus florida, Desmodium glutinosum, Dicanthelium boscii, Erigeron pulchellus, Fagus grandifolia, Galium circaezans, Hepatica americana, Hexalectris spicata, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Lycopus europaeus, Matelea carolinensis, Nyssa sylvatica, Parthenocissus quinquefolia, Polymnia uvedalia, Prunus serotina, Quercus alba, Sanguinaria canadensis, Toxicodendron radicans, Uvularia perfoliatum, Vaccinium spp., Verononia glauca, Viburnum acerfolium, Vitis aestivalus

CW-6, College Woods, *Aralia spp.* Gorge
Acer rubrum, Amphicarpa bracteata, Aralia nudicaulis, Aralia racemosa, Arisaema triphyllum, Aristolochia serpentaria, Asarum canadense, Brachelytrum erectum, Carpinus caroliniana, Carya cordiformis, Carya glabra, Desmodium glutinosum, Desmodium nudiflorum, Desmodium pauciflorum, Epifagus virginiana, Euonymus americanus, Fagus grandifolia, Hepatica americana, Hexastylis virginica, Lindera benzoin, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Phegopteris hexagonoptera, Polysthichum acrostichoides, Prunus serotina, Prenanthes sp., Quercus alba, Quercus velutina, Smilicina racemosa, Solidago caesia, Toxicodendron radicans, Vaccinium spp., Viburnum acerifolium

GC-7, Grove Creek, Old Country Rd. Ravine
Acer barbatum, Acer rubrum, Adiantum pedatum, Arisaema triphyllum, Asarum canadense, Asimina triloba, Aster sp., Athyrium thelypteroides, Botrychium virginianum, Brachyelytrum erectum, Carex bromoides, Carpinus caroliniana, Desmodium glutinosum, Dicanthelium commutatum, Dirca palustris, Equisetum hyemale, Euonymus americanus, Fagus grandifolia, Fraxinus sp. , Galium circaezans, Galium triflorum, Hieracium gronovii, Hepatica americana, Lindera benzoin, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Mitella diphylla, Nyssa sylvatica, Panax quinquifolius, Parthenocissus quinquefolia, Pinus taeda, unknown Poaceae, Polygonatum biflorum, Polystichum acrostichoides, Prunus serotina, Prenanthes sp., Quercus velutina, Sanicula sp., Senecio aureus, Smilacina racemosa, Solidago flexicaulis, Solidago caesia, Thalictrum revolutum, Theylpteris noveboracensis, Viburum acerifolium

GC-8, Grove Creek, Fire Station Ravine
Acer barbatum, Acer rubrum, Adiantum pedatum, Aralia racemosa, Arisaema triphyllum, Asarum canadense, Asimina triloba, Carex laevivaginatum, Carpinus caroliniana, Carya cordiformis, Cimicifuga racemosa, Circaea lutetiana, Decumaria barbara, Desmodium nudiflorum, Dicanthelium commutatum, Epifagus virginiana, Euonymus americanus, Fagus grandifolia, Fraxinus pennsylvanica, Galium circaezans, Glyceria striata, Goodyera pubescens, Hepatica americana, Hexastylis virginica, Hieracium gronovii, Hydrocotyle ranunculoides, Lindera benzoin, Liquidambar styraciflua, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Lysimachia ciliata, Mitchella repens, Microstegium vimineum, Mikania scandens, Mimulus alatus, Murdannia keisak, Nyssa sylvatica, Oldenlandia spp., Parthenocissus quinquefolia, Phegopteris hexagonoptera, unknown Poaceae, Polygonum sp., Polystichum acrostichoides, Prunus serotina, Prenanthes spp., Quercus rubra, Quercus velutina, Samolus parviflorus, Sanguinaria canadensis, Sanicula spp., Saururus cernuus, Senecio aureus, Smilacina racemosa, Solidago flexicaulis, Solidago caesia, Toxicodendron radicans, Ulmus rubra, Veronica anagallis-aquatica, Viola sp.

Table 6 (continued)

HF-9 and HF-10, Hickory Fork Rd. *Aralia racemosa* and *Desmodium glutinosum* Ravines

Acer rubrum, Agrimonia spp., Amphicarpa bracteata, Aralia racemosa, Arisaema triphyllum, Asarum canadense, Asimina triloba, Athyrium felix-femina, Botrychium virginianum, Carpinus caroliniana, Carya spp., Cercis canadensis, Cornus florida, Cryptotaenia canadensis, Desmodium glutinosum, Desmodium nudiflorum, Desmodium sp., Dicanthelium commutatum, Dioscorea villosa, Euonymus americanus, Fagus grandifolia, Galium circaezans, Goodyera pubescens, Impatiens capensis, Lindera benzoin, Liriodendron tulipifera, Lonicera japonica, Lorinseria areolata, Luzula acuminata, Lycopus americana, Mitchella repens, Monotropa uniflora, Nyssa sylvatica, Parthenocissus quinquefolia, unknown Poaceae, unknown Poaceae, Podophyllum peltatum, Polygonatum biflorum, Polystichum acrostichoides, Ponthieva racemosa, Prunus serotina, Saguinaria canadensis, Sanicula canadensis, Selaginella apoda, Senecio aureus, Smilacina racemosa, Solidago caesia, Toxicodendron radicans, Uvularia perfoliatum, Viola sp., Vitis rotundifolia

CNA-11, Cheatham Naval Annex, *Aralia racemosa* Ravine

Acer rubrum, Aralia racemosa, Asimina triloba, Bignonia capreolata, Carex spp., Carpinus caroliniana, Circeae lutetiana, Cornus florida, Decumaria barbara, Dioscorea villosa, Diospyros virginiana, Elephantopus tomentosum, Fagus grandifolia, Fraxinus pennsylvanica, Hepatica americana, Hexastylis virginiana, Luzula acuminata, Mitchella repens, Myrica cerifera, Parthenocissus quinquefolia, Phryma leptostachya, unknown Poaceae, Polygonatum biflora, Polystichum acrostichoides, Prunus serotina, Quercus alba, Quercus falcata, Sanicula gregaria, Saururus cernuus, Smilicina racemosa, Solidago flexicaulis, Toxicodendron radicans, Viburnum acerifolium, Viola spp., Vitis rotundifolia

CNA-12, Cheatham Naval Annex, *Athyrium pycnocarpon* Ravine

Acer rubrum, Arisaema triphyllum, Aristolochia serpentaria, Asmina triloba, Aster sp., Athyrium pycnocarpon, Boehmeria cylindrica, Carex spp., Carpinus caroliniana, Carya cordiformis, Cercis canadensis, Cornus florida, Desmodium nudiflorum, Dicanthelium boscii, Diospyros virginiana, Duchesnea indica, Elephantopus tomentosum, Euonymus americanus, Fraxinus pennsylvanica, Galium triflorum, Galium cicaezans, Hexastylis virginiana, Liquidambar styraciflua, Liriodendron tulipifera, Lonicera japonica, Luzula acuminata, Mitchella repens, Parthenocissus quinquefolia, Phyrma leptostachya, Poa sp., Polystichum acrostichoides, Ponthieva racemosa, Prunus serotina, Ranunculus hispidis, Smilax rotundifolia, Smilicina racemosa, Toxicodendron radicans, Viburnum acerifolium, Viola sp.

CP-13, Chippokes Plantation St. Park, *Athyrium pycnocarpon* Ravine

Acer rubrum, Aralia spinosa, Arisaema triphyllum, Athyrium pycnocarpon, Berchemia scandens, Bignonia capreolata, Botrychium dissectum, Botrychium virginianum, Carex bromoides, Carex spp., Carpinus caroliniana, Carya cordiformis, Circaea lutetiana, Cornus florida, Decumaria barbara, Desmodium spp., Epifagus virginiana, Euonymus americanus, Eupatorium coelestinum, Fagus grandifolia, Fraxinus pennsylvanica, Ilex opaca, Lindera benzoin, Liquidambar styraciflua, Lonicera japonica, Matelea carolinensis, Mitchella repens, Microstegium vimineum, Oxalis stricta, Parthenocissus quinquefolia, Phegopteris hexagonoptera, Polystichum acrostichoides Quercus michauxii, Quercus velutina, Ranunculus hispidis, Sanicula canadensis, Senecio aureus, Toxicodendron radicans, Vitis rotundifolia

Table 6 (continued)

CP-14, Chippokes Plantation St. Park, *Hexalectris spicata* Ravine
Acer rubrum, Arisaema triphyllum, Berchemia scandens, Carex bromoides, Carex spp., Carpinus caroliniana, Carya cordiformis, Cimicifuga racemosa, Circaeae lutetiana, Desmodium pauciflorum, Desmodium sp., Dicanthelium boscii, Drypoteris celsa, Elephantopus carolinianus, Elephantopus tomentosa, Euonymus americanus, Fagus grandifolia, Fraxinus pennsylvanica,Galium circaezans, Hexalectris spicata, Hydrocotyle ranunculoides, Ilex opaca, Lindera benzoin, Lonicera japonica, Matelea caronlinensis, Oxalis stricta, Partheocissus quinquefolia, Phyrma leptostachya, Polystichum acrostichoides, Ponthieva racemosa, Prunus serotina, Quercus velutina, Salvia lyrata, Sanguinaria canadensis, Sanicula gregaria, Sassafras albidum, Smilax bona-nox, Smilicina racemosa, Thalictrum revolutum, Toxicodendron radicans, Vitis rotundifolia

CS-15, Hickory Hollow, Cabin Swamp
Acer rubrum, Amelanchier arborea, Amphicarpa bracteata, Antennaria solitaria, Apios americana, Arisaema triphyllum, Asimina triloba, Aster sp., Caltha palustris, Cardamine bulbosa, Carex blanda, Carex crinita, Carpinus caroliniana, Carya pallida, Cicuta maculata, Claytonia virginica, Desmodium glutinosum, Desmodium sp., Dicanthelium boscii, Dioscorea villosa, Euonymus americanus, Fagus grandifolia, Galium obtusum, Galium triflorum, Gaylussacia baccata, Gaylussacia frondosa, Geum canadense, Hexastylis virginica, Impatiens capensis, Itea virginica, Lindera benzoin, Liquidambar styraciflua, Liriodendron tulpifera, Luzula echinata, Mikania scandens, Mitchella repens, Monotropsis odorata, Onoclea sensibilis, Oxypolis rigidior, Parthenocissus quinquefolia, Phegopteris hexagonoptera, Poa autumnalis, Polygonum sagittatum, Polygonum virginianum, Quercus alba, Quercus rubra, Ranunculus hispidus, Rhododendron sp., Rudbeckia laciniata, Sanicula sp., Saururus cernuus, Scutellaria elliptica, Senecio aureus, Symplocarpus foetidus, Smilax bona-nox, Smilax hispida, Solidago rugosa, Solidago sp., Sphenopholis obtusata, Thelypteris palustris, Toxicodendron radicans, Ulmus rubra, Ulmus sp., Uvularia sessilifolia, Vaccinium pallidum, Veratrum viride, Viburnum prunifolium, Viola conspersa, Viola cucullata, Viola sororia, Viola sp., Vitis sp.

Non-Calcareous Ravines

CT-16, Casey Tract, Ravine #1
Acer rubrum, Carpinus caroliniana, Carya cordiformis, Dicanthelium commutatum, Diospyros virginiana, Euonymus americanus, Euphorbia corollata, Fagus grandifolia, Liquidambar styraciflua, Liriodendron tulipifera, Mitchella repens, Parthenocissus quinquefolia, Poa sp., Prunus serotina, Quercus alba, Quercus velutina, Sassafras albidum, Smilicina racemosa, Vaccinium spp., Vitis rotundifolia

CT-17, Casey Tract, Ravine #2
Acer rubrum, Amelanchier arborea, Arisaema triphyllum, Bignonia capreolata, Carex sp., Carpinus caroliniana, Carya cordiformis, Diospyros virginiana, Euonymus americanus, Fraxinus pennsylvanica, Lindera benzoin, Liquidambar styraciflua, Lonicera japonica, Magnolia virginiana, Matelea carolinensis, Mitchella repens, Osmunda regalis; Parthenocissus quinquefolia, Quercus alba, Senecio aureus, Smilicina racemosa, Ulmus americana, Vaccinium spp., Vitis rotundifolia, Woodwardia areolata

CW-18, College Woods, *Galax urceolata* Ravine
Acer rubrum, Chimaphila maculata, Fagus grandifolia, Galax urceolata, Hexastylis virginica, Hieracium gronovii, Lorinseria areolata, Luzula acuminata, Mitchella repens, Osmunda cinnamomea, Oxydendron arboreum, Prunus serotina, Quercus velutina, Vaccinium spp.

Table 7. The calcareous sites and ravines where disjunct species are located. **Occurrence of species at sites** indicates the number of general locations in the study in which the species was found. **Occurrence in ravines** refers to how many ravines in the study in which the species was present. **Sites and ravines** lists the general location of the ravine first (underlined) and the name of the ravine in which the species was found second. The species are listed in order of those occuring at the greatest number of sites. The sites in the study are as follows: Grove Creek, James City Co; College Woods, James City Co.; Cheatham Naval Annex, York Co.; Hickory Fork Rd., Gloucester Co.; Chippokes Plantation St. Park, Surry Co.; and Hickory Hollow in Cabin Swamp, Lancaster Co. The ravine codes from Table 6 are listed after each entry. One mountain disjunct species *Galax urceolata* occurred in one non-calcareous ravine in the College Woods called the *Galax urceolata* Ravine (CW-18).

	Occurrence of species		
Disjunct Species	at Sites	in Ravines	Sites and Ravines
Quercus muehlenbergii	5/6	5/15	Grove Creek: Fire Station and Old Country Rd. Ravines (GC-8 & GC-&7) College Woods: *Aruncus dioicus* Gorge (CW-3) HickoryFork Rd. *Desmodium glutinosum* Ravine (HF-10) Chippokes Plantation St. Park: *Hexalectris spicata* Ravine (CP-14)
Desmodium glutinosum	4/6	7/15	Grove Creek: Fire Station and Old Country Road Ravines (GC-8 & GC-7) College Woods: *Aralia nudicaulis* Ravine, *Ponthieva racemosa* Ravine (CW-4 & CW-2) Hickory Fork Rd.: *Desmodium glutinosum* Ravine, *Aralia racemosa* Ravine (HF-10 & HF-9) Cabin Swamp: Hickory Hollow Ravine (CS-15)
Aralia racemosa	3/6	3/15	Grove Creek: Fire Station Ravine (GC-8) College Woods: *Aralia spp.* Gorge (CW-3) Hickory Forks Rd.: *Aralia racemosa* Ravine (HF-9)

Table 7. (continued)

Disjunct Species	*Occurrence of species* at Sites	*Occurrence of species* in Ravines	*Sites and Ravines*
Solidago flexicaulis	3/6	4/15	GroveCreek: Fire Station and Old Country Road Ravines (GC-8 & GC-7) College Woods: *Ponthieva racemosa* Ravine (CW-2) Cheatham Naval Annex: *Aralia racemosa* Ravine (CNA-11)
Aruncus dioicus	3/6	3/15	Grove Creek: Fire Station Ravine (GC-8) College Woods: *Ponthieva racemosa* Ravine (CW-2) College Woods: *Aruncus dioicus* Gorge
Veronica anagallis-aquatica	2/6	2/15	Grove Creek: Fire Station Ravine (GC-8) Hickory Fork Rd.: *Aralia racemosa* Ravine (HF-9)
Dirca palustris	2/6	2/15	Grove Creek: Fire Station and Old Country Rd. Ravines (GC-8 & GC-7) Known to occur in Chippokes Plantation St. Park near the *Hexalectris spicata* Ravine, but was not in the sampled ravine.
Magnolia tripetala	2/6	2/15	Grove Creek: Fire Station Ravine (GC-8) Hickory Forks Rd.: *Desmodium glutinosum* Ravine (HF-10)
Agrimonia pubescens	2/6	2/15	College Woods: *Hexalectris spicata* Ravine (CW-5) Hickory Fork Rd.: *Desmodium glutinosum* Ravine (HF-10)

Table 7. (continued)

Disjunct Species	Occurrence of species at Sites	in Ravines	Sites and Ravines
Magnolia tripetala	2/6	2/15	Grove Creek: Fire Station Ravine (GC-8) Hickory Fork Rd.: *Desmodium glutinosum* Ravine (HF-10)
Cornus alternifolia	2/6	2/15	College Woods: *Actaea pachypoda* Ravine (CW-1) College Woods: *Ponthieva racemosa* Ravine (CW-2) Known to occur in Cabin Swamp, but was not in the sampled ravine.
Athyrium pycnocarpon	2/6	2/15	Cheatham Naval Annex: *Athyrium pycnocarpon* Ravine (CNA-12) Chippokes Plantation St. Park: *Athyrium pycnocarpon* Ravine (CP-13)
Carex bromoides	2/6	2/15	Grove Creek: Old Country Rd. Ravine (GC-7) Chippokes Plantation St. Park: *Athyrium pycnocarpon* Ravine (CNA-12)
Hexalectris spicata	2/6	2/15	College Woods: *Hexalectris spicata* Ravine (CW-5) Chippokes Plantation St. Park: *Hexalectris spicata* Ravine (CP-14)
Tilia americana	1/6	1/15	Grove Creek: Old Country Rd. and Fire Station Ravines (GC-7 & GC-8) This species is also known to occur in the College Woods, but was not in any sampled ravine.
Aralia nudicaulis	1/6	1/15	College Woods: *Aralia nudicaulis* Ravine (CW-4)

Table 7. (continued)

Disjunct Species	Occurrence of species at Sites	in Ravines	Sites and Ravines
Panax quinquifolius	1/6	1/15	Grove Creek: Old Country Rd. Ravine (GC-7)
Mitella diphylla	1/6	1/15	Grove Creek: Old Country Rd. Ravine (GC-7)
Athryium thelypteroides	1/6	1/15	Grove Creek: Old Country Rd. Ravine (GC-7)
Stewartia ovata	1/6	1/15	Grove Creek: Old Country Rd. Ravine (GC-7)
Euonymous atropurpureus	1/6	1/15	College Woods: Near *Aralia nudicaulis* Ravine (CW-4)
Actaea pachypoda	1/6	1/15	College Woods: *Actaea pachypoda* Ravine (CW-1)
Viola conspersa	1/6	1/15	Cabin Swamp: Hickory Hollow Ravine (CS-15)
Veratrum viride	1/6	1/15	Cabin Swamp: Hickory Hollow Ravine (CS-15)
Monotropsis odorata	1/6	1/15	Cabin Swamp: Hickory Hollow Ravine (CS-15)

calcareous ravine. The disjunct species in calcareous ravines occurred on ravine slopes with these exceptions. *Veronica anagallis-aquatica* is a floodplain species, and *Magnolia tripetala* and *Solidago flexicaulis* extended from the slopes out onto the immediately adjacent upland of the ravine, and *Monotropsis odorata* was found only in one plot of the immediately adjacent upland. All herbaceous disjunct species were present in the ravines only sporadically and even when present, were usually not in dense or large colonies. *Athyrium pycnocarpon,* a mountain disjunct species, is an exception to this situation because it did occur in large colonies. *Quercus muehlenbergii,* occurred at 5 of the 6 study sites, but only 5 of 15 studied calcareous ravines, and *Desmodium glutinosum* occurred at fewer (4) of the 6 study sites, but in more ravines (7). *Solidago flexicaulis, Aralia racemosa,* and *Aruncus dioicus* occurred at 3 study sites (Table 7). The sites with the most mountain disjuncts were Grove Creek with 15 species and the College Woods with 13 species. Such numbers are sums of all ravines at a site, because individual ravines were unlikely to contain all the disjuncts present at a site. Some of the ravines examined contained only one or two disjunct species, like the *Aralia racemosa* Ravine at Cheatham Naval Annex (10-CNA), (see Table 6 for ravine names and codes) with *Solidago flexicaulis* and *Aralia racemosa,* and the *Aralia spp.* "Gorge" in the College Woods (CW-6) with *Aralia racemosa* and *Desmodium glutinosum.* The presence of any one disjunct species was not a good indicator of which other disjunct species were likely to be present (Table 7 and pers. obs.). However, two mountain disjunct species, *Aruncus dioicus* and *Solidago flexicaulis,* were found together in 3 ravines (Table 7).

Associated and Exotic Species

Some species have continuous distributions across Virginia but in the Coastal Plain are largely confined to ravines so that they are regularly associated with disjunct species.

Associated non-disjunct species commonly found in the calcareous ravines include *Asarum canadense, Adiantum pedatum, Phegopteris hexagonoptera, Dicanthelium boscii, Dicanthelium commutatum, Brachyelyctrum erectum,* and *Luzula acuminata* var. *carolinae.* However, many of the other species found associated with disjuncts in the ravine communities are found throughout the Coastal Plain in a variety of habitats. Some of these species are *Euonymus americana, Galium circaezans, Parthenocissus quinquefolia, Toxicodendron radicans,* and *Polystichum acrostichoides*. Also included in this group are several tree species that occurred as seedlings in the ground layer plots, such as *Cornus florida, Quercus alba, Fagus grandifolia, Quercus rubra, Quercus velutina,* and *Carpinus caroliniana.* It is worth mentioning that in almost all of the ravines examined, both calcareous and non-calcareous, exotic invasive species like *Lonicera japonica* and *Microstegium vimineum* were present, with the first species usually not comprising a significant cover, and the latter being densely abundant and vigorous where present. *Murdannia keisak* , the only other exotic species, was present at one site in a ravine floodplain.

Other Phytogeographically Significant Species: Rare Species and those at their Northern Limit

The calcareous ravines investigated in this study are home to species that in addition to being disjunct are rare throughout the state. Most notable are *Hexalectris spicata* and *Panax quinquefolius*. These species were found at the following sites: College Woods, James City Co.; Chippokes Plantation St. Park, Surry Co. and Grove Creek, James City Co. (Table 6).

Several species at their northern most range inhabiting the calcareous ravines are *Ponthieva racemosa, Decumaria barbara, Berchemia scandens* and *Acer barbatum* (Ware and Ware 1992). These species occur in my study plots at Grove Creek, James City Co.; Hickory Fork Rd., Gloucester Co.; Cheatham Naval Annex, York Co.; College Woods, James City Co.; and Chippokes Plantation St. Park, Surry Co. (Table 1). Several species were found only in non-calcareous ravines. *Galax urceolata,* considered a mountain disjunt species, was found in one acidic ravine in the College Woods, James City Co. The ravine in which this species present is called the *Galax urceolata* Ravine in Table 6. Other species that were present in this ravine but not in any of the calcareous ravines are *Osmunda cinnamomea* and *Lorinseria areolata.* The latter species also occurred in another non-calcareous ravine called the Casey Tract Ravine #2 (Table 6). Two other species occurring in the non-calcareous Casey Tract Ravines and not in any of the calcareous ravines are *Euphorbia corollata* and *Osmunda regalis* (Table 6).

Effects of Herbivory

In all of the study sites deer grazing was evident. The intensity of grazing seemed to be greater along the slopes of the calcareous ravines than on the associated uplands of the ravines. Deer grazing was documented on the mountain disjunct species *Solidago flexicaulis* and *Actaea pachypoda*. Herbivory was present in the non-calcareous ravines, but to a much lesser extent.

Soil pH of the Calcareous and Non-Calcareous Ravines

The soil pHs for the calcareous ravines are recorded in Table 8, and for the non-calcareous ravines in Table 9. Other soil variables are listed in Appendix D. The upland edge plots of the calcareous ravines were the most acidic with pHs ranging from 4.2-5.8, with a median of 4.8, and the ravine floors/floodplains were most basic with pHs from 5.8-7.0, with a median of 6.5. The pH values of the slopes of the calcareous ravines have the widest range (4.1- 7.4), with a median of 6.1. While there is much overlap in pH ranges of the calcareous slopes and associated uplands, the median values suggest that a pH difference exists between the uplands and the slopes of the calcareous ravines. In a previous study of 27 stands in upland hardwood forests in Virginia's Coastal Plain (DeWitt and Ware 1979), soil pH ranged from 4.3 to 5.6 with only five stands with pH > 5.0. The median pH value of uplands associated with calcareous ravines fits into the range that DeWitt and Ware (1979) found; however the pH medians for slopes (6.1) and floodplains (6.5) in calcareous ravines were higher than any values Dewitt and Ware (1979) found for the stands they studied. For this reason, the slope and floodplain soil pH medians, 6.1 and 6.5 respectively,

Table 8. Soil pH for the calcareous ravines and associated uplands. When more than one portion of a topographic feature was sampled, more soil samples were gathered. The pH values in each column are listed in order of most basic to acidic. N/A indicates ravines that did not have that topographic feature or there was no appropriate place for a plot.

Site, Ravine and Ravine Code	Upland	Slope	Ravine Floor
Grove Creek, Fire Station Ravine, GC-8	4.4, 4.3, 4.2	6.5, 6.4, 6.2, 5.5, 4.9, 4.8	6.6
Grove Creek, Old Country Rd., GC-7	5.7, 5.4, 4.7	6.7, 5.2	6.2
Cheatham Naval Annex, *Aralia racemosa* Ravine, CNA-11	4.4,	4.7	6.9, 6.1
Cheatham Naval Annex, *Athyrium pycnocarpon* Ravine, CNA-12	5.2	4.7	6.1, 5.8
Chippokes Plantation St. Park, *Hexalectris spicata* Ravine, CP-14	4.7	7.0	7.0
Chippokes Plantation St. Park, *Athyrium pycnocarpon* Ravine, CP-13	4.4	6.0, 5.2	7.0
College Woods, *Aralia nudicaulis* Ravine, CW-4	4.6	7.1	6.5
College Woods, *Aruncus dioicus* Gorge, CW-3	4.9	7.4	N/A
College Woods, *Aralia spp.* Gorge, CW-6	4.4	6.4, 4.7	N/A
College Woods, *Ponthieva racemosa* Ravine, CW-2	5.3	7.4	N/A
College Woods, *Hexalectris spicata* Ravine, CW-5	4.9	6.5, 6.0	N/A
Hickory Fork Rd., *Aralia racemosa* Ravine, HF-9	4.7	6.4	N/A

Table 8 (continued)

Site, Ravine and Ravine Code	**Upland**	**Slope**	**Ravine Floor**
Hickory Fork Rd, *Desmodium glutinosum* Ravine, HF-10	5.8	4.8	N/A
College Woods, *Actaea pachypoda* Ravine, CW-1	4.9	7.1	N/A
Cabin Swamp, Hickory Hollow, CS-15	N/A	4.6, 4.1	6.1, 5.1

Table 9. Soil pH for the non-calcareous ravines. N/A indicates there was no appropriate place for a plot.

Site, Ravine and Ravine Code	**Ridge**	**Slope**	**Ravine Floor**
Casey Tract, Ravine #1, CT-16	4.5	4.4	4.4
Casey Tract, Ravine #2, CT-17	4.6	4.3	4.6
College Woods, *Galax urceolata* Ravine, CW-18	3.9	4.1	N/A

are considered rather high for this region. Therefore, pH values between 5.0 and 6.1 are treated here as moderately high and pH values < 5.0 are considered as normal for the Coastal Plain soils. The mountain disjunct species and their associated soil pHs (Table 10) indicate that these species as a group occurred on a range of soil pHs that were much higher than the average for uplands for the Coastal Plain in general. Most mountain disjunct species, including *Solidago flexicaulis, Hexalectris spicata, Aralia racemosa, Aruncus dioicus, Veronica anagallis-aquatica, Euonymus americanus, Cornus alternifolia, Aralia nudicaulis, Actaea pachypoda, Carex bromoides, Veratrum viride* and *Viola conspersa* occurred consistently on high to moderately high pH soils in all study sites (Table 10). Species such as *Desmodium glutinosum, Magnolia tripetala, Dirca palustris, Agrimonia pubescens, Quercus muehlenbergii* and *Athyrium pycnocarpon* were in found primarily in high to moderately high soil pH, but also occasionally in low pH soil. *Panax quinquifolius, Tilia americana, Athyrium thelypterioides,* and *Mitella diphylla* occurred in only moderately high pH soil. Two mountain disjunct species, *Galax urceolata* and *Monotropsis odorata,* occurred strictly on low pH soil (3.9, 4.1). The pH values of the floodplains, slopes and associated uplands of non-calcareous ravines are consistently acidic (3.9 – 4.6) with no pH differential between the associated uplands, slopes, and ravine floors of these ravines (Table 9).

Table 10. Mountain Disjunct Species and Soil pH. These pH values represent collections taken along the upland, slopes and floodplains where the disjunct plants occurred in the ravine. The following codes indicate the study sites (as in Table 6): Grove Creek (GC), College Woods (CW), Hickory Fork Rd. (HF), Cheatham Naval Annex (CNA), Chippokes Plantation St. Park (CP) and Cabin Swamp (CS). All ravines listed are calcareous except for the *Galax urceolata* Ravine in the College Woods.

Disjunct Species	**Site & Ravine Code, Ravine and Plot Position**	**pH**
Desmodium glutinosum	GC-7, Old Country Rd, slope CW-2, *Ponthieva racemosa* Ravine, slope CW-5, *Hexalectris spicata* Ravine, slope CS-15, Hickory Hollow, slope	6.7 7.4 6.0 4.6
Veronica anagallis- aquatica	GC-8, Fire Station, floodplain	6.6
Aralia racemosa	GC-8, Fire Station, slope CW-3, *Aralia spp.* Gorge, slope HF-9, *Aralia racemosa* Ravine, slope CNA-11, *Aralia racemosa* Ravine, slope	6.5 6.4 6.4 6.9
Aralia nudicaulis	CW-4, *Aralia. nudicaulis* Ravine, slope	7.1
Panax quinquefolius	GC-7, Old Country Rd, slope	5.2
Hexalectris spicata	CW-5, *Hexalectris spicata* Ravine, slope CP-14, *Hexalectris spicata* Ravine, slope	6.0 7.0
Mitella diphylla	GC-7, Old Country Rd, slope	5.2
Carex bromoides	GC-7, Old Country Rd., floodplain CP-13, *Athyrium pyc.* Ravine, floodplain	6.2 6.0
Athyrium thelypteroides	GC-7, Old Country Rd., slope	5.2
Dirca palustris	GC-7, Old Country Rd., slope CP-14, *Hexalectris spicata* Ravine, slope	6.7 6.0, 5.2
Tilia americana	GC-7, Old Country Rd, slopes	5.2
Magnolia tripetala	GC-8, Fire Station, slope HF-10, *Desmodium glutinosum* Ravine, slope	6.6 4.8

Table 10. (continued)

Disjunct Species	**Site, Ravine and Plot Position**	**pH**
Stewartia ovata	GC-7, Old Country Rd., slope	6.7
Quercus muehlenbergii	GC-8, Fire Station, slope GC-7, Old Country Rd., slope CW-3, *Aruncus dioicus* Gorge, slope HF-9, *Aralia racemosa* Ravine, slope CP-14, *Hexalectris spicata* Ravine, slope CNA-12, *Athyrium pyc.* Ravine, slope	6.4, 6.5 6.7 7.4 6.4 6.0 4.7
Aruncus dioicus	GC-8, Fire station, slope CW-2, *Ponthieva racemosa* Ravine, slope CW-3, *Aruncus dioicus* Gorge, slope	6.4 7.4 7.4
Agrimonia pubescens	CW-5, *Hexalectris spicata* Ravine, slope HF-10, *Desmodium glutinosum* Ravine, slope	6.0 4.8
Cornus alternifolia	CW-1, *Actaea pachypoda* Ravine, slope CW-2, *Ponthieva racemosa* Ravine, slope	7.1 7.4
Euonymus americanus	CW-4, *Aralia nudicaulis* Ravine, floodplain	6.5
Athyrium pycnocarpon	CNA-12, *Athyrium pycn.* Ravine, slope CP-13, *Athyrium pycno.* Ravine, slope	4.7 6.5, 5.2
Actaea pachypoda	CW-1, *Actaea pachpypoda* Ravine, slope	7.1
Solidago flexicaulis	GC-8, Fire Station Ravine, slope GC-7, Old. Country Rd., slope CNA-11, *Aralia racemosa* Ravine, slope	6.6 5.2 6.9
Monotropsis odorata	CS-15, Hickory Hollow, upland	4.1
Veratrum viride	CS-15, Hickory Hollow, floodplain	6.1
Viola conspersa	CS-15, Hickory Hollow, floodplain	6.1
Galax urceolata	CW-18, *Galax urceolata* Ravine, slope	3.9

Detrended Correspondence Analysis Ordination of the Ground Layer Vegetation Plots

The initial DCA ordination was performed with all of the 66 ground layer study plots and included both calcareous and non-calcareous plots. Data on all ground layer plots are recorded in Appendix E. Ordination plot numbers and their corresponding sites and ravines are listed in Table 11. The resulting ordination is shown in Figs. 26 & 27. The eigenvalues for the first and second axes of the ordination are 0.766 and 0.593, respectively. Six of these variables were negatively correlated with the first axis at the $P < 0.01$ level. These were pH ($r = -0.5950$), Ca ($r = -0.5374$), Mg ($r = -0.5028$), B ($r = -0.3379$), Mn ($r = -0.3658$), and K ($r = -0.3074$). The seventh variable, P ($r = -0.2959$), correlated negatively at the $P < 0.05$ level. Soil Fe was positively correlated with the first axis ($r = 0.2936$, $P < 0.05$). Two soil variables also were significantly correlated with the second ordination axis at the $P < 0.01$ level. These were Mn ($r = 0.4219$) and B ($r = 0.3370$).

There is a clear segregation of plots along the first axis (Fig. 27) by topography from left to right: calcareous floodplain plots on the far left, calcareous slope plots mixed with some calcareous floodplain plots in the center of the ordination, (hereafter Group I) and upland edge plots of calcareous ravines mixed with the non-calcareous plots on the right half (hereafter Group II). The correlation of pH with the first axis of the ordination was highly significant, and this difference in soil pH of Group II versus Group I may contribute greatly

Table 11. Plot numbers for the ground layer data and their corresponding sites and ravines of calcareous and non-calcareous ravines. The plot numbers indicated on the DCA ordinations are listed below with their site, ravine locations and ravine code (Table 6). There is no plot number seven for a total of 66 herbaceous plots.

Plot numbers	Site, Ravine and Ravine Code
1-4	College Woods, *Actaea pachypoda* Ravine, CW-1
5-6	Grove Creek, Old Country Rd. Ravine, GC-8
8-11	College Woods, *Ponthieva racemosa* Ravine, CW-2
12-15	College Woods, *Aruncus dioicus* Ravine, CW-3
16-19	Hickory Fork, *Desmodium glutinosum* Ravine, HF-10
20-22	Hickory Fork, *Aralia racemosa* Ravine, HF-9
23-27	Grove Creek, Fire Station Ravine, GC-7
28-30	College Woods, *Aralia nudicaulis* Ravine, CW-4
31-33	College Woods, *Hexalectris spicata* Ravine, CW-5
34-37	College Woods, *Aralia spp.* Ravine, CW-6
38-42	Chippokes Plantation St. Park, *Athyrium pycnocarpon* Ravine, CP-13
43-45	Chippokes Plantation St. Park, *Hexalectris spicata* Ravine, CP-14
46-48	Cheatham Naval Annex, *Aralia racemosa* Ravine, CNA-11
49-52	Cheatham Naval Annex, *Athyrium pycnocarpon* Ravine, CNA-12
53-56	Casey Tract, Ravine #1, CT-16
57-59	Casey Tract Ravine #2, CT-17
60-63	College Woods, *Galax urceolata* Ravine, CW-18
64-67	Cabin Swamp, Hickory Hollow Ravine, CS-15

Fig. 26. DCA ordination of all 66 ground layer plots, including non-calcareous plots ◆ , upland edge plots of calcareous ravines ◆ , calcareous slope plots ▲ and calcareous floodplain plots ●. Symbols that are open indicate plots containing disjunct species, often more than one. Most of the 22 plots containing disjunct species are slope plots. One upland edge plot (□) of a calcareous ravine on the right of the ordination contains one disjunct species, *Monotropsis odorata,* an acidophile, found only in that plot. The non-calcareous plots (◇) on the far right contain *Galax urceolata,* found only in those plots.

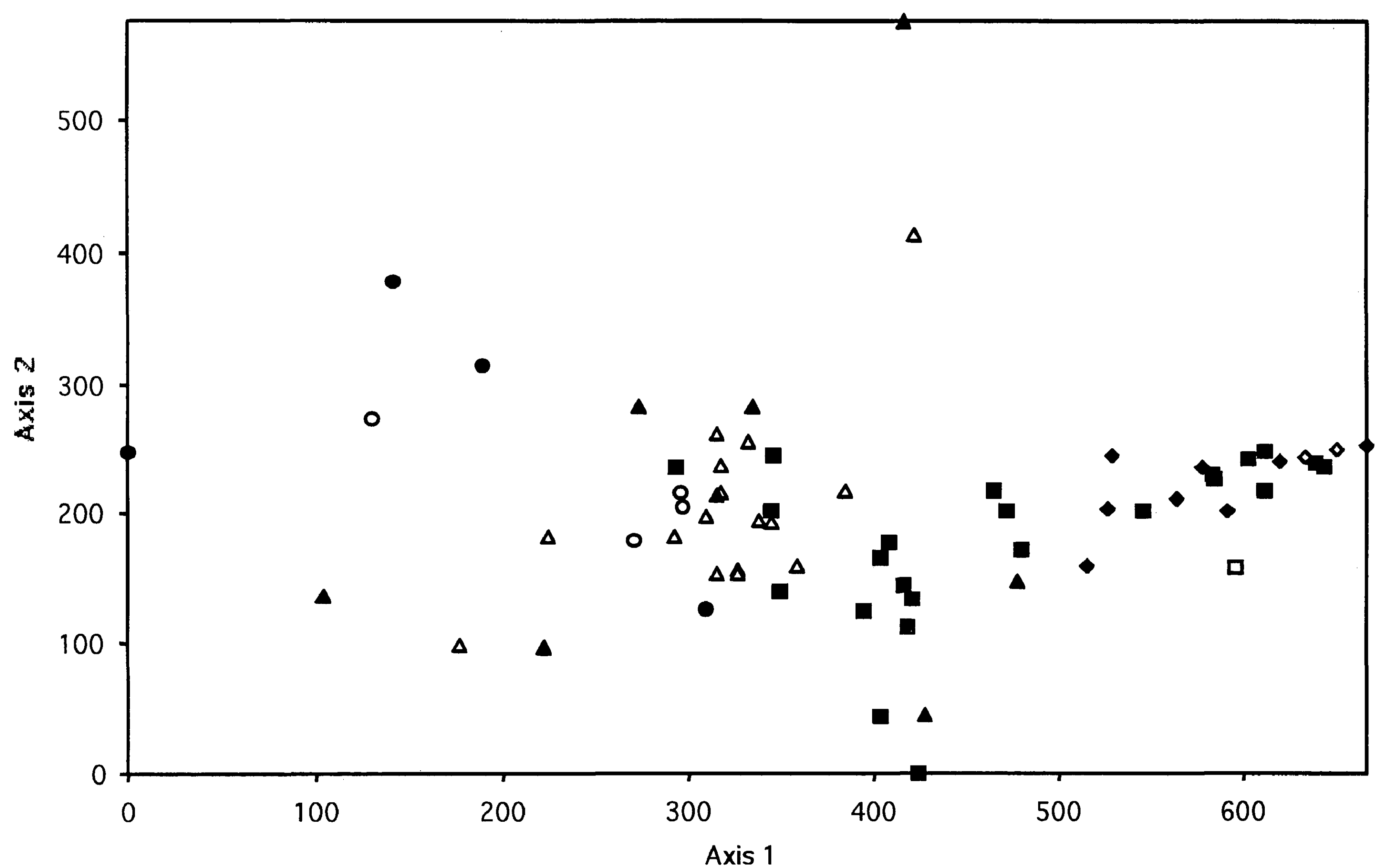


Fig. 26

Fig. 27. DCA ordination of all ground layer plots showing vegetational groups. Symbols represent ◆ non-calcareous plots, ■ upland edge plots of calcareous ravine, ▲ calcareous slope plots, ● calcareous floodplain plots. The calcareous floodplain plots are on the far left of the ordination and are dominated by *Carex bromoides* (Cabr), *Glyceria striata* (Glst) and *Caltha palustris* (Capa). The calcareous slope plots (Group I) are distributed around the center of the ordination with a few of the other plot types. The upland edge plots of calcareous ravines are distributed into two groups along the first axis; the group II-B on the far right is due to high abundance of woody ericads and is mixed with the non-calcareous plots, and group II-A contains upland edge plots of calcareous ravines with two calcareous slope plots. Environmental variables (soil composition variables and aspect) that significantly correlate with the axes are listed in order of decreasing correlation coefficient. The direction of the arrow indicates a positive or negative correlation. The segregation of Group I and Group II is presumably due, in part, to the difference in soil pH between these two groups.

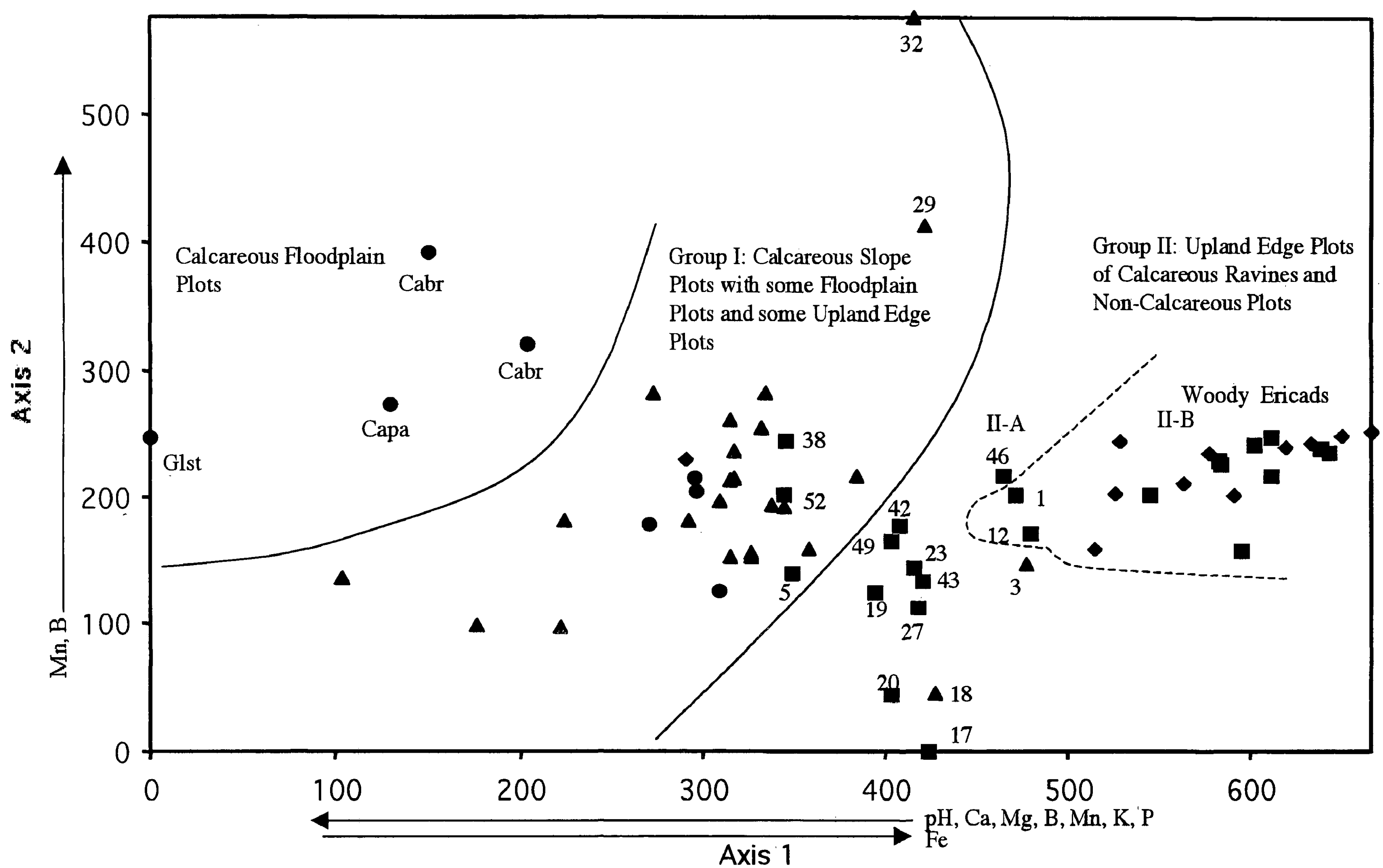

Calcareous Floodplain Plots
Cabr
Cabr
Capa
Glst
Group I: Calcareous Slope Plots with some Floodplain Plots and some Upland Edge Plots
Group II: Upland Edge Plots of Calcareous Ravines and Non-Calcareous Plots
Woody Ericads
II-A
II-B
32
29
38
52
5
42
49
23
43
19
27
20
18
17
46
1
12
3
Axis 2
Mn, B
Axis 1
pH, Ca, Mg, B, Mn, K, P
Fe
0
100
200
300
400
500
600

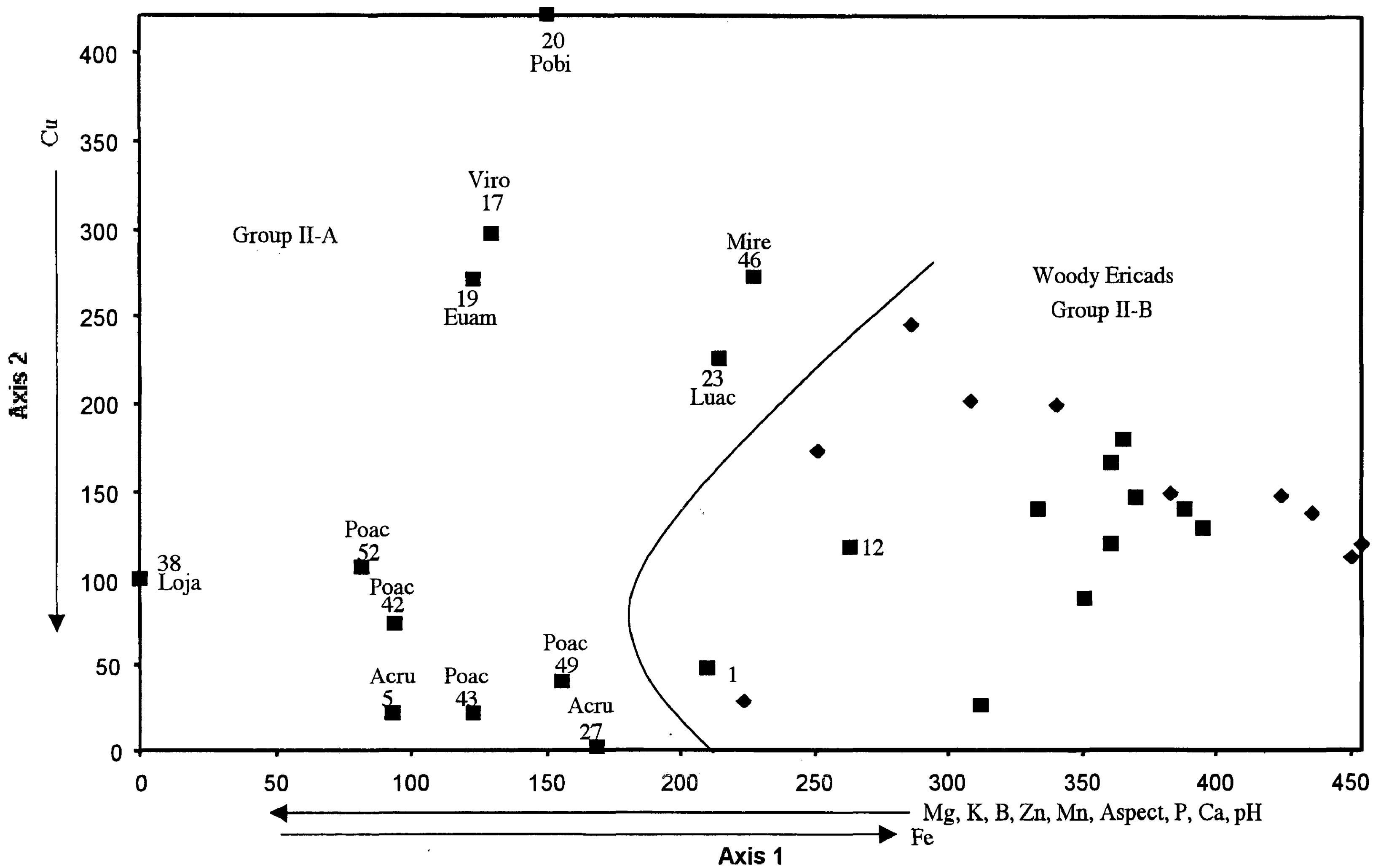
Fig. 27

to the differences in vegetation of these two groups. Group II, the upland edge plots of calcareous ravines and non-calcareous plots, segregate into two subgroups; one subgroup II-A with upland edge plots of calcareous ravines and two calcareous slope plots, and subgroup II-B on the far right portion of the ordination, with a mixture of upland edge plots of calcareous ravines and non-calcareous plots. Subgroup II-B plots, on the far right portion of the ordination, are dominated by woody ericads. Groups I and II were subjected to further ordination.

Group II: The Upland Edge Plots of Calcareous Ravines and the Non-Calcareous Plots

A separate DCA ordination of Group II, the upland edge plots of calcareous ravines and non-calcareous plots, was performed (Fig. 28). The eigenvalue for the first axis of the ordination is 0.703, and the eigenvalue for the second axis is 0.518. This ordination includes all of the upland edge plots of calcareous ravines, irrespective of Group (including 5, 52 and 38) and omits two calcareous slope plots in Group II-A (18 and 3). The seven environmental variables negatively correlated with the first axis at the $P < 0.01$ level were B ($r = -0.7928$), Mg ($r = -0.7603$), K ($r = -0.7592$), Zn ($r = -0.6452$), Mn ($r = -0.5598$), P ($r = -0.4851$), Ca ($r = -0.4793$), and pH ($r = -0.4122$). Soil Fe ($r = 0.6389$) and aspect ($r = 0.4916$) were positively correlated with the first axis at the $P < 0.01$ level. Soil Cu ($r = -0.4278$) was negatively correlated with the second axis at the 0.01 level. The contour line encloses to the right all of the non-calcareous plots and the upland edge plots of calcareous ravines dominated by *Vaccinium spp.* and/or *Gaylussacia spp.*, indicated as "woody ericads" on Fig. 27 and Fig. 28. The

Fig. 28. DCA ordination of Group II from Fig. 27. Environmental variables that significantly correlate with the axes are listed in order of decreasing correlation coefficient. The direction of the arrow indicates a positive or negative correlation. The contour line encloses the non-calcareous plots (◆) and the upland edge plots of calcareous ravines (■) dominated the woody ericads (Group II-A). The upland edge plots to the left of the contour (Group II-B) are dominated by *Polystichum acrostichoides* (Poac), *Acer rubrum* (Acru), *Luzula acuminata* (Luac), *Euonymus americanus* (Euam), *Vitis rotundifolia* (Viro), *Mitchella repens* (Mire), *Polygonatum biflorum* (Pobi) and *Lonicera japonica* (Loja).



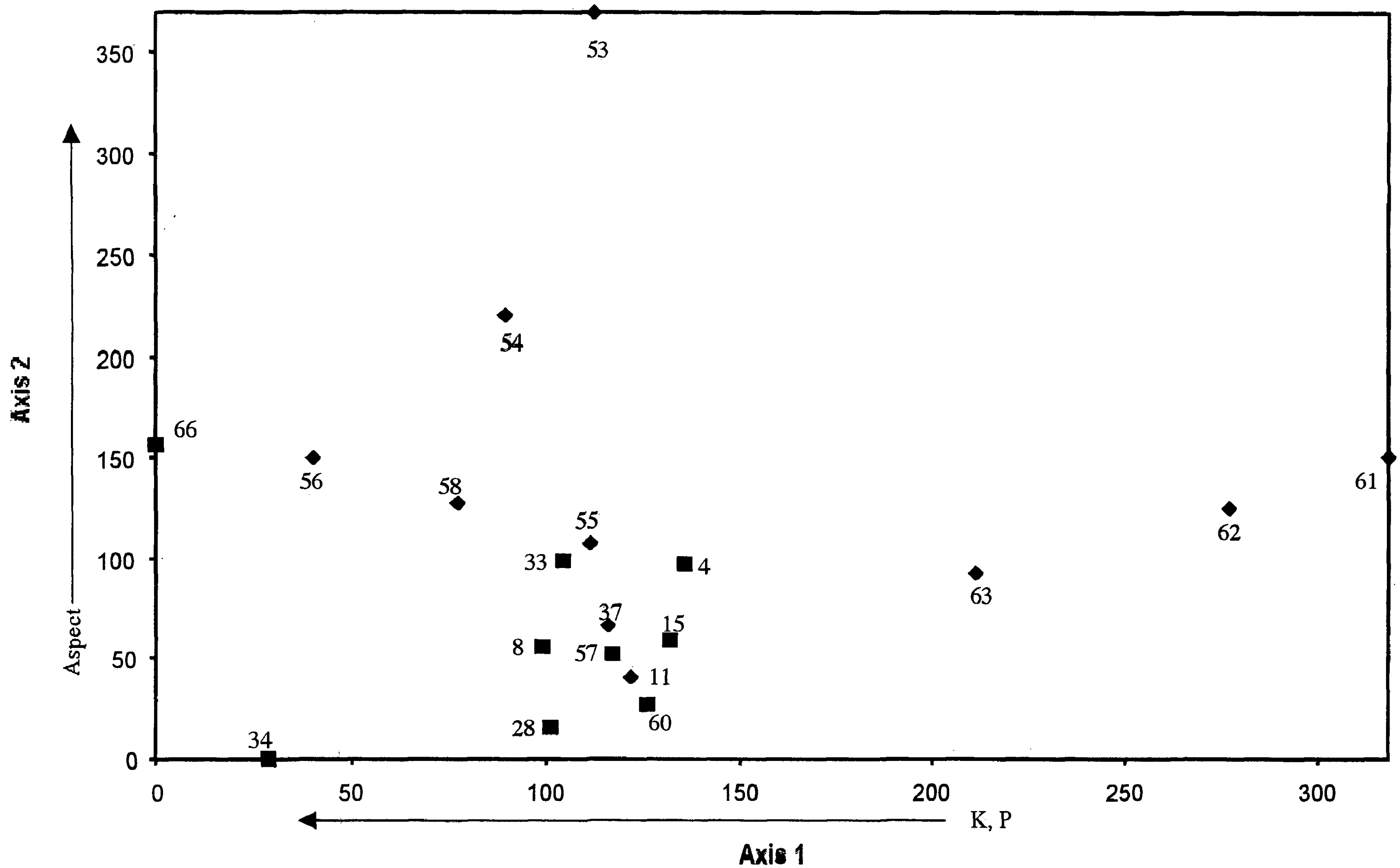
20
Pobi
Viro
17
Group II-A
19
Euam
Mire
46
23
Luac
Woody Ericads
Group II-B
12
Poac
52
38
Loja
Poac
42
Poac
49
1
Acru
5
Poac
43
Acru
27
Axis 2
Cu
Axis 1
Mg, K, B, Zn, Mn, Aspect, P, Ca, pH
Fe

Fig. 28

remaining upland edge plots of calcareous ravines, left of the ericad contour (Fig. 28), had lower ericad importance and were dominated by *Polystichum acrostichoides* and several other species including *Acer rubrum, Mitchella repens, Vitis rotundifolia, Euonymus americanus* and *Luzula acuminata.* In other words, the segregation in Fig. 27 of the woody ericad-dominated Group II-B plots and the Group II-A upland edge plots of calcareous ravines lacking woody ericads is maintained when these plots alone are ordinated (Fig. 28); this indicates that the segregation is due to the presence of woody ericads in one group and the lack thereof in the other.

A further DCA ordination of the plots dominated by *Vaccinium spp.* and *Gaylussacia spp.* enclosed by the contour in Fig. 28 was performed to determine whether the non-calcareous plots could be separated from the upland edge plots of calcareous ravines, and this ordination is presented in Fig. 29. The eigenvalue for the first axis of the ordination is 0.651 and the eigenvalue for the second axis is 0.505. The environmental variables negatively correlated with the first axis in this ordination (Fig.29) were P ($r = -0.4497$, $P < 0.05$) and K ($r = -0.5607$, $P < 0.01$). Aspect ($r = 0.5437$, $P < 0.05$) was correlated significantly with the second axis. It is evident from this ordination that the calcareous and non-calcareous plots are still quite intermixed. Since the abundance of woody ericad species may be responsible for the clustering of the non-calcareous and upland edge plots of calcareous ravines, a new ordination of these plots was run, but with the woody ericads removed. In this new ordination with the woody ericads removed (Fig. 30), the following environmental variables were negatively correlated with the first axis K ($r = -0.6521$, $P < 0.01$), pH ($r = -0.6261$, $P < 0.01$), P ($r = -0.4565$, P <

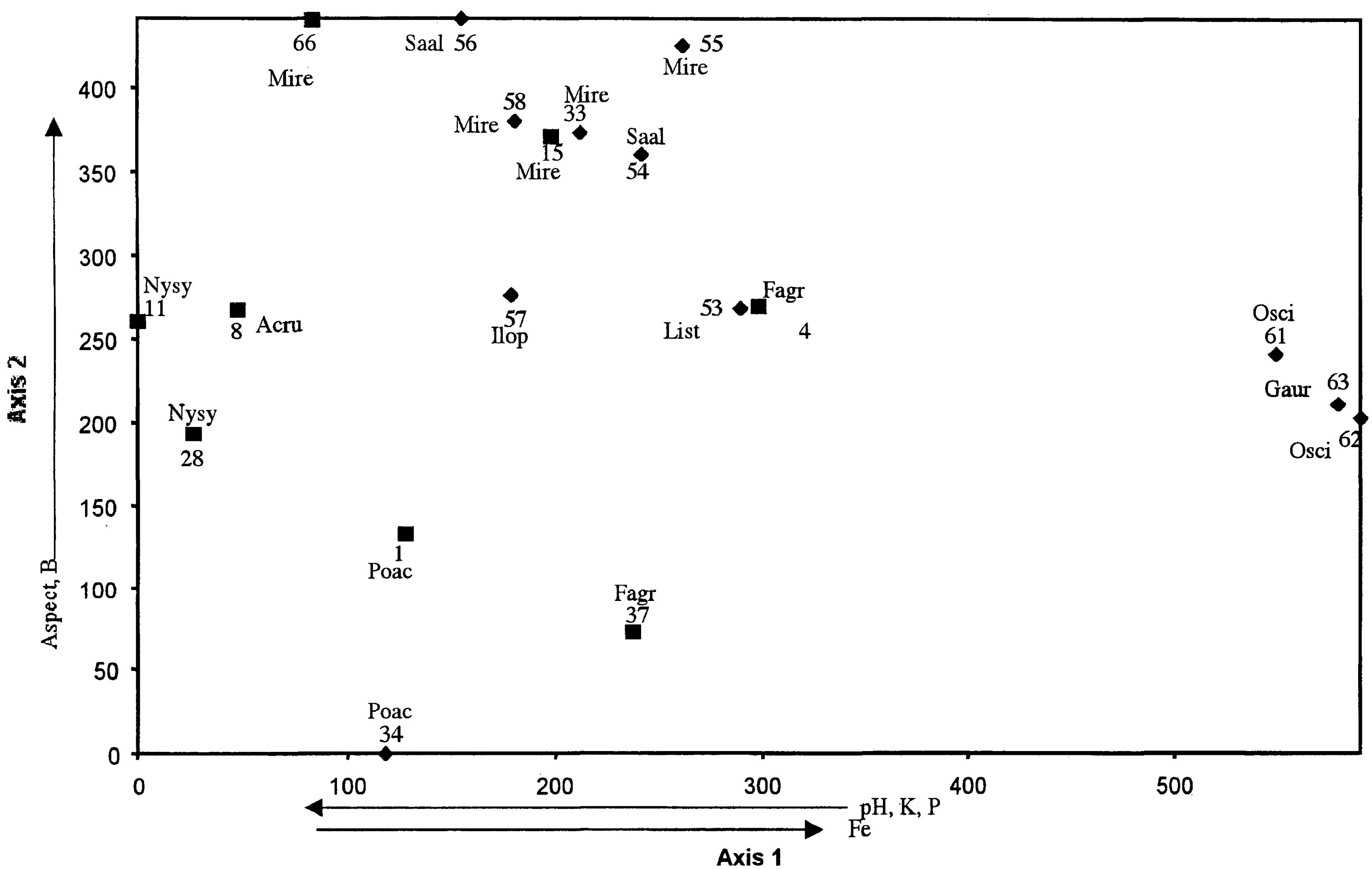
Fig. 29. DCA ordination of plots dominated by woody ericads. This subset of upland edge plots of calcareous ravines(■) and the non-calcareous plots (◆) are still intermixed in the lower center of the ordination. Environmental variables that correlate with the axes are listed in order of decreasing correlation coefficient. The direction of the arrow indicates a positive or negative correlation.



Axis 2
Aspect
Axis 1
K, P
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
53
54
66
56
58
55
33
4
37
15
8
57
11
28
60
34
63
62
61

Fig. 29

Fig. 30. DCA ordination of the plots in Fig. 29 with *Vaccinium spp.* and *Gaylussacia spp.* removed. With these species removed there is much less overlap of the upland edge plots of calcareous ravines (■),mostly on the far left and the non-calcareous plots(◆). This shows that the presence of woody ericads caused the plots to cluster in previous ordinations. The four letter codes indicate the second dominant species, in the plot. For plots 61 and 62 the code indicates the dominant species, as the woody ericads were abundant in those plots, but were not the most dominant species. Environmental variables that correlate with the axes are listed in order of decreasing correlation coefficient. The direction of the arrow indicates a positive or negative correlation.



66
Mire
Saal 56
55
Mire
58
Mire
Mire
33
15
Mire
Saal
54
Nysy
11
8
Acru
57
Ilop
53
List
Fagr
4
Osci
61
Gaur
63
Osci
62
Nysy
28
1
Poac
Fagr
37
Poac
34
Axis 2
Aspect, B
0
50
100
150
200
250
300
350
400
0
100
200
300
400
500
pH, K, P
Fe
Axis 1

Fig. 30

0.05), and Fe ($r = 0.4342$, $P < 0.05$) was positively correlated with the first axis. Soil B ($r = 0.5579$, $P < 0.01$) and aspect ($r = 0.5472$, $P < 0.01$) were positively correlated with the second axis. The eigenvalue for the first axis of the ordination is 0.872, and the eigenvalue for the second axis is 0.607. In this ordination, upland edge plots of calcareous ravines and the non-calcareous plots separated in ordination space; the cluster of plots in the center bottom of Fig. 29 moved to the top of the ordination in Fig. 30 (an axis reversal), but in general the upland edge plots of calcareous ravines are largely concentrated on the left third of the first axis, and the non-calcareous plots occur in two clusters on the right two thirds of the axis. The plots on the far right (61, 63, 62), already somewhat separated on the previous ordination, were very different from the other plots once *Vaccinium spp.* and *Gaylussacia spp.* were removed. Plots 61 and 62 contain *Osmunda cinnamomea* as the dominant species, which no other plots possessed, and plot had *Galax urceolata*, which no other plot possessed, as the dominant after the removal of the woody ericads. Several of the plots (55, 33, 58, 15, 54, 66 and 56) in the upper left of the ordination share *Mitchella repens* or *Sassafras albidum* as the second dominant species. Some of these were non-calcareous (58, 33, 54, 55, and 56) and some were upland edge plots of calcareous ravines (66 and 54). The other plots in the middle of the ordination contain other species as second dominant. The upland edge plots of calcareous ravines (8,11, 28, 1, 34 and 37) on the left have as the second (non-ericad) dominant several species not important in the non-calcareous plots.

Group I: The Calcareous Slope Plots

The calcareous slope plots in Fig. 27 (the original ordination) are to the left of the Group II contour line. While these plots do not all share one or two dominant species, they fall together on the original ordination because they share several less important species, which collectively constitute much of the total importance value of each plot. Further, these calcareous slope plots lack high importance of species that are important in stands on the right half of the ordination. A new DCA ordination of these calcareous slope plots was performed (Fig. 31) including plots 32, 29, 18 and 3 and excluding the floodplain plots that occurred with the slope plots in Fig. 26. Soil Mn ($r = 0.5515$, $P < 0.01$) and Cu ($r = 0.5356$, $P < 0.01$) positively correlated with the first ordination axis and P ($r = 0.4042$, $P < 0.05$) with the second axis. Lack of a significant correlation of aspect with the first axis.value showed that within the ravines direction of exposure was not important.. The eigenvalue for the first axis of the ordination is 0.817, and the eigenvalue for the second axis is 0.616. Seventeen of the 23 calcareous slope plots contain disjunct species (Fig. 26), though only 7 are dominated by these disjunct species (Fig. 31). This indicates that most disjuncts usually do not have a high coverage or density where they are present. Mountain disjunct species that were dominant in at least one plot include *Desmodium glutinosum, Aralia racemosa, Athyrium pycnocarpon, Actaea pachypoda, Panax quinquefolius,* and *Aralia nudicaulis.* Several non-disjunct species characeristic of the calcareous ravine communities dominated some slope plots. These species include *Phegopteris hexagonoptera* (Phhe), *Brachyelytrum erectum* (Brer), and *Asarum canadense* (Asca). Widespread species of the Coastal Plain that dominate

Fig. 31. DCA ordination of all of the calcareous slope plots. The calcareous slope plots are dominated by different species indicated by the four letter code over each plot. Plots dominated by mountain disjunct species are indicated by the open symbols. Arnu (*Aralia nudicaulis)*, Degl (*Desmodium glutinosum)*, Acpa (*Actaea pachypoda)*, Paqu (*Panax quinquefolius)*, *Atpy (Athyrium pycnocarpon)*, Sofl (*Solidago flexicaulis)* and Arra (*Aralia racemosa)* are mountains disjunct species that dominate their plots. Environmental variables that correlate with the axes are listed in order of decreasing correlation coefficient. The direction of the arrow indicates a positive or negative correlation.

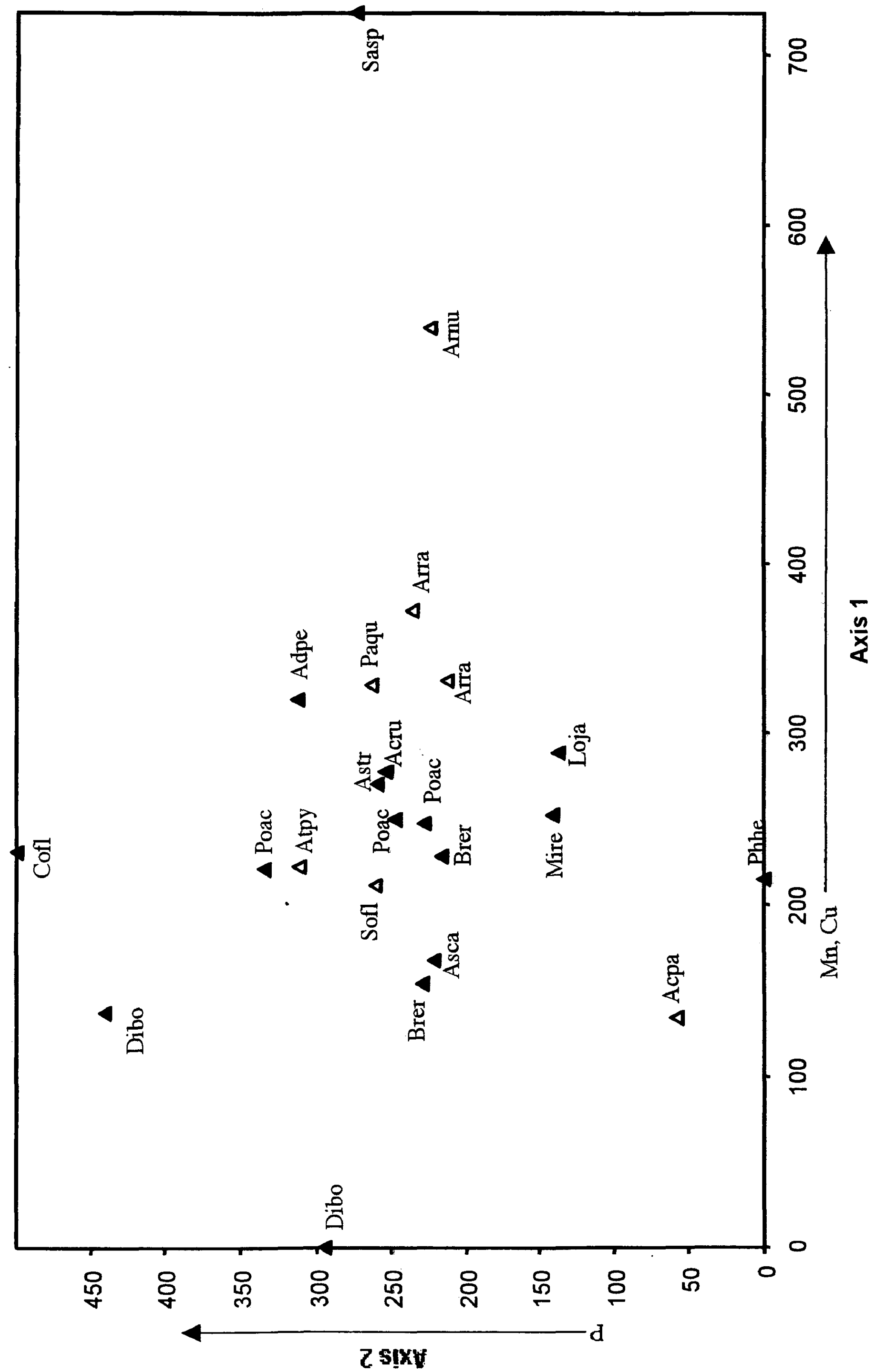

Axis 2
P
Axis 1
Mn, Cu
0
50
100
150
200
250
300
350
400
450
500
600
700
Sasp
Amu
Arra
Adpe
Paqu
Arra
Loja
Astr
Acru
Poac
Poac
Atpy
Poac
Cofl
Brer
Mire
Phhe
Sofl
Asca
Brer
Acpa
Dibo
Dibo

Fig. 31

some of the calcareous slope plots are *Polystichum acrostichoides* (Poac), *Mitchella repens* (Mire) and *Cornus florida* (Cofl) (Fig. 31). In one plot the invasive exotic species *Lonicera japonica* was the dominant and in another the introduced *Acer rubrum* (Acru) was the dominant.

Ground Layer Plot Diversity

The mean Shannon Diversity Index value was highest for the calcareous slope plots at 1.49 ± 0.51 (s. d.), followed by the upland edge plots of calcareous ravines at 1.34 ± 0.55, and the lowest mean was 0.94, ± 0.47, for the non-calcareous plots. The non-calcareous plots consistently had lower Shannon values than the other plot types because the species present in these plots besides *Vaccinium spp.* and *Galylussacia spp.* were few.

Woody Vegetation Results

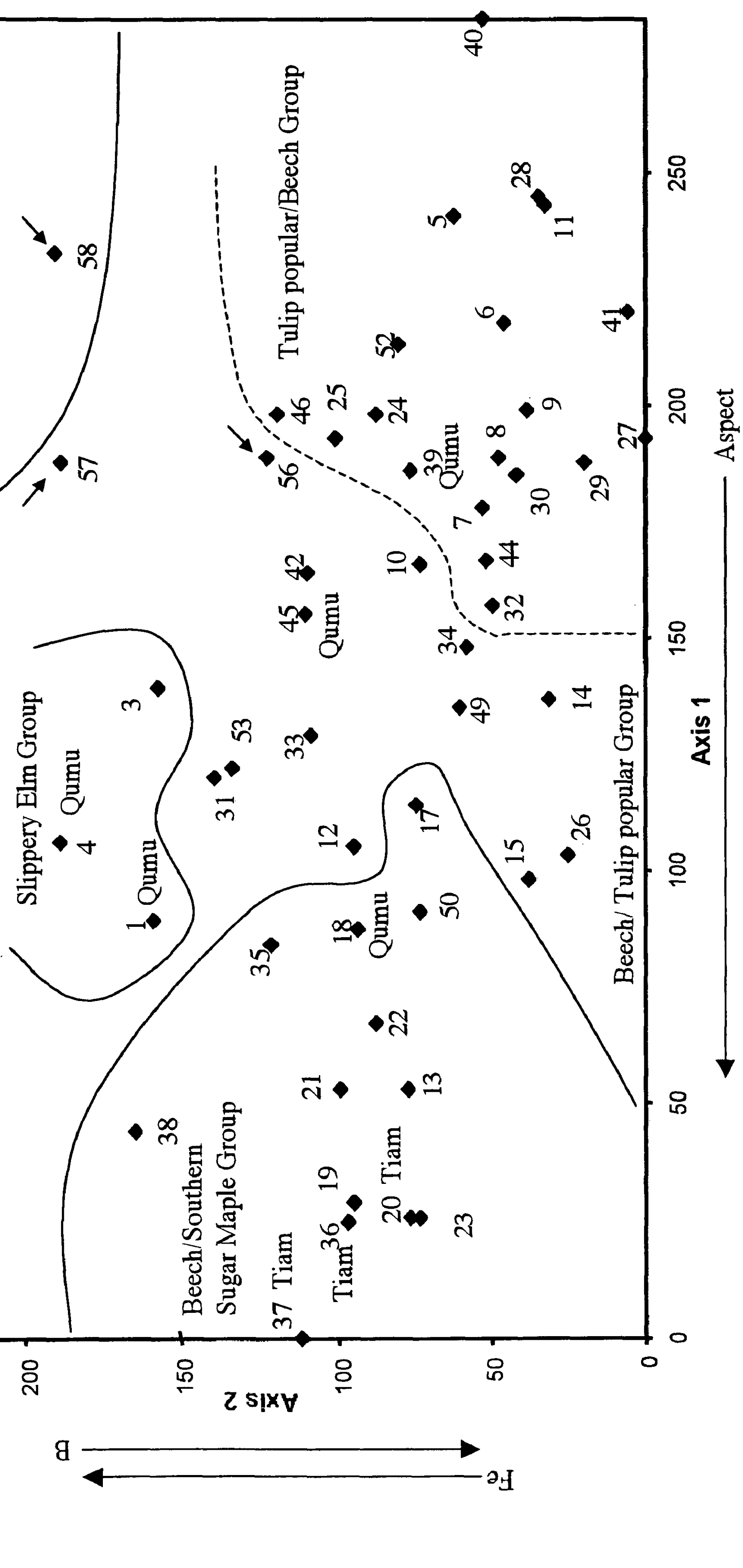
Mountain Disjunct and Calciphilic Tree Species

Quercus muehlenbergii, chinquapin oak, and *Tilia americana,* basswood, are the only large canopy tree species that are mountain disjuncts. The first species was more widespread than the second, which occurred at only one site. *Quercus muehlenbergii* was a dominant tree species in the *Aruncus dioicus* Ravine, College Woods and in Fire Station Ravine, Grove Creek and was present in the *Hexalectris spicata* Ravine and *Athyrium pycnocarpon* Ravine, Chippokes Plantation St. Park and in the *Desmodium glutinosum* Ravine, Hickory Fork Rd. (Table 6 and Table 7). *Tilia americana* was present in three plots sampled at Grove Creek in the Old Country Rd. Ravine. Other species of interest are *Ulmus rubra* (slippery elm) and *Carya cordiformis* (bitternut hickory), which are known to be especially frequent in calcareous sites in the Coastal Plain, though they are not generally regarded as calciphiles elsewhere in their range. Slippery elm was an abundant species in the *Ponthieva racemosa* Ravine and *Aruncus dioicus* Ravine, both in the College Woods. Bitternut hickory was abundant in the Fire Station Ravine, Grove Creek and the *Athyrium pycnocarpon* Ravine, Chippokes Plantation St. Park.

Tree Layer Ordination

A grand DCA ordination of the trees greater than 4 cm at breast height occurring over the herbaceous layer plots was performed. However, all plots clustered over the left portion of the x-axis except five floodplain plots that separated from all the rest. These five anomalous floodplain plots, four from calcareous ravines and one from a non-calcareous ravine, were removed for a better separation of stands on the ordination, and a new ordination of the remaining plots was performed (Fig. 32). Plot numbers and corresponding site and ravine information are recorded in Table 12. Plots from non-calcareous ravines separated weakly from calcareous ravines and are indicated on upper right of the ordination. The eigenvalue for the first axis of the ordination is 0.402, and the eigenvalue for the second axis is 0.307. Aspect ($r = -0.3108$) was negatively correlated with the first axis. Soil Fe ($r = 0.4250$) was positively and B ($r = -0.2586$) negatively correlated with the second axis ($P < 0.05$). The plots can be classified into 5 groups across the ordination, based on the dominant tree species in the plots. The groups occur from right to left on the ordination and are

Fig. 32. DCA ordination of the tree layer data. The vegetation separates along the first axis into five groups. The groups are named for the most dominant and second dominant species found in those plots. A dashed line is placed between the tulip popular/beech group and the beech/tulip popular group because these groups blend to some extent and a few plots of each group are found on either side of the line. Aspect correlated negatively with the first axis. Fe correlates positively and B correlates negatively with the second axis. The non-calcareous plots are indicated by the arrows. The presence (not dominance) of the mountain disjunct species *Quercus muehlenbergii* (Qumu) and *Tilia americana* (Tiam) are indicated next to the plots they occur in.



White Oak Group
Tulip popular/Beech Group
Slippery Elm Group
Beech/Southern Sugar Maple Group
Beech/ Tulip popular Group
Qumu
Tiam
Axis 1
Axis 2
Aspect
Fe
B

Fig. 32

Table 12. Plot numbers for the tree and shrub data and their corresponding sites and ravines. Calcareous and non-calcareous ravines are included.

Plot Numbers	*Site and Ravine*
1-2	College Woods, *Ponthieva racemosa* Ravine
3-4	College Woods, *Aruncus dioicus* Ravine
5-10	Hickory Fork Rd., *Desmodium glutinosum* Ravine
11-12	Hickory Fork Rd., *Aralia racemosa* Ravine
13-23	Grove Creek, Fire Station Ravine
24-26	Cheatham Naval Annex, *Aralia racemosa* Ravine
27-30	Cheatham Naval Annex, *Athyrium pycnocarpon* Ravine
31-34	College Woods, *Actaea pachypoda* Ravine
35-38	Grove Creek, Old Country Rd.
39-43	Chippokes Plantation St. Park, *Athyrium pycnocarpon* Ravine
44-45	Chippokes Plantation St. Park, *Hexalectris spicata* Ravine
46-47	College Woods, *Aralia nudicaulis* Ravine
48	College Woods, *Hexalectris spicata* Ravine
49-51	College Woods, *Aralia spp.* Gorge
52-54	Cabin Swamp, Hickory Hollow
55	College Woods, *Galax urceolata* Ravine
56-57	Casey Tract, Ravine #1
58	Casey Tract, Ravine #2

the white oak group, the tulip poplar/ beech group, the beech/ tulip poplar group, slippery elm group and the beech/ southern sugar maple group. In cases where the group has two species in its name the first had the highest I. V. and the second had the second highest I. V.

Four plots in the upper right portion of the ordination are dominated by *Quercus alba* and hence called the white oak group. These plots have as their next most dominant species *Quercus muehlenbergii* (48), *Quercus rubra* (2, 47) and *Liquidambar styraciflua* (58). *Quercus muehlenbergii,* a mountain disjunct species, ranked second in plot 48 and third in plot 47.

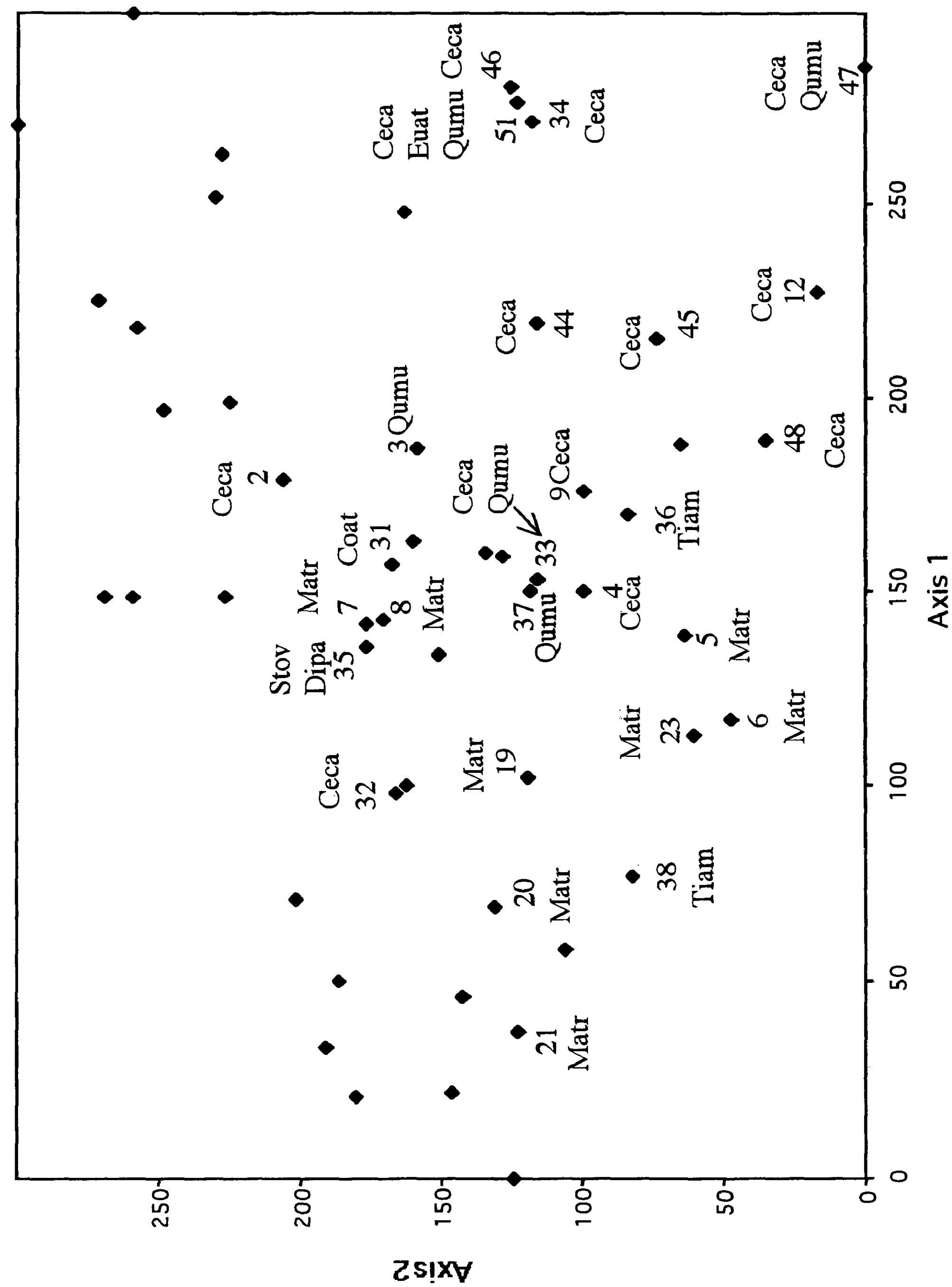
Most plots in the ordination fall into the tulip poplar/ beech group and the beech/ tulip poplar group. These two groups are located from the lower right to the center of the ordination. Intermixed with these plots are a few plots dominated by other species like *Pinus taeda* in plots 24 and 44 and *Quercus rubra* in plot 56. The second most dominant species in these plots are *Fagus grandifolia* (24), *Acer rubrum* (44) and *Liquidambar styraciflua* (56). Throughout the right portion of the ordination plots are dominated by *Liriodendron tulipifera* and secondarily dominated by *Fagus grandifolia.* These plots include (from right to left) 40, 41, 52, 9, 27, 46, 30, 29, 46, 39 and 32. Two plots in this group, 7 and 8 are dominated by *Fagus grandifolia* and secondarily dominated by *Liriodendron tulipifera.* Four plots on the far right (5, 6, 28, 11) are dominated by *Liriodendron tulipifera* with species other than beech as the second most dominant and are *Liquidambar styraciflua* (5,11), *Pinus taeda* (6), and *Cornus florida* (28). The polar plot 40 on the far right does have *Fagus grandifolia* as the second most important species. Toward the center of the ordination beech becomes the dominant species and tulip popular the second dominant. Some plots (42, 25, 26 and 53) in the center of the ordination contain species other than *L. tulipifera* as the second most dominant and they are plots 42 with *Pinus taeda,* 25 with *Cornus florida,* 26 and 53 with *Nyssa sylvatica,* and 49 with *Fraxinus sp.* Three plots located in the beech/tulip popular and tulip popular/beech groups have chinquapin oak present (6, 39 and 45).

In the upper center of the ordination are 3 plots with high importance of *Ulmus rubra,* slippery elm. Plots 1 and 3 are dominated by this species and plot 4 is dominated by *Q. muehlenbergii,* which is also present in plot 1. The group of plots on the far left of the ordination are composed of *F. grandifolia* and *Acer barbatum* and is called the beech/southern sugar maple group. In almost all plots beech is the dominant and southern sugar maple the second most dominant species, but in plots 36, 20, 38, 22 and 50 dominance is switched between those two species. One plot (18) was dominated by *Q. muehlenbergii. Tilia americana* is the second most important species in plot 36 and is also present in plots 37 and 20 in high abundance. *Carya cordiformis* (20), *Fraxinus americana* (38), *Liquidambar styraciflua* (22), and *Fraxinus sp.*(50) are each the second most important species in one plot.

Mountain Disjunct and Calciphilic Species in the Shrub/Sapling Layer

For the DCA ordination of the shrub/sapling data (Fig. 33 and 34), the plot numbers and corresponding site and ravine information for the shrub/sapling layer are indicated in Table 12. Five anomalous plots, three floodplain plots and two plots with bottomland influence were removed from

Fig. 33. DCA ordination of the shrub/sapling data with the occurrences of mountain disjunct and calciphilic species indicated. *Magnolia tripetala* (Matr), *Quercus muehlenbergii* (Qumu), *Tilia americana* (Tiam), *Stewartia ovata* (Stov), *Dirca palustris* (Dipa) and *Euonymus atropurpureus* (Euat) are mountain disjunct species. *Cercis canadensis* (Ceca) is a species known to occur in calcareous habitats in the Coastal Plain.



Axis 2
Axis 1
0
50
100
150
200
250
Ceca
2
3 Qumu
Ceca
Euat
Qumu
Qumu Ceca
46
51
34
Ceca
Stov
Dipa
35
Matr
7
8
Coat
31
Matr
Ceca
Qumu
33
37
Qumu
9Ceca
4
Ceca
36
Tiam
5
Matr
Ceca
44
Ceca
45
Ceca
12
48
Ceca
Ceca
Qumu
47
Ceca
32
Matr
19
Matr
23
6
Matr
20
Matr
38
Tiam
21
Matr

Fig. 33

Fig. 34. DCA ordination of the shrub/sapling data. The vegetation separates along the first axis into three general groups named for the most dominant species in those plots and they are American holly group, paw paw group, and the beech group. The subgroups are indicated by dashed lines and are the *Cercis canadensis* (Ceca), *Acer barbatum* (Acba) and mixed species. The subgroups indicate places in the ordination with high importance of the species indicated. Plots that are assigned to subgroups are not dominated by those species indicated unless otherwise noted in the text. Fe correlates negatively and B correlate postively with the first axis and pH, Ca correlate negatively and Cu correlates postively with the second axis.

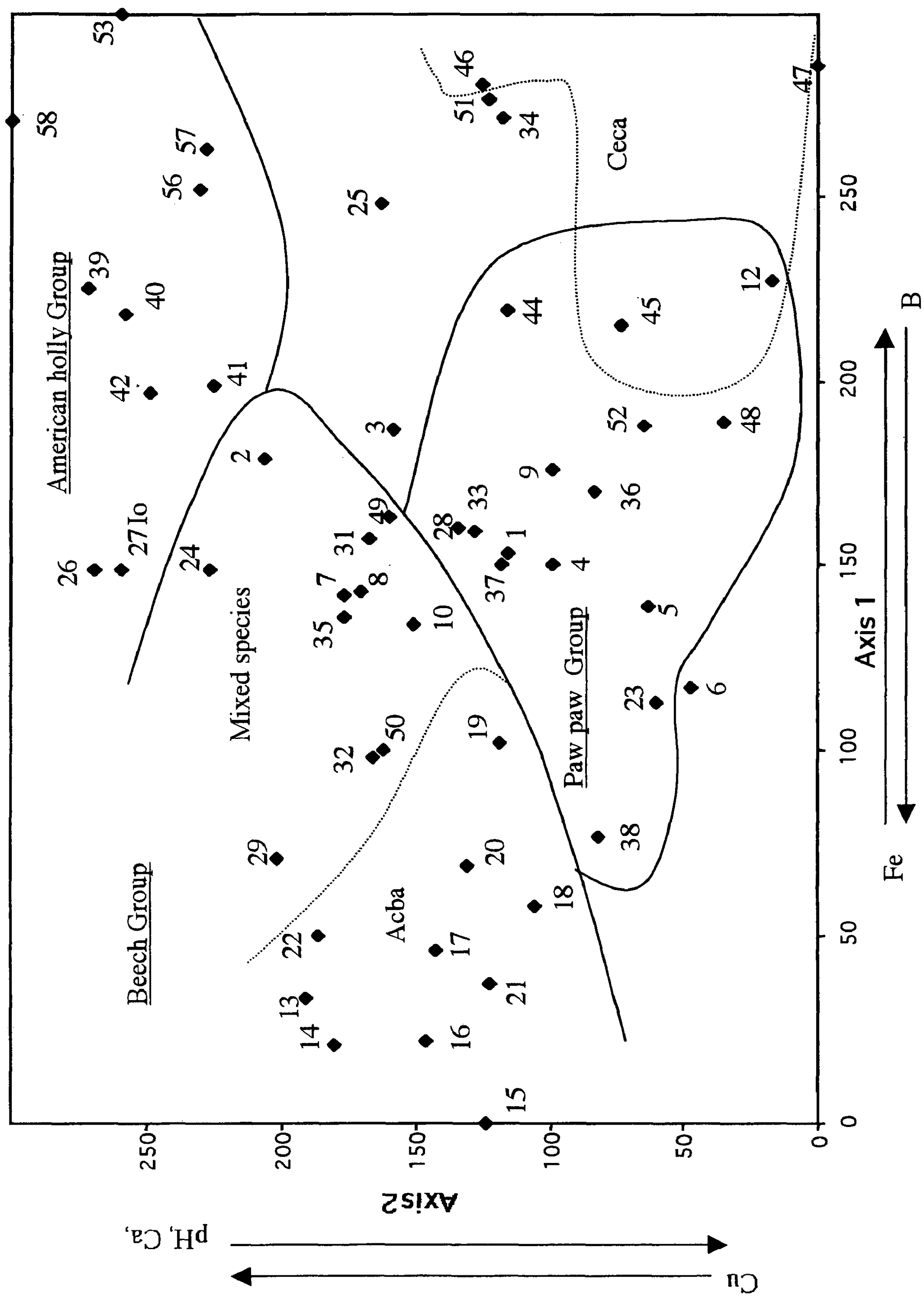

American holly Group
Mixed species
Beech Group
Acba
Paw paw Group
Ceca
Axis 1
Axis2
Fe
B
pH, Ca,
Cu

Fig. 34

the ordination. Four of the removed plots were from calcareous ravines, one from a non-calcareous ravine, and three removed plots were the same for the canopy ordination (43, 55, and 54). The eigenvalue of first axis of the ordination (Figs. 33 and 34) is 0.462, the eigenvalue for the second axis is 0.367. Many of the plots in the shrub/sapling layer contain either mountain disjunct species or species known to occur in calcareous habitats in the Coastal Plain. The mountain disjunct small tree species in the shrub/sapling layer found most often was *Magnolia tripetala,* the umbrella magnolia. It was present in the following plots from right to left on the DCA
ordination of the shrub/sapling plot data in Fig 33: 7, 8, 5, 6, 23, 19, 20 and 21. This species dominated plot 6 and was in high abundance in plot 21. Other mountain disjunct species that were present but only scattered throughout the ordination were *Quercus muehlenbergii* (47, 51, 3, 33, 10, 37), *Tilia americana* (38, 36), *Euonymus atropurpureus* (51), *Cornus alternifolia* (31), *Dirca palustris* (35) and *Stewartia ovata* (35). *Cercis canadensis* is considered a calciphilic species in the Coastal Plain and it occurred in 13 of the 58 plots in the shrub/sapling layer, located predominantly in plots at the bottom right of the ordination.

Shrub and Sapling Layer Vegetation

The remaining shrub/sapling plots (Fig. 34) can be divided into three general groups across the ordination: the American holly, paw paw and beech groups. Soil Fe ($r = 0.5219$) correlates positively and B correlates negatively ($r = -0.2539$) with the first axis, and pH ($r = -0.2711$) and Ca ($r = -0.3381$) correlate negatively and Cu (r = 0.3426) correlates positively with the second axis ($P < 0.05$).

The *Ilex opaca* or American holly group occurs on the upper right portion of the ordination. All of the non-calcareous plots (56, 57, and 58) occur in this group. All of these plots have *Ilex opaca* as the first or second species. In plots 40, 56 and 57 *Cornus florida* is the most important species and *Ilex opaca* the second most important. In plot 53 *Kalmia latifolia* is the most important species with *I. opaca* as the second most dominant species. The remaining plots in this group (except 26) are dominated by *I. opaca*. Plot 26 occurs near the American holly group in the ordination but does not fit neatly into any of the groups and its most important species are *Carya cordiformis* and *Oxydendrum arboreum*.

In the lower center of the ordination is the *Asimina triloba* or paw paw group. This group contains the largest number of plots on the ordination. The plots in the center of this group contain beech as the second most important species, except plots 9, 28 and 37 which contain *I. opaca* in that role. The plots 36, 52, and 48 contain high abundance of *Carpinus caroliniana* with this species being the dominant in plot 36. Above and to the left of the paw paw group are two ordination plots (3 and 25) that do not have much paw paw but have high abundance of *Carpinus caroliniana*. One plot (44) contained *Pinus taeda* as the second most dominant species. The cluster of plots on the bottom right of the ordination all contain redbud and these plots overlap with the paw paw group. Two plots on the right, 34 and 51, do not fit into any of the described groups and contain *Fraxinus pennsylvanica* as the most important species.

The beech group occurs in the upper center and to the far left of the ordination. *Fagus grandifolia* is the most important species in nearly all of these plots, but there are two subgroupss. In the mixed group plots 24, 2, and 8 have *Cornus florida* as the second most dominant; 29, 10 and 35 have *I. opaca;* 32 and 49 have *Ulmus rubra;* 50 and 35 have *A. triloba;* and 31 contains *Fraxinus pennsylvanica* as the second most dominant species. On the far left is the *A. barbatum* subgroup with most plots containing beech as the dominant species and *A. barbatum* as the second most dominant species. In the subgroup containing *A. barbatum* two plots, 17 and 15, actually contain this species as the most dominant and beech as the next most important. Plot, 21, occurring just outside of the beech/southern sugar maple group, contains a high abundance of beech and has *Magnolia tripetala,* a disjunct species, as the next most important species. Another plot (6) occurring on the lower portion of the ordination outside of the paw paw group has *M. tripetala* as the dominant and beech second.

Results of the Soil Tolerance Experiments

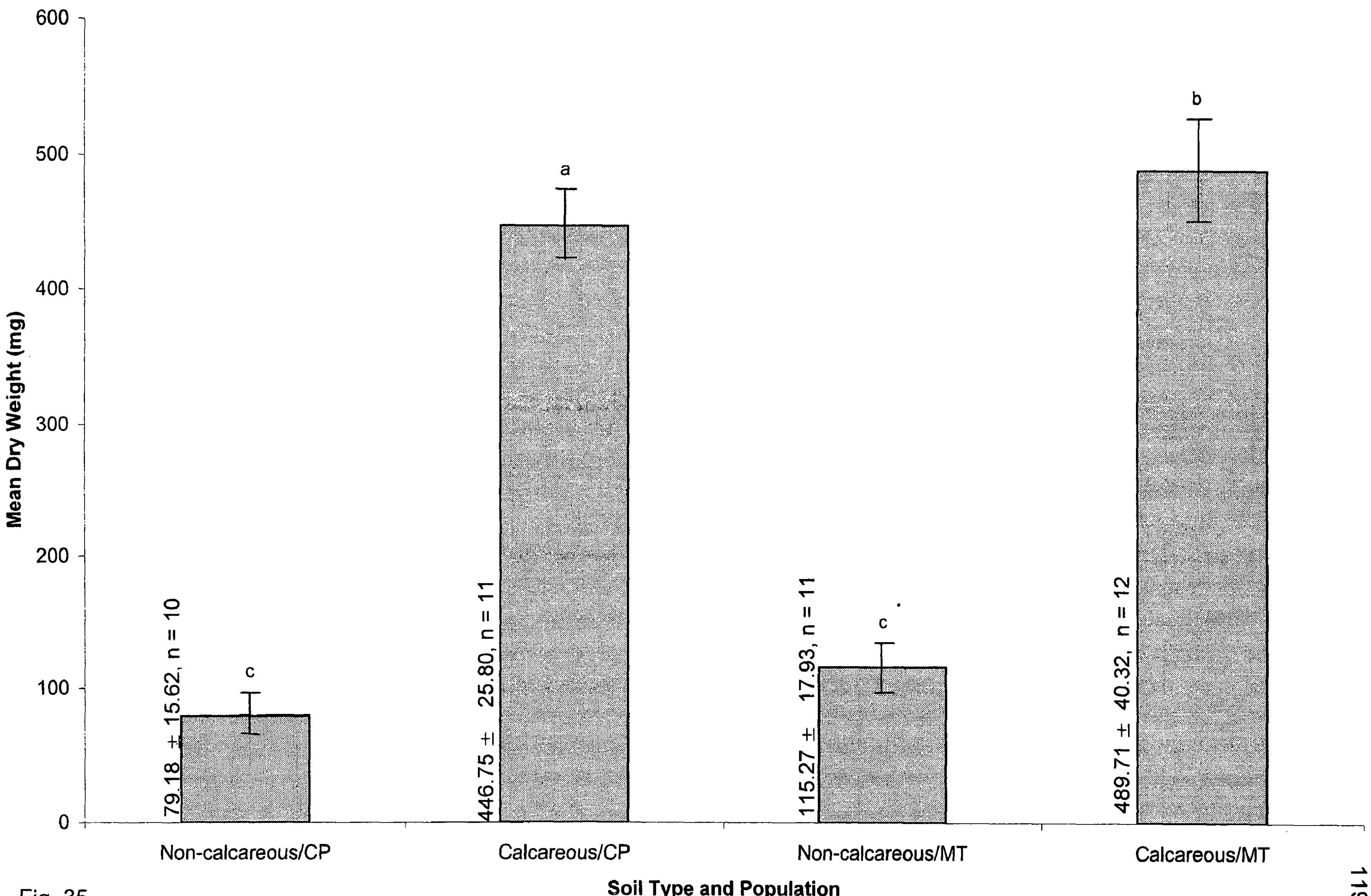
Of the seven mountain disjunct species for which seeds were available from Coastal Plain populations, mountain populations, or both, enough seeds were successfully germinated in five species to set up tolerance experiments. The two species that did not have successful germination were *Veronica anagallis-aquatica* and *Actaea pachypoda.*

For two of the disjunct species (*Solidago flexicaulis* and *Desmodium glutinosum)* sufficient seedlings were available to test soil tolerance of both mountain and Coastal Plain populations. In *Solidago flexicaulis* (zig-zag goldenrod) seedlings from the mountains and Coastal Plain grew much better on calcareous soil than on non-calcareous soil (Fig. 35). The data in this experiment were not normally distributed and data transformations could not normalize the data, nor were the variances equal, so ANOVA could not be used. A Mann-Whitney U-test indicated that growth on calcareous soil was significantly greater than on non-calcareous soil ($P < 0.01$). Mountain plants grew better (were more robust) than Coastal Plain plants on both soil types (Fig. 35), although this difference was statistically significant only on the calcareous soil (Mann-Whitney U-test, $P < 0.05$).

In *Desmodium glutinosum* seed germination was very low (about 10% vs about 90% in *Solidago flexicaulis*) and early mortality of seedlings was high. Thus, number of seedlings per treatment were low ($n = 3$) at the beginning of the experiment, and with only one mountain seedling still surviving on calcareous soil at the end of the experiment. Yet, even so, growth was substantially much greater on calcareous soil than on non-calcareous soil for both mountain and Coastal Plain populations (Fig. 36) that the difference between soil types was statistically significant ($P < 0.05$, one way analysis of variance) for both populations. Further, both the mountain and Coastal Plain plants growing on non-calcareous soil had at least one leaf with necrotic spots, which can be a sign of stress.

None of the seeds of *Aralia racemosa* collected from the mountains germinated, and only a small number of seeds collected from the Coastal Plain did (less than 5%). The Coastal Plain seedlings grew to be more robust on

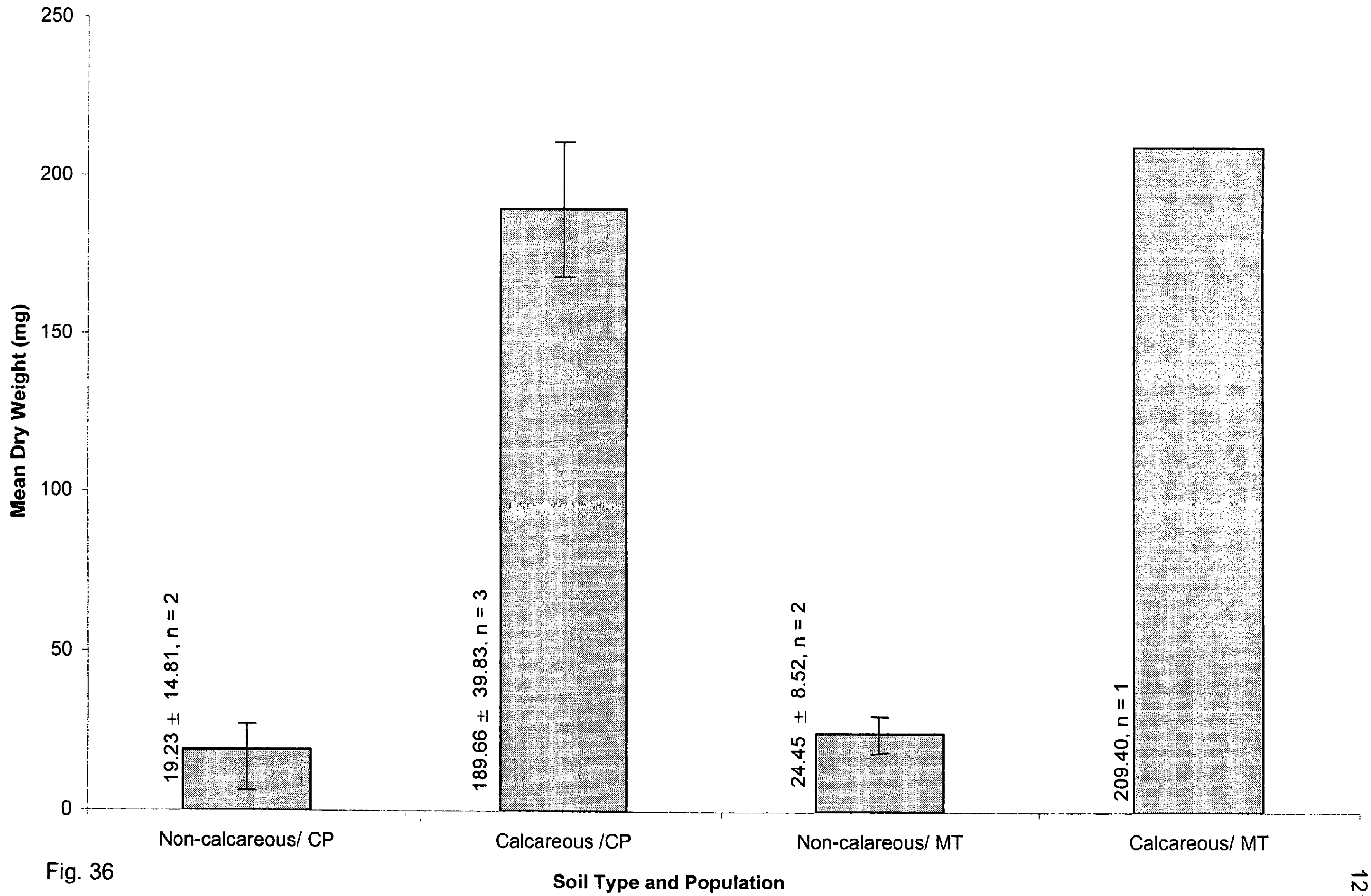
Fig. 35. Mean dry weight (mg) of *Solidago flexicaulis* from mountain and Coastal Plain populations grown on non-calcareous and calcareous soils. CP = Coastal Plain population and MT = mountain population. Mean dry weight values and standard error are presented next to the growth bars. A Mann-Whitney U-test indicated that growth on calcareous soil was significantly greater than on non-calcareous soil ($P < 0.01$). Mountain plants grew better (were more robust) than Coastal Plain plants on both soil types, although this difference was statistically significant only on the calcareous soil (Mann-Whitney U-test, $P < 0.05$). Non-identical letters (a/c, and b/c) are significant at $P > 0.01$, and a/b is significant at $P < 0.05$).



600
500
400
300
200
100
0
Mean Dry Weight (mg)
79.18 ± 15.62, n = 10
c
446.75 ± 25.80, n = 11
a
115.27 ± 17.93, n = 11
c
489.71 ± 40.32, n = 12
b
Non-calcareous/CP
Calcareous/CP
Non-calcareous/MT
Calcareous/MT
Soil Type and Population

Fig. 35

Fig. 36. Mean dry weight (mg) of *Desmodium glutinosum* from mountain and Coastal Plain populations grown on non-calcareous and calcareous soils. CP = Coastal Plain population and MT = mountain population. Mean dry weight values and standard error are presented next to the growth bars. Both plants grown from seeds collected in the mountains and plants grown from seeds collected in the Coastal Plain grew better on calcareous soil than on non-calcareous soil ($P < 0.05$).



250
200
150
100
50
0
Mean Dry Weight (mg)
19.23 ± 14.81, n = 2
189.66 ± 39.83, n = 3
24.45 ± 8.52, n = 2
209.40, n = 1
Non-calcareous/ CP
Calcareous /CP
Non-calareous/ MT
Calcareous/ MT
Soil Type and Population

Fig. 36

calcareous soil (292.11 ± 66.14 mg dry weight, n = 8) than on non-calcareous soil (160.53 ± 40.22, n = 3), but the one way ANOVA performed showed that this difference was not significant (Fig. 37).

Collinsonia canadensis seeds were available only from the mountains. More than 90% of its seeds germinated, so sample size was not a problem. However, the data on growth did not have equal variances and had to be transformed (log-transformed). Figure 38 is thus based on back-transformed means and their confidence intervals (posititive L_1 and negative L_2, following Sokal and Rohlf (1994)), instead of untransformed means and standard error. The plants grown on high calcium soil (n = 13) had a mean dry weight of 389.04 mg (confidence interval: L_1 = +130.76, L_2 = -236.83) and plants grown on non-calcareous soil (n = 11) had a mean dry weight of 175.30 mg (L_1 = +595.11, L_2 = -254.30) (Fig. 38). The mean of dry weight of plants grown on calcareous soil was significantly different ($P < 0.05$) from the mean of dry weight of plants grown on non-calcareous soils.

For *Agrimonia gryposepala,* seeds were available from the mountains, and only 6 seeds germinated (allowing for 3 for each soil type). Two of the three planted in non-calcareous soil died in the first weeks of the experiment. The remaining seedlings growing on non-calareous soil weighed more (281.0 (mg) than the average weight of the seedlings on calcareous soil (256.56 ± 116.35). These results could not subjected to statistical tests because of the very small sample size.

Fig. 37. Mean dry weight (mg) of *Aralia racemosa* from Coastal Plain populations grown on non-calcareous and calcareous soils. CP = Coastal Plain population. Mean dry weight values and standard error are presented next to the growth bars. While the plants grown on calcareous soil were more robust than those on non-calcareous soil, this difference was not significant.

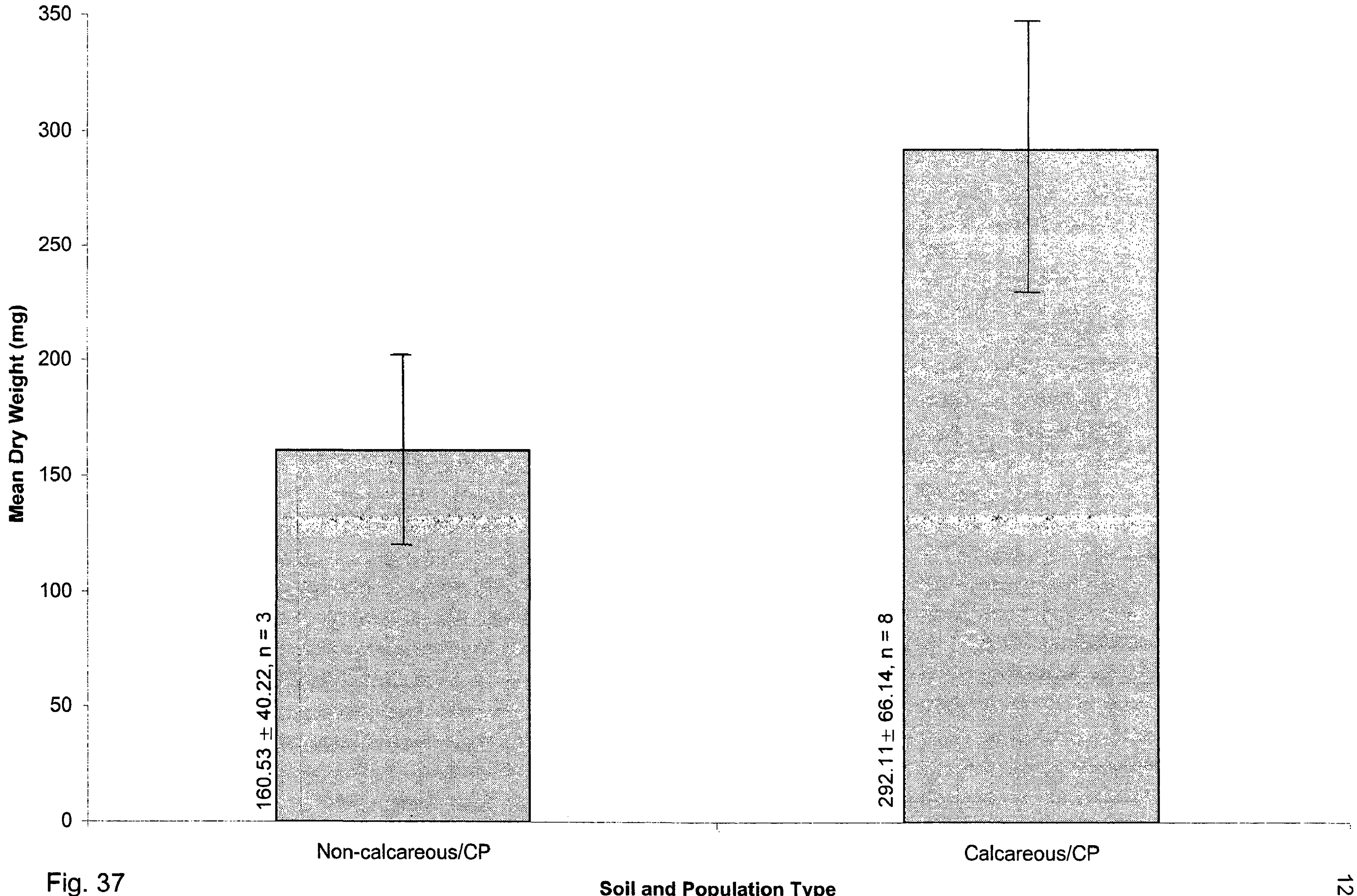

Mean Dry Weight (mg)
350
300
250
200
150
100
50
0
160.53 ± 40.22, n = 3
292.11 ± 66.14, n = 8
Non-calcareous/CP
Calcareous/CP
Soil and Population Type

Fig. 37

Fig. 38. Back-transformed mean dry weight (mg) of *Collinsonia canadensis* from mountain populations on non-calcareous and calcareous soils. MT = mountain population. Mean dry weight values and confidence intervals of the transformed data are presented next to the growth bars. The plants grown on calcareous soil grew better then the individuals grown on non-calcareous soil ($P < 0.05$).

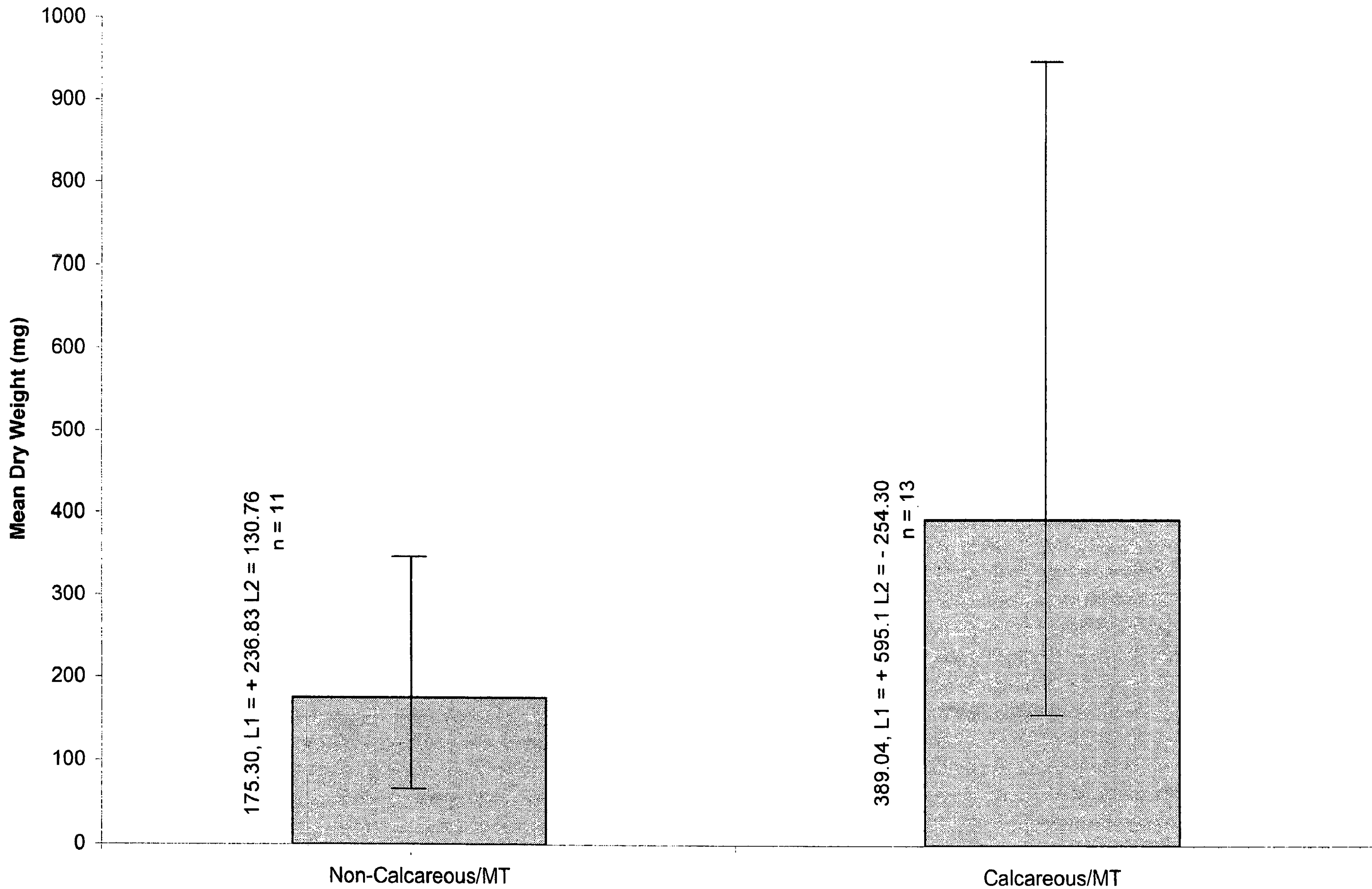

Mean Dry Weight (mg)
1000
900
800
700
600
500
400
300
200
100
0
175.30, L1 = + 236.83 L2 = 130.76
n = 11
389.04, L1 = + 595.1 L2 = - 254.30
n = 13
Non-Calcareous/MT
Calcareous/MT
Soil and Population Type

Fig. 38

DISCUSSION

Maps of Individual Collection Locations for the Less Disjunct Species

The maps of individual collection locations indicated that many (8 of 20) of the species whose disjunctions were in question based on their Atlas maps show a wider mountain-Coastal Plain gap on their individual collections maps because the mapping technique employed provides better resolution of the disjunction, and hence a disjunction of greater magnitude. In the future, if new species are identified as potentially disjunct, a study of their individual collections locations across the state (rather than county based distribution) will be the best way to assess the strength of disjunction. Even those species whose distributions form a corridor through the Piedmont and those species with several occurrences in the Piedmont should still be considered disjunct, at least ecologically, because these Piedmont collections may represent localized colonies growing in a specific microhabitat which is rare throughout the Piedmont or at least rare in the eastern Piedmont but more common in the Coastal Plain and mountains. It is apparent that the habitat and edaphic requirements of mountain disjuncts in the Piedmont need to be studied in order to fully understand the reasons for their present distributions.

Distribution of the Ground Layer Vegetation

The presence of any particular disjunct species in a ravine was not a predictor of the presence of any other disjunct species in that ravine, nor was the presence of any disjunct species or a suite of disjunct species in a ravine a good indicator of the disjunct species in surrounding ravines. While many of the calcareous slope plots contained disjunct species (Fig. 26 and Fig. 31), only a few of those plots were dominated by disjunct species. The patchy presence of disjuncts in ravines and unpredictable occurrence in neighboring ravines may be related to difficulties in seed dispersal from one ravine into neighboring ravines. Wind might carry seeds within a ravine, or blow them into the stream that cuts through the ravine floor, which might carry them to a new location in that same ravine, but it is less likely that wind dispersed seeds would blow from one deep ravine over the upland and into neighboring ravines. This explanation may describe the distribution of *Solidago flexicaulis* and *Aruncus dioicus* in ravines, because colonies of these species are often scattered throughout a ravine, but do not necessarily occur in neighboring ravines with apparently similar habitats. While at first glance it might seem that disjunct species with animal dispersed seeds might be able to better disperse their seeds from ravine to ravine than wind dispersed disjuncts, species with animal dispersed seeds (like *Aralia racemosa, Desmodium glutinosum, Panax quinquefolius,* and *Aralia nudicaulis)* were no more likely to be found in neighboring ravines (with presumably the same environment) than were species with wind dispersed seeds. While dispersal mechanisms may influence the localized distribution of disjuncts among ravines, limited suitable microhabitat or "safe sites" for seedling establishment may cause the patchy distribution of most disjunct species within ravines. Further, some mountain disjunct species have persisted in some ravines but not others for unknown reasons.

One explanation for the occurrence of mountain disjuncts in Coastal Plain ravines is that ravines are moister than the surrounding uplands. While this is true, it is also true that non-calcareous ravines possess the same topographic features (upland edges, slopes and ravine floors) that calcareous ravines do, and should also be moister than uplands. Yet the non-calcareous ravines lacked all disjuncts except *Galax urceolata,* a known acidophile. This suggests that it is the soil chemistry of the calcareous ravines that makes them suitable habitat for the mountain disjuncts. On the other hand, non-calcareous ravines in the local area around my study sites are not as steep-sided as, and are shallower than, calcareous ravines, which may make the non-calcareous ravines environmentally more similar to the uplands of the Coastal Plain. Ravines that cut into the Yorktown Formation are not only different from non-calcareous ravines because they have high levels of calcium, but because faster erosion produces a deeper, very steep-sloped ravine, often with springs occurring at the contact between the upper sediments and the Yorktown. It could be argued that while non-calcareous ravines in the Coastal Plain offer another ravine habitat that disjuncts could potentially inhabit, they are sufficiently different in depth and steepness (and thus soil moisture) from calcareous ravines that disjuncts are restricted to ravines that cut into the Yorktown Formation. Only a comparison of growing season soil moisture in calcareous slopes, non-calcareous slopes and uplands away from calcareous ravines can fully eliminate soil moisture as a causative difference between the calcareous and non-calcareous ravines, and confirm that it is soil chemistry that makes the difference.

Asarum canadense, Phegopteris hexagonoptera, Dicanthelium boscii, Dicanthelium communtatum, Brachyelytrum erectum and *Luzula acuminata* are non-disjunct species; that is they occur all across Virginia. Nevertheless, they do not occur widely throughout the Coastal Plain, but are largely found in calcareous ravines with disjunct species. While these non-disjunct species were present in many calcareous ravines (Table 6), their presence or importance could not be used to predict the presence of disjunct species within a ravine or in neighboring ravines. That is, no intimate associations exists between these associated species and disjunct species to the extent that when one species was present a disjunct species could be found in the same ravine. All these associated non-disjunct species are known to occur on calcareous substrates in the mountains of Virginia (Fleming 1999) and *Asarum canadense* is also known to occur on calcareous substrates in South Carolina (Hill 1992). These associated species may have wider substrate tolerances, be better dispersers or be better competitors than disjunct species and, therefore they both occur with disjunct species, and also in places in the Coastal Plain where disjunct species are unable to grow.

There is a clear difference in both the flora and vegetation between upland edges of calcareous ravines and calcareous slopes (Fig. 27). Disjunct species were confined to the slopes and a few floodplain plots with none occurring in upland edge plots. Further, the upland edges of some calcareous ravines were dominated by acidophiles or by species largely indifferent to soil pH and soil calcium. The upland edge plots of calcareous ravines themselves fell into two groups, those dominated by substrate and pH indifferent species like *Polystichum acrostichoides, Euonymus americana,* and *Mitchella repens,* and those that, like the associated uplands of non-calcareous ravines were dominated by woody ericads. These two types upland edges bordering calcareous ravines are different from the vegetation that occurs on the slopes (where most of the disjunct species occur). This difference in vegetation on the uplands versus the slopes is presumably due to the pH and calcium differentials between the upland and slopes, with the uplands being acidic with low soil calcium, and the slopes being more alkaline with higher soil calcium. The similar vegetation (woody ericads) shared by the non-calcareous plots and some of the upland edge plots of calcareous ravines (Fig. 28 and Fig. 29) is probably due to the low pH and low calcium levels that these plot types share.

Woody Vegetation

Unlike the ground layer vegetation in which the ravine slope communities are quite different from the upland communities, the woody vegetation is dominated by species that are common in the Coastal Plain, with the exception of *Acer barbatum* in the beech/southern sugar maple group. *Liriodendron tulipifera* and *Fagus grandifolia,* the dominants in the tulip popular/beech and beech/tulip popular groups (the two groups with the most plots) are abundant through the Coastal Plain,with the first an early successional species (Monette and Ware 1983) and the second a climax species (Ware 1978). *Ulmus rubra* of the slippery elm group is a species of moister, usually calcareous sites in the Coastal Plain (Parsons and Ware 1982, Glascock and Ware 1979), but by no means is confined to ravines. *Quercus alba* of the white oak group is the most common oak species in the Coastal Plain (Monette and Ware 1983). *Quercus muehlenbergii,* a disjunct/calciphilic species, occurred in several plots of the white oak group, but did not have high importance in the groups mentioned. *Acer barbatum* of the beech/southern sugar maple group is found only in a few places in the Coastal Plain of Virginia (Ware and Ware 1992). The disjuncts *Quercus muehlenbergii* and *Tilia americana* are present in some plots in this latter group, but neither are dominants in plots in which they occur.

Shrub/Sapling Layer

The shrub/sapling data are dominated by species that are common in the Coastal Plain (Fig. 34). Most of the plots are dominated by *Fagus grandifolia,* which indicates that this species is reproducing and persisting under the canopy. In several of the plots containing beech as the dominant species, *Acer barbatum* was the second most dominant species. High importance of *Acer barbatum* in shrub/sapling plots is in contrast with what Ware and Ware found in their 1992 study of Grove Creek. The high importance of *Acer barbatum* in the shrub/sapling layer indicates that this species is reproducing successfully in the portion of the Grove Creek watershed included in this study. The other plots are dominated by either *Asimina triloba* or *Ilex opaca*. *Asimina triloba* is considered to be an indicator of calcium-rich substrates for South Carolina, but has been observed on non-calcareous substrates there as well (Hill 1992). This species seems to maintain a similar edaphic tolerance in the Coastal Plain of Virginia, as it is found both on calcareous ravine slopes and their associated upland edges. Finally, *Ilex opaca,* American holly, is a common understory species in oak and beech forests in the Coastal Plain (Monette and Ware 1983).

There are more species which are disjunct and considered calciphiles in the shrub/sapling layer than in the tree layer (Fig. 33). The presence of more disjunct species in the shrub/sapling layer is probably due to 1) there being a greater number of disjuncts that are shrubs or small trees (*Magnolia tripetala, Stewartia ovata, Euonymus atropurpureus* and *Cornus alternifolia*) than are canopy trees (*Tilia americana* and *Quercus muehlenbergii*) and 2) the combination of sapling disjunct canopy species in the same vegetation layer with the disjunct shrubs and small trees species.

Soil Tolerance Experiments

Ware and Ware (1992) suggest in their study that most of the mountain disjunct species that occur in Grove Creek behave as calciphiles there, when in the majority of their range most of these species are not calciphiles. All but one of the species (*Agrimonia gryposepala)* in the soil tolerance experiment were found in Grove Creek (*Solidago flexicaulis, Desmodium glutinosum, Aralia racemosa* and *Collinsonia canadensis).* Both mountain and Coastal Plain seeds of *Solidago* *flexicaulis* performed much better on calcareous soils, which suggests that it could be a calciphile in both of these physiographic provinces. This species has been found growing on a calcareous substrate in the mountains of Virginia (Fleming 1999) which supports its being a calciphile in both of the Coastal Plain and mountains. *Desmodium glutinosum,* followed the same trend, and grew better on calcareous soil than on non-calcareous soil. This species also has been found on calcareous substrates in the mountains of Virginia (Fleming 1999) and in calcareous cliff communities in South Carolina, and is considered a non-obligate calciphile there (Hill 1992). The results of the soil experiments suggest that *Desmodium glutinosum* grows best in a calcareous substrate in the mountains and Coastal Plain; however, a larger sample size in the experiment would enable better inference about this species. *Collinisonia canadensis* may be a calciphile, at least in the mountains, because it grew better on calcareous soil than non-calcareous soil. The results for *Aralia racemosa* suggest that it may not an obligate calciphile in the Coastal Plain, because while it grew better on calcareous soils than on non-calcareous soils, this difference was not significant.

Possible and Future Studies

There are several conclusions from this study that lead to other questions that would make reasonable follow-up studies. Some mountain disjuncts are considered less disjunct because they have occurrences in the Piedmont, but it is unclear whether these Piedmont occurrences represent typical Piedmont habitats or whether they are in local microhabitats similar to those in the Coastal Plain or mountains. The habitat requirements of mountain disjuncts that occur in the Piedmont should be investigated.

The conclusion that many disjunct species have a patchy or spotty distribution within ravines and within a system of ravines is interesting and may provide support to Harvill's (1965) theory that these populations are relics from an early time. Such patchy and spotty distribution in "ecological islands" like the calcareous ravines is characteristic of relict island patterns (Darlington 1965, Carlquist 1965). Evidence about the degree of isolation of these species in the Coastal Plain may be revealed through genetic analysis of populations within the Coastal Plain and between the Coastal Plain and mountains.

The soil tolerance experiments performed in this study were performed on only a few mountain disjuncts, and studies of more of these species is necessary to make conclusions about whether mountain disjunct species as a group are or are not calciphiles in the Coastal Plain. Finally, the ecological studies on distribution and abundance in this project concentrated on those disjunct species that occur in calcareous ravines. Little is known about the habitat conditions required by mountain disjuncts species that do not occur in ravines. Studies of these species are necessary to better comprehend the role of these mountain disjuncts in the communities in which they occur.

Addendum

Since the publication of the Atlas (Harvill et al. 1992) collections have been made throughout Piedmont counties of several disjunct species and their status as disjuncts no longer holds (G. P. Fleming, pers. comm., 2000). New collections of *Quercus muehlenbergii* in thirteen Piedmont counties have been recorded, thereby filling in the gap between the mountains and Coastal Plain. While this species' disjunct distribution no longer holds, it is still considered a calciphile. Other species that are probably common throughout Piedmont counties are *Collinsonia canadensis* and *Agrimonia pubescens* (G. P. Fleming, pers. comm., 2000). Other species that may be considered locally frequent in most Piedmont counties are *Juglans cinerea* and *Aruncus dioicus* (G. P. Fleming, pers. comm., 2000).

APPENDIX A

The number of specimens of less disjunct species examined and mapped.

Table 13. The number of specimens of less disjunct species examined and mapped.

Less Disjunct Species	Number of Specimens
Amianthium muscaetoxicum	53
Comptonia peregrina	50
Galax urceolata	86
Anemone quinquefolius	50
Dirca palustris	68
Bidens cernua	67
Scutellaria ovata	27
Tilia americana	91
Taenidia integerrima	72
Veronica anagallis-aquatica	89
Athyrium thelypterioides	91
Collinsonia canadensis	95
Panax quinquefolius	65
Celastrus scandens	42
Pellea atropurpurea	76
Aruncus dioicus	73
Ranunculus septentrionalis	28
Agrimonia pubescens	69
Hexalectris spicata	37
Juglans cinerea	50

APPENDIX B

Maps of the study sites.

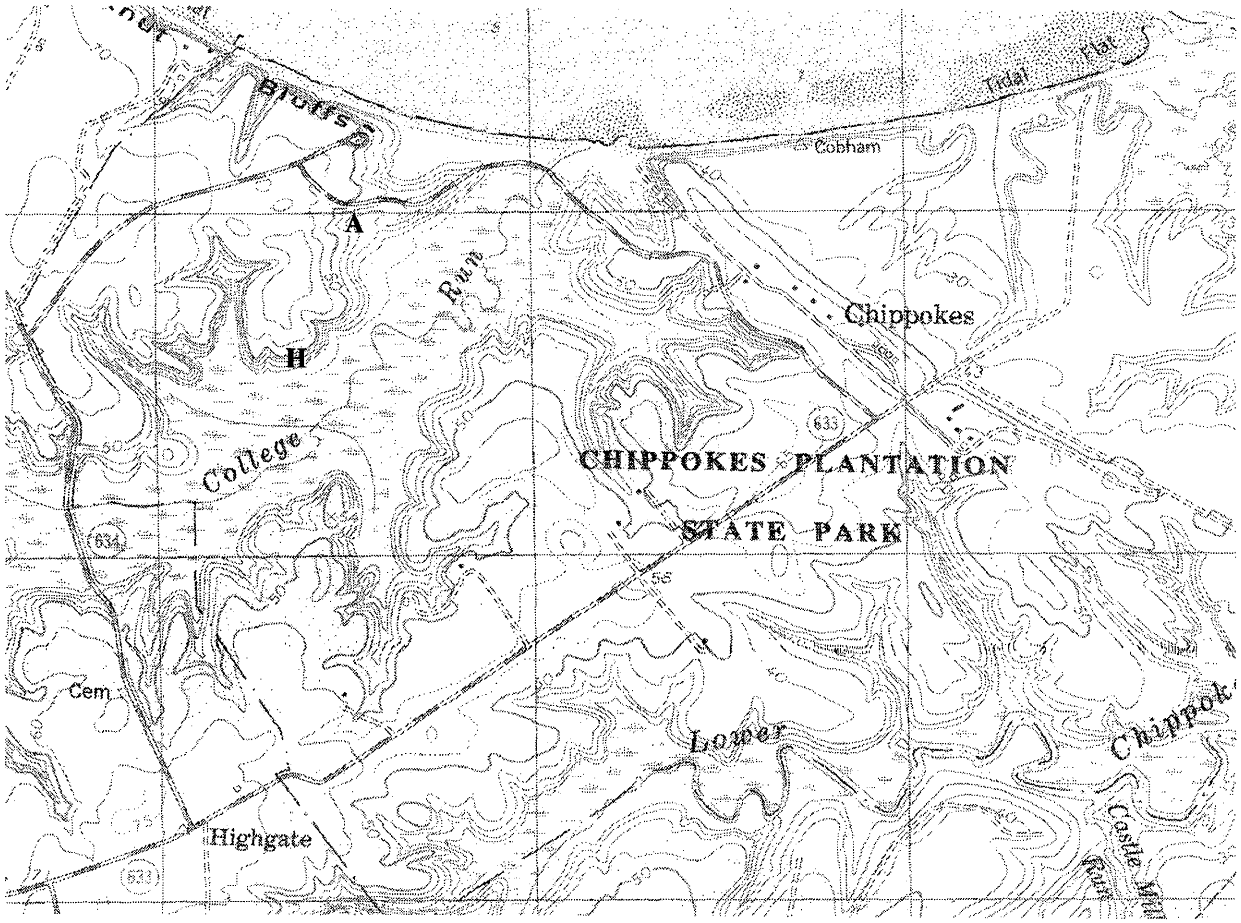


Fig. 39. Map of Chippokes Plantation St. Park study site with ravines identified. Taken from the USGS Hog Island quadrangle topographic map. A = *Athyrium pycnocarpon* ravine, H = *Hexalectris spicata* ravine (both ravines are calcareous).

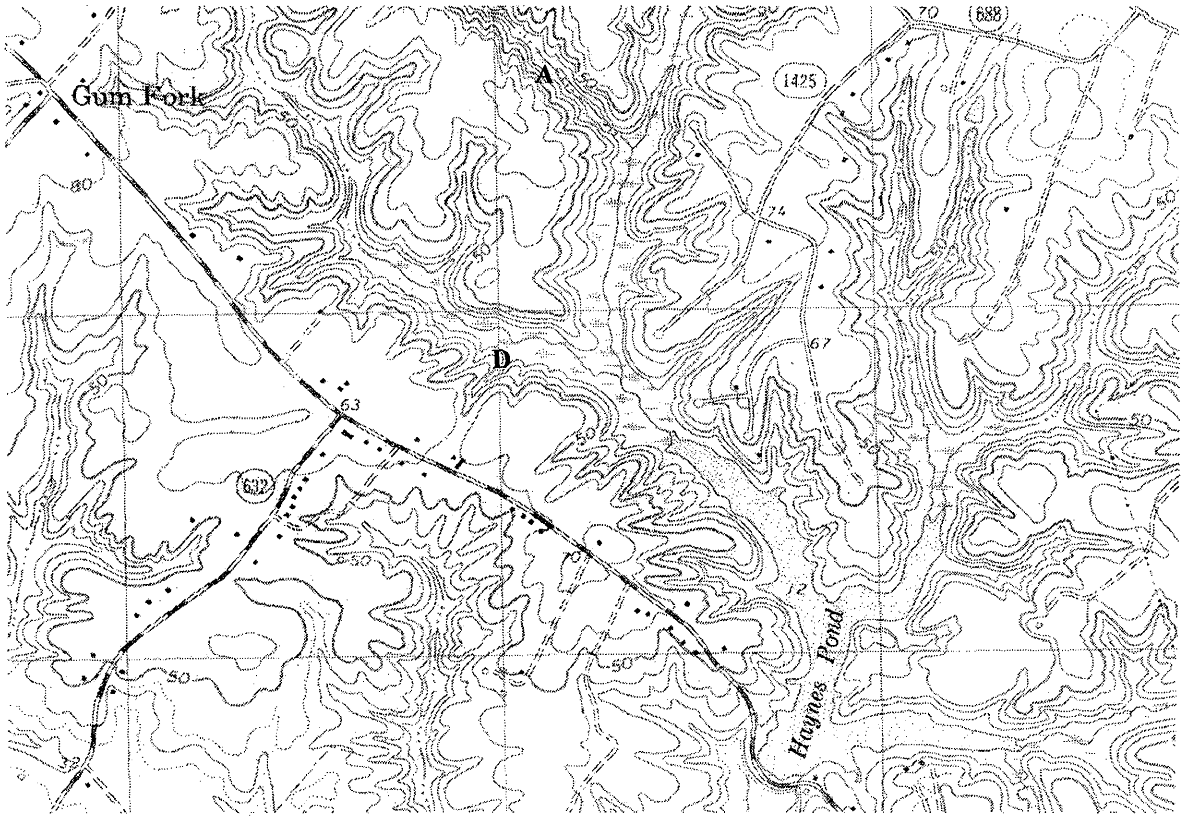


Fig. 41. Map of the Hickory Fork Rd. study site with ravines identified. Taken from the USGS Clay Bank quadrangle topographic map. A = *Aralia racemosa* Ravine, D = *Desmodium glutinosum* Ravine (both are calcareous ravines).

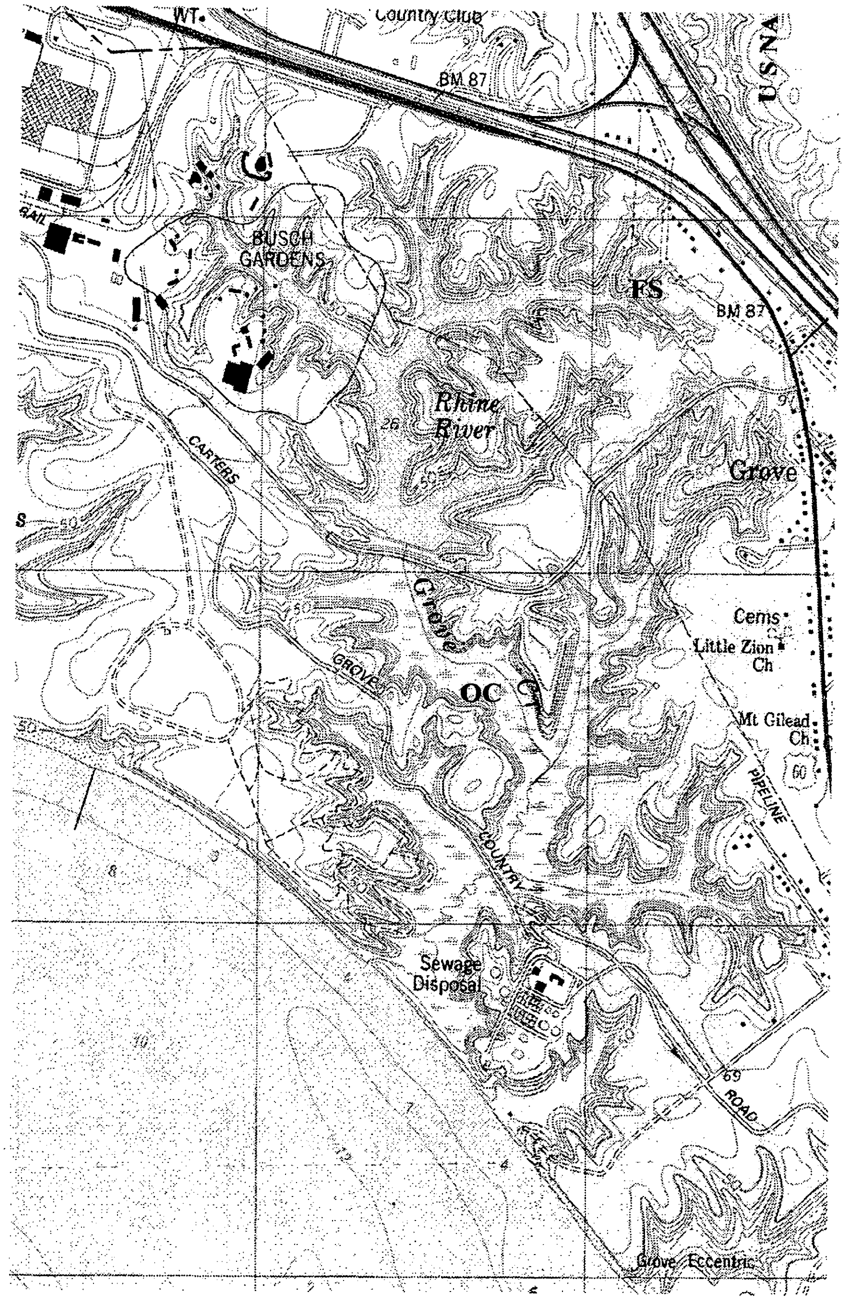


Fig. 41. Map with Grove Creek study site ravines identified. Taken from the USGS Hog Island quadrangle topographic map. FS = Fire Station Ravine and OC = Old Country Rd Ravine (both are calcareous ravines.

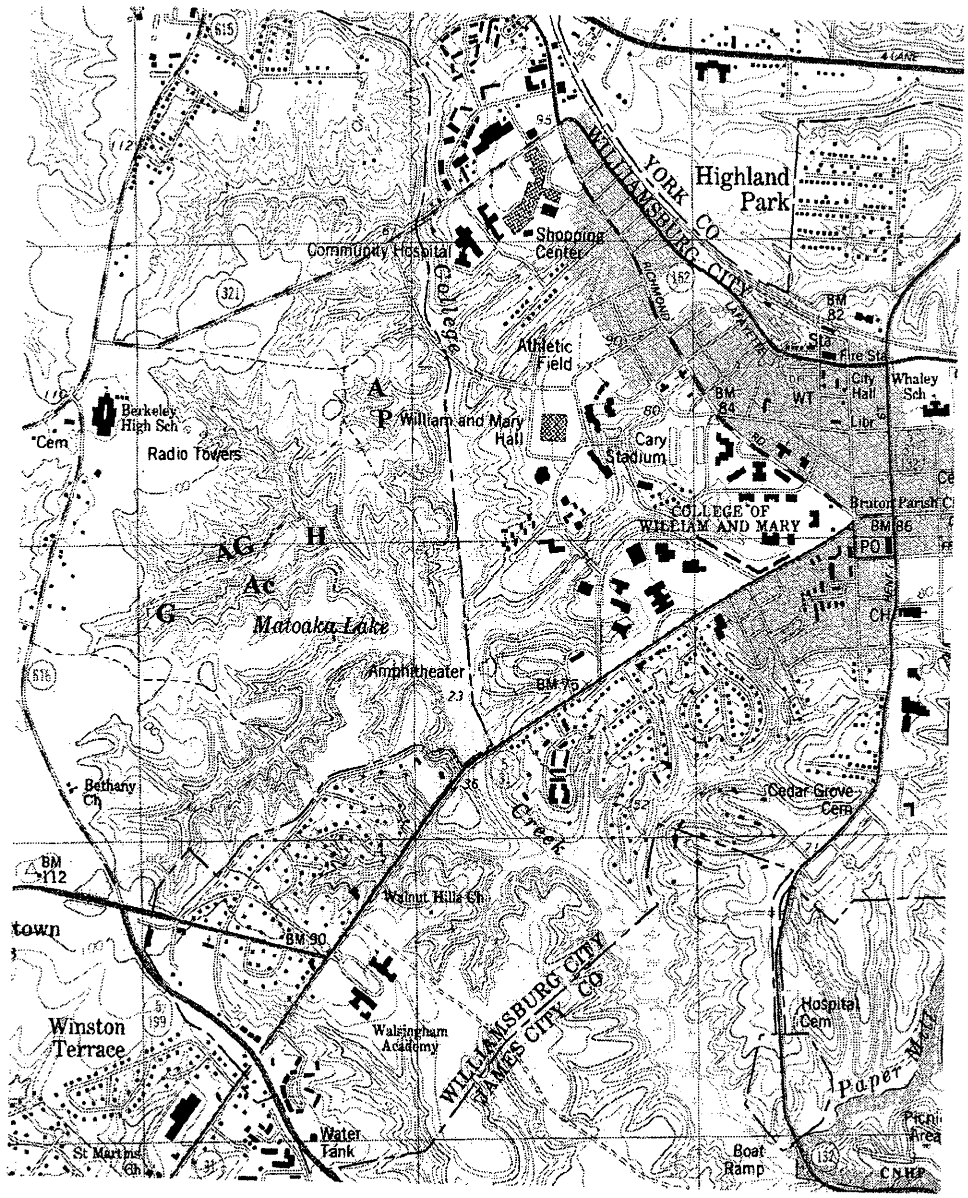


Fig. 42 Map of the College Woods study site with ravines identified. Taken from the USGS Williamsburg quadrangle topographic map. The calcareous ravines are: A = *Aruncus dioicus* Ravine, P = *Ponthieva racemosa* Ravine, H = *Hexalectris spicata* Ravine, AG = *Aralia spp.* Gorge, Ac = *Acteae pachypoda* Ravine. The non-calcareous ravine is G = *Galax urceolata* Ravine

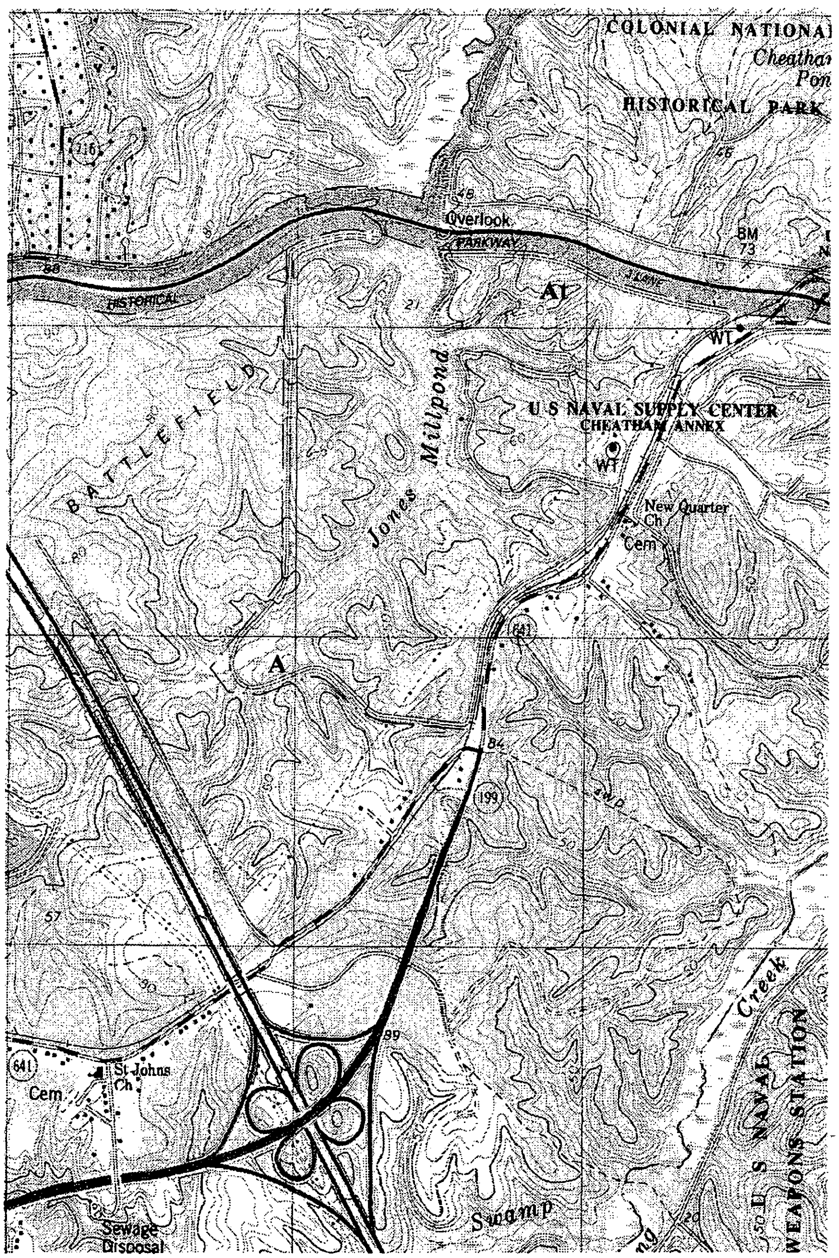


Fig. 43. Map of the Cheatham Naval Annex study site with ravines identified. Taken from the USGS Williamsburg quadrangle topographic map. A = *Aralia racemosa* ravine, At = *Athyrium pycnocarpon* ravine (both are calcareous ravine).

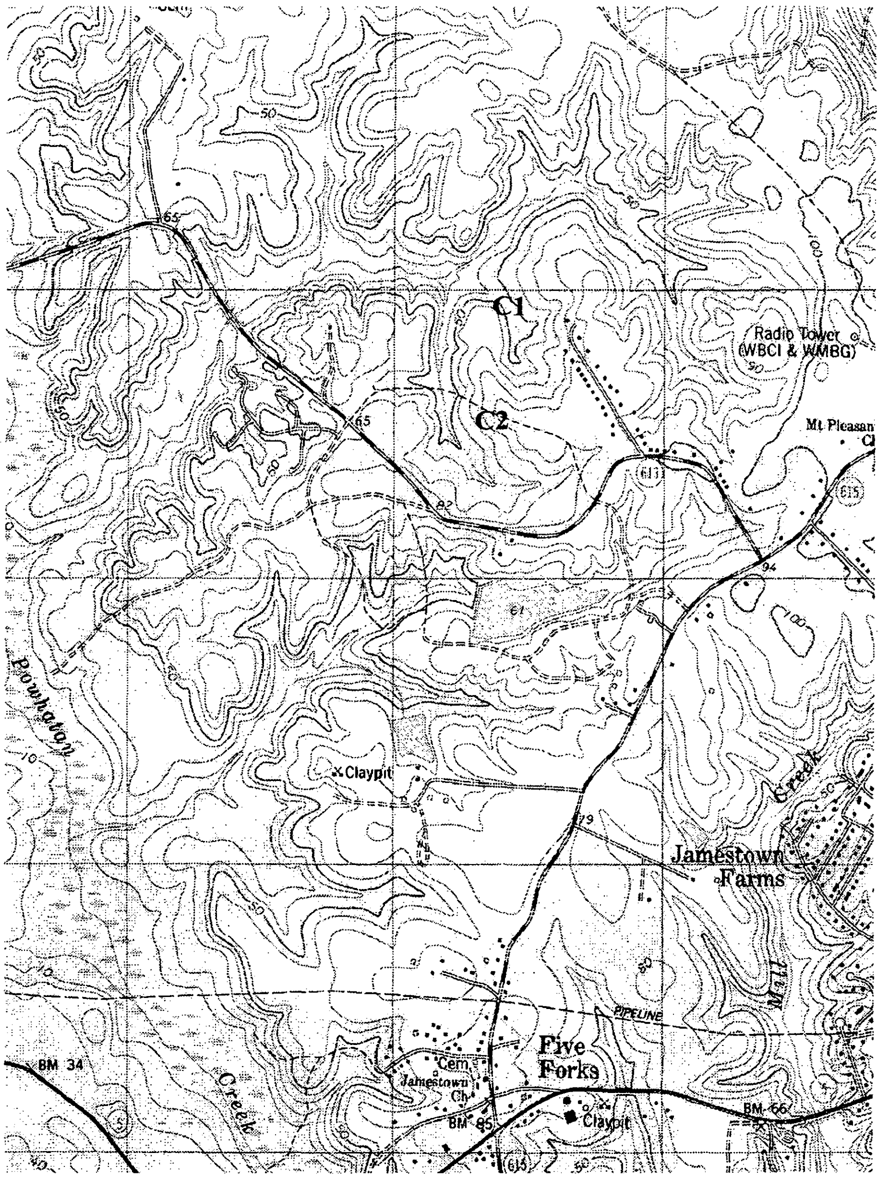


Fig. 44. Map of the Casey Tract study site with ravines identified. Taken from the USGS Norge quadrangle topographic map. C1 = Casey Tract ravine #1, C2 = Casey Tract ravine #2 (both are non-calcareous ravines).

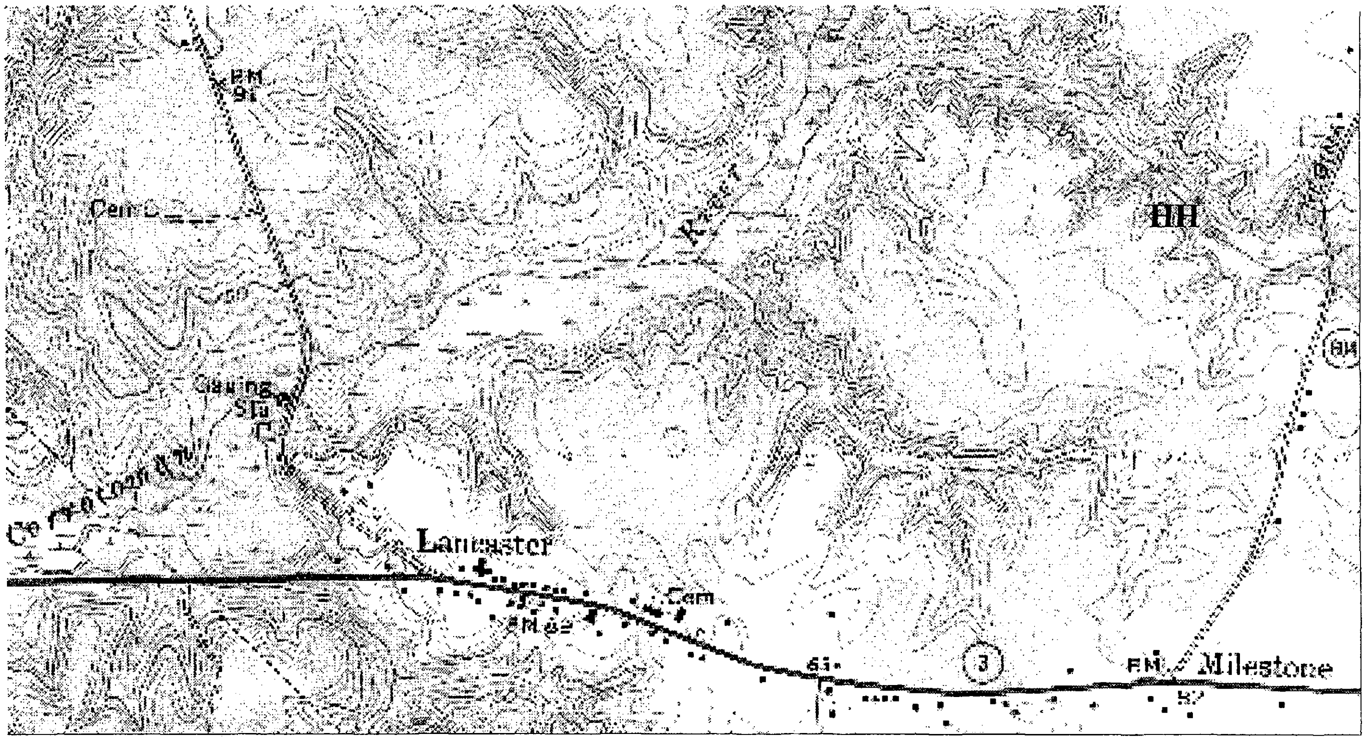


Fig. 45 Map of the Cabin Swamp study site with the ravine identified Taken from the USGS Lancaster quandrangle topographic map. HH = Hickory Hollow ravine (a calcareous ravine).

APPENDIX C

Seed sources for the species used in the soil tolerance experiments.

Table 14. Seed sources for the species used in the soil tolerance experiments. N/A indicates that seeds from that province were not used in the soil tolerance experiments. All counties indicated are in Virginia.

Species	Coastal Plain Seed Source	Mountain Seed Source
Solidago flexicaulis	College Woods, The College of William and Mary, James City Co. Grove Creek study site, James City Co.	Jones Run Falls, Albemarle Co.
Desmodium glutinosum	College Woods, The College of William and Mary, James City Co.; Hickory Fork Rd. study site, Gloucester Co.	Monticello, Albemarle Co.
Aralia racemosa	Hickory Fork Rd. study site, Gloucester Co.	N/A
Collinosinia canadensis	N/A	Peaks of Otter, Bedford Co.
Agrimonia gryposepala	N/A	White Top Mt., Grayson Co.

APPENDIX D

Soil data for all study sites.

Table 15. Soil data for all sites. Environmental variables are listed by site, ravine and the topographic location from which the sample was collected. All values except pH are give in ppm in soil.

Site/Ravine/topographic position	soil pH	P	K	Ca	Mg	Zn	Mn	Cu	Fe	B
GC, Fire Station,mid slope	4.8	3.5	45.5	408	37	1.3	6.5	0.3	23.6	0.3
GC, Fire Station, bottom slope	6.6	21.5	53	3016	66	2.1	16.1	0.2	12.8	1.4
GC, Fire Station, ridge	4.4	5	34.5	204	24	1.1	2.2	0.2	40.8	0.3
GC, Fire Station, bottom slope	6.2	3.5	36	1383.2	48	1.5	14.3	0.1	10.5	0.8
GC, Fire Station, bottom slope	4.9	5	36	696	44.5	1.4	6.3	0.4	25.1	0.4
GC, Fire Station, mid slope	6.4	11	29.5	3084	31	0.9	5.1	0.2	8.5	0.7
GC, Fire Station, ridge	4.3	4	36	216	26.5	1.2	1.2	0.3	37.1	0.3
GC, Fire Station, bottom slope	5.5	3.5	53	1245	55	2.6	7.6	0.3	43.2	0.6
GC, Fire Station, mid slope	6.5	10.5	45.5	2328	53	1.6	16.1	0.2	6.2	1.2
GC, Fire Station, bottom slope	4.2	4	47	324	27.5	1.6	2.9	0.5	43.5	0.4
CNA, Aralia racemsoa Ravine, bottom slope	6.1	10.5	66	3460	68.5	1.1	9.1	0.2	13.9	1
CNA, Aralia racemosa Ravine, upper slope	4.7	3.5	33	324	27.5	1.3	5.1	0.2	35.1	0.3
CNA, Aralia racemosa Ravine, ridge	4.4	3	36	504	49	1.3	4.2	0.1	28.5	0.3
CNA, Athyrium pycnocarpon Ravine, bottom slope	6.1	3.5	59.5	1283.6	95	1.4	16.1	0.2	5.4	1.1
CNA, Aralia racemosa Ravine, bottom slope	6.9	17.5	70.5	4688	105.5	1.7	16.1	0.1	6.3	2
CNA, Athyrium pycnocarpon Ravine, upper slope	4.7	7	50	552	59	1.3	14.5	0.2	11.6	0.5
CNA, Athyrium pycnocarpon Ravine, bottom slope	5.8	8	59.5	1068	89	1.9	16.1	0.2	5.7	0.9
CNA, Athyrium pycnocarpon Ravine, ridge	5.2	7	61	900	110.5	2.5	16.1	0.2	5	0.7
CP, Hexalectris spicata Ravine, mid slope	7	29	50	4428	65	1.7	16.1	0.1	2.7	1.6
CP, Hexalectris spicata Ravine, ridge	4.7	7	48.5	492	61	1.9	16.1	0.3	23.9	0.5
CP, Hexalectris spicata Ravine, floodplain	7	10.5	56.5	3172	120	3.3	16.1	0.2	16.2	1.9
CP, Athyrium pycnocarpon Ravine, floodplain	7	15	64.5	1742.4	69.5	1.3	16.1	0.4	41.2	0.7
CP, Athyrium pycnocarpon Ravine, bottom slope	6	5.5	70.5	1188	119	1.7	16.1	0.2	7.9	0.9

Table 15. (continued)

Site/Ravine/topographic position	soil pH	P	K	Ca	Mg	Zn	Mn	Cu	Fe	B
CP, Athyrium pycnocarpon Ravine, mid slope	5.2	5	69	1008	117.5	1.5	16.1	0.3	18	0.9
CP, Athyrium pycnocarpon Ravine, ridge	4.4	7	61	444	69.5	3	16.1	0.3	27.2	0.5
CW, Aralia nudicaulis, bottom slope	6.5	7	40.5	3476	50.5	1.2	16.1	0.5	27.5	0.9
CW, Aralia nudicaulis, upper slope	7.1	7.5	53	2772	50.5	1.1	16.1	0.3	12.9	1.2
CW, Aralia nudicaulis, ridge	4.6	4	39	192	20.5	2.3	2.5	0.3	102	0.3
Casey Tract, Ravine 1, ravine floor	4.4	7	59.5	144	37	1.9	16.1	0.3	17.7	0.4
Casey Tract, Ravine 1, mid slope	4.4	7.5	44	180	37	2.3	16.1	0.3	14.4	0.4
Casey Tract, Ravine 1, ridge	4.5	6.5	36	168	35	1.6	13.2	0.2	13.4	0.2
Casey Tract, Ravine 2, mid slope	4.3	5	34.5	84	20.5	1	1.6	0.2	53	0.3
Casey Tract, Ravine 2, floodplain	4.6	7	40.5	528	48	2.3	4.3	0.3	108	0.3
Casey Tract, Ravine 2, ridge	4.6	6.5	44	156	32.5	1.3	4	0.2	19	0.3
CW, Aralia spp. Gorge, mid slope	4.7	3	37.5	300	30	1.1	6	0.2	57.7	0.2
CW, Aralia spp. Gorge, ridge	4.4	3	34.5	144	21.5	1.3	2.9	0.2	48.9	0.1
CW, Aralia spp. Gorge, bottom slope	6.4	11.5	55	4588	56.5	0.8	8.2	0.2	8.8	0.3
CW, Hexalectris spicata Ravine, bottom slope	6.5	4	40.5	5352	48	0.6	11.4	0.1	11.1	0.7
CW, Hexalectris spicata Ravine, midslope	6	8.5	40.5	1299.6	32.5	0.8	9.4	0.2	56.6	0.4
CW, Hexalectris spicata Ravine, ridge	4.9	3	31	144	18	4.5	0.9	0.2	29.8	0.1
CW, Aruncus dioicus Gorge, ridge	4.9	3	40.5	204	27.5	1	8.8	0.2	53	0.2
CW, Aruncus dioicus Gorge, slope	7.4	3	39	5396	54	0.1	4.6	0.1	1.3	0.7
CW, Ponthieva racemosa Ravine, ridge	5.3	4.5	42	552	24	1.2	9.9	0.2	17.9	0.2
CW, Ponthieva racemosa Ravine, slope	7.4	2.5	31	5344	43	0.3	2.3	0.1	0.9	0.5
CW, Actaea pachypoda Ravine, bottom slope	7.1	3	51.5	5316	59	0.4	5.4	0.1	0.8	0.8
CW, Actaea pachypoda Ravine, ridge	4.9	3.5	33	312	23	1.6	4.5	0.2	20.2	0.1
CW, Galax urceolata Ravine, ridge	3.9	1	29.5	84	15.5	0.8	0.7	0.2	90.5	0.1
CW, Galax urceolata Ravine, slope	4.1	1	18.5	84	19	1	2	0.2	76.8	0.1
HF, Desmodium glutinosum Ravine, ridge	5.8	3	64.5	696	78	1.6	9.3	0.2	9.8	0.4
HF, Desmodium glutinosum Ravine, slope	4.8	2	107.5	948	103	1.2	5.5	0.3	14.3	0.5
HF, Aralia racemosa Ravine, ridge	4.7	3.5	37.5	228	35	1.4	1.8	0.2	38.3	0.1

Table 15. (continued)

Site/Ravine/topographic position	soil pH	P	K	Ca	Mg	Zn	Mn	Cu	Fe	B
HF, Aralia racemosa Ravine, slope	6.4	5	61	948	84	0.8	12.8	0.2	6	0.5
GC, Old Country Rd., floodplain	6.2	2	23.5	1236	38.5	1.4	11.5	0.2	50.7	0.5
GC, Old Country Rd., mid slope	5.2	2	44	1092	43	1	8.2	0.2	24.3	0.4
GC, Old Country Rd., ridge	4.7	2	36	468	33.5	1.6	5.8	0.2	21.2	0.2
GC, Old Country Rd., mid slope	6.7	2.5	37.5	5216	53	0.5	6.8	0.1	4.2	0.6
GC, Old Country Rd., ridge	5.7	2.5	42	828	62.5	1.4	8.7	0.2	3.6	0.4
GC, Old Country Rd., ridge	5.4	2	37.5	768	54	1.2	7.3	0.2	4.5	0.4
CS, Hickory Hollow, floodplain	6.1	2.5	56.5	1628	44.5	1.8	6.1	0.2	104	0.4
CS, Hickory Hollow, mid slope	4.6	4	23.5	204	25	1	1.7	0.2	51.7	0.1
CS, Hickory Hollow, slope	4.1	1.5	26.5	84	17	0.8	0.9	0.2	82.5	0.1
CS, Hickory Hollow, floodplain	5.1	2.5	34.5	924	45.5	1.6	3.9	0.3	81.8	0.2

APPENDIX E

Ground layer data.

College Woods Actaea Ravine

College Woods Actaea Ravine
Transect 1
Plot # 1ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	8	76.19%	27.5	91.67%	167.86%	-0.271934	-0.207188
Viburnum acerifolium	2.5	23.81%	2.5	8.33%	32.14%	-1.435085	-0.341687
	10.5	100.00%	30	100.00%	200.00%		**-0.548874**
Fagus grandifolia	P						

College Woods Actaea Ravine
Transect 1
Plot # 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Actaea pachypoda	2.5	16.13%	7.5	50.00%	66.13%	-1.824549	-0.294282
Brachyelytrum erectum	8	51.61%	2.5	16.67%	68.28%	-0.661398	-0.341367
Aster sp.	2.5	16.13%	2.5	16.67%	32.80%	-1.824549	-0.294282
Carex sp.	2.5	16.13%	2.5	16.67%	32.80%	-1.824549	-0.294282
	15.5	100.00%	15	100.00%	200.00%		**-1.224213**
bareground	35%						
moss	5%						
Liriodendron tulipifera	P						

College Woods Actaea Ravine
Transect 1
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	33.33%	22.5	81.82%	115.15%	-1.098612	-0.366204
Fagus grandifolia	2.5	33.33%	2.5	9.09%	42.42%	-1.098612	-0.366204
Acer rubrum	2.5	33.33%	2.5	9.09%	42.42%	-1.098612	-0.366204
Carya cordiformis	7.5	100.00%	27.5	100.00%	200.00%		**-1.098612**

College Woods Actaea Ravine
Transect 1
Plot # 4 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	76.19%	22.5	90.00%	166.19%	-0.271934	-0.207188
Fagus grandifolia	2.5	23.81%	2.5	10.00%	33.81%	-1.435085	-0.341687
	10.5	100.00%	25	100.00%	200.00%		**-0.548874**

College Woods Actaea Ravine
Transect 2
Plot # 1 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	2.5	25.00%	22.5	75.00%	100.00%	-1.386294	-0.346574
Fagus grandifolia	2.5	25.00%	2.5	8.33%	33.33%	-1.386294	-0.346574
Acer rubrum	2.5	25.00%	2.5	8.33%	33.33%	-1.386294	-0.346574
Viburnum acerifolium	2.5	25.00%	2.5	8.33%	33.33%	-1.386294	-0.346574
	10	100.00%	30	100.00%	200.00%		**-1.386294**

College Woods Actaea Ravine
Transect 2
Plot # 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Fagus grandifolia	2.5	12.20%	2.5	12.50%	24.70%	-2.104134	-0.256602
Actaea pachypoda	2.5	12.20%	7.5	37.50%	49.70%	-2.104134	-0.256602
Euonymus americana	8	39.02%	2.5	12.50%	51.52%	-0.940983	-0.367213
Circaea lutetiana	2.5	12.20%	2.5	12.50%	24.70%	-2.104134	-0.256602
Toxicodendron radicans	2.5	12.20%	2.5	12.50%	24.70%	-2.104134	-0.256602
Lindera benzoin	2.5	12.20%	2.5	12.50%	24.70%	-2.104134	-0.256602
	20.5	100.00%	20	100.00%	200.00%		**-1.650222**

College Woods Actaea Ravine
Transect 2
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Adiantum pedatum	8	61.54%	12.5	71.43%	132.97%	-0.485508	-0.298774
Asarum canadense	2.5	19.23%	2.5	14.29%	33.52%	-1.648659	-0.31705
Fagus grandifolia	2.5	19.23%	2.5	14.29%	33.52%	-1.648659	-0.31705
	13	100.00%	17.5	100.00%	200.00%		**-0.932874**

College Woods Actaea Ravine
Transect 2
Plot # 4 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	76.19%	42.5	94.44%	170.63%	-0.271934	-0.207188
Quercus velutina	2.5	23.81%	2.5	5.56%	29.37%	-1.435085	-0.341687
	10.5	100.00%	45	100.00%	200.00%		**-0.548874**

College Woods Actaea Ravine
Transect 3
Plot # 1 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Fagus grandifolia	2.5	20.00%	2.5	9.09%	29.09%	-1.609438	-0.321888
Vaccinium spp.	2.5	20.00%	17.5	63.64%	83.64%	-1.609438	-0.321888
Quercus rubra	2.5	20.00%	2.5	9.09%	29.09%	-1.609438	-0.321888
Quercus alba	2.5	20.00%	2.5	9.09%	29.09%	-1.609438	-0.321888
Lonicera japonica	2.5	20.00%	2.5	9.09%	29.09%	-1.609438	-0.321888
	12.5	100.00%	27.5	100.00%	200.00%		**-1.609438**

College Woods Actaea Ravine
Transect 3
Plot # 2 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Actaea pachypoda	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Dicanthelium boscii	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Brachyelytrum erectum	8	28.57%	2.5	9.09%	37.66%	-1.252763	-0.357932
Agrimonia rostellata	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Galium trifolium	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Carex spp.	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Lindera benzoin	2.5	8.93%	7.5	27.27%	36.20%	-2.415914	-0.215707
Asarum canadense	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
Cornus florida	2.5	8.93%	2.5	9.09%	18.02%	-2.415914	-0.215707
	28	100.00%	27.5	100.00%	200.00%		**-2.083585**
Fagus grandifolia	P						
Vitis rotundifolia	P						
Viola spp.	P						
Polygonatum biflorum	P						
Pinus taeda	P						
Lycopus americana	P						

College Woods Actaea Ravine
Transect 3
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrosticoides	2.5	33.33%	27.5	84.62%	117.95%	-1.098612	-0.366204
Vaccinium spp.	2.5	33.33%	2.5	7.69%	41.03%	-1.098612	-0.366204
Quercus rubra	2.5	33.33%	2.5	7.69%	41.03%	-1.098612	-0.366204
	7.5	100.00%	32.5	100.00%	200.00%		**-1.098612**

College Woods Actaea Ravine
Transect 3
Plot # 4 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	61.54%	17.5	77.78%	139.32%	-0.485508	-0.298774
Quercus alba	2.5	19.23%	2.5	11.11%	30.34%	-1.648659	-0.31705
Prunus serotina	2.5	19.23%	2.5	11.11%	30.34%	-1.648659	-0.31705
	13	100.00%	22.5	100.00%	200.00%		**-0.932874**

College Woods Ponthieva Ravine 7/21/99

Transect 1 College Woods Ponthieva Ravine 7/21/99
Plot # 1ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	2.5	23.81%	2.5	7.58%	31.39%	-1.435085	-0.34
Vaccinium spp.	8	76.19%	30.5	92.42%	168.61%	-0.271934	-0.21
	10.5	100.00%	33	100.00%	200.00%		**-0.55**
Viburnum acerifolium	P						
Quercus alba	P						
bareground	<5%						

Transect 1 College Woods Ponthieva Ravine 7/21/99
Plot # 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asarum canadense	22	41.51%	27.5	40.74%	82.25%	-0.879249	-0.36
Desmodium glutinosum	2.5	4.72%	12.5	18.52%	23.24%	-3.054001	-0.14
Fraxinus pennsylvanica	2.5	4.72%	2.5	3.70%	8.42%	-3.054001	-0.14
Solidago flexicaulis	8	15.09%	2.5	3.70%	18.80%	-1.89085	-0.29
Parthenocissus quinquefolia	2.5	4.72%	7.5	11.11%	15.83%	-3.054001	-0.14
Brachyelytrum erectum	8	15.09%	2.5	3.70%	18.80%	-1.89085	-0.29
Polystichum acrostichoides	2.5	4.72%	7.5	11.11%	15.83%	-3.054001	-0.14
Aruncus dioicus	2.5	4.72%	2.5	3.70%	8.42%	-3.054001	-0.14
Solidago spp. unknown #1	2.5	4.72%	2.5	3.70%	8.42%	-3.054001	-0.14
	53	100.00%	67.5	100.00%	200.00%		**-1.80**
Acer rubrum	P						
Carpinus caroliniana	P						
Cornus florida	P						

Transect 1 College Woods Ponthieva Ravine 7/21/99
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asarum canadense	8	7.73%	12.5	15.63%	23.35%	-2.56013	-0.20
Desmodium glutinosum	2.5	2.42%	2.5	3.13%	5.54%	-3.723281	-0.09
Solidago flexicaulis	8	7.73%	2.5	3.13%	10.85%	-2.56013	-0.20
Pathenocissus quinquefolia	2.5	2.42%	7.5	9.38%	11.79%	-3.723281	-0.09
Brachyelytrum erectum	64.5	62.32%	22.5	28.13%	90.44%	-0.472906	-0.29
Aruncus dioicus	2.5	2.42%	22.5	28.13%	30.54%	-3.723281	-0.09
Fagus grandifolia	2.5	2.42%	2.5	3.13%	5.54%	-3.723281	-0.09
Viola spp.	2.5	2.42%	2.5	3.13%	5.54%	-3.723281	-0.09
Dicanthelium boscii	8	7.73%	2.5	3.13%	10.85%	-2.56013	-0.20
Luzula acuminata	2.5	2.42%	2.5	3.13%	5.54%	-3.723281	-0.09
	103.5	100.00%	80	100.00%	200.00%		**-1.43**

Transect 1 College Woods Ponthieva Ravine 7/21/99
Plot # 4 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	51.61%	27.5	78.57%	130.18%	-0.661398	-0.34
Vitis aestivalus	2.5	16.13%	2.5	7.14%	23.27%	-1.824549	-0.29
Nyssa sylvatica	2.5	16.13%	2.5	7.14%	23.27%	-1.824549	-0.29
Carya cordiformis	2.5	16.13%	2.5	7.14%	23.27%	-1.824549	-0.29
	15.5	100.00%	35	100.00%	200.00%		**-1.22**
Quercus alba	P						

Transect 2 College Woods Ponthieva Ravine 7/21/99

Plot #1 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	2.5	16.13%	2.5	8.33%	24.46%	-1.824549	-0.29
Quercus alba	2.5	16.13%	2.5	8.33%	24.46%	-1.824549	-0.29
Vaccinium spp.	8	51.61%	22.5	75.00%	126.61%	-0.661398	-0.34
Parthenocissus quinquefolia	2.5	16.13%	2.5	8.33%	24.46%	-1.824549	-0.29
	15.5	100.00%	30	100.00%	200.00%		**-1.22**
Prunus serotina	P						

Transect 2 College Woods Ponthieva Ravine 7/21/99

Plot # 2 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	19.23%	27.5	64.71%	83.94%	-1.648659	-0.32
Aruncus dioicus	2.5	19.23%	7.5	17.65%	36.88%	-1.648659	-0.32
Luzula acuminata	8	61.54%	7.5	17.65%	79.19%	-0.485508	-0.30
	13	100.00%	42.5	100.00%	200.00%		**-0.93**
moss	50%						

Transect 2 College Woods Ponthieva Ravine 7/21/99

Plot # 3 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Luzula acuminata	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Acer rubrum	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Solidago flexicaulis	22	28.39%	42.5	54.84%	83.23%	-1.259235	-0.36
Vitis rotundifolia	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Quercus alba	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Brachyelytrum erectum	22	28.39%	7.5	9.68%	38.06%	-1.259235	-0.36
Desmodium glutinosum	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Asarum canadense	8	10.32%	7.5	9.68%	20.00%	-2.270836	-0.23
Unknown #3	8	10.32%	2.5	3.23%	13.55%	-2.270836	-0.23
Viola sp.	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
Sanguinaria canadensis	2.5	3.23%	2.5	3.23%	6.45%	-3.433987	-0.11
	77.5	100.00%	77.5	100.00%	200.00%		**-1.96**
Liriodendron tulipifera	P						
Liverworts	5%						

Transect 2 College Woods Ponthieva Ravine 7/21/99

Plot # 4 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	2.5	50.00%	7.5	50.00%	100.00%	-0.693147	-0.35
Acer rubrum	2.5	50.00%	7.5	50.00%	100.00%	-0.693147	-0.35
	5	100.00%	15	100.00%	200.00%		**-0.69**
Quercus alba	P						
Liriodendron tulipifera	P						
Parthenocissus quinquefolia	P						

Transect 1 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 1 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Fagus grandifolia	2.5	20.00%	7.5	17.65%	37.65%	-1.609438	-0.32
Polysthicum acrostichoides	2.5	20.00%	27.5	64.71%	84.71%	-1.609438	-0.32
Mitchella repens	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.32
Desmodium nudiflorum	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.32
Prunus serotina	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.32
	12.5	100.00%	42.5	100.00%	200.00%		**-1.61**
Parthenocissus quinquefolia	P						
Galium circaezans	P						
Carpinus caroliniana	P						
Polygonum sp.	P						

Transect 1 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 2 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Hepatica americana	8	14.41%	2.5	3.57%	17.99%	-1.936941	-0.28
Luzula acuminata	2.5	4.50%	2.5	3.57%	8.08%	-3.100092	-0.14
Senecio aureus	2.5	4.50%	7.5	10.71%	15.22%	-3.100092	-0.14
Asarum canadense	8	14.41%	17.5	25.00%	39.41%	-1.936941	-0.28
Brachyelytrum erectum	22	39.64%	12.5	17.86%	57.50%	-0.925341	-0.37
Solidago sp.	2.5	4.50%	2.5	3.57%	8.08%	-3.100092	-0.14
Agrimonia sp.	2.5	4.50%	2.5	3.57%	8.08%	-3.100092	-0.14
Unknown #5	2.5	4.50%	2.5	3.57%	8.08%	-3.100092	-0.14
Desmodium glutinosum	2.5	4.50%	17.5	25.00%	29.50%	-3.100092	-0.14
Unknown # 7	2.5	4.50%	2.5	3.57%	8.08%	-3.100092	-0.14
	55.5	100.00%	70	100.00%	200.00%		**-1.90**
moss	50%						
bareground	10%						
liverworts	35%						
Lonicera japonica	P						
Poaceae #6	P						
Acer rubrum	P						
Cornus florida	P						

Transect 1 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 3 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Euonymus americana	2.5	19.23%	2.5	11.11%	30.34%	-1.648659	-0.32
Polystichum acrostichoides	8	61.54%	17.5	77.78%	139.32%	-0.485508	-0.30
Hepatica americana	2.5	19.23%	2.5	11.11%	30.34%	-1.648659	-0.32
	13	100.00%	22.5	100.00%	200.00%		**-0.93**
moss	40%						
bareground	50%						

Transect 1 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 4 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium sp.	8	100.00%	17.5	100.00%	200.00%	0	0.00
	8		17.5				
Liriodendron tulipifera	P						
Quercus alba	P						
Fagus grandifolia	P						
Asimina triloba	P						
Polystichum acrostichoides	P						

Transect 2 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 1 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium sp.	2.5	25.00%	7.5	50.00%	75.00%	-1.386294	-0.35
Mitchella repens	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.35
Hieracium gronovii	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.35
Toxicodendron radicans	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.35
	10	100.00%	15	100.00%	200.00%		**-1.39**
Quercus alba	P						
Liriodendron tulipifera	P						
Acer rubrum	P						
bareground	P						

Transecct 2 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 2 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Toxicodendron radicans	2.5	10.64%	2.5	9.09%	19.73%	-2.24071	-0.24
Asarum canadense	8	34.04%	2.5	9.09%	43.13%	-1.077559	-0.37
Solidago flexicaulis	8	34.04%	7.5	27.27%	61.32%	-1.077559	-0.37
Arisaema triphyllum	2.5	10.64%	7.5	27.27%	37.91%	-2.24071	-0.24
Senecio aureus	2.5	10.64%	7.5	27.27%	37.91%	-2.24071	-0.24
	23.5	100.00%	27.5	100.00%	200.00%		**-1.45**
Brachyelytrum erectum	P						
Aristolochia serpentaria	P						
Lonicera japonica	P						

Transect 2 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 3 slope	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asarum canadense	8	22.22%	12.5	20.83%	43.06%	-1.504077	-0.33
Solidago flexicaulis	8	22.22%	7.5	12.50%	34.72%	-1.504077	-0.33
Arisaema triphyllum	2.5	6.94%	7.5	12.50%	19.44%	-2.667228	-0.19
Lonicera japonica	2.5	6.94%	2.5	4.17%	11.11%	-2.667228	-0.19
Aruncus dioicus	2.5	6.94%	2.5	4.17%	11.11%	-2.667228	-0.19
Polystichum acrostichoides	2.5	6.94%	7.5	12.50%	19.44%	-2.667228	-0.19
Luzula acuminata	2.5	6.94%	2.5	4.17%	11.11%	-2.667228	-0.19
Prenanthes sp.	2.5	6.94%	2.5	4.17%	11.11%	-2.667228	-0.19
Asimina triloba	2.5	6.94%	7.5	12.50%	19.44%	-2.667228	-0.19
Cimicifuga racemosa	2.5	6.94%	7.5	12.50%	19.44%	-2.667228	-0.19
	36	100.00%	60	100.00%	200.00%		**-2.15**
Solidago sp.							
moss							
liverworts							

Transect 2 College Woods Aruncus dioicus Gorge 7/21/99

Plot # 4 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium sp.	22	81.48%	42.5	89.47%	170.96%	-0.204794	-0.17
Cary cordiformis	2.5	9.26%	2.5	5.26%	14.52%	-2.379546	-0.22
Mitchella repens	2.5	9.26%	2.5	5.26%	14.52%	-2.379546	-0.22
Quercus alba	27	100.00%	47.5	100.00%	200.00%		**-0.61**

College Woods Field Data 7/9/99

Aralia nudicaulis Ridge, Transect # 4
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Toxicodendron radicans	2.5	13.89%	2.5	3.45%	17.34%	-1.974081	-0.274178
Euonymus americana	2.5	13.89%	2.5	3.45%	17.34%	-1.974081	-0.274178
Viburnum acerifolium	2.5	13.89%	2.5	3.45%	17.34%	-1.974081	-0.274178
Vaccinium spp.	8	44.44%	62.5	86.21%	130.65%	-0.81093	-0.360413
Cornus florida	2.5	13.89%	2.5	3.45%	17.34%	-1.974081	-0.274178
	18	100.00%	72.5	100.00%	200.00%		**-1.457125**

Aralia nudicaulis Ridge, Transect # 4
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Aralia nudicaulis	8	18.82%	42.5	68.00%	86.82%	-1.670063	-0.314365
Toxicodendron radicans	2.5	5.88%	2.5	4.00%	9.88%	-2.833213	-0.16666
Sanicula spp.	22	51.76%	7.5	12.00%	63.76%	-0.658462	-0.340851
Euonymus americana	2.5	5.88%	2.5	4.00%	9.88%	-2.833213	-0.16666
Lonicera japonica	2.5	5.88%	2.5	4.00%	9.88%	-2.833213	-0.16666
Lycopus virginiana	2.5	5.88%	2.5	4.00%	9.88%	-2.833213	-0.16666
Luzula acuminata	2.5	5.88%	2.5	4.00%	9.88%	-2.833213	-0.16666
	42.5	100.00%	62.5	100.00%	200.00%		**-1.488513**
Hexastylis virginica	P						
Prunus serotina	P						
Quercus alba	P						
Dicanthelium commutatum	P						
Viburnum acerifolium							

Aralia nudicaulis Ridge, Transect # 4
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Quercus alba	2.5	20.00%	2.5	20.00%	40.00%	-1.609438	-0.321888
Lonicera japonica	2.5	20.00%	2.5	20.00%	40.00%	-1.609438	-0.321888
Dioscorea villosa	2.5	20.00%	2.5	20.00%	40.00%	-1.609438	-0.321888
Galium circaezans	2.5	20.00%	2.5	20.00%	40.00%	-1.609438	-0.321888
Fagus grandifolia	2.5	20.00%	2.5	20.00%	40.00%	-1.609438	-0.321888
	12.5	100.00%	12.5	100.00%	200.00%		**-1.609438**
moss	5%						

Aralia nudicaulis Ridge, Transect # 4
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Toxicodendron radicans	2.5	1.69%	7.5	6.25%	7.94%	-4.080922	-0.068934
Lonicera japonica	2.5	1.69%	2.5	2.08%	3.77%	-4.080922	-0.068934
Senecio aureus	8	5.41%	22.5	18.75%	24.16%	-2.917771	-0.157717
Glyceria striata	100	67.57%	42.5	35.42%	102.98%	-0.392042	-0.264893
Boehmeria cylindrica	8	5.41%	12.5	10.42%	15.82%	-2.917771	-0.157717
Impatiens capensis	2.5	1.69%	2.5	2.08%	3.77%	-4.080922	-0.068934
Saururus cernuus	2.5	1.69%	2.5	2.08%	3.77%	-4.080922	-0.068934
Cicuta maculata	22	14.86%	27.5	22.92%	37.78%	-1.90617	-0.28335
	148	100.00%	120	100.00%	200.00%		**-1.139415**

Aralia nudicaulis Ridge, Transect # 4
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Sanicula spp.	2.5	33.33%	2.5	33.33%	66.67%	-1.098612	-0.366204
Dioscorea villosa	2.5	33.33%	2.5	33.33%	66.67%	-1.098612	-0.366204
Cercis canadensis	2.5	33.33%	2.5	33.33%	66.67%	-1.098612	-0.366204
	7.5	100.00%	7.5	100.00%	200.00%		**-1.098612**
Aristolochia serpentaria	P						
Cypripedium calceolus	P						
Amphicarpa bracteata	P						
Parthenocissus quinquefolia	P						

Aralia nudicaulis Ridge, Transect # 4
Plot # 6

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Quercus alba	2.5	13.51%	7.5	17.65%	31.16%	-2.00148	-0.27047
Vaccinium spp.	8	43.24%	32.5	76.47%	119.71%	-0.838329	-0.362521
Mitchella repens	8	43.24%	2.5	5.88%	49.13%	-0.838329	-0.362521
	18.5	100.00%	42.5	100.00%	200.00%		**-0.995512**
Acer rubrum	P						
Desmodium nudiflorum	P						
bareground	5%						
Prunus serotina	P						
moss	5%						

Transect # 1, Hexalectris spicata Ravine (College Woods)
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	51.61%	32.5	81.25%	132.86%	-0.661398	-0.341367
Nyssa sylvatica	2.5	16.13%	2.5	6.25%	22.38%	-1.824549	-0.294282
Parthenocissus quinquefolia	2.5	16.13%	2.5	6.25%	22.38%	-1.824549	-0.294282
Vitis aestivalus	2.5	16.13%	2.5	6.25%	22.38%	-1.824549	-0.294282
	15.5	100.00%	40	100.00%	200.00%		**-1.224213**

Transect # 1, Hexalectris spicata Ravine (College Woods)
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Hexalectris spicata	8	13.45%	2.5	5.26%	18.71%	-2.006535	-0.269786
Ulvularia perfoliatum	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Cercis canadensis	2.5	4.20%	7.5	15.79%	19.99%	-3.169686	-0.13318
Hepatica americana	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Veronica glauca	8	13.45%	7.5	15.79%	29.23%	-2.006535	-0.269786
Toxicodendron radicans	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Agrimonia pubescens	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Amphicarpa bracteata	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Erigeron pulchellus	8	13.45%	2.5	5.26%	18.71%	-2.006535	-0.269786
Cornus florida	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Lycopus europaeus	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Luzula acuminata	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Dicanthelium boscii	8	13.45%	2.5	5.26%	18.71%	-2.006535	-0.269786
Lonicera japonica	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
Unknown grass	2.5	4.20%	2.5	5.26%	9.46%	-3.169686	-0.13318
	59.5	100.00%	47.5	100.00%	200.00%		**-2.544125**
Viburnum acerifolium	P						
moss	10%						

Transect # 1, Hexalectris spicata Ravine (College Woods)
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Veronica glauca	2.5	6.94%	7.5	10.71%	17.66%	-2.667228	-0.185224
Cornus florida	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Luzula acuminata	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Dicanthelium boscii	8	22.22%	17.5	25.00%	47.22%	-1.504077	-0.334239
Unkown grass	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Desmodium glutinosum	8	22.22%	27.5	39.29%	61.51%	-1.504077	-0.334239
Sanguinaria canadensis	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Prunus serotina	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Anemone virginiana	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
Matelea carolinensis	2.5	6.94%	2.5	3.57%	10.52%	-2.667228	-0.185224
	36	100.00%	70	100.00%	200.00%		**-2.150272**

Virburnum acerifolium	P
Aristolochia serpentaria	P
Galium circaezans	P
Liriodendron tulipifera	P
Agrimonia pubescens	P

Transect # 1, Hexalectris spicata Ravine (College Woods)
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vernonia glauca	2.5	7.35%	2.5	4.00%	11.35%	-2.61007	-0.191917
Luzula acuminata	2.5	7.35%	2.5	4.00%	11.35%	-2.61007	-0.191917
Dicanthelium boscii	8	23.53%	7.5	12.00%	35.53%	-1.446919	-0.340452
Galium circaezans	8	23.53%	2.5	4.00%	27.53%	-1.446919	-0.340452
Matelea canrolinensis	2.5	7.35%	2.5	4.00%	11.35%	-2.61007	-0.191917
Agrimonia pubescens	2.5	7.35%	2.5	4.00%	11.35%	-2.61007	-0.191917
Polymnia uvedalia	8	23.53%	42.5	68.00%	91.53%	-1.446919	-0.340452
	34		62.5	100.00%	200.00%		**-1.789022**
bareground	10%						
Carpinus carolinana	P						
Cercis canadensis	P						
Toxicodendron radicans	P						
Amphicarpa bracteata	P						
Sanguinaria canadensis	P						

Transect # 1, Hexalectris spicata Ridge
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Hexalectris spicata	2.5	50.00%	2.5	25.00%	75.00%	-0.693147	-0.346574
Cornus florida	2.5	50.00%	7.5	75.00%	125.00%	-0.693147	-0.346574
	5	100.00%	10	100.00%	200.00%		**-0.693147**
Sanguinaria canadensis	P						
Prunus serotina	P						
Quercus alba	P						
Fagus grandifolia	P						

Transect # 2, Aralia Gorge
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	20.00%	32.5	76.47%	96.47%	-1.609438	-0.321888
Toxicodendron radicans	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.321888
Vaccinium spp.	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.321888
Carya glabra	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.321888
Epifagus virginiana	2.5	20.00%	2.5	5.88%	25.88%	-1.609438	-0.321888
	12.5	100.00%	42.5	100.00%	200.00%		**-1.609438**
Prunus serotina	P						
Fagus grandifolia	P						
Arisaema triphyllum	P						
Luzula acuminata	P						
Quercus alba	P						

Transect # 2, Aralia Gorge
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium pauciflorum	2.5	12.20%	17.5	58.33%	70.53%	-2.104134	-0.256602
Liriodendron tulipifera	8	39.02%	2.5	8.33%	47.36%	-0.940983	-0.367213
Euonymus americana	2.5	12.20%	2.5	8.33%	20.53%	-2.104134	-0.256602
Lonicera japonica	2.5	12.20%	2.5	8.33%	20.53%	-2.104134	-0.256602
Viburnum acerifolium	2.5	12.20%	2.5	8.33%	20.53%	-2.104134	-0.256602
Asarum canadense	2.5	12.20%	2.5	8.33%	20.53%	-2.104134	-0.256602
	20.5	100.00%	30	100.00%	200.00%		**-1.650222**
Carpinus caroliniana	P						

Transect # 2, Aralia Gorge
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carpinus caroliniana	8	38.10%	2.5	4.55%	42.64%	-0.965081	-0.36765
Brachyelytrum erectum	8	38.10%	7.5	13.64%	51.73%	-0.965081	-0.36765
Aralia racemosa	2.5	11.90%	42.5	77.27%	89.18%	-2.128232	-0.253361
Amphicarpa bracteata	2.5	11.90%	2.5	4.55%	16.45%	-2.128232	-0.253361
	21	100.00%	55	100.00%	200.00%		**-1.242022**
Acer rubrum	P						
bareground	80%						

Transect # 2, Aralia Gorge
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asarum canadense	8	38.10%	2.5	16.67%	54.76%	-0.965081	-0.36765
Brachyelytrum erectum	8	38.10%	7.5	50.00%	88.10%	-0.965081	-0.36765
Acer rubrum	2.5	11.90%	2.5	16.67%	28.57%	-2.128232	-0.253361
Solidago spp. unkown	2.5	11.90%	2.5	16.67%	28.57%	-2.128232	-0.253361
	21	100.00%	.15	100.00%	200.00%		**-1.242022**
bareground	100%						
Lindera benzion	P						
Liriodendron tulipifera	P						

Transect # 2, Aralia Gorge
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Fagus grandifolia	2.5	33.33%	7.5	33.33%	66.67%	-1.098612	-0.366204
Vaccinium spp.	2.5	33.33%	12.5	55.56%	88.89%	-1.098612	-0.366204
Epifagus virginiana	2.5	33.33%	2.5	11.11%	44.44%	-1.098612	-0.366204
	7.5	100.00%	22.5	100.00%	200.00%		**-1.098612**
Smilacina racemosa	P						
Quercus alba	P						

Transect # 3 Aralia Gorge
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	2.5	50.00%	7.5	75.00%	125.00%	-0.693147	-0.346574
Epifagus virginiana	2.5	50.00%	2.5	25.00%	75.00%	-0.693147	-0.346574
	5	100.00%	10	100.00%	200.00%		**-0.693147**
Prunus serotina	P						
Toxicodendron radicans	P						
bareground	5%						

Transect # 3 Aralia Gorge
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Viburnum acerifolium	2.5	2.27%	2.5	5.88%	8.16%	-3.78419	-0.086004
Luzula acuminata	2.5	2.27%	2.5	5.88%	8.16%	-3.78419	-0.086004
Amphicarpa bracteata	2.5	2.27%	2.5	5.88%	8.16%	-3.78419	-0.086004
Phegopteris hexagonoptera	100	90.91%	32.5	76.47%	167.38%	-0.09531	-0.086646
Prenanthes spp.	2.5	2.27%	2.5	5.88%	8.16%	-3.78419	-0.086004
	110	100.00%	42.5	100.00%	200.00%		**-0.430663**
Fagus grandifolia	P						
Asarum canadense	P						
Sanguinaria canadensis	P						
Liriodendron tulipifera	P						
Brachyelytrum erectum	P						
Aristolochia serpentaria	P						
Hepatica americana	P						
bareground	15%						

Transect # 3 Aralia Gorge
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium glutinosum	8	51.61%	27.5	55.00%	106.61%	-0.661398	-0.341367
Amphicarpa bracteata	2.5	16.13%	7.5	15.00%	31.13%	-1.824549	-0.294282
Desmodium nudiflorum	2.5	16.13%	12.5	25.00%	41.13%	-1.824549	-0.294282
Phegotperis hexagonoptera	2.5	16.13%	2.5	5.00%	21.13%	-1.824549	-0.294282
	15.5	100.00%	50	100.00%	200.00%		**-1.224213**

Transect # 3 Aralia Gorge
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	39.02%	42.5	77.27%	116.30%	-0.940983	-0.367213
Carya cordiformis	2.5	12.20%	2.5	4.55%	16.74%	-2.104134	-0.256602
Viburnum acerifolium	2.5	12.20%	2.5	4.55%	16.74%	-2.104134	-0.256602
Polystichum acrostichoides	2.5	12.20%	2.5	4.55%	16.74%	-2.104134	-0.256602
Toxicodendron radicans	2.5	12.20%	2.5	4.55%	16.74%	-2.104134	-0.256602
Epifagus virginiana	2.5	12.20%	2.5	4.55%	16.74%	-2.104134	-0.256602
	20.5	100.00%	55	100.00%	200.00%		**-1.650222**
Fagus grandifolia	P						
Hexastylis virginica	P						
Prunus serotina	P						
Quercus velutina	P						
bareground							

Transect # 3 Aralia Gorge
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Viburnum acerifolium	2.5	20.00%	2.5	11.11%	31.11%	-1.609438	-0.321888
Polystichum acrostichoides	2.5	20.00%	12.5	55.56%	75.56%	-1.609438	-0.321888
Hexastylis virginica	2.5	20.00%	2.5	11.11%	31.11%	-1.609438	-0.321888
Aralia nudicaulis	2.5	20.00%	2.5	11.11%	31.11%	-1.609438	-0.321888
Luzula acuminata	2.5	20.00%	2.5	11.11%	31.11%	-1.609438	-0.321888
	12.5	100.00%	22.5	100.00%	200.00%		**-1.609438**
moss	10%						
bareground	15%						

Grove Creek Fire Station Ravine

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine
Plot #1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Prenanthes sp.	8	16.00%	2.5	6.25%	22.25%	-1.832581	-0.293213
Acer rubrum	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Microstegium vimineum	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Acer barbatum	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Fraxinus pennsylvanica	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Solidago flexicaulis	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Liriodendron tulipifera	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Mitchella repens	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	-0.149787
Luzula acuminata	22	44.00%	17.5	43.75%	87.75%	-0.820981	-0.361231
Hexastylis virginica	2.5	5.00%	2.5	6.25%	11.25%	-2.995732	0.916291
	50	100.00%	40	100.00%	200.00%		**-0.78666**
moss			5%				
bareground			5%				

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine
Plot #2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Cimicfuga spp	2.5	16.67%	7.5	15.00%	31.67%	-1.791759	-0.298627
Polystichum acrostichoides	2.5	16.67%	12.5	25.00%	41.67%	-1.791759	-0.298627
Adiantum pedatum	2.5	16.67%	12.5	25.00%	41.67%	-1.791759	-0.298627
Asimina triloba	2.5	16.67%	12.5	25.00%	41.67%	-1.791759	-0.298627
Acer rubrum	2.5	16.67%	2.5	5.00%	21.67%	-1.791759	-0.298627
Fagus grandifolia	2.5	16.67%	2.5	5.00%	21.67%	-1.791759	-0.298627
	15	100.00%	50	100.00%	200.00%		**-1.791759**
Acer barbatum	P						

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine
Plot #3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Luzula acuminata	8	19.05%	7.5	6.25%	25.30%	-1.658228	-0.315853
Aralia racemosa	2.5	5.95%	62.5	52.08%	58.04%	-2.821379	-0.167939
Hexastylis virginica	2.5	5.95%	2.5	2.08%	8.04%	-2.821379	-0.167939
Mitchella repens	8	19.05%	2.5	2.08%	21.13%	-1.658228	-0.315853
Desmodium nudiflorum	2.5	5.95%	12.5	10.42%	16.37%	-2.821379	-0.167939
Solidago unknown #2	8	19.05%	27.5	22.92%	41.96%	-1.658228	-0.315853
Epigaea repens	8	19.05%	2.5	2.08%	21.13%	-1.658228	-0.315853
Hepatica americana	2.5	5.95%	2.5	2.08%	8.04%	-2.821379	-0.167939
	42	100.00%	120	100.00%	200.00%		**-1.935169**
moss	80%						

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine
Plot #4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Oldenlandia sp	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Acer rubrum	8	11.27%	2.5	3.85%	15.11%	-2.183238	-0.245999
Senecio aureus	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Acer barbatum	8	11.27%	7.5	11.54%	22.81%	-2.183238	-0.245999
Solidago flexicaulis	8	11.27%	7.5	11.54%	22.81%	-2.183238	-0.245999
Phegopteris hexagonoptera	2.5	3.52%	7.5	11.54%	15.06%	-3.346389	-0.117831
Arisaema triphyllum	22	30.99%	12.5	19.23%	50.22%	-1.171637	-0.363043
Liriodendron tulipifera	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Prunus serotina	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Fagus grandifolia	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Luzula acuminata	2.5	3.52%	7.5	11.54%	15.06%	-3.346389	-0.117831
Carpinus caroliniana	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Ulmus rubra	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
Glyceria striata	2.5	3.52%	2.5	3.85%	7.37%	-3.346389	-0.117831
	71	100.00%	65	100.00%	200.00%		**-2.279345**
Fraxinus pennsylvanica	P						
Glyceria striata	P						

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine

Plot #5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	8.04%	12.5	15.15%	23.19%	-2.520716	-0.202671
Senecio aureus	22	22.11%	32.5	39.39%	61.50%	-1.509115	-0.333674
Microstegium vimineum	64.5	64.82%	27.5	33.33%	98.16%	-0.433492	-0.281008
Acer barbatum	2.5	2.51%	2.5	3.03%	5.54%	-3.683867	-0.092559
Solidago flexicaulis	2.5	2.51%	7.5	9.09%	11.60%	-3.683867	-0.092559
	99.5	100.00%	82.5	100.00%	200.00%		**-1.002471**
Fraxinus pennsylvanica	P						
Glyceria striata	P						

Transect #1 Grove Creek Data 6/28/99, Fire Station Ravine

Plot #6

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Microstegium viminium	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Acer barbatum	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Liquidambar styraciflua	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Arisaema triphyllum	2.5	8.20%	7.5	16.67%	24.86%	-2.501436	-0.205036
Ulmus rubra	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Glyceria striata	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Hexastylis virginica	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Mitchella repens	2.5	8.20%	2.5	5.56%	13.75%	-2.501436	-0.205036
Desmodium nudiflorum	8	26.23%	12.5	27.78%	54.01%	-1.338285	-0.351026
Prenanthes sp.	2.5	8.20%	7.5	16.67%	24.86%	-2.501436	-0.205036
	30.5	100.00%	45	100.00%	200.00%		**-2.196347**
Galium circaezans	P						
Carya cordiformis	P						
Epifagus virginiana	P						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine

Plot #0

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Luzula acuminata	2.5	10.64%	12.5	38.46%	49.10%	-2.24071	-0.238373
Acer barbatum	8	34.04%	2.5	7.69%	41.73%	-1.077559	-0.366829
Solidago flexicaulis	2.5	10.64%	2.5	7.69%	18.33%	-2.24071	-0.238373
Fagus grandifolia	2.5	10.64%	2.5	7.69%	18.33%	-2.24071	-0.238373
Mitchella repens	8	34.04%	12.5	53.19%	87.23%	-1.077559	-0.366829
	23.5	100.00%	32.5	114.73%	214.73%		**-1.448777**
moss	5%						
Liquidambar styraciflua	P						
Liriodendron tulipifera	P						
Parthenocissus quinquefolia	P						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine

Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	14.95%	2.5	4.76%	19.72%	-1.90024	-0.284148
Luzula acuminata	8	14.95%	12.5	23.81%	38.76%	-1.90024	-0.284148
Asimina triloba	2.5	4.67%	2.5	4.76%	9.43%	-3.063391	-0.143149
Hexastylis virginica	2.5	4.67%	2.5	4.76%	9.43%	-3.063391	-0.143149
Smilacina racemosa	2.5	4.67%	2.5	4.76%	9.43%	-3.063391	-0.143149
Polystichum acrostichoides	8	14.95%	27.5	52.38%	67.33%	-1.90024	-0.284148
Mitchella repens	22	41.12%	2.5	4.76%	45.88%	-0.888639	-0.365422
	53.5	100.00%	52.5	100.00%	200.00%		**-1.647313**
Preanthes spp.	P						
Carpinus carolinana	P						
moss	50%						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine

Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer barbatum	8	28.07%	2.5	7.69%	35.76%	-1.270463	-0.356621
Solidago flexicaulis	8	28.07%	17.5	53.85%	81.92%	-1.270463	-0.356621
Epigaea repens	2.5	8.77%	2.5	7.69%	16.46%	-2.433613	-0.213475
Sanicula spp.	2.5	8.77%	2.5	7.69%	16.46%	-2.433613	-0.213475
Asarum canadense	2.5	8.77%	2.5	7.69%	16.46%	-2.433613	-0.213475
Toxicodendron radicans	2.5	8.77%	2.5	7.69%	16.46%	-2.433613	-0.213475
Lindera benzoin	2.5	8.77%	2.5	7.69%	16.46%	-2.433613	-0.213475
	28.5	100.00%	32.5	100.00%	200.00%		**-1.780616**
Carya cordiformis	P						
Fagus grandifolia	P						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine

Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	17.02%	2.5	7.14%	24.16%	-1.770706	-0.301397
Luzula acuminata	2.5	5.32%	7.5	21.43%	26.75%	-2.933857	-0.156056
Acer barbatum	8	17.02%	2.5	7.14%	24.16%	-1.770706	-0.301397
Solidago flexicaulis	8	17.02%	7.5	21.43%	38.45%	-1.770706	-0.301397
Hepatica americana	2.5	5.32%	2.5	7.14%	12.46%	-2.933857	-0.156056
Carpinus caroliniana	8	17.02%	2.5	7.14%	24.16%	-1.770706	-0.301397
Arisaema triphyllum	2.5	5.32%	2.5	7.14%	12.46%	-2.933857	-0.156056
Quercus velutina	2.5	5.32%	2.5	7.14%	12.46%	-2.933857	-0.156056
Liriodendron tulipifera	2.5	5.32%	2.5	7.14%	12.46%	-2.933857	-0.156056
Epigaea repens	2.5	5.32%	2.5	7.14%	12.46%	-2.933857	-0.156056
	47	100.00%	35	100.00%	200.00%		**-2.141924**

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	22	39.64%	7.5	12.50%	52.14%	-0.925341	-0.366802
Acer barbatum	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
Solidago flexicaulis	8	14.41%	12.5	20.83%	35.25%	-1.936941	-0.279199
Arisaema triphyllum	8	14.41%	7.5	12.50%	26.91%	-1.936941	-0.279199
Liriodendron tulipifera	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
Epigaea repens	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
Viola spp.	2.5	4.50%	17.5	29.17%	33.67%	-3.100092	-0.139644
Lonicera japonica	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
Carpinus caroliniana	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
Fagus grandifolia	2.5	4.50%	2.5	4.17%	8.67%	-3.100092	-0.139644
	55.5	100.00%	60	100.00%	200.00%		**-1.902706**
Parthenocissus quinquefolia	P						
Sanicula sp.	P						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Cimicifuga racemosa	2.5	50.00%	2.5	50.00%	100.00%	-0.693147	-0.346574
Asimina triloba	2.5	50.00%	2.5	50.00%	100.00%	-0.693147	-0.346574
	5	100.00%	5	100.00%	200.00%	0	**-0.693147**
Acer rubrum	P						
Prunus serotina	P						
Epifagus virginiana	P						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 6

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
Luzula aciminata	2.5	25.00%	7.5	50.00%	75.00%	-1.386294	-0.346574
Hepatica americana	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
Hexastylis virginica	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
	10	100.00%	15	100.00%	200.00%		**-1.386294**
Decumaria barbara	P						
Carpinus caroliniana	P						
Quercus rubra	P						
Smilacina racemosa	P						
Sanguinaria canadensis	P						
bareground	10%						

Transect #2 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 7

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya cordiformis	2.5	8.47%	2.5	7.14%	15.62%	-2.4681	-0.209161
Acer rubrum	22	74.58%	2.5	7.14%	81.72%	-0.293348	-0.218768
Acer barbatum	2.5	8.47%	27.5	78.57%	87.05%	-2.4681	-0.209161
Hexastylis virginica	2.5	8.47%	2.5	7.14%	15.62%	-2.4681	-0.209161
	29.5	100.00%	35	100.00%	200.00%		**-0.846251**
moss	10%						

Transect # 3 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	39.02%	2.5	16.67%	55.69%	-0.940983	-0.367213
Polystichum acrostichoides	2.5	12.20%	2.5	16.67%	28.86%	-2.104134	-0.256602
Hexastylis virginica	2.5	12.20%	2.5	16.67%	28.86%	-2.104134	-0.256602
Fagus grandifolia	2.5	12.20%	2.5	16.67%	28.86%	-2.104134	-0.256602
Goodyera pubescens	2.5	12.20%	2.5	16.67%	28.86%	-2.104134	-0.256602
Mitchella repens	2.5	12.20%	2.5	16.67%	28.86%	-2.104134	-0.256602
	20.5	100.00%	15	100.00%	200.00%		**-1.650222**

Transect # 3 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Phegopteris hexagonoptera	2.5	6.67%	12.5	29.41%	36.08%	-2.70805	-0.180537
Carpinus caroliniana	8	21.33%	2.5	5.88%	27.22%	-1.544899	-0.329579
Asimina triloba	2.5	6.67%	12.5	29.41%	36.08%	-2.70805	-0.180537
Acer rubrum	22	58.67%	12.5	29.41%	88.08%	-0.533298	-0.312868
Hexastylis virginica	2.5	6.67%	2.5	5.88%	12.55%	-2.70805	-0.180537
	37.5	100.00%	42.5	100.00%	200.00%		**-1.184057**

Transect # 3 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	23.88%	2.5	4.35%	28.23%	-1.432104	-0.341995
Saururus cernuus	2.5	7.46%	12.5	21.74%	29.20%	-2.595255	-0.193676
Unknown #15	2.5	7.46%	12.5	21.74%	29.20%	-2.595255	-0.193676
Solidago flexicaulis	2.5	7.46%	7.5	13.04%	20.51%	-2.595255	-0.193676
Acer barbatum	8	23.88%	2.5	4.35%	28.23%	-1.432104	-0.341995
Luzula acuminata	2.5	7.46%	2.5	4.35%	11.81%	-2.595255	-0.193676
Circaea lutetiana	2.5	7.46%	7.5	13.04%	20.51%	-2.595255	-0.193676
Arisaema triphyllum	2.5	7.46%	2.5	4.35%	11.81%	-2.595255	-0.193676
Lysimachia ciliata	2.5	7.46%	7.5	13.04%	20.51%	-2.595255	-0.193676
	33.5	100.00%	57.5	100.00%	200.00%		**-2.03972**
Carpinus caroliniana	P						
Toxicodendron radicans	P						
Sanicula spp	P						
Viola spp.	P						

Transect # 3 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carpinus carolinana	8	17.98%	2.5	7.69%	25.67%	-1.716048	-0.308503
Acer rubrum	8	17.98%	2.5	7.69%	25.67%	-1.716048	-0.308503
Solidago flexicaulis	8	17.98%	7.5	23.08%	41.05%	-1.716048	-0.308503
Sanicula sp.	2.5	5.62%	2.5	7.69%	13.31%	-2.879198	-0.161753
Asarum canadense	2.5	5.62%	2.5	7.69%	13.31%	-2.879198	-0.161753
Microstegium viminium	8	17.98%	7.5	23.08%	41.05%	-1.716048	-0.308503
Euonymus americana	2.5	5.62%	2.5	7.69%	13.31%	-2.879198	-0.161753
Fraxinus americana	2.5	5.62%	2.5	7.69%	13.31%	-2.879198	-0.161753
Lonicera japonica	2.5	5.62%	2.5	7.69%	13.31%	-2.879198	-0.161753
	44.5	100.00%	32.5	100.00%	200.00%		**-2.042775**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carex sp.	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Arisaema triphyllum	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Acer barbatum	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Acer rubrum	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Epifagus virginiana	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Luzula acuminata	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Carpinus caroliniana	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Prenanthes spp.	2.5	9.09%	7.5	23.08%	32.17%	-2.397895	-0.21799
Mitchella repens	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Lonicera japonica	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
Parthenocissus quinquefolia	2.5	9.09%	2.5	7.69%	16.78%	-2.397895	-0.21799
	27.5	100.00%	32.5	100.00%	200.00%		**-2.397895**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer barbatum	2.5	16.67%	2.5	4.55%	21.21%	-1.791759	-0.298627
Liriodendron tulipifera	2.5	16.67%	2.5	4.55%	21.21%	-1.791759	-0.298627
Polygonatum biflorum	2.5	16.67%	2.5	4.55%	21.21%	-1.791759	-0.298627
Asimina triloba	2.5	16.67%	17.5	31.82%	48.48%	-1.791759	-0.298627
Cimicifuga racemosa	2.5	16.67%	27.5	50.00%	66.67%	-1.791759	-0.298627
Fagus grandifolia	2.5	16.67%	2.5	4.55%	21.21%	-1.791759	-0.298627
	15	100.00%	55	100.00%	200.00%		**-1.791759**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer barbatum	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
Acer rubrum	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
Prunus serotina	2.5	25.00%	2.5	16.67%	41.67%	-1.386294	-0.346574
Dennstaedtia punctilobula	2.5	25.00%	7.5	50.00%	75.00%	-1.386294	-0.346574
	10		15	100.00%	200.00%		**-1.386294**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Saururus cernuus	8	4.41%	32.5	15.12%	19.52%	-3.121814	-0.137601
Mimulus alatus	2.5	1.38%	12.5	5.81%	7.19%	-4.284965	-0.059022
Samolus parviflorus	8	4.41%	7.5	3.49%	7.90%	-3.121814	-0.137601
Mikania scandens	2.5	1.38%	7.5	3.49%	4.87%	-4.284965	-0.059022
Ranunculus parviflorus	22	12.12%	12.5	5.81%	17.94%	-2.110213	-0.255783
Veronica anagallis-aquatica	22	12.12%	7.5	3.49%	15.61%	-2.110213	-0.255783
Unknown Poaceae	64.5	35.54%	62.5	29.07%	64.61%	-1.03459	-0.367664
Carex laevivaginatam	22	12.12%	17.5	8.14%	20.26%	-2.110213	-0.255783
Hydrocotyle ranunculoides	22	12.12%	42.5	19.77%	31.89%	-2.110213	-0.255783
Murdannia keisak	8	4.41%	12.5	5.81%	10.22%	-3.121814	-0.137601
	181.5	100.00%	215	100.00%	200.00%		**-1.921643**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
Luzula acuminata	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
Solidago flexicaulis	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
Hexastylis viginica	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
Asimina triloba	2.5	11.11%	7.5	20.00%	31.11%	-2.197225	-0.244136
Dicanthelium commutatum	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
Desmodium nudiflorum	2.5	11.11%	7.5	20.00%	31.11%	-2.197225	-0.244136
Carya cordiformis	2.5	11.11%	7.5	20.00%	31.11%	-2.197225	-0.244136
Lonicera japonica	2.5	11.11%	2.5	6.67%	17.78%	-2.197225	-0.244136
	22.5	100.00%	37.5	100.00%	200.00%		**-2.197225**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 6

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer barbatum	2.5	7.94%	2.5	7.14%	15.08%	-2.533697	-0.201087
Luzula acuminata	8	25.40%	22.5	64.29%	89.68%	-1.370546	-0.348075
Hieracium gronovii	8	25.40%	2.5	7.14%	32.54%	-1.370546	-0.348075
Polygonum sp.	8	25.40%	2.5	7.14%	32.54%	-1.370546	-0.348075
Hexastylis virginica	2.5	7.94%	2.5	7.14%	15.08%	-2.533697	-0.201087
Lonicera japonica	2.5	7.94%	2.5	7.14%	15.08%	-2.533697	-0.201087
	31.5	100.00%	35	100.00%	200.00%		**-1.647487**

Transect # 4 Grove Creek Data 6/28/99, Fire Station Ravine
Plot # 7

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	9.09%	27.5	52.38%	61.47%	-2.397895	-0.21799
Arisaema triphyllum	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Acer barbatum	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Liriodendron tulipifera	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Acer rubrum	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Epifagus virginiana	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Luzula acuminata	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Carpinus caroliniana	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Prenanthes sp.	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Mitchella repens	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
Nyssa sylvatica	2.5	9.09%	2.5	4.76%	13.85%	-2.397895	-0.21799
	27.5	100.00%	52.5	100.00%	200.00%		**-2.397895**

Grove Creek Old Country Road 7/20/99
Transect 1
Plot # 1ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichium acrosticoides	2.5	16.13%	7.5	18.99%	35.12%	-1.824549	-0.294282
Theylpteris noveboracensis	2.5	16.13%	7.5	18.99%	35.12%	-1.824549	-0.294282
Acer barbatum	8	51.61%	2.5	6.33%	57.94%	-0.661398	-0.341367
Acer rubrum	2.5	16.13%	22	55.70%	71.83%	-1.824549	-0.294282
	15.5	100.00%	39.5	100.00%	200.00%		**-1.224213**

Grove Creek Old Country Road 7/20/99
Transect 1
Plot # 2 slope
SPECIES

Acer rubrum	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Dicanthelium commutatum	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Prenanthes sp.	22	22.92%	2.5	6.25%	29.17%	-1.473306	-0.337633
Lonicera japonica	8	8.33%	2.5	6.25%	14.58%	-2.484907	-0.207076
Hepatica americana	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Galium circaezans	8	8.33%	2.5	6.25%	14.58%	-2.484907	-0.207076
Poaceae #4	22	22.92%	2.5	6.25%	29.17%	-1.473306	-0.337633
Solidago spp. #5	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Desmodium glutinosum	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Senecio aureus	8	8.33%	2.5	6.25%	14.58%	-2.484907	-0.207076
Mitella diphylla	2.5	2.60%	7.5	18.75%	21.35%	-3.648057	-0.095001
Adiantum pedatum	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Asarum canadense	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Hieracium gronovii	2.5	2.60%	2.5	6.25%	8.85%	-3.648057	-0.095001
Sanicula spp.	8	8.33%	2.5	6.25%	14.58%	-2.484907	-0.207076
	96	100.00%	40	100.00%	200.00%		**-2.263579**
Nyssa sylvatica	P						
Smilacina racemosa	P						
Unknown #7	P						
moss	50%						
bareground	50%						

Grove Creek Old Country Road 7/20/99
Transect 1
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	8	10.32%	2.5	5.26%	15.59%	-2.270836	-0.234409
Dicanthelium commutatum	22	28.39%	22.5	47.37%	75.76%	-1.259235	-0.35746
Sanicula sp.	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Prenanthes sp.	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Loncera japonica	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Thalictrum revolutum	22	28.39%	2.5	5.26%	33.65%	-1.259235	-0.35746
Galium circaezans	8	10.32%	2.5	5.26%	15.59%	-2.270836	-0.234409
Equisetum hyemale	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Dirca palustris	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Viburnum acerifolium	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
Solidago sp.	2.5	3.23%	2.5	5.26%	8.49%	-3.433987	-0.110774
	77.5	100.00%	47.5	100.00%	200.00%		**-1.959155**
moss	65%						
bareground	25%						
Prunus serotina	P						
Poaceae #4	P						
Pinus taeda	P						

Grove Creek Old Country Road 7/20/99
Transect 2

Plot # 1 ridge	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
SPECIES	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Fagus grandifolia	8	34.78%	2.5	14.29%	49.07%	-1.056053	-0.367323
Acer rubrum	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Phegopteris hexagonoptera	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Liriodendron tulipifera	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Seedling unknown #9	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Lonicera japonica	2.5	10.87%	2.5	14.29%	25.16%	-2.219203	-0.241218
Carpinus caroliniana	23	100.00%	17.5	100.00%	200.00%		**-1.814629**
Aster sp.	P						

Grove Creek Old Country Road 7/20/99
Transect 2
Plot # 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asimina triloba	2.5	12.20%	22.5	30.00%	42.20%	-2.104134	-0.256602
Panax quinquefolius	2.5	12.20%	2.5	3.33%	15.53%	-2.104134	-0.256602
Polystichum acrostichoides	2.5	12.20%	27.5	36.67%	48.86%	-2.104134	-0.256602
Prenanthes sp.	2.5	12.20%	12.5	16.67%	28.86%	-2.104134	-0.256602
Fagus grandifolia	2.5	12.20%	7.5	10.00%	22.20%	-2.104134	-0.256602
Acer rubrum	8	39.02%	2.5	3.33%	42.36%	-0.940983	-0.367213
	20.5	100.00%	75	100.00%	200.00%		**-1.650222**
bareground	60%						

Grove Creek Old Country Road 7/20/99
Transect 2
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitella diphylla	2.5	12.20%	2.5	4.50%	16.70%	-2.104134	-0.256602
Polystichum acrostichoides	2.5	12.20%	32.5	58.56%	70.75%	-2.104134	-0.256602
Acer rubrum	2.5	12.20%	2.5	4.50%	16.70%	-2.104134	-0.256602
Liriodendron tulipifera	8	39.02%	8	14.41%	53.44%	-0.940983	-0.367213
Polygonatum biflorum	2.5	12.20%	2.5	4.50%	16.70%	-2.104134	-0.256602
Solidago flexicaulis	2.5	12.20%	7.5	13.51%	25.71%	-2.104134	-0.256602
	20.5	100.00%	55.5	100.00%	200.00%		**-1.650222**
Luzula acuminata	P						
moss	1%						

Grove Creek Old Country Road 7/20/99

Transect 3	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Plot # 1 ridge	7.5	23.81%	22.5	25.00%	48.81%	-1.435085	-0.341687
SPECIES	8	25.40%	2.5	2.78%	28.17%	-1.370546	-0.348075
Luzula acuminata	8	25.40%	62.5	69.44%	94.84%	-1.370546	-0.348075
Lonicera japonica	8	25.40%	2.5	2.78%	28.17%	-1.370546	-0.348075
Asimina triloba	31.5	100.00%	90	100.00%	200.00%		**-1.385912**
Galium triflorum							

Grove Creek Old Country Road 7/20/99
Transect 3
Plot # 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitella diphylla	2.5	13.89%	2.5	9.09%	22.98%	-1.974081	-0.274178
Polystichum acrostichoides	2.5	13.89%	12.5	45.45%	59.34%	-1.974081	-0.274178
Fagus grandifolia	8	44.44%	2.5	9.09%	53.54%	-0.81093	-0.360413
Luzula acuminata	2.5	13.89%	7.5	27.27%	41.16%	-1.974081	-0.274178
Asarum canadense	2.5	13.89%	2.5	9.09%	22.98%	-1.974081	-0.274178
	18	100.00%	27.5	100.00%	200.00%		**-1.457125**
Viburnum acerifolium	P						
moss	1%						
bareground	5%						

Grove Creek Old Country Road 7/20/99
Transect 3
Plot # 3 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	2.22%	2.5	2.56%	4.79%	-3.806662	-0.084592
Fagus grandifolia	2.5	2.22%	2.5	2.56%	4.79%	-3.806662	-0.084592
Carex bromoides	100	88.89%	85	87.18%	176.07%	-0.117783	-0.104696
Acer rubrum	2.5	2.22%	2.5	2.56%	4.79%	-3.806662	-0.084592
Lonicera japonica	2.5	2.22%	2.5	2.56%	4.79%	-3.806662	-0.084592
Asimina triloba	2.5	2.22%	2.5	2.56%	4.79%	-3.806662	-0.084592
	112.5	100.00%	97.5	100.00%	200.00%		**-0.527659**

Grove Creek Old Country Road 7/20/99
Transect 4
Plot # 1 ridge

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	11.90%	7.5	50.00%	61.90%	-2.128232	-0.253361
Acer barbatum	8	38.10%	2.5	16.67%	54.76%	-0.965081	-0.36765
Brachyelytrum erectum	8	38.10%	2.5	16.67%	54.76%	-0.965081	-0.36765
Lonicera japonica	2.5	11.90%	2.5	16.67%	28.57%	-2.128232	-0.253361
	21	100.00%	15	100.00%	200.00%		**-1.242022**
Acer rubrum	P						
Parthenocissus quinquefolia	P						
Botrychium virginianum	P						
Fraxinus sp.	P						
Carpinus caroliniana	P						
Prunus serotina	P						

Grove Creek Old Country Road 7/20/99
Transect 4
Plot # 1 ridge

SPECIES							
Athyrium thelypteroides							
Asimina triloba	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	20.00%	22.5	42.86%	62.86%	-1.609438	-0.321888
Arisaema triphyllum	2.5	20.00%	17.5	33.33%	53.33%	-1.609438	-0.321888
Lindera benzoin	2.5	20.00%	7.5	14.29%	34.29%	-1.609438	-0.321888
	2.5	20.00%	2.5	4.76%	24.76%	-1.609438	-0.321888
Acer barbatum	2.5	20.00%	2.5	4.76%	24.76%	-1.609438	-0.321888
Fagus grandifolia	12.5	100.00%	52.5	100.00%	200.00%		**-1.609438**
Euonymus americana	P						
Quercus velutina	P						
	P						
	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 0

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	8	10.60%	2.5	5.49%	16.09%	-2.24469	-0.237848
Agrimonia sp.	22.5	29.80%	8	17.58%	47.38%	-1.21062	-0.36078
Asarum canadense	2.5	3.31%	2.5	5.49%	8.81%	-3.40784	-0.112842
Sanguinaria canadensis	22	29.14%	7.5	16.48%	45.62%	-1.23309	-0.359311
Galium circaezans	2.5	3.31%	2.5	5.49%	8.81%	-3.40784	-0.112842
Fagus grandifolia	8	10.60%	7.5	16.48%	27.08%	-2.24469	-0.237848
Toxicodendron radicans	2.5	3.31%	7.5	16.48%	19.79%	-3.40784	-0.112842
Cercis canadensis	2.5	3.31%	2.5	5.49%	8.81%	-3.40784	-0.112842
Carya spp.	2.5	3.31%	2.5	5.49%	8.81%	-3.40784	-0.112842
Lonicera japonica	2.5	3.31%	2.5	5.49%	8.81%	-3.40784	-0.112842
	75.5	100.00%	45.5	100.00%	200.00%		**-1.872842**
Prunus serotina	P						
Cornus florida	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vitis rotundifolia	2.5	13.89%	22.5	60.00%	73.89%	-1.97408	-0.274178
Uvularia perfoliatam	8	44.44%	7.5	20.00%	64.44%	-0.81093	-0.360413
Carya spp.	2.5	13.89%	2.5	6.67%	20.56%	-1.97408	-0.274178
Euonymus americana	2.5	13.89%	2.5	6.67%	20.56%	-1.97408	-0.274178
Fagus grandifolia	2.5	13.89%	2.5	6.67%	20.56%	-1.97408	-0.274178
	18	100.00%	37.5	100.00%	200.00%		**-1.457125**

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	2.5	13.89%	2.5	3.70%	17.59%	-1.97408	-0.274178
Dennstaedtia punctilobula	2.5	13.89%	32.5	48.15%	62.04%	-1.97408	-0.274178
Asimina triloba	8	44.44%	12.5	18.52%	62.96%	-0.81093	-0.360413
Desmodium nudiflorum	2.5	13.89%	7.5	11.11%	25.00%	-1.97408	-0.274178
Vitis rotundifolia	2.5	13.89%	12.5	18.52%	32.41%	-1.97408	-0.274178
	18	100.00%	67.5	100.00%	200.00%		**-1.457125**
Carpinus caroliniana	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	2.5	9.80%	2.5	2.63%	12.44%	-2.32239	-0.227685
Sanguinaria canadensis	2.5	9.80%	2.5	2.63%	12.44%	-2.32239	-0.227685
Lonicera japonica	2.5	9.80%	2.5	2.63%	12.44%	-2.32239	-0.227685
Polystichum ascrostichoides	2.5	9.80%	32.5	34.21%	44.01%	-2.32239	-0.227685
Athyrium asplenioides	8	31.37%	42.5	44.74%	76.11%	-1.15924	-0.363682
Desmodium glutinosum	2.5	9.80%	7.5	7.89%	17.70%	-2.32239	-0.227685
Senecio aureus	2.5	9.80%	2.5	2.63%	12.44%	-2.32239	-0.227685
Amphicarpa bracteata	2.5	9.80%	2.5	2.63%	12.44%	-2.32239	-0.227685
	25.5	100.00%	95	100.00%	200.00%		**-1.957478**
Carya sp.	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum
Transect # 1
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Lonicera japonica	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
Desmodium nudiflorum	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
Euonymus americana	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
Botrychium virginianum	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
Parthenocissus quinquefolia	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
Podophyllum peltatum	2.5	14.29%	7.5	33.33%	47.62%	-1.94591	-0.277987
Desmodium sp.	2.5	14.29%	2.5	11.11%	25.40%	-1.94591	-0.277987
	17.5	100.00%	22.5	100.00%	200.00%		**-1.94591**

Asarum canadense	P
Galium circaezans	P
Carya spp.	P
Prunus serotina	P

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 5

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	22	35.77%	27.5	20.00%	55.77%	-1.02799	-0.367738
Galium circaezans	2.5	4.07%	7.5	5.45%	9.52%	-3.20275	-0.130193
Cercis canadensis	2.5	4.07%	2.5	1.82%	5.88%	-3.20275	-0.130193
Carya sp.	2.5	4.07%	12.5	9.09%	13.16%	-3.20275	-0.130193
Cornus florida	2.5	4.07%	2.5	1.82%	5.88%	-3.20275	-0.130193
Polystichum acrostichoides	2.5	4.07%	2.5	1.82%	5.88%	-3.20275	-0.130193
Desmodium glutinosum	2.5	4.07%	27.5	20.00%	24.07%	-3.20275	-0.130193
Asimina triloba	22	35.77%	42.5	30.91%	66.68%	-1.02799	-0.367738
Carpinus caroliniana	2.5	4.07%	12.5	9.09%	13.16%	-3.20275	-0.130193
	61.5	100.00%	137.5	100.00%	200.00%		**-1.646827**

Prunus serotina
Sanguinaria canadensis
Fagus grandifolia
Lonicera japonica

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 1
Plot # 6

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	2.5	10.87%	2.5	2.13%	13.00%	-2.2192	-0.241218
Galium circaezans	2.5	10.87%	2.5	2.13%	13.00%	-2.2192	-0.241218
Carya sp.	2.5	10.87%	12.5	10.64%	21.51%	-2.2192	-0.241218
Desmodium glutinosum	8	34.78%	62.5	53.19%	87.97%	-1.05605	-0.367323
Senecio aureus	2.5	10.87%	2.5	2.13%	13.00%	-2.2192	-0.241218
Amphicarpa bracteata	2.5	10.87%	32.5	27.66%	38.53%	-2.2192	-0.241218
Poaceae unknown	2.5	10.87%	2.5	2.13%	13.00%	-2.2192	-0.241218
	23	100.00%	117.5	100.00%	200.00%		**-1.814629**
Lonicera japonica	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 2
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya spp.	2.5	20.00%	2.5	14.29%	34.29%	-1.60944	-0.321888
Mitchella repens	2.5	20.00%	2.5	14.29%	34.29%	-1.60944	-0.321888
Asimina triloba	2.5	20.00%	2.5	14.29%	34.29%	-1.60944	-0.321888
Prunus serotina	2.5	20.00%	7.5	42.86%	62.86%	-1.60944	-0.321888
Vitis rotundifolia	2.5	20.00%	2.5	14.29%	34.29%	-1.60944	-0.321888
	12.5	100.00%	17.5	100.00%	200.00%		**-1.609438**

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 2
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	8	30.77%	7.5	30.00%	60.77%	-1.17865	-0.362663
Fagus grandifolia	2.5	9.62%	2.5	10.00%	19.62%	-2.34181	-0.225174
Goodyera pubescens	2.5	9.62%	2.5	10.00%	19.62%	-2.34181	-0.225174
Monotropa uniflora	2.5	9.62%	2.5	10.00%	19.62%	-2.34181	-0.225174
Solidago spp.	2.5	9.62%	2.5	10.00%	19.62%	-2.34181	-0.225174
Smilacina racemosa	8	30.77%	7.5	30.00%	60.77%	-1.17865	-0.362663
	26	100.00%	25	100.00%	200.00%		**-1.626021**
moss	10%						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 2
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium nudiflorum	2.5	8.77%	7.5	14.29%	23.06%	-2.43361	-0.213475
Sanguinaria canadensis	8	28.07%	7.5	14.29%	42.36%	-1.27046	-0.356621
Viola sp.	2.5	8.77%	2.5	4.76%	13.53%	-2.43361	-0.213475
Carya sp.	2.5	8.77%	2.5	4.76%	13.53%	-2.43361	-0.213475
Circaea lutetiana	2.5	8.77%	22.5	42.86%	51.63%	-2.43361	-0.213475
Ponthieva racemosa	8	28.07%	7.5	14.29%	42.36%	-1.27046	-0.356621
Mitchella repens	2.5	8.77%	2.5	4.76%	13.53%	-2.43361	-0.213475
	28.5	100.00%	52.5	100.00%	200.00%		**-1.780616**
Liriodendron tulipifera	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 2
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya spp.	8	20.51%	7.5	9.09%	29.60%	-1.58412	-0.324948
Mitchella repens	8	20.51%	7.5	9.09%	29.60%	-1.58412	-0.324948
Polystichum acrostichoides	2.5	6.41%	22.5	27.27%	33.68%	-2.74727	-0.176107
Carpinus caroliniana	2.5	6.41%	12.5	15.15%	21.56%	-2.74727	-0.176107
Fagus grandifolia	2.5	6.41%	7.5	9.09%	15.50%	-2.74727	-0.176107
Asimina triloba	2.5	6.41%	12.5	15.15%	21.56%	-2.74727	-0.176107
Euonymus americana	8	20.51%	2.5	3.03%	23.54%	-1.58412	-0.324948
Dioscorea villosa	2.5	6.41%	7.5	9.09%	15.50%	-2.74727	-0.176107
Sanicula canadensis	2.5	6.41%	2.5	3.03%	9.44%	-2.74727	-0.176107
	39	100.00%	82.5	100.00%	200.00%		**-2.031486**
Galium circaezans	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 3
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Smilicina racemosa	8	30.19%	27.5	45.83%	76.02%	-1.1977	-0.361571
Desmodium nudiflorum	2.5	9.43%	17.5	29.17%	38.60%	-2.36085	-0.222722
Mitchella repens	8	30.19%	7.5	12.50%	42.69%	-1.1977	-0.361571
Euonymus americana	8	30.19%	7.5	12.50%	42.69%	-1.1977	-0.361571
	26.5	100.00%	60	100.00%	200.00%		**-1.307434**

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 3
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium glutinosum	2.5	2.78%	12.5	9.09%	11.87%	-3.58352	-0.099542
Parthenocissus quinquefolia	2.5	2.78%	17.5	12.73%	15.51%	-3.58352	-0.099542
Impatiens capensis	8	8.89%	2.5	1.82%	10.71%	-2.42037	-0.215144
Asarum canadense	64.5	71.67%	62.5	45.45%	117.12%	-0.33314	-0.238754
Amphicarpa bracteata	2.5	2.78%	12.5	9.09%	11.87%	-3.58352	-0.099542
Toxicodendron radicans	2.5	2.78%	12.5	9.09%	11.87%	-3.58352	-0.099542
Cryptotaenia canadensis	2.5	2.78%	2.5	1.82%	4.60%	-3.58352	-0.099542
Fagus grandifolia	2.5	2.78%	7.5	5.45%	8.23%	-3.58352	-0.099542
Woodwardia areolata	2.5	2.78%	7.5	5.45%	8.23%	-3.58352	-0.099542
	90	100.00%	137.5	100.00%	200.00%		**-1.150693**
Carpinus caroliniana	P						
Liquidambar styraciflua	P						
Sanguinaria canadensis	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 3
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Sanguinaria canadensis	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Fagus grandifolia	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Polystichum acrostichoides	2.5	12.50%	42.5	70.83%	83.33%	-2.07944	-0.25993
Lonicera japonica	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Lindera benzoin	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Acer rubrum	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Liriodendron tulipifera	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
Smilicina racemosa	2.5	12.50%	2.5	4.17%	16.67%	-2.07944	-0.25993
	20	100.00%	60	100.00%	200.00%		**-2.079442**
bareground	10%						
Hepatica americana	P						

Hickory Fork Site, Gloucester Co., Desmodium glutinosum Ravine
Transect # 3
Plot # 4

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium glutinosum	8	17.78%	62.5	56.82%	74.60%	-1.72722	-0.307062
Asarum canadense	22	48.89%	32.5	29.55%	78.43%	-0.71562	-0.349859
Amphicarpa bracteata	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
Smilicina racemosa	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
Dicanthelium commutatum	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
Nyssa sylvatica	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
Prunus serotina	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
Viola sp.	2.5	5.56%	2.5	2.27%	7.83%	-2.89037	-0.160576
	45	100.00%	110	100.00%	200.00%		**-1.620377**
Lonicera japonica	P						
Botrychium virginianum	P						
Toxicodendron radicans	P						
Carpinus caroliniana	P						
Fagus grandifolia	P						
Liriodendron tulipifera	P						

Hickory Fork Site, Gloucester Co., Aralia racemosa Ravine
Transect # 4
Plot # 1

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya spp.	2.5	19.23%	2.5	20.00%	39.23%	-1.64866	-0.31705
Polygonatum biflorum	2.5	19.23%	7.5	60.00%	79.23%	-1.64866	-0.31705
Euonymus americana	8	61.54%	2.5	20.00%	81.54%	-0.48551	-0.298774
	13	100.00%	12.5	100.00%	200.00%		**-0.932874**
Acer rubrum	P						

Hickory Fork Site, Gloucester Co., Aralia racemosa Ravine
Transect # 4
Plot # 2

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Aralia racemosa	2.5	33.33%	42.5	89.47%	122.81%	-1.09861	-0.366204
Prenanthes spp.	2.5	33.33%	2.5	5.26%	38.60%	-1.09861	-0.366204
Desmodium nudiflorum	2.5	33.33%	2.5	5.26%	38.60%	-1.09861	-0.366204
	7.5	100.00%	47.5	100.00%	200.00%		**-1.098612**
Cercis canadensis	P						
Acer rubrum	P						
bareground	100%						

Hickory Fork Site, Gloucester Co., Aralia racemosa Ravine
Transect # 4
Plot # 3

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Solidago unknown #44	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Arisaema triphyllum	8	15.69%	7.5	15.00%	30.69%	-1.85238	-0.29057
Amphicarpa bracteata	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Mitchella repens	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Impatiens capensis	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Galium circaezans	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Carpinus caroliniana	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Cornus florida	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Uvularia perfoliatum	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Unknown Poaceae	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Lycopus virginicus	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Viola sp.	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Selaginella apoda	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Luzula acuminata	8	15.69%	7.5	15.00%	30.69%	-1.85238	-0.29057
Carya spp.	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
Smilicina racemosa	2.5	4.90%	2.5	5.00%	9.90%	-3.01553	-0.14782
	51	100.00%	50	100.00%	200.00%		**-2.650625**

Transect 1, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 1 ridge 350

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	22	67.69%	7.5	42.86%	**110.55%**	-0.3902	-0.2641
Asimina triloba	2.5	7.69%	2.5	14.29%	**21.98%**	-2.5649	-0.1973
Myrica cerifera	8	24.62%	7.5	42.86%	**67.47%**	-1.4018	-0.3451
	32.5	100.00%	17.5	100.00%	**200.00%**		**-0.8065**
Acer rubrum	P						

Transect 1, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot #2 slope 330

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Aralia racemosa	2.5	100.00%	12.5	100.00%	**200.00%**	0.0000	0.0000
	2.5	100.00%	12.5	100.00%			
Fagus grandifolia	P						
Carpinus caroliniana	P						
Luzula acuminata	P						
bareground	<5%						

Transect 1, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 3 floodplain level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Saururus cernua	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Parthenocissus quinquefolia	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Fagus grandifolia	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Decumaria barbara	2.5	8.20%	7.5	25.00%	**33.20%**	-2.5014	-0.2050
Bignonia capreolata	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Quercus alba	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Fraxinus pennsylvanica	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Sanicula gregaria	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Elephantopus tomentosus	2.5	8.20%	2.5	8.33%	**16.53%**	-2.5014	-0.2050
Carex sp.	8	26.23%	2.5	8.33%	**34.56%**	-1.3383	-0.3510
	30.5	100.00%	30	100.00%	200.00%		**-2.1963**
Carpinus caroliniana	P						
Viola sp.	P						

Transect 2, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 1 ridge 100

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Fagus grandifolia	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Dioscorea villosa	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Cornus florida	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Quercus alba	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Asimina triloba	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Carpinus caroliniana	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Poaceae unknown #5	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
Poaceae Unknown #2	2.5	12.50%	2.5	12.50%	**25.00%**	-2.0794	-0.2599
	20	100.00%	20	100.00%	**200.00%**		**-2.0794**

Transect 2, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine

Plot #2 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	14.29%	12.5	45.45%	**59.74%**	-1.9459	-0.2780
Dioscorea villosa	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
Smilicina racemosa	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
Luzula acuminata	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
Hexastylis virginica	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
Diospyros virginiana	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
Poaceae Unknown #2	2.5	14.29%	2.5	9.09%	**23.38%**	-1.9459	-0.2780
	17.5	100.00%	27.5	100.00%	200.00%		**-1.9459**
Fagus grandifolia	P						
Viola sp.	P						
bareground	30%						

Transect 2, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine

Plot # 3 floodplain 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Solidago flexicaulis	8	76.19%	7.5	25.00%	**101.19%**	-0.2719	-0.2072
Polystichum acrostichoides	2.5	23.81%	22.5	75.00%	**98.81%**	-1.4351	-0.3417
	10.5	100.00%	30	100.00%	200.00%		**-0.5489**
Hepatica americana	P						
Fagus grandifolia	P						

Transect 3, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 1 ridge 90

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carpinus caroliniana	2.5	20.00%	7.5	23.08%	**43.08%**	-1.6094	-0.3219
Parthenocissus quinquefolia	2.5	20.00%	2.5	7.69%	**27.69%**	-1.6094	-0.3219
Vitis rotundifolia	2.5	20.00%	12.5	38.46%	**58.46%**	-1.6094	-0.3219
Polygonatum biflorus	2.5	20.00%	2.5	7.69%	**27.69%**	-1.6094	-0.3219
Quercus falcata	2.5	20.00%	7.5	23.08%	**43.08%**	-1.6094	-0.3219
	12.5	100.00%	32.5	100.00%	200.00%		**-1.6094**
Acer rubrum	P						
Lonicera japonica	P						
Liriodendron tulipifera	P						

Transect 3, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 2 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Asimina triloba	2.5	33.33%	12.5	29.41%	**62.75%**	-1.0986	-0.3662
Polystichum acrostichoides	2.5	33.33%	27.5	64.71%	**98.04%**	-1.0986	-0.3662
Hexastylis virginica	2.5	33.33%	2.5	5.88%	**39.22%**	-1.0986	-0.3662
	7.5	100.00%	42.5	100.00%	200.00%		**-1.0986**
moss	< 5%						
bareground	25%						
Toxicodendron radicans	P						
Fagus grandifolia	P						

Transect 3, Cheatham Naval Annex 7/29/99 Aralia racemosa Ravine
Plot # 3 flood/bottom slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Asimina triloba	2.5	11.90%	12.5	41.67%	**53.57%**	-2.1282	-0.2534
Solidago flexicaulis	8	38.10%	7.5	25.00%	**63.10%**	-0.9651	-0.3676
Phyrma leptostachya	8	38.10%	7.5	25.00%	**63.10%**	-0.9651	-0.3676
Luzula acuminata	2.5	11.90%	2.5	8.33%	**20.24%**	-2.1282	-0.2534
	21	100.00%	30	100.00%	200.00%		**-1.2420**
Circaea lutetiana	P						
Carpinus caroliniana	P						
Viola sp.	P						
moss	<5%						
bareground	<5%						

Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 1 ridge 350

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Polystichum acrostichoides	2.5	12.50%	27.5	61.11%	**73.61%**	-2.0794	-0.2599
Luzula acuminata	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Virburnum acerifolium	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Carpinus caroliniana	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Prunus serotina	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Mitchella repens	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Liquidambar styraciflua	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
Liriodendron tulipifera	2.5	12.50%	2.5	5.56%	**18.06%**	-2.0794	-0.2599
	20	100.00%	45	100.00%	200.00%		**-2.0794**
moss	<5%						

Transect 1, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 2 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	2.5	25.00%	17.5	58.33%	**83.33%**	-1.3863	-0.3466
Luzula acuminata	2.5	25.00%	7.5	25.00%	**50.00%**	-1.3863	-0.3466
Aster sp.	2.5	25.00%	2.5	8.33%	**33.33%**	-1.3863	-0.3466
Lonicera japonica	2.5	25.00%	2.5	8.33%	**33.33%**	-1.3863	-0.3466
	10	100.00%	30	100.00%	**200.00%**		**-1.3863**
Acer rubrum	P						
Viburnum acerifolium	P						
Carpinus caroliniana	P						
moss	40%						
bareground	25%						

Transect 1, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 3 slope 170

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Athyrium pycnocarpon	8	51.61%	62.5	89.29%	**140.90%**	-0.6614	-0.3414
Arisaema triphyllum	2.5	16.13%	2.5	3.57%	**19.70%**	-1.8245	-0.2943
Lonicera japonica	2.5	16.13%	2.5	3.57%	**19.70%**	-1.8245	-0.2943
Geum sp.	2.5	16.13%	2.5	3.57%	**19.70%**	-1.8245	-0.2943
	15.5	100.00%	70	100.00%	**200.00%**		**-1.2242**
Ponthieva racemosa	P						
Fagus grandifolia	P						

Transect 1, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine

Plot # 4 ridge 200

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Polystichum acrostichoides	8	28.57%	27.5	52.38%	**80.95%**	-1.2528	-0.3579
Acer rubrum	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Lonicera japonica	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Fagus grandifolia	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Liriodendron tulipifera	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Prunus serotina	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Phyrma leptostachya	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
Elephantopus tomentosus	2.5	8.93%	7.5	14.29%	**23.21%**	-2.4159	-0.2157
Aristolochia serpentaria	2.5	8.93%	2.5	4.76%	**13.69%**	-2.4159	-0.2157
	28	100.00%	52.5	100.00%	200.00%		**-2.0836**

Transect 2, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine

Plot # 1 ridge 20

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carya cordiformis	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Polystichum acrostichoides	2.5	11.11%	22.5	47.37%	**58.48%**	-2.1972	-0.2441
Luzula acuminata	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Mitchella repens	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Elephantopus tomentosus	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Carpinus caroliniana	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Cercis canadensis	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
Desmodium nudiflorum	2.5	11.11%	7.5	15.79%	**26.90%**	-2.1972	-0.2441
Poaceae unknown #11	2.5	11.11%	2.5	5.26%	**16.37%**	-2.1972	-0.2441
	22.5	100.00%	47.5	100.00%	200.00%		**-2.1972**
moss	<5%						
Galium circaezans	P						

Transect 2, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 2 slope 330

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carya cordiformis	2.5	25.00%	2.5	7.14%	**32.14%**	-1.3863	-0.3466
Arisaema triphyllum	2.5	25.00%	2.5	7.14%	**32.14%**	-1.3863	-0.3466
Polystichum acrostichoides	2.5	25.00%	22.5	64.29%	**89.29%**	-1.3863	-0.3466
Luzula acuminata	2.5	25.00%	7.5	21.43%	**46.43%**	-1.3863	-0.3466
	10	100.00%	35	100.00%	200.00%		**-1.3863**
moss	<5%						
bareground	<5%						

Transect 2, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 3 slope 150

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Athyrium pycnocarpon	8	25.81%	85	82.93%	**108.73%**	-1.3545	-0.3496
Ranunculus hispidus	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
Carya cordiformis	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
Lonicera japonica	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
Fraxinus pennsylvanica	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
Unknown Poaceae #8	8	25.81%	2.5	2.44%	**28.25%**	-1.3545	-0.3496
Unknown Sedge #9	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
Boehmeria cylindrica	2.5	8.06%	2.5	2.44%	**10.50%**	-2.5177	-0.2030
	31	100.00%	102.5	100.00%	200.00%		**-1.9174**
Viola spp.	P						
moss	5%						
bareground	90%						
Acer rubrum	P						
Prunus serotina	P						

Transect 2, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 4 ridge 120

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya cordiformis	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
Lonicera japonica	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
Liquidambar styraciflua	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
Mitchella repens	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
Elephantopus tomentosus	2.5	6.94%	7.5	9.38%	**16.32%**	-2.6672	-0.1852
Parthenocissus quinquefolia	2.5	6.94%	7.5	9.38%	**16.32%**	-2.6672	-0.1852
Asimina triloba	8	22.22%	42.5	53.13%	**75.35%**	-1.5041	-0.3342
Galium circaezans	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
Dicanthelium boscii	8	22.22%	7.5	9.38%	**31.60%**	-1.5041	-0.3342
Unknown #12	2.5	6.94%	2.5	3.13%	**10.07%**	-2.6672	-0.1852
	36	100.00%	80	100.00%	200.00%		-2.1503
Viola spp.	P						

Transect 3, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Polystichum acrostichoides	8	34.78%	32.5	61.90%	**96.69%**	-1.0561	-0.3673
Parthenocissus quinquefolia	2.5	10.87%	7.5	14.29%	**25.16%**	-2.2192	-0.2412
Acer rubrum	2.5	10.87%	2.5	4.76%	**15.63%**	-2.2192	-0.2412
Fraxinus pensylvanica	2.5	10.87%	2.5	4.76%	**15.63%**	-2.2192	-0.2412
Mitchella repens	2.5	10.87%	2.5	4.76%	**15.63%**	-2.2192	-0.2412
Luzula acuminata	2.5	10.87%	2.5	4.76%	**15.63%**	-2.2192	-0.2412
Smilax rotundifolia	2.5	10.87%	2.5	4.76%	**15.63%**	-2.2192	-0.2412
	23	100.00%	52.5	100.00%	200.00%		**-1.8146**
Toxicodendron radicans	P						

Transect 3, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 2 slope 350

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Athyrium pycnocarpon	8	51.61%	85	91.89%	**143.50%**	-0.6614	-0.3414
Cornus florida	2.5	16.13%	2.5	2.70%	**18.83%**	-1.8245	-0.2943
Galium triflorum	2.5	16.13%	2.5	2.70%	**18.83%**	-1.8245	-0.2943
Boehemeria cylindrica	2.5	16.13%	2.5	2.70%	**18.83%**	-1.8245	-0.2943
	15.5	100.00%	92.5	100.00%	200.00%		**-1.2242**

Transect 3, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 3 slope 150

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Euonymus americana	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
Polystichum acrostichoides	2.5	8.93%	7.5	23.08%	**32.01%**	-2.4159	-0.2157
Prunus serotina	8	28.57%	2.5	7.69%	**36.26%**	-1.2528	-0.3579
Elephantopus tomentosus	2.5	8.93%	7.5	23.08%	**32.01%**	-2.4159	-0.2157
Parthenocissus quinquefolia	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
Unknown #8	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
Arisaema triphyllum	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
Acer rubrum	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
Lonicera japonica	2.5	8.93%	2.5	7.69%	**16.62%**	-2.4159	-0.2157
	28	100.00%	32.5	100.00%	200.00%		**-2.0836**
Circaea lutetiana	P						
Ranunculus hispidus	P						
moss	10%						
bareground	5%						

Transect 3, Transect 1, Cheatham Naval Annex 7/29/99 Athyrium pycnocarpon Ravine
Plot # 4 ridge 120

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Arisaema triphyllum	8	28.07%	7.5	27.27%	**55.34%**	-1.2705	-0.3566
Acer rubrum	8	28.07%	7.5	27.27%	**55.34%**	-1.2705	-0.3566
Mitchella repens	2.5	8.77%	2.5	9.09%	**17.86%**	-2.4336	-0.2135
Cercis canadensis	2.5	8.77%	2.5	9.09%	**17.86%**	-2.4336	-0.2135
Carpinus caroliniana	2.5	8.77%	2.5	9.09%	**17.86%**	-2.4336	-0.2135
Unknown sedge #9	2.5	8.77%	2.5	9.09%	**17.86%**	-2.4336	-0.2135
Sanguinaria canadensis	2.5	8.77%	2.5	9.09%	**17.86%**	-2.4336	-0.2135
	28.5	100.00%	27.5	100.00%	200.00%		**-1.7806**

Chippokes Field Data 8/13/99

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 1
Plot # 1 ridge 50

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carpinus caroliniana	2.5	1.79%	2.5	6.67%	**8.45%**	-4.0254	-0.0719
Quercus michauxii	2.5	1.79%	2.5	6.67%	**8.45%**	-4.0254	-0.0719
Arisaema triphyllum	22	15.71%	7.5	20.00%	**35.71%**	-1.8506	-0.2908
Microstegium vimineum	100	71.43%	12.5	33.33%	**104.76%**	-0.3365	-0.2403
Euonymus americana	8	5.71%	7.5	20.00%	**25.71%**	-2.8622	-0.1636
Vitis rotundifolia	2.5	1.79%	2.5	6.67%	**8.45%**	-4.0254	-0.0719
Matelea sp.	2.5	1.79%	2.5	6.67%	**8.45%**	-4.0254	-0.0719
	140	100.00%	37.5	100.00%	200.00%		**-0.9822**
Botrychium virginianum	P						
Desmodium spp.	P						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 1
Plot # 2 slope 60

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lonicera japonica	2.5	12.20%	2.5	6.25%	**18.45%**	-2.1041	-0.2566
Decumaria barbara	2.5	12.20%	7.5	18.75%	**30.95%**	-2.1041	-0.2566
Sanicula canadensis	2.5	12.20%	2.5	6.25%	**18.45%**	-2.1041	-0.2566
Ariseama triphyllum	2.5	12.20%	2.5	6.25%	**18.45%**	-2.1041	-0.2566
Athyrium pycnocarpon	8	39.02%	22.5	56.25%	**95.27%**	-0.9410	-0.3672
Oxalis stricta	2.5	12.20%	2.5	6.25%	**18.45%**	-2.1041	-0.2566
	20.5	100.00%	40	100.00%	200.00%		**-1.6502**

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 1
Plot # 3 slope 260

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Phegopteris hexagonoptera	8	34.04%	32.5	76.47%	**110.51%**	-1.0776	-0.3668
Lonicera japonica	8	34.04%	2.5	5.88%	**39.92%**	-1.0776	-0.3668
Quercus velutina	2.5	10.64%	2.5	5.88%	**16.52%**	-2.2407	-0.2384
Quercus michauxii	2.5	10.64%	2.5	5.88%	**16.52%**	-2.2407	-0.2384
Carex spp.	2.5	10.64%	2.5	5.88%	**16.52%**	-2.2407	-0.2384
	23.5	100.00%	42.5	100.00%	200.00%		**-1.4488**
Acer rubrum	P						
Carpinus caroliniana	P						
Parthenocissus quinquefolia	P						
Ranunculus hispidus	P						
Cornus florida	P						
bareground	10%						
moss	<5%						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 1
Plot # 4 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Polystichum acrostichoides	8	31.37%	62.5	78.13%	**109.50%**	-1.1592	-0.3637
Carya cordiformis	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Mitchella repens	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Berchemia scandens	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Fraxinus pennslyvanica	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Lindera benzoin	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Lonicera japonica	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
Parthenocissus quinquefolia	2.5	9.80%	2.5	3.13%	**12.93%**	-2.3224	-0.2277
	25.5	100.00%	80	100.00%	200.00%		**-1.9575**
Carpinus caroliniana	P						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 2
Plot#1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lonicera japonica	64.5	92.81%	2.5	33.33%	**126.14%**	-0.0747	-0.0693
Liquidambar styraciflua	2.5	3.60%	2.5	33.33%	**36.93%**	-3.3250	-0.1196
Quercus michauxii	2.5	3.60%	2.5	33.33%	**36.93%**	-3.3250	-0.1196
	69.5	100.00%	7.5	100.00%	200.00%		**-0.3085**

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 2
Plot# 2 slope 60

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Aralia spinosa	2.5	2.17%	12.5	23.81%	**25.98%**	-3.8286	-0.0832
Senecio aureus	2.5	2.17%	2.5	4.76%	**6.94%**	-3.8286	-0.0832
Aster spp.	2.5	2.17%	2.5	4.76%	**6.94%**	-3.8286	-0.0832
Microstegium vimineum	100	86.96%	17.5	33.33%	**120.29%**	-0.1398	-0.1215
Polystichum acrostichoides	2.5	2.17%	12.5	23.81%	**25.98%**	-3.8286	-0.0832
Ranunculus hispidus	2.5	2.17%	2.5	4.76%	**6.94%**	-3.8286	-0.0832
Bignonia capreolata	2.5	2.17%	2.5	4.76%	**6.94%**	-3.8286	-0.0832
	115	100.00%	52.5	100.00%	200.00%		**-0.6209**

bareground

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 2
Plot# 3 slope 220

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Athyrium pycnocarpon	8	39.02%	42.5	70.83%	**109.86%**	-0.9410	-0.3672
Circaea lutetiana	2.5	12.20%	2.5	4.17%	**16.36%**	-2.1041	-0.2566
Ranunculus hispidus	2.5	12.20%	2.5	4.17%	**16.36%**	-2.1041	-0.2566
Fagus grandifolia	2.5	12.20%	2.5	4.17%	**16.36%**	-2.1041	-0.2566
Carex sp.	2.5	12.20%	7.5	12.50%	**24.70%**	-2.1041	-0.2566
Decumaria barbara	2.5	12.20%	2.5	4.17%	**16.36%**	-2.1041	-0.2566
	20.5	100.00%	60	100.00%	200.00%		-1.6502

Carpinus caroliniana	P
Acer rubrum	P
moss	<5%

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 2
Plot# 4 slope 240

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lonicera japonica	100	97.56%	2.5	50.00%	**147.56%**	-0.0247	-0.0241
Carya cordiformis	2.5	2.44%	2.5	50.00%	**52.44%**	-3.7136	-0.0906
	102.5	100.00%	5	100.00%	200.00%		-0.1147

Epigagus virginiana	P
moss	< 5%

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 3
Plot# 1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Liquidambar styraciflua	2.5	100.00%	2.5	100.00%	**200.00%**	0.0000	0.0000

Lonicer japonica	P

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 3
Plot# 2 slope 80

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Mitchella repens	2.5	13.89%	2.5	3.45%	**17.34%**	-1.9741	-0.2742
Polystichum acrostichoides	8	44.44%	62.5	86.21%	**130.65%**	-0.8109	-0.3604
Botrychium biternatum	2.5	13.89%	2.5	3.45%	**17.34%**	-1.9741	-0.2742
Fraxinus pennsylvanica	2.5	13.89%	2.5	3.45%	**17.34%**	-1.9741	-0.2742
Luzula acuminata	2.5	13.89%	2.5	3.45%	**17.34%**	-1.9741	-0.2742
	18	100.00%	72.5	100.00%	200.00%		**-1.4571**
Carpinus caroliniana	P						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 3
Plot# 3 floodplain level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Toxicodendron radicans	2.5	9.80%	2.5	4.17%	**13.97%**	-2.3224	-0.2277
Carex bromoides	8	31.37%	32.5	54.17%	**85.54%**	-1.1592	-0.3637
Lindera benzoin	2.5	9.80%	7.5	12.50%	**22.30%**	-2.3224	-0.2277
Decumaria barbara	2.5	9.80%	2.5	4.17%	**13.97%**	-2.3224	-0.2277
Circaea lutetiana	2.5	9.80%	2.5	4.17%	**13.97%**	-2.3224	-0.2277
Polystichum acrostichoides	2.5	9.80%	7.5	12.50%	**22.30%**	-2.3224	-0.2277
Euonymous americana	2.5	9.80%	2.5	4.17%	**13.97%**	-2.3224	-0.2277
Cornus florida	2.5	9.80%	2.5	4.17%	**13.97%**	-2.3224	-0.2277
	25.5	100.00%	60	100.00%	200.00%		**-1.9575**
Berchemia scandens	P						
Eupatorium rugosum							
moss	5%						
bareground	30%						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 3
Plot#4 slope 210

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Mitchella repens	2.5	23.81%	2.5	50.00%	**73.81%**	-1.4351	-0.3417
Lonicera japonica	8	76.19%	2.5	50.00%	**126.19%**	-0.2719	-0.2072
	10.5	100.00%	5	100.00%	200.00%		-0.5489
Botrychium virginianum	P						

Athyrium pycnocarpon Ravine (Chippokes Plantation St. Park)
Transect 3
Plot# 5 ridge 210

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vitis rotundifolia	2.5	13.51%	2.5	33.33%	**46.85%**	-2.0015	-0.2705
Mitchella repens	8	43.24%	2.5	33.33%	**76.58%**	-0.8383	-0.3625
Lonicera japonica	8	43.24%	2.5	33.33%	**76.58%**	-0.8383	-0.3625
	18.5	100.00%	7.5	100.00%	200.00%		-0.9955
Ilex opaca	P						
Toxicodendron radicans	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 1
Plot# 1 ridge 100

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Polystichum acrostichoides	2.5	50.00%	22.5	90.00%	**140.00%**	-0.6931	-0.3466
Carya cordiformis	2.5	50.00%	2.5	10.00%	**60.00%**	-0.6931	-0.3466
	5	100.00%	25	100.00%	200.00%		**-0.6931**
Vitis rotundifolia	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 1
Plot# 2 slope 140

		R. DENSITY					
SPECIES	DENSITY	3.70%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Circaea lutetiana	2.5	32.59%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Dicanthelium boscii	22	3.70%	7.5	15.79%	**48.38%**	-1.1211	-0.3654
Carpinus caroliniana	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Elephantopus tomentosus	2.5	11.85%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Salvia lyrata	8	3.70%	2.5	5.26%	**17.12%**	-2.1327	-0.2528
Sanguinaria canadensis	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Fraxinus pennsylvanica	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Sanicula gregaria	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Oxalis stricta	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Berchemia scandens vine	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Hexalectris spicata	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Quercus velutina	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Phryma leptostachya	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Elephantopus carolinianus	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Vitus rotundifolia	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Lonicera japonica	2.5	3.70%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
Smilax spp.	2.5	100.00%	2.5	5.26%	**8.97%**	-3.2958	-0.1221
	67.5		47.5	100.00%	200.00%		**-2.4492**
Smilacina racemosa	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 1

Plot# 3 floodplain level		R. DENSITY					
SPECIES	DENSITY	9.09%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carex bromoides	8	73.30%	12.5	41.67%	**50.76%**	-2.3979	-0.2180
Ponthieva racemosa	64.5	2.84%	7.5	25.00%	**98.30%**	-0.3107	-0.2277
Decumaria barbara	2.5	9.09%	2.5	8.33%	**11.17%**	-3.5610	-0.1012
Desmodium pauciflorum	8	2.84%	2.5	8.33%	**17.42%**	-2.3979	-0.2180
Lindera benzoin	2.5	2.84%	2.5	8.33%	**11.17%**	-3.5610	-0.1012
Circaea lutetiana	2.5	100.00%	2.5	8.33%	**11.17%**	-3.5610	-0.1012
	88		30	100.00%	200.00%		**-0.9672**
Acer rubrum	P						
Hydrocotyle ranunculoides	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 2

Plot# 1 ridge 210		R. DENSITY					
SPECIES	DENSITY	7.25%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Polystichum acrostichoides	2.5	7.25%	17.5	25.00%	**32.25%**	-2.6247	-0.1902
Carya cordiformis	2.5	7.25%	2.5	3.57%	**10.82%**	-2.6247	-0.1902
Acer rubrum	2.5	7.25%	2.5	3.57%	**10.82%**	-2.6247	-0.1902
Parthenocissus quinquefolia	2.5	63.77%	12.5	17.86%	**25.10%**	-2.6247	-0.1902
Vitis rotundifolia	22	7.25%	32.5	46.43%	**110.20%**	-0.4499	-0.2869
Lonicer japonica	2.5	100.00%	2.5	3.57%	**10.82%**	-2.6247	-0.1902
	34.5		70	100.00%	200.00%		**-1.2379**
Sassafras albidum	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 2

Plot#2 slope 210		R. DENSITY					
SPECIES	DENSITY	7.25%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carya cordiformis	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Cimicfuga spp.	2.5	7.25%	12.5	38.46%	**45.71%**	-2.6247	-0.1902
Salvia lyrata	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Elephantopus tomentosus	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Galium circaezans	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Ariseama triphyllum	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Matelea sp.	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Sanguinaria canadensis	2.5	7.25%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
Oxalis stricta	2.5	65.22%	2.5	7.69%	**14.94%**	-2.6247	-0.1902
	22.5		32.5	100.00%	165.22%		**-1.7117**

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 2

Plot# 3 floodplain level		R. DENSITY					
SPECIES	DENSITY	4.07%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Dryopteris celsa	2.5	35.77%	2.5	4.35%	**8.41%**	-3.2027	-0.1302
Carex bromoides	22	4.07%	17.5	30.43%	**66.21%**	-1.0280	-0.3677
Sanicula spp.	2.5	35.77%	2.5	4.35%	**8.41%**	-3.2027	-0.1302
Arisaema triphyllum	22	4.07%	7.5	13.04%	**48.82%**	-1.0280	-0.3677
Ponthieva racemosa	2.5	4.07%	2.5	4.35%	**8.41%**	-3.2027	-0.1302
Circaea lutetiana	2.5	4.07%	2.5	4.35%	**8.41%**	-3.2027	-0.1302
Toxicodendron radicans	2.5	4.07%	2.5	4.35%	**8.41%**	-3.2027	-0.1302
Polystichum acrostichoides	2.5	4.07%	7.5	13.04%	**17.11%**	-3.2027	-0.1302
Lindera benzoin	2.5	100.00%	12.5	21.74%	**25.80%**	-3.2027	-0.1302
	61.5		57.5	100.00%	200.00%		**-1.6468**
Euonymus americana	P						
moss	<5%						
Viola sp.	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 3

Plot# 3 floodplain level170		R. DENSITY					
SPECIES	DENSITY	47.31%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carex bromoides	22	5.38%	27.5	73.33%	**120.65%**	-0.7484	-0.3541
Lindera benzoin	2.5	47.31%	2.5	6.67%	**12.04%**	-2.9232	-0.1572
Ponthieva racemosa	22	100.00%	7.5	20.00%	**67.31%**	-0.7484	-0.3541
	46.5		37.5	100.00%	200.00%		**-0.8653**
Prunus serotina	P						
Berchemia scandens	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 3

Plot#2 slope 150		R. DENSITY					
SPECIES	DENSITY	3.50%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lonicera japonica	2.5	3.50%	7.5	12.00%	**15.50%**	-3.3534	-0.1173
Parthenocissus quinquefolia	2.5	3.50%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Thalictrum revolutum	2.5	3.50%	7.5	12.00%	**15.50%**	-3.3534	-0.1173
Matalea sp.	2.5	3.50%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Vitis rotundifolia	2.5	3.50%	7.5	12.00%	**15.50%**	-3.3534	-0.1173
Euonymus americana	2.5	30.77%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Hexalectris spicata	22	3.50%	2.5	4.00%	**34.77%**	-1.1787	-0.3627
Fraxinus spp.	2.5	3.50%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Ilex opaca	2.5	30.77%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Carex spp. #2	22	3.50%	17.5	28.00%	**58.77%**	-1.1787	-0.3627
Dicanthelium boscii	2.5	3.50%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Carya cordiformis	2.5	3.50%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
Desmodium sp.	2.5	100.00%	2.5	4.00%	**7.50%**	-3.3534	-0.1173
	71.5		62.5	100.00%	200.00%		**-2.0151**
Fagus grandifolia	P						

Hexalectris spicata Ravine (Chippokes Plantation St. Park)
Transect 3

Plot# 1 slope 160		R. DENSITY					
SPECIES	DENSITY	50.00%	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Carya cordiformis	2.5	50.00%	2.5	50.00%	**100.00%**	-0.6931	-0.3466
Lonicera japonica	2.5	100.00%	2.5	50.00%	**100.00%**	-0.6931	-0.3466
	5		5	100.00%	200.00%		**-0.6931**

Transect 1, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot # 1 slope, 110 degrees

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Asimina triloba	2.5	2.17%	17.5	9.28%	11.46%	-3.829	-0.08323133
Carpinus caroliniana	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Euonymus americana	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Hexastylis virginica	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Antennaria solitaria	27.5	23.91%	64.5	34.22%	58.13%	-1.431	-0.34213494
Dicanthelium boscii	32.5	28.26%	64.5	34.22%	62.48%	-1.264	-0.35713036
Amphicarpa bracteata	32.5	28.26%	22	11.67%	39.93%	-1.264	-0.35713036
Poa autumnalis	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Viola cucullata	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Galium triflorum	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Desmodium sp.	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Scutellaria elliptica	2.5	2.17%	2.5	1.33%	3.50%	-3.829	-0.08323133
Total	115	100.00%	188.5	100.00%	200.00%		-1.8054777
Acer rubrum	P						

Transect 1, Hickory Hollow/ Cabin Swamp Field Data 5/11/00
Plot # 2 floodplain/bottom slope, 110 degrees

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Desmodium glutinosum	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Asimina triloba	8	12.50%	7.5	8.57%	21.07%	-2.079	-0.25993019
Carpinus caroliniana	8	12.50%	27.5	31.43%	43.93%	-2.079	-0.25993019
Arisaema triphyllum	2.5	3.91%	7.5	8.57%	12.48%	-3.243	-0.12666376
Galium obtusum	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Luzula echinata	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Euonymus americana	8	12.50%	7.5	8.57%	21.07%	-2.079	-0.25993019
Parthenocissus quinquefolia	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Viola sp.	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Toxicodendron radicans	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Hexastylis virginica	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Rhododendron sp.	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Carya pallida	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Vitis sp.	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Lindera benzoin	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Fagus grandifolia	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Vaccinium pallidum	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Liquidambar styraciflua	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Saururus cernuus	2.5	3.91%	2.5	2.86%	6.76%	-3.243	-0.12666376
Totals	64	100.00%	87.5	100.00%	200.00%		-2.8064108
moss	< 5%						

Transect 2, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot # 1 slope 23

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Monotropsis odorata	2.5	8.47%	2.5	25.00%	33.47%	-2.468	-0.20916098
Mitchella repens	22	74.58%	2.5	25.00%	99.58%	-0.293	-0.21876786
Vaccinium pallidum	2.5	8.47%	2.5	25.00%	33.47%	-2.468	-0.20916098
Acer rubrum	2.5	8.47%	2.5	25.00%	33.47%	-2.468	-0.20916098
Totals	29.5	100.00%	10	100.00%	200.00%		**-0.8462508**

Transect 2, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot # 2 slope 60

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Veratrum viride	22	24.86%	42.5	25.37%	50.23%	-1.392	-0.34602398
Symplocarpus foetidus	8	9.04%	62.5	37.31%	46.35%	-2.404	-0.21727105
Toxicodendron radicans	8	9.04%	2.5	1.49%	10.53%	-2.404	-0.21727105
Sanicula sp.	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Galium triflorum	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Galium obtusum	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Amphicarpa bracteata	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Oxypolis rigidior	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Aster sp.	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Carex spp.	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Carex blanda	2.5	2.82%	17.5	10.45%	13.27%	-3.567	-0.10075457
Carex crinita	8	9.04%	2.5	1.49%	10.53%	-2.404	-0.21727105
Rudbeckia laciniata	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Arisaema triphyllum	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Apios americana	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Luzula echinata	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Senecio aureus	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Impatiens capensis	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Euonymus americana	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Dioscorea villosa	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Carpinus caroliniana	2.5	2.82%	2.5	1.49%	4.32%	-3.567	-0.10075457
Totals	88.5	100.00%	167.5	100.00%	200.00%		-2.7106648
Quercus alba	P						

Transect 2, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot # 3 floodplain- flat

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Viola conspersa	8	7.58%	2.5	2.27%	9.86%	-2.579	-0.19558441
Viola cucullata	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Onoclea sensibilis	2.5	2.37%	7.5	6.82%	9.19%	-3.742	-0.08868294
Amphicarpa bracteata	22	20.85%	42.5	38.64%	59.49%	-1.568	-0.32690718
Hexastylis viriginica	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Toxicodendron radicans	2.5	2.37%	7.5	6.82%	9.19%	-3.742	-0.08868294
Itea virginica	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Thelypteris palustris	8	7.58%	7.5	6.82%	14.40%	-2.579	-0.19558441
Geum canadense	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Arisaema triphyllum	22	20.85%	7.5	6.82%	27.67%	-1.568	-0.32690718
Galium obtusum	8	7.58%	2.5	2.27%	9.86%	-2.579	-0.19558441
Galium triflorum	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Ranunculus hispidus	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Luzula echinata	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Smilax hispida	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Carex blanda	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Carex sp.	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Lindera benzoin	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Claytonia virginica	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Sphenopholis obtusata	2.5	2.37%	2.5	2.27%	4.64%	-3.742	-0.08868294
Totals	105.5	100.00%	110	100.00%	200.00%		-2.5708117
moss							
Impatiens capensis	P						
Cicuta maculata	P						

Transect 3, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot #1 slope, 23 degrees

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Gaylussacia frondosa	2.5	13.89%	22.5	60.00%	73.89%	-1.974	-0.27417792
Vaccinium pallidum	8	44.44%	7.5	20.00%	64.44%	-0.811	-0.36041343
Quercus rubra	2.5	13.89%	2.5	6.67%	20.56%	-1.974	-0.27417792
Amelanchier arborea	2.5	13.89%	2.5	6.67%	20.56%	-1.974	-0.27417792
Gaylussacia baccata	2.5	13.89%	2.5	6.67%	20.56%	-1.974	-0.27417792
Totals	18	100.00%	37.5	100.00%	200.00%		-1.4571251

Transect 3, Hickory Hollow/ Cabin Swamp Field Data 5/11/00

Plot # 2 floodplain- flat

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Caltha palustris	22	30.34%	62.5	53.19%	83.54%	-1.193	-0.36187545
Thelypteris palustris	2.5	3.45%	7.5	6.38%	9.83%	-3.367	-0.11611365
Saururus cernuus	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Carex crinita	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Cicuta maculata	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Impatiens capensis	8	11.03%	2.5	2.13%	13.16%	-2.204	-0.243216
Galium obtusum	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Lindera benzoin	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Toxicodendron radicans	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Acer rubrum	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Mikania scandens	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Sanicula sp.	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Fraxinus pennsylvanica	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Polygonum sagittatum	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Ulmus sp.	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Cardamine bulbosa	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Solidago sp.	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Polygonum virginianum	2.5	3.45%	2.5	2.13%	5.58%	-3.367	-0.11611365
Viburnum prunifolium	2.5	3.45%	7.5	6.38%	9.83%	-3.367	-0.11611365
Totals	72.5	100.00%	117.5	100.00%	200.00%		-2.5790235

Transect 3, Hickory Hollow/ Cabin Swamp Field Data 5/11/00
Plot # 3 floodplain- flat

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Toxicodendron radicans	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Desmodium glutinosum	8	6.81%	27.5	19.30%	26.11%	-2.687	-0.18294446
Phegopteris hexagonoptera	22	18.72%	62.5	43.86%	62.58%	-1.675	-0.31369114
Dicanthelium boscii	8	6.81%	7.5	5.26%	12.07%	-2.687	-0.18294446
Amphicarpa bracteata	22	18.72%	7.5	5.26%	23.99%	-1.675	-0.31369114
Discorea villosa	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Carpinus caroliniana	22	18.72%	2.5	1.75%	20.48%	-1.675	-0.31369114
Solidago rugosa	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Uvularia sessilifolia	8	6.81%	2.5	1.75%	8.56%	-2.687	-0.18294446
Hexastylis virginica	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Liriodendron tulipifera	2.5	2.13%	7.5	5.26%	7.39%	-3.85	-0.08191803
Viola cucullata	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Aster sp.	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Smilax bona-nox	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Oxypolis rigidior	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Ulmus rubra	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Geum canadense	2.5	2.13%	2.5	1.75%	3.88%	-3.85	-0.08191803
Totals	117.5	100.00%	142.5	100.00%	200.00%		-2.3910052

Non-calcareous Ravines
Casey Tract 8/16/99

Transect 1, Casey Tract 8/16/99 Ravine 1
Plot # 1ridge (360)

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Liquidambar styraciflua	2.5	50.00%	7.5	75.00%	**125.00%**	-0.6931	-0.3466
Sassafras albidum	2.5	50.00%	2.5	25.00%	**75.00%**	-0.6931	-0.3466
	5	100.00%	10	100.00%	**200.00%**	-1.3863	**-0.6931**

Transect 1, Casey Tract 8/16/99 Ravine 1
Plot # 2 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Sassafras albidum	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
Vaccinium spp.	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
Carpinus caroliniana	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
	7.5	100.00%	7.5	100.00%	**200.00%**		**-1.0986**
Mitchella repens	P						

Transect 1, Casey Tract 8/16/99 Ravine 1
Plot # 3 slope140

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	19.23%	12.5	71.43%	**90.66%**	-1.6487	-0.3170
Mitchella repens	8	61.54%	2.5	14.29%	**75.82%**	-0.4855	-0.2988
Diospyros virginiana	2.5	19.23%	2.5	14.29%	**33.52%**	-1.6487	-0.3170
	13	100.00%	17.5	100.00%	**200.00%**		**-0.9329**

Transect 1, Casey Tract 8/16/99 Ravine 1
Plot #4 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Mitchella repens	2.5	13.89%	2.5	20.00%	**33.89%**	-1.9741	-0.2742
Diospyros virginiana	2.5	13.89%	2.5	20.00%	**33.89%**	-1.9741	-0.2742
Carya cordiformis	2.5	13.89%	2.5	20.00%	**33.89%**	-1.9741	-0.2742
Dicanthelium commutatum	8	44.44%	2.5	20.00%	**64.44%**	-0.8109	-0.3604
Poa unknown	2.5	13.89%	2.5	20.00%	**33.89%**	-1.9741	-0.2742
	18	100.00%	12.5	100.00%	**200.00%**		**-1.4571**
moss	25%						
bareground	<5%						

Transect 2, Casey Tract 8/16/99 Ravine 1
Plot #1 ridge 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vacciniums spp	2.5	100.00%	2.5	100.00%	**200.00%**	0.0000	0.0000
	2.5	100.00%	2.5	100.00%	**200.00%**		

Transect 2, Casey Tract 8/16/99 Ravine 1
Plot# 2 slope 320

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Carya cordiformis	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
Vaccinium spp.	8	51.61%	42.5	85.00%	**136.61%**	-0.6614	-0.3414
Vitis rotundifolia	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
Smilicina racemosa	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
	15.5	100.00%	50	100.00%	**200.00%**		**-1.2242**

Transect 2, Casey Tract 8/16/99 Ravine 1
Plot# 3 slope 180

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Euphorbia sp.	2.5	16.13%	2.5	6.25%	**22.38%**	-1.8245	-0.2943
Vaccinium spp.	8	51.61%	32.5	81.25%	**132.86%**	-0.6614	-0.3414
Vitis rotundifolia	2.5	16.13%	2.5	6.25%	**22.38%**	-1.8245	-0.2943
Smilicina racemosa	2.5	16.13%	2.5	6.25%	**22.38%**	-1.8245	-0.2943
	15.5	100.00%	40	100.00%	**200.00%**		**-1.2242**

Transect 2, Casey Tract 8/16/99 Ravine 1
Plot# 4 slope 150

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Parthenocissus quinquifolia	2.5	16.13%	2.5	25.00%	**41.13%**	-1.8245	-0.2943
Euonymus americana	8	51.61%	2.5	25.00%	**76.61%**	-0.6614	-0.3414
Mitchella repens	2.5	16.13%	2.5	25.00%	**41.13%**	-1.8245	-0.2943
Carya cordiformis	2.5	16.13%	2.5	25.00%	**41.13%**	-1.8245	-0.2943
	15.5	100.00%	10	100.00%	**200.00%**		**-1.2242**
Liriodendron tulipfera	P						

Transect 3, Casey Tract 8/16/99 Ravine 1
Plot# 1 ridge 360

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	33.33%	7.5	60.00%	**93.33%**	-1.0986	-0.3662
Mitchella repens	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
Quercus alba	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
	7.5	100.00%	12.5	100.00%	**200.00%**		**-1.0986**

Transect 3, Casey Tract 8/16/99 Ravine 1
Plot# 2 slope 20

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	2.5	20.00%	2.5	20.00%	**40.00%**	-1.6094	-0.3219
Mitchella repens	2.5	20.00%	2.5	20.00%	**40.00%**	-1.6094	-0.3219
Quercus velutina	2.5	20.00%	2.5	20.00%	**40.00%**	-1.6094	-0.3219
Acer rubrum	2.5	20.00%	2.5	20.00%	**40.00%**	-1.6094	-0.3219
Carya cordiformis	2.5	20.00%	2.5	20.00%	**40.00%**	-1.6094	-0.3219
	12.5	100.00%	12.5	100.00%	**200.00%**		**-1.6094**
Parthenocissus quinquefolia	P						

Transect 3, Casey Tract 8/16/99 Ravine 1
Plot# 3 slope 150

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	2.5	25.00%	17.5	70.00%	**95.00%**	-1.3863	-0.3466
Quercus velutina	2.5	25.00%	2.5	10.00%	**35.00%**	-1.3863	-0.3466
Vitis rotundifolia	2.5	25.00%	2.5	10.00%	**35.00%**	-1.3863	-0.3466
Prunus serotina	2.5	25.00%	2.5	10.00%	**35.00%**	-1.3863	-0.3466
	10	100.00%	25	100.00%	**200.00%**		**-1.3863**

Transect 3, Casey Tract 8/16/99 Ravine 1
Plot# 4 ridge 60

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	44.44%	32.5	76.47%	**120.92%**	-0.8109	-0.3604
Carya cordiformis	2.5	13.89%	2.5	5.88%	**19.77%**	-1.9741	-0.2742
Prunus serotina	2.5	13.89%	2.5	5.88%	**19.77%**	-1.9741	-0.2742
Diospyros virginiana	2.5	13.89%	2.5	5.88%	**19.77%**	-1.9741	-0.2742
Fagus grandifolia	2.5	13.89%	2.5	5.88%	**19.77%**	-1.9741	-0.2742
	18	100.00%	42.5	100.00%	**200.00%**		**-1.4571**

Transect 1 Casey Tract Ravine #2
Plot#1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	51.61%	42.5	85.00%	**136.61%**	-0.6614	-0.3414
Quercus rubra	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
Mitchella repens	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
Vitis rotundifolia	2.5	16.13%	2.5	5.00%	**21.13%**	-1.8245	-0.2943
	15.5	100.00%	50	100.00%	**200.00%**		**-1.2242**

Transect 1 Casey Tract Ravine #2
Plot#2 slope 80

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	38.10%	12.5	62.50%	**100.60%**	-0.9651	-0.3676
Mitchella repens	8	38.10%	2.5	12.50%	**50.60%**	-0.9651	-0.3676
Diospyros virginiana	2.5	11.90%	2.5	12.50%	**24.40%**	-2.1282	-0.2534
Euonymus americana	2.5	11.90%	2.5	12.50%	**24.40%**	-2.1282	-0.2534
	21	100.00%	20	100.00%	**200.00%**		**-1.2420**
Amelanchiar arborea	P						

Transect 1 Casey Tract Ravine #2
Plot#3 floodplain level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lorinseria areolata	22	59.46%	22.5	60.00%	**119.46%**	-0.5199	-0.3091
Bignonia capreolata	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
Carpinus caroliniana	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
Arisaema triphyllum	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
Liquidambar styraciflua	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
Lonicera japonica	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
Fraxinus pennsylvanica	2.5	6.76%	2.5	6.67%	**13.42%**	-2.6946	-0.1821
	37	100.00%	37.5	100.00%	**200.00%**		**-1.4015**

Transect 2 Casey Tract Ravine #2
Plot#1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Acer rubrum	2.5	9.26%	2.5	5.26%	**14.52%**	-2.3795	-0.2203
Vaccinium spp.	22	81.48%	42.5	89.47%	**170.96%**	-0.2048	-0.1669
Quercus alba	2.5	9.26%	2.5	5.26%	**14.52%**	-2.3795	-0.2203
	27	100.00%	47.5	100.00%	**200.00%**		**-0.6075**
Vitis rotundifolia	P						
Michella repens	P						

Transect 2 Casey Tract Ravine #2
Plot#2 slope 40

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Vaccinium spp.	8	38.10%	17.5	70.00%	**108.10%**	-0.9651	-0.3676
Vitis rotundifolia	8	38.10%	2.5	10.00%	**48.10%**	-0.9651	-0.3676
Carya cordiformis	2.5	11.90%	2.5	10.00%	**21.90%**	-2.1282	-0.2534
Mitchella repens	2.5	11.90%	2.5	10.00%	**21.90%**	-2.1282	-0.2534
	21	100.00%	25	100.00%	**200.00%**		**-1.2420**

Transect 2 Casey Tract Ravine #2
Plot#3 floodplain level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	IMP VAL	ln(pi)	shannon
Woodwardia areolata	8	21.33%	27.5	73.33%	**94.67%**	-1.5449	-0.3296
Euonymus americana	22	58.67%	2.5	6.67%	**65.33%**	-0.5333	-0.3129
Bignonia capreolata	2.5	6.67%	2.5	6.67%	**13.33%**	-2.7081	-0.1805
Carex sp.	2.5	6.67%	2.5	6.67%	**13.33%**	-2.7081	-0.1805
Acer rubrum	2.5	6.67%	2.5	6.67%	**13.33%**	-2.7081	-0.1805
	37.5	100.00%	37.5	100.00%	**200.00%**		**-1.1841**

Transect 3 Casey Tract Ravine #2
Plot#1 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	22	81.48%	85	89.47%	**170.96%**	-0.2048	-0.1669
Diospyros virginiana	2.5	9.26%	2.5	2.63%	**11.89%**	-2.3795	-0.2203
Carya cordiformis	2.5	9.26%	7.5	7.89%	**17.15%**	-2.3795	-0.2203
	27	100.00%	95	100.00%	**200.00%**		**-0.6075**

Transect 3 Casey Tract Ravine #2
Plot# 2 slope 40

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	31.37%	22.5	56.25%	**87.62%**	-1.1592	-0.3637
Carya cordiformis	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Smilicina racemosa	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Euonymus americana	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Acer rubrum	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Quercus alba	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Parthenocissus quinquefolia	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
Mitchella repens	2.5	9.80%	2.5	6.25%	**16.05%**	-2.3224	-0.2277
	25.5	100.00%	40	100.00%	**200.00%**		**-1.9575**
Carpinus caroliniana	P						

Transect 3 Casey Tract Ravine #2
Plot#3 floodplain level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Acer rubrum	2.5	1.15%	2.5	5.88%	**7.03%**	-4.4682	-0.0512
Mitchella repens	2.5	1.15%	2.5	5.88%	**7.03%**	-4.4682	-0.0512
Osmunda regalis	2.5	1.15%	17.5	41.18%	**42.32%**	-4.4682	-0.0512
Senecio aureus	8	3.67%	17.5	41.18%	**44.85%**	-3.3051	-0.1213
Lindera benzoin	2.5	1.15%	2.5	5.88%	**7.03%**	-4.4682	-0.0512
	18	8.26%	42.5	100.00%	**108.26%**		**-0.3262**
Matelea sp.	P						

Transect 4 Casey Tract Ravine #2
Plot#1 ridge 360

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	61.54%	22.5	60.00%	**121.54%**	-0.4855	-0.2988
Ilex opaca	2.5	19.23%	12.5	33.33%	**52.56%**	-1.6487	-0.3170
Parthenocissus quinquefolia	2.5	19.23%	2.5	6.67%	**25.90%**	-1.6487	-0.3170
	13	100.00%	37.5	100.00%	**200.00%**		**-0.9329**
Michella repens	P						
Acer rubrum	P						

Transect 4 Casey Tract Ravine #2
Plot#2 slope 360

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Euonymus americana	2.5	16.13%	2.5	10.00%	**26.13%**	-1.8245	-0.2943
Magnolia virginiana	2.5	16.13%	2.5	10.00%	**26.13%**	-1.8245	-0.2943
Vaccinium spp.	8	51.61%	12.5	50.00%	**101.61%**	-0.6614	-0.3414
Liquidambar styraciflua	2.5	16.13%	7.5	30.00%	**46.13%**	-1.8245	-0.2943
	15.5	100.00%	25	100.00%	**200.00%**		**-1.2242**

Transect 4 Casey Tract Ravine #2
Plot#3 slope level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Lorinseria areolata	22	55.00%	12.5	50.00%	**105.00%**	-0.5978	-0.3288
Euonymus americana	2.5	6.25%	2.5	10.00%	**16.25%**	-2.7726	-0.1733
Fraxinus pennsylvanica	8	20.00%	2.5	10.00%	**30.00%**	-1.6094	-0.3219
Magnolia virginiana	2.5	6.25%	2.5	10.00%	**16.25%**	-2.7726	-0.1733
Ulmus americana	2.5	6.25%	2.5	10.00%	**16.25%**	-2.7726	-0.1733
Carpinus carolinana	2.5	6.25%	2.5	10.00%	**16.25%**	-2.7726	-0.1733
	40	100.00%	25	100.00%	**200.00%**		**-1.3438**

Transect 1 Galax urceolata Ravine
Plot#1 ridge 140

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	100.00%	27.5	100.00%	**200.00%**	0.0000	0.0000

Transect 1 Galax urceolata Ravine
Plot#2 slope 140

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Osmunda cinnamomea	2.5	20.00%	12.5	55.56%	**75.56%**	-1.6094	-0.3219
Hexastylis virginiana	2.5	20.00%	2.5	11.11%	**31.11%**	-1.6094	-0.3219
Lorinseria areolata	2.5	20.00%	2.5	11.11%	**31.11%**	-1.6094	-0.3219
Mitchella repens	2.5	20.00%	2.5	11.11%	**31.11%**	-1.6094	-0.3219
Luzula acuminata	2.5	20.00%	2.5	11.11%	**31.11%**	-1.6094	-0.3219
	12.5	100.00%	22.5	100.00%	**200.00%**		**-1.6094**
Prunus serotina	P						

Transect 1 Galax urceolata Ravine
Plot# 3 slope 10

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Osumunda cinnemomea	2.5	33.33%	7.5	60.00%	**93.33%**	-1.0986	-0.3662
Hexastylis virginica	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
Luzula acuminata	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
	7.5	100.00%	12.5	100.00%	**200.00%**		**-1.0986**
moss	60%						

Transect 1 Galax urceolata Ravine
Plot# 4 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	51.61%	7.5	50.00%	**101.61%**	-0.6614	-0.3414
Hexastylis virginiana	2.5	16.13%	2.5	16.67%	**32.80%**	-1.8245	-0.2943
Galax urceolata	2.5	16.13%	2.5	16.67%	**32.80%**	-1.8245	-0.2943
Quercus velutina	2.5	16.13%	2.5	16.67%	**32.80%**	-1.8245	-0.2943
	15.5	100.00%	15	100.00%	**200.00%**		**-1.2242**

Transect 2 Galax urceolata Ravine
Plot#1 ridge 90

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	100.00%	7.5	100.00%	**200.00%**	0.0000	0.0000

Transect 2 Galax urceolata Ravine
Plot# 2 slope 90

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	33.33%	7.5	60.00%	**93.33%**	-1.0986	-0.3662
Fagus grandifolia	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
Quercus velutina	2.5	33.33%	2.5	20.00%	**53.33%**	-1.0986	-0.3662
	7.5	100.00%	12.5	100.00%	**200.00%**		**-1.0986**

Transect 2 Galax urceolata Ravine
Plot# 3 slope 310

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	23.81%	2.5	50.00%	**73.81%**	-1.4351	-0.3417
Galax urceolata	8	76.19%	2.5	50.00%	**126.19%**	-0.2719	-0.2072
	10.5	100.00%	5	100.00%	**200.00%**		**-0.5489**
Hieracium gronovii	P						
moss	90%						

Transect 2 Galax urceolata Ravine
Plot# 4 ridge level

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	43.24%	7.5	60.00%	**103.24%**	-0.8383	-0.3625
Fagus grandifolia	2.5	13.51%	2.5	20.00%	**33.51%**	-2.0015	-0.2705
Galax urceolata	8	43.24%	2.5	20.00%	**63.24%**	-0.8383	-0.3625
	18.5	100.00%	12.5	100.00%	**200.00%**		**-0.9955**

Transect 3 Galax urceolata Ravine
Plot# 1 ridge 90

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	100.00%	12.5	100.00%	**200.00%**	0.0000	0.0000
Chimaphila maculata	P						

Transect 3 Galax urceolata Ravine
Plot# 2 slope 120

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Osmunda cinnamomea	8	100.00%	22.5	100.00%	**200.00%**	0.0000	0.0000
Moss	<5%						

Transect 3 Galax urceolata Ravine
Plot# 3 slope 340

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	23.81%	2.5	50.00%	**73.81%**	-1.4351	-0.3417
Galax urceolata	8	76.19%	2.5	50.00%	**126.19%**	-0.2719	-0.2072
	10.5	100.00%	5	100.00%	**200.00%**		**-0.5489**
moss	95%						

Transect 3 Galax urceolata Ravine
Plot# 4 ridge 350

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	8	76.19%	32.5	92.86%	**169.05%**	-0.2719	-0.2072
Galax urceolata	2.5	23.81%	2.5	7.14%	**30.95%**	-1.4351	-0.3417
	10.5	100.00%	35	100.00%	**200.00%**		**-0.5489**

Transect 4 Galax urceolata Ravine
Plot# 1 ridge 160

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
Chimaphila maculata	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
Oxydendrum arboreum	2.5	33.33%	2.5	33.33%	**66.67%**	-1.0986	-0.3662
	7.5	100.00%	7.5		**200.00%**		**-1.0986**
Carya spp.	P						

Transect 4 Galax urceolata Ravine
Plot# 2 slope

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Osmunda cinnamomea	8	76.19%	32.5	81.25%	**157.44%**	-0.2719	-0.2072
Luzula acuminata	2.5	23.81%	7.5	18.75%	**42.56%**	-1.4351	-0.3417
	10.5	100.00%	40	100.00%	**200.00%**		**-0.5489**
Quercus alba	P						
moss	5%						

Transect 4 Galax urceolata Ravine
Plot# 3 slope 10

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	19.23%	2.5	33.33%	**52.56%**	-1.6487	-0.3170
Galax urceolata	8	61.54%	2.5	33.33%	**94.87%**	-0.4855	-0.2988
Fagus grandifolia	2.5	19.23%	2.5	33.33%	**52.56%**	-1.6487	-0.3170
	13	100.00%	7.5	100.00%	**200.00%**		**-0.9329**
moss	85%						

Transect 4 Galax urceolata Ravine

Plot# 4 slope 20

SPECIES	DENSITY	R. DENSITY	COVERG	R CONVG	**IMP VAL**	ln(pi)	shannon
Vaccinium spp.	2.5	23.81%	7.5	75.00%	**98.81%**	-1.4351	-0.3417
Galax urceolata	8	76.19%	2.5	25.00%	**101.19%**	-0.2719	-0.2072
	10.5	100.00%	10		**200.00%**		**-0.5489**

Quercus velutina	P
Acer rubrum	P
moss	< 5%
bareground	<5%

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Vita

Born on October 28, 1974 in Fairfax, Virginia. Graduated from St. Stephen's and St. Agnes High School in Alexandria, Virginia in May, 1993 and attended Rhodes College in Memphis, Tennessee. Received a Bachelor of Science in biology with a minor in philosophy in May 1997. Began graduate studies at the College of William and Mary in August 1998. Worked with Virginia's Division of Natural Heritage in the summer of 2000 surveying calcareous ravine communities in the Coastal Plain. Accepted employment with the Nature Conservancy and Association of Biodiversity Information, Arlington, VA in August of 2000.