ECOLOGICAL CLASSIFICATION OF GROUNDWATER-FED SEEPAGE WETLANDS OF THE MARYLAND COASTAL PLAIN

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INTRODUCTION

The objective of this project was to refine the classification of groundwater-fed seepage wetland communities of the Maryland Coastal Plain. The project was conceived by the Maryland Natural Heritage Program of the Maryland Department of Natural Resources and funded through state wildlife grant funds provided by U.S. Congress. The information obtained by this project serves to improve our ecological understanding of these natural communities and provides a contemporary assessment of overall wetland health and function. This project builds upon a number of historical surveys and ecological studies by Shreve et al. (1910), McAtee (1918), Sipple & Klockner (1980), Broersma (1984), Hull & Whigham (1985) and Tiner and Burke (1995). Finally, this project serves as a tool in advancing the Maryland Natural Community Classification (Harrison 2010) and the U.S. National Vegetation Classification (USNVC; Grossman et al. 1998, NatureServe 2010). By adhering to standards established by the Ecological Society of America (2004) for classifying and describing vegetation associations of the U.S. National Vegetation Classification this project complements regional and national natural community assessments.

Natural communities are assemblages of co-existing, interacting species that live together in a particular physical environment. The conservation of natural communities provides a "coarse filter" approach that ensures the protection of ecological systems and interdependent species that may not otherwise receive attention. It is estimated that the wetland communities studied during this project are utilized by over 150 species of greatest conservation need (Maryland Department of Natural Resources 2005). Species of greatest conservation need are those animals, both aquatic and terrestrial, that are at risk or are declining in Maryland. They include threatened and endangered species, as well as many other species whose populations are of concern in Maryland (Maryland Department of Natural Resources 2005). The classification of natural communities (i.e., terrestrial) is based on vegetation. Vegetation is a faithful indicator of specific site conditions and that reflects biological and ecological patterns across a landscape. Natural communities recur across the landscape under similar environmental conditions, and present recognizable habitat units that can be described and mapped. The Maryland Natural Heritage Program is developing a natural community classification (Harrison 2010) to use as the basis for tracking and ranking occurrences of all types of natural communities in Maryland. It is compatible with the U.S. National Vegetation Classification, which is maintained by NatureServe, a nonprofit organization providing biodiversity information for conservation. The Maryland Natural Heritage Program of the Maryland Department of Natural Resources conducts inventories for, maps, and maintains databases on the natural biological diversity of the state, including natural communities and rare plants and animals. Natural Heritage Program ecologists track occurrences of rare natural communities as well as high quality examples of common natural communities.

STUDY AREA

The study area consists of the areas east of the fall line or fall zone; an area that applies to the boundary between the Appalachian Piedmont province and the Atlantic Coastal Plain (Schmidt 1993; Figure 1) and includes all or part of the following 13 Maryland counties: Anne Arundel, Calvert, Cecil, Charles, Dorchester, Kent, Prince George, Queen Annes, Somerset, St. Mary's, Talbot, Wicomico and Worcester. Approximately 54% of Maryland's total 9837 square miles and ca. 94% of the state's wetland habitat is located in the Atlantic Coastal Plain Physiographic Province (Tiner & Burke 1995). Approximately 94% of the of the state's wetland habitats are located on the Atlantic Coastal Plain.

The fall line or zone separates the Coastal Plain and Piedmont Physiographic provinces. Vegetative plots were taken within the fall zone due to floristic similarities. The fall zone represents only 3 percent of Maryland's land surface and 0.2% of the states wetlands (Tiner & Burke 1995). This area has been significantly developed and altered due to the presence of Washington D.C, Baltimore and their associated suburban areas.

The study area can be broken into two primary physical areas. These are the Eastern and Western Shores of the Chesapeake Bay (Figure 1). The Eastern Shore lies south of the fall line in Cecil County, and is bordered by the Elk River and Chesapeake Bay. The Eastern Shore is a significant part of the Delmarva Peninsula and makes up ca. 55% of the entire land mass. The elevation of the Eastern Shore is no more than 30m at any

location. West of the Chesapeake Bay is an area referred to as the Western Shore. The Western Shore, as referred to here, is located south of the fall line and is located at the northeastern tip of Maryland where bordering Delaware, extending south and west across Maryland to almost Washington, D.C., near the Virginia border. The plain is flat and rises to ca. 60m on the Western Shore (Schmidt 1993).

The geologic formations of the Coastal Plain west of the Chesapeake Bay, in descending percent of landmass, are from the Cretaceous, Tertiary: Pliocene, Tertiary: Miocene through Paleocene, and Quaternary formations (Schmidt 1993). The geologic formations of Maryland's Eastern Shore are markedly younger and are, in descending percent of landmass, from the Quaternary, Tertiary: Pliocene, Cretaceous, and Tertiary: Miocene through Paleocene formations (Schmidt 1993). These geologic differences may be the reason for the vegetative differences of these coastal areas, which are found at the same latitude.

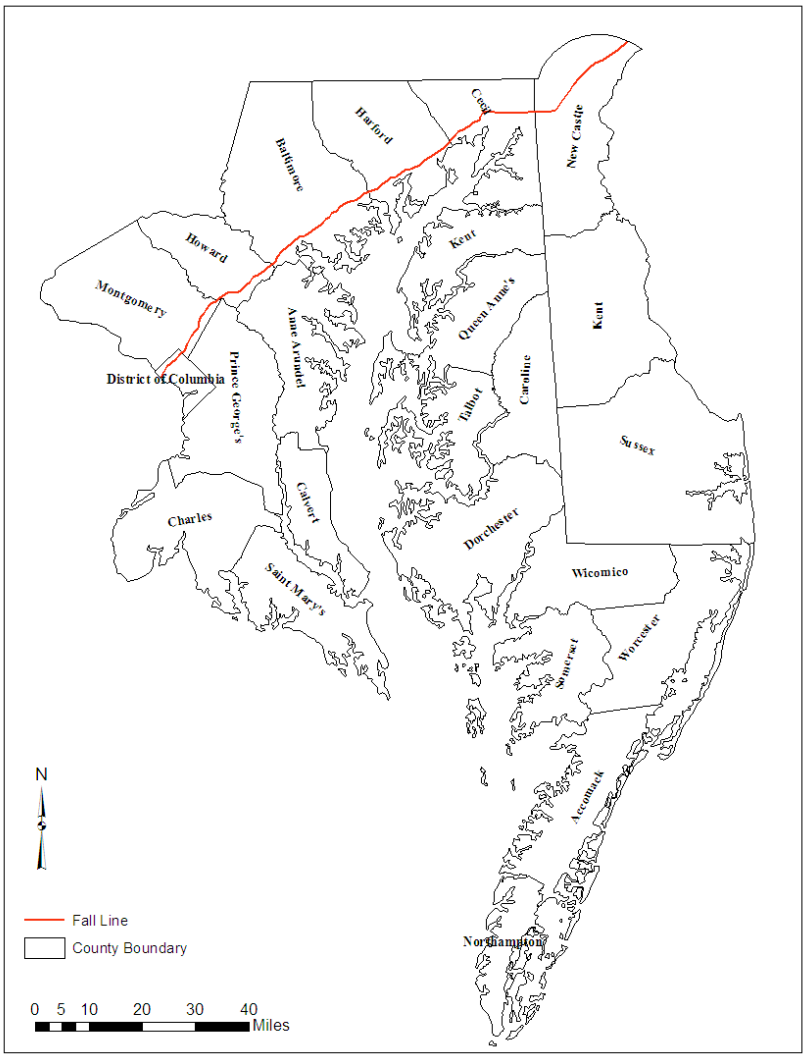

Figure 1. Map of study area with fall line separating Piedmont and Coastal Plain physiographic provinces indicated in red.

METHODS

Sampling Plan

Prior to the 2007 field season we examined existing site information, literature, and quantitative vegetation plot data extracted from Maryland Natural Heritage Program databases to assist us in selecting and prioritizing sites for sampling. Based on this review, we determined which sites were adequately sampled and which sites required additional data collection (e.g., bryophyte collection, soil sample collection) prior to analysis. Since the sampling protocols employed by ecologists have evolved over the years it was important that we screen existing plot data for any compatibility issues and remove any problematic data from the dataset. The initial "filtered" dataset included data collected from 37 sample plots representing a wide-variety of groundwater-fed wetlands within the study area. These data originated from studies of Zekiah Swamp (Meininger and McCarthy 1997), fall-line terrace gravel bogs (Simmons and Strong 2002), Nassawango Creek (Wilson 2004), and national parks of the National Capital East Region (NatureServe, in prep). The data from the 39 archived sample plots were collected between 18 June 1996 and 25 September 1996; 4 June 2002 and 27 November 2002; 17 June 2003; 3 October 2004; and 25 August 2006.

A large majority of sites selected within the study area have been historically documented by Shreve et al. (1910), McAtee (1918), and more recently Sipple & Klockner (1980), Broersma (1984), Hull & Whigham (1985) and Tiner and Burke (1995). Although the historical documentation is invaluable this study builds upon those efforts by presenting a classification of vegetation types consistent with the U.S. National Vegetation Classification (USNVC; Grossman et al. 1998, NatureServe 2010). We identified new sites for sampling by consulting with regional experts and biologists familiar with the study area and through review of various vector and raster data layers in ArcGIS 9.2 (ESRI 2006). Such layers included 2007 NAIP imagery, 2007-2008 digital orthophoto quad imagery, USGS topographic quadrangles, USFWS national wetlands inventory maps, NRCS soil maps, and various MD Natural Heritage Program vector layers.

Field Methods

During this study we collected data from 14 sample plots between 1 July 2007 and 30 October 2007; and between 1 July 2008 and 2 October 2008. These data were combined with 37 archived sample plots for a total of 51 sample plots.

We sampled plots in compliance with standards established by the Ecological Society of America (2004) for describing and classifying associations in the U.S. National Vegetation Classification. Following the releve method (*sensu* Peet et al. 1998), we positioned plots in uniform habitats types, with 400 m^2 plots established in forest and woodland vegetation, and 100 m^2 plots in shrubland and herbaceous vegetation. As a rule, plots are 20 X 20 m and 10 X 10 m square units. More rectangular configurations (26.66 X 15 m, 20 X 5 m, and 15 X 6.66 m) may be used in a few cases to conform to the shapes of homogeneous vegetation zones of narrow forest stands, along wetland edges, and other special settings.

Vegetation

Plot locations were carefully positioned in areas with relatively homogeneous and representative vegetation. The percent cover of each vascular plant species within each plot is estimated as a vertical projection onto the plot area and assigned to one of nine numerical cover classes (Table 1). Cover for species rooted outside the plot but overhanging inside the plot boundary was estimated and listed parenthetically. Cover was also estimated for the following six height classes: Herb layer (including woody stems <0.5 m tall), Shrub layer (0.5-6 m tall), *T6* Tree layer (6-10 m tall), *T10* Tree layer (10-20 m tall), *T20* Tree layer (20-35 m tall), and *T35* Tree layer (>35 m tall). Total cover of each taxon in all height classes was calculated as a single cover class value for use in analysis.

In forested and woodland plots, the diameters of all woody stems from ≥2.5 to 40 cm at breast height are measured and placed into diameter classes at 5 cm increments. Trunks >40 cm dbh are measured to the nearest 1 cm with a dbh tape.

During plot sampling, voucher specimens were routinely collected to verify field identifications. All voucher specimens were deposited with the Maryland Department of Natural Resources. Names for vascular plants follow Weakley (2010) in cases where no valid name was included in Weakley we used Gleason and Cronquist (1991). Names for bryophytes follows The PLANTS Database (USDA, NRCS 2010).

Table 1. Cover class scores used in field sampling and data analysis

Estimated Percent Cover	Cover Class	Cover Class Midpoints (%)
Trace	1	0.05
< 1%	2	0.55
1 – 2%	3	1.50
2 – 5%	4	3.50
5 – 10%	5	7.50
10 – 25%	6	17.5
25 – 50%	7	37.5
50 – 75%	8	62.5
75 – 100%	9	87.5

Environment

At each plot we collected a standard set of data (see Table 2) that summarizes the physical environment. The elevation at each location was determined through measurements with global positioning systems (GPS) and later verified with USGS topographic quadrangle maps. Using a compass, slope inclination and aspect were measured and recorded to the nearest degree. Surface substrate was estimated visually so that values summed to 100%. Scalar values were assigned to assess topographic position, slope shape (both horizontally and vertically), soil drainage class, soil moisture regime, and inundation. To the extent possible, the underlying parent material and geological formation was determined using the most current geological mapping information provided by the Maryland Geological Survey (MGS).

Soil samples were collected at each site from the top 10 cm of mineral or organic soil (below the surficial litter or humus). Samples were air-dried and sent to Brookside Laboratories Inc., New Knoxville, Ohio for nutrient chemical and textural analyses. The nutrient chemical analysis was conducted using the Melich III method (Mehlich 1984) where samples were analyzed for pH, phosphorus (P), soluble sulfur (S), exchangeable cations (calcium [Ca], magnesium [Mg], potassium [K], and sodium [Na], in ppm), extractable micronutrients (boron [B], iron [Fe], manganese [Mn], copper [Cu], zinc [Zn], and aluminum [Al], in ppm), total exchange capacity, and percent organic matter. Particle size analysis was employed to determine percent organic matter, gravel (>2.0 mm), sand (0.5-2.0 mm), silt (.002 - .05 mm), and clay (<.002 mm). In addition to the laboratory texture analysis, we determined soil texture in the field by using Brewer and McCann's (1982) simplified key.

Any information regarding current or past disturbances at each were appropriately recorded onto the plot data forms. Such information may include logging, invasive species, pest damage, storm or wind damage, erosion, fire, hydrologic alterations and beaver activity.

Metadata

At each site we recorded standard metadata such as site name, date of survey, surveyor(s), landowner, county, USGS topographic quadrangle, photograph filename, latitude and longitude, type of GPS unit, GPS receiver status, positional dilution of precision (PDOP), plot size and dimensions, relative stand size, and a written description of the plot. The written description focuses on how representative the vegetation type being sampled is and if there is any variation of structure or environment within the occurrence. Descriptions often include dominant, characteristic, or differential species and information on landscape context such as adjacent communities. Finally, all plot data were assigned unique alphanumeric codes and archived into the Maryland Natural Heritage Program Plots Database.

Table 2. Topographic / hydrologic environmental indices recorded at each plot sampling site.

System	Soil Moisture Regime	Inundation	Surface Substrate (% cover)
A – terrestrial	A – very xeric	A – never	Decaying wood
B – palustrine	B – xeric (moist for brief time)	B – infrequently	Bedrock
C – estuarine	C – somewhat xeric (moist for short time)	C – regularly; for <6 mos	Boulders (>24" diameter)
D – marine	D – submesic (moist for mod. short time)	D – regularly; for >6 mos	Stones (>10" round or >15" flattened)
E – riverine	E – mesic (moist for sig time)	E – always submerged by shallow water.	Cobbles (3-10"; rounded)
Physiographic Province	F – subhygric (wet for sig part of growing season (mottles<20cm)	F – always submerged by deep water	Channery (thin; <6")
A – coastal plain (Upper)	G – hygric (wet for most of the growing season perm seepage/mottling	**Hydrological Regime**	Gravel
B – coastal plain (Lower)	H – subhydric (water table at or above surface for most of the year.	A - Terrestrial	Mineral soil
C – fall line	I – hydric (water table at or above surface year round)	Tidal	Organic matter
D – piedmont	__ - ephemeral seepage/ subsurface water pres locally in plot	A – Irregularly exposed	Water
E – blue ridge	**Soil Drainage Class**	B – Regularly flooded	Other:
F – ridge and valley	A – very poorly drained	C – Irregularlly flooded	Moss/lichen cover
G – Appalachian plateau	B – poorly drained	D – Wind tidally flooded	**Slope**
Topographic Position	C – somewhat poorly	Non-Tidal	A – 0-3% (level or nearly so)
A – plain/level	D – moderately drained	A – Permanently flooded	B – 3-8 (gentle/undulating)
B – toe	E – well drained	B – Semiperman. flooded	C – 8-16 (sloping/rolling)
C – lower slope	F – rapidly drained	C – Seasonally flooded	D – 16-30 (moderately/hilly)
D – middle slope	**Salinity/Halinity**	D – Intermittently flooded	E – 30-65 (steep)
E – upper slope	A – Saltwater	E – Temporarily flooded	F – 65-75 (very steep)
F – escarpment	B – Brackish	F – Saturated	G – 75-100 (extremely steep)
G – ledge/terrace	C – Oligohaline		H – hummock hollow microtography
H – crest	D – Freshwater		I – irreg. bouldery microtopography
I – basin/depression	_____ ppt		
J – floodplain			
K – stream bottom			

Slope Shape		Aspect	
Vert	***Horiz***	F (Flat)	
C-concave	C-concave	V (Variable)	
X-convex	X-convex	N	NE
S-straight	S-straight	E	SE
		S	SW

ANALYSIS

The main focus of this analysis was on the vegetation and environmental factors that drive these natural systems. Our approach follows five steps (*sensu* Fleming 2007) to progressively segment the dataset into more ecologically meaningful units. The following steps are:

1. Data preparation and transformation
2. Numerical classification (i.e., *Hierarchical cluster analysis*)
3. Statistical analysis (i.e., *Multi-response permutation procedures*) and compositional summary statistics (i.e., *Excel Macros*)
4. Ordination (i.e., *Non-metric multidimensional scaling*)
5. Assignment to USNVC vegetation association type

Data Preparation and Transformations

All plot data from within the study area were extracted from the Maryland Natural Heritage Program Plot Database and formatted for use in the PC-Ord multivariate statistical package (version 5.21; (McCune and Mefford 2006). The initial dataset contained data from 51 sample plots. Because the dataset contained 37 legacy plots it was critical to reconcile different levels of species identification. For example, many of the legacy plots contained bryophyte data that were identified to the genus level rather than the specific level (e.g., *Sphagnum* sp.). These situations were carefully reviewed *ad hoc* and led to the deletion of that entry from the dataset. All generic and higher-level taxa deleted from the dataset are listed in Table 3. In addition, many of the varieties and subspecies of taxa were not consistently recognized and therefore had to be lumped into a higher level of taxonomic identification. For example, identifications of *Carex atlantica* Bailey ssp. *atlantica* and *Carex atlantica* Bailey ssp. *capillacea* were notoriously inconsistent and had to be merged as *Carex atlantica*. Taxonomic resolution was also lost with *Carex canescens* Linnaeus var. *disjuncta* Fernald and *Carex canescens* Linnaeus var. *canescens* because many of the legacy plots did not identify this species to

variety. And finally, the varieties of *Lindera benzoin, Arisaema triphyllum,* and *Juniperus virginiana* were inconsistently used, omitted from the dataset, and entered at the specific level.

Table 3. Generic and higher-level taxa deleted from dataset.

Acronym	Species	Common Name	Plot Frequency
CARESP01	Carex sp. 1	A sedge	5
CARESP02	Carex sp. 2	A sedge	5
CUSCSP01	Cuscuta sp.	A dodder	3
ELEOSP01	Eleocharis sp.	A spikerush	4
SPHASP01	Sphagnum sp.	A sphagnum moss	24
VIOLSP01	Viola sp.	A violet	2
XYRISP01	Xyris sp.	A yellow-eyed grass	4

Data transformation is an important step prior to any analysis of environmental data. Ecologically, a transformed dataset improves distance measure performance, equalizes (or alters) the relative importance of common and rare species, and emphasizes informative species at the expense of uninformative species (McCune and Grace 2002). Statistically, transformations improve assumptions of normality, linearity, and homogeneity of variance and make units at different scales comparable (McCune and Grace 2002). The full compositional dataset of 51 plots was transformed and saved using the various protocols for independent analyses: (1) raw cover class scores, (2) cover class scores relativized by species maximum, and (3) cover class scores relativized by plot maximum. All mean values for continuous and scalar environmental variables were calculated to assist in recognizing variation among plots. Scalar values used for topographic position, slope, and soil moisture variables were converted to ordinal values (Table 4). The soil values for boron (B), calcium (Ca), copper (Cu), iron (Fe), potassium (K), manganese (Mn), nitrogen (N), sodium (Na), phosphorous (P), sulfur (S), and zinc (Zn) were natural log-transformed. A synthetic fertility index (CEC x TBS\100) and a calcium-to-magnesium (Ca:Mg) ratio were calculated for each plot. Finally, percentage values for organic matter (OM), total base saturation (TBS), sand, silt, and clay were transformed using the arcsine square-root transformation. This method of transformation is recommended by many statisticians for improving normality by spreading the ends of the scale for proportion data, while compressing the middle (Sokal & Rohlf 1995).

Table 4. Ordinal values for scalar topographic and soil moisture variables.

Topographic Position	Ordinal value
Basin/depression	*-1*
Floodplain, stream bottom, plain/level	*0*
Toe slope	*+1*
Lower slope	*2*
Middle slope	*3*
Upper slope	*4*
Crest	*5*
Soil Moisture Regime	**Ordinal value**
Very xeric	*1*
Xeric	*2*
Somewhat xeric	*3*
Submesic	*4*
Mesic	*5*
Subhygric	*6*
Hygric	*7*
Subhydric	*8*
Hydric	*9*
Slope Shape – Vertical and Horizontal	**Ordinal value**
Concave	*-1*
Convex	*+1*
Straight	*0*

Hierarchical Cluster Analysis

The full compositional dataset of 51 plots was analyzed using Cluster Analysis in PC-Ord (version 5.21; McCune and Mefford 2006). Cluster Analysis is a hierarchical, polythetic, agglomerative clustering technique that produces a numerical classification of plots similar in floristic composition and species abundances. This technique has long been used in a wide variety of ecological applications when groups are sought from multivariate ecological data (McCune and Grace 2002). We selected the Sørensen similarity (Bray-Curtis coefficient) distance measure and the compatible, yet space conserving Flexible-beta linkage method (Lance & Williams 1967) to identify compositionally similar groups of plots. Flexible-beta linkage is considered flexible because of user-specified beta settings that control its space distorting properties or measures of between-group distance. The default beta setting of -0.25 is a conservative approach that produce results similar to Ward's method or minimum-variance clustering (Lance & Williams 1967). We explored the use of beta settings between of -0.25 and -0.500 and found that the beta settings -0.25 and -0.375 produced the best results and most interpretable dendrogram. All three data protocols (raw cover class scores, cover class scores relativized by species maximum, and cover class scores relativized by plot maximum) were analyzed with the different beta settings and all performed comparably suggesting strong group membership among plots with few compositionally heterogeneous plots.

Use of the Lance Williams Flexible-beta method, default beta setting of -0.25, Sørenson (Bray-Curtis) distance measure, and raw cover class scores our dataset of 51 plots produced two major groups representing, 1)open-canopied wetland habitats dominated by herbs and shrubs and, 2)forested wetland habitats dominated by woody vegetation. These major groups were further analyzed independently using the various settings and protocols and explained in the results.

Statistical Analysis

To test the hypothesis of no difference between groups we employed Multi-Response Permutation Procedures (MRPP) implemented in PC-Ord (version 5.21; McCune and Mefford 2006) using a natural group weighting, rank-transformed distance matrix, and Sørenson (Bray-Curtis) distance measure. MRPP is a nonparametric test that calculates a test statistic, *T*, which essentially describes the separation between groups. The more negative *T* is, the stronger the separation (McCune and Grace 2002). In addition, to the test statistic (*T)*, a *p*-value is calculated for evaluating how likely the observed difference is due to chance and an agreement statistic, *A,* that estimates the within-group homogeneity. According to McCune and Grace (2002), values for *A* in community ecology are commonly below 0.1 even when the observed delta differs significantly from the expected. A result of 1.0 for *A* suggests all plots must be identical. Results with an *A* value exceeding 0.3 are often considered fairly high and suggest a strong ecological relationship (McCune and Grace 2002).

Compositional summary statistics (Table 5) were calculated for all species in each group of plots identified as a community type. These procedures were executed in Microsoft® Excel using a customized macro written by Phillip P. Coulling formerly of the Virginia Natural Heritage Program. Use of the macro made it possible to efficiently evaluate each community type recognized in the cluster analysis. In addition, the compositional summary statistics generated from the analysis provided the basis for the naming and description of each community type. Prior to the statistical analysis, mean cover and total frequency were calculated for all species in the 51 plot dataset. This calculation was performed by converting the cover class scores for every species to their respective midpoints (see Table 1) so the midpoints could be averaged. Once averaged, the calculated values were back-transformed to the appropriate cover class score for further calculations.

A summary of all environmental variables was averaged for each community type recognized. We performed these calculations using raw values for pH, B, Ca, Cu, Fe, K, Mg, Mn, N, Na, P, S, Zn, fertility index, calcium-to-magnesium ratio, total base saturation, organic matter, gravel, sand, silt, and clay. Proportion data for surface substrate were also average using raw values. These included the variables for large rocks (>10cm), small rocks (.2-10cm), litter, wood, water, exposed mineral soil, and nonvascular species cover. During the data preparation and transformation phase of the analysis we converted scalar values to ordinal values. That step made it possible to average ordinal values for topographic slope and soil moisture regime.

Table 5. Compositional Summary Statistics

Compositional Statistic	Definition
Frequency	The number of samples in a group in which a species occurs
Mean Cover	Back-transformed cover class value corresponding to mean percent cover calculated from midpoint values of cover class ranges
Relative Cover	The arithmetic difference between mean cover (for a given group of samples) and total mean cover (for the entire dataset)(= Mean Cover – Total Mean Cover)
Constancy	The proportion of samples in a group in which a species occurs (= Frequency / Number of Samples in a Group x 100)
Fidelity	The degree to which a species is restricted to a group, expressed as the proportion of total frequency that frequency in a give group constitutes (= Frequency / Total Frequency x 100)
Diagnostic Value (DV)	A synthetic value indicating species that are both frequent within and relatively restricted to a group of plots (= Constancy x Fidelity / 100)
Diagnostic Value Adjusted by Cover, Scale	(Adj DV [scaled]) (= Indicator Value x Mean Cover / 9)
Diagnostic Value Adjusted by Cover, Unscaled	(Adj DV [unscaled]) (= Indicator Value x $2^{\text{relative cover}}$)
Mean Species Richness	The average number of species present per plot (S); only species rooted inside plot boundaries were included in this calculation
Homoteneity	The mean constancy of the S most constant species, expressed as a fraction. This value (*sensu* Curtis 1959) can be considered the constancy of the average species in a community type; higher values (typically >0.600 in ecological studies) suggest greater uniformity in species composition among plots. Homoteneity is not independent of group size therefore values increase as the number of plots within a group decrease.

Ordination

Ordination is a collective term for multivariate techniques that arrange sites (i.e., plots) along axes on the basis of data on species composition (Jongman et al. 1987). In community ecology, ordination is a useful tool because it seeks out relationships and patterns that may not be recognized in other techniques such as cluster analysis. We selected non-metric multidimensional scaling (NMS; Kruskal 1964) in PC-Ord (version 5.21; McCune and Mefford 2006) to help validate the classification and identify the environmental gradients along which the community types are distributed. Unlike other ordination methods (e.g., PCA and CCA) that may show only a limited perspective, NMS provides a view into multidimensional "species space" by displaying the strongest structure (McCune and Grace 2002). Furthermore, NMS has proven to be well suited to non-normal data (i.e., ecological data) that may be on arbitrary or discontinuous scales (McCune and Grace 2002).

In NMS we must specify *a priori* the number of ordination dimensions (axes) and supply an initial ordination of plots (Jongman et al. 1987). Initially, plots are randomly assigned coordinates in ordination space. As NMS

progresses the ordination is modified iteratively to minimize stress between the set of ordination distances and matrix of dissimilarity among plots. The process continues by moving coordinates in species space, and recalculating stress until stress cannot be further reduced. The ordination fits perfectly (stress = 0) if the dissimilarities are monotonic with the distances (Jongman et al. 1987).

To minimize distortion in the ordination we removed outliers with an average distance greater than 2.0 standard deviations greater than the overall mean distance. As our default, each ordination was performed using the Sørenson (Bray-Curtis) distance measure, 50 random starting configurations and runs with real data, 400 iterations, an instability criterion of 0.00001, and 100 runs with randomized data for a Monte Carlo test of significance that equivalent solution could have been achieved by chance. The resulting 2D or 3D solution with the lowest stress was selected for interpretation. To improve interpretation of the ordination solution we selected the Varimax rotation option in PC-Ord because of its tendency to identify groups of species and plots that correspond.

To better understand the relationship of the vegetation to the environment we calculated Pearson and Kendall's correlation scores for 32 environmental variables on each axis. Significant correlations are displayed as joint plot overlays on the ordination diagrams and summarized in subsequent tables (Tables and 11 and 12). Of the 32 environmental variables 18 are soil chemistry variables, 5 are soil texture variables, 8 are surface substrate variables, and one is a variable for species richness (Table 13).

Assignment to the U.S. National Vegetation Classification System

Results of the analysis were carefully reviewed for synonymy within the context of the U.S. National Vegetation Classification System (Grossman et al. 1998, NatureServe 20010). This study recognized five globally standard USNVC vegetation associations and identified two new vegetation associations. For each of the vegetation associations identified we wrote detailed local descriptions that include information such as vegetation composition, diagnostic species, rare and uncommon taxa, physical characteristics, and distribution.

RESULTS AND DISCUSSION

Flora

The vegetation composition of the seepage wetlands surveyed during this project resulted in the inventory and documentation of 343 taxa representing 180 genera, from 86 plant families (Table 6, Appendix I). Of these taxa only 16 (4.5%) were exotic. The plant families comprising the largest number of taxa were the Cyperaceae (52), Poaceae (35) and Asteraceae (29), Rosaceae (17), Ericaceae (15), Fagaceae (11), Juncaceae (10) and Orchidaceae (10) (Table 7). Noticeably absent from these habitats is the Fabaceae and Euphorbiaceae, which are two of the most diverse families of flowering plants in North America (Smith et. al 2004). *Carex*, with 25 taxa, was the largest genus, followed by, *Rhynchospora* (10), *Juncus* (10), *Sphagnum* (9), *Quercus* (9), and *Dichanthelium* (9) (Table 8).

A number of taxa considered rare and tracked by the Maryland Natural Heritage Program (2007; Table 9) were encountered. These taxa are shown, by community type, in Table 9. In total, 69 occurrences of 45 species tracked by the Maryland Natural Heritage Program were inventoried as a component of this project. Of the species inventoried 14 are legally defined as Endangered and 7 Threatened by Nongame and Endangered Species Conservation Act (Annotated Code of Maryland 10-2A-01). Nineteen of these species are S1 highly state rare, 13 species are S2 state rare, 1 species is S2/S3 state rare/watchlist, and 12 species are S3 watchlist (see Appendix III for definitions of state conservation ranks).

Two of the most significant species discovered were *Rhynchospora rariflora* and *Sphagnum portoricense. Rhynchospora rariflora* was discovered in Prince Georges County and represents a rediscovery to the Maryland Flora. *Rhynchospora rariflora* was historically known from only a single collection, made in 1940 from Wicomico Co., Maryland ("sphagnum bog, 7 miles E.S.E. of Salisbury and 4 miles SW of Parsonsburg in Wicomico Co.," 4 August 1940, J.B.S. Norton, *s.n.*, MARY). Also discovered as new to the state was

Sphagnum portoricense. This species of peat moss is known along the Atlantic Coastal Plain from New York, New Jersey, North and South Carolina, Florida, Alabama, Louisiana, Texas, Mexico, the West Indies and South America (McQueen & Andrus 2007). Carl Darigo confirmed the identity of this species and it is included as new to Maryland in his Checklist to the Maryland Mosses (*in press*).

Table 6. Summary of general floristics at sample sites in study.

	Totals
Taxa	343
Species	341
Families	86
Genera	180
Rare & Uncommon	49
S1 species	19
S2 species	13
S3 (Watch List)	12
Pteridophytes	13
Gymnosperms	8
"Monocots"	133
"Dicots"	175
Exotic taxa	16

Table 7. Families represented in the study with the greatest number of taxa.

Family	Genera	Taxa
Cyperaceae	12	52
Poaceae	18	35
Asteraceae	12	29
Roseaceae	10	17
Ericaceae	9	15
Fagaceae	3	11
Juncaceae	1	10
Orchidaceae	7	10

Table 8. The most common Genera observed and their associated number of taxa.

Genus	Taxa
Carex	25
Rhynchospora	10
Juncus	10
Sphagnum	9
Quercus	9
Dichanthelium	9
Quercus	9
Eleocharis	7
Eupatorium	7

Table 9. Summary of rare taxa reported from 7 community types classified in this study. See Appendix III for definitions of state and global conservation ranks.

Community Type	Taxon	MD Status	MD State Rank	Global Rank	Federal Status
Sea-Level Fen (CEGL006310)	*Bidens mitis*	E	S1	G4?	
	Chamaecyparis thyoides		S3	G4	
	Juncus pelocarpus	E	S1	G5	
	Platanthera blephariglottis var. *blephariglottis*	T	S2	G4G5	
	Platanthera ciliaris	T	S2	G5	
Delmarva Poor Fen (CEGL006467)	*Alnus maritima*		S3	G3	
	Calapogon tuberosus var. *tuberosus*	E	S1	G5T5	
	Chamaecyparis thyoides		S3	G4	
	Dichanthelium roanokense		(DE-S2)	G?	
	Dichanthelium scabriculum	E	S1 (DE-S1)	G4	
	Drosera rotundifolia		S2	G5	
	Eriocaulon compressum	E	S1 (DE-S2)	G5	
	Eriophorum virginicum		S3	G5	
	Juncus pelocarpus		S2	G5	
	Pagonia ophioglossoides		(DE-S2)	G5	
	Rhynchospora fusca		(DE-S2)	G4G5	
	Rhynchospora alba		(DE-S2)	G5	
	Rhynchospora inundata	E	S1	G4?	
	Sarracenia purpurea		S3 (DE-S2)	G5	
	Sclerolepis uniflora		S1	G4	
	Sphagnum portoricense		(DE-S1)	G5	
	Taxodium distichum		(DE-S2)	G5	
	Utricularia gibba		(DE-S2)	G5	
	Xyris fimbriata	E	S1	G5	
Coastal Plain Acidic Seepage Swale (CEGL006499)	*Chamaecyparis thyoides*		S3	G4	
	Eriocaulon decangulare		S2	G5	
	Juncus caesariensis	E	S1	G2	
	Juncus longii	E	S1	G4/G5 (Knapp & Naczi 2008)	
	Polygala cruciata		S2	G5	
	Rhynchospora alba		S2	G5	
	Rhynchospora microcephala		S2S3	G5	
	Sarracenia purpurea		S3	G5	
	Scleria muehlenbergii *		n/a [S1]*	G5	
	Sclerolepis uniflora	T	S2	G4	
	Sphagnum portoricense		S1	G5	
	Utricularia subulata		S3	G5	
Coastal Plain Dwarf-Shrub Peatland (CEGL006852)	*Arundinaria gigantea*		S2	G5	
	Carex bullata		S3	G5	
	Carex exilis	E	G5	S1	
	Chamaedaphne calyculata	T	S1	G5	
	Drosera rotundifolia		S3	G5	
	Eriophorum virginicum		S3	G5	
	Juncus pelocarpus	E	S1	G5	
	Platanthera ciliaris	T	S1	G5	
	Rhynchospora alba		S3	G5	
	Sarracenia purpurea	T	S2	G5	
	Vaccinium macrocarpon		S3	G4	
Coastal Plain Emergent Millpond Bog (CEGL006853)	*Chamaedaphne calyculata*	T	S1	G5	
	Juncus pelocarpus	E	S1	G5	
	Rhynchospora alba		S3	G5	
	Utricularia subulata		S3	G5	
	Vaccinium macrocarpon		S3	G4	
Fall-Line Terrace Gravel Bog (CEGL006219)	*Asclepias rubra*	E	S1	G4G5	
	Carex bullata		S3	G5	
	Drosera filiformis †		n/a		
	Eriocaulon decangulare		S2	G5	
	Gaylussacia dumosa *		n/a [S1]*		
	Juncus longii	E	S1	G4/G5 (Knapp & Naczi 2008)	
	Rhynchospora cephalantha	E	S1	G5	
	Rhynchospora rariflora ✪	X	S1	G5	
	Sarracenia purpurea †	T	S2	G5	
	Scleria muhlenbergii *		n/a [S1]*	G5	
	Solidago uliginosa var. *uliginosa*		S3	G4G5`	
Coastal Plain Acidic Seepage Swamp (CEGL006238)	*Helonias bullata*	E	S2	G3	T
	Parnassia asarifolia	E	S1	G4	
	Platanthera cristata		S3	G5	
	Sagittaria engelmaniana	T	S2	G5?	
	Sarracenia purpurea	T	S2	G5	
	Thyelypteris simulata	T	S2	G4G5	

✪ - Rediscovery to the Flora of Maryland

† - Non-native at site

* - Species not ranked by the MD NHP but believed to be rare by the authors. S-rank in ( )'s assigned by authors.

Community Classification

The community classification was based on a dataset of 51 vegetation plot samples with a total species richness of 343 vascular and nonvascular plant taxa. We identified community types to the "vegetation association" level of the U.S. National Vegetation Classification (USNVC; Grossman et al. 1998, NatureServe 2010). The vegetation association level is equivalent to the fundamental unit (i.e., *association)* of many traditional vegetation studies where relatively compositionally similar stands share a set of physical characteristics and recur on the landscape (Mueller-Dombois & Ellenberg 1974). Applying this concept and nomenclatural protocols of the USNVC (Ecological Society of America 2004; p. 54) this classification study recognizes five existing USNVC vegetation associations and presents support for two associations that have not been previously identified. The vegetation associations we identified in this study represent a suite of Coastal Plain wetland types that are driven by groundwater hydrology (Table 10). Examples include sea-level fens, poor fens, acidic seepage swamps, and fall-line terrace gravel bogs (i.e., *Magnolia Bogs, McAtee Bogs*).

Table 10. Classification of Community Types and USNVC Vegetation Associations identified in the study area.

Sea-level Fen	*Eleocharis rostellata – Cladium mariscoides – Eryngium aquaticum* var. *aquaticum* Herbaceous Vegetation (CEGL006310) [2 plots]
Delmarva Poor Fen	*Cladium mariscoides – Eriocaulon decangulare* var. *decangulare – Eriophorum virginicum* Herbaceous Vegetation (CEGL006467) [3 plots]
Coastal Plain Acidic Seepage Swale	*Alnus serrulata – Magnolia virginiana – Andropogon glomeratus – Eupatorium pilosum – Rhynchospora gracilenta – Xyris torta* Shrubland (CEGL006499) [5 plots]
Coastal Plain Dwarf-Shrub Fen	*Chamaedaphne calyculata - Vaccinium macrocarpon / Rhynchospora alba / Sphagnum* spp. Dwarf Shrubland (CEGL006852) [9 plots] NEWLY PROPOSED
Coastal Plain Emergent Millpond Bog	*Juncus pelocarpus - Rhynchospora alba – (Nymphaea odorata* ssp. *odorata)* Herbaceous Vegetation (CEGL006853) [8 plots] NEWLY PROPOSED
Fall-Line Terrace Gravel Bog	*Nyssa sylvatica - Magnolia virginiana - (Pinus rigida) / Rhododendron viscosum* var. *viscosum - Toxicodendron vernix / Smilax pseudochina* Woodland (CEGL006219) [14 plots]
Coastal Plain Acidic Seepage Swamp	*Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum* var. *nudum / Osmunda cinnamomea - Woodwardia areolata* Forest (CEGL006238) [10 plots]

The results of cluster analysis fragmented the 51-plot dataset into two groups that are ecologically related but on a coarse scale. The groups are identified as major stems of the cluster dendrogram (see Fig. 2) and represent a natural aggregation of 1) early successional, open-canopied wetland habitats dominated by herbs and shrubs and, 2) mid-late successional, forested wetland habitats dominated by woody vegetation. The results and protocols employed for all cluster analyses and procedures in MRPP are reported in the caption of each dendrogram. Of the total 51 plots, 27 plots correspond to open-canopied wetlands and 24 are attributed to forested wetlands. Separate data subsets of these two groups were prepared and independently analyzed in PC-Ord (version 5.21; McCune and Mefford 2006).

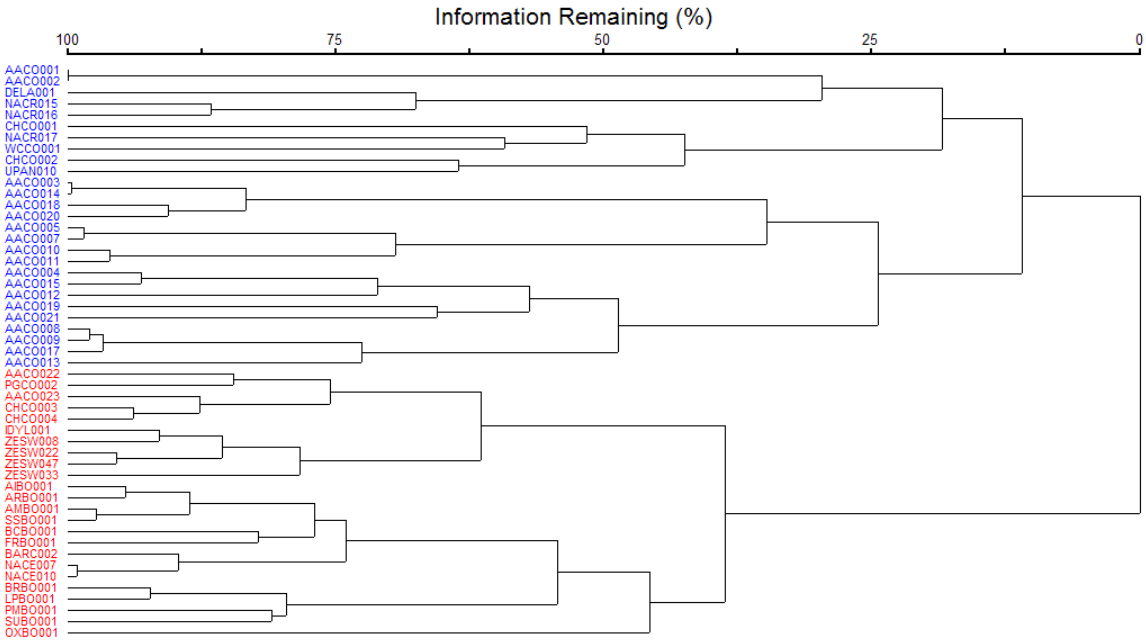

Figure 2. Color-coded dendrogram identifying the two major ecological groups resulting from cluster analysis using the Lance-Williams Flexible-Beta method (b = -0.25), raw cover class scores, and Sorenson (Bray-Curtis) distance. Multi-Response Permutation Procedures (MRPP) test statistic (T) = -25.59; chance-corrected within-group (A) = 0.327; p = <0.000000001. The blue grouping represents early successional vegetation of open-canopied wetland habitats often dominated by herbs and shrubs. The red grouping represents mid-late successional vegetation of forested wetland habitats dominated by woody vegetation.

Cluster analysis results (Fig. 3) from the 27 plot subset yielded five different community types with group membership ranging from 2 to 9 plots (mean = 5). Both MRPP and the compositional summary statistics calculated (see Appendix I) for each group indicate relatively strong group membership. Homoteneity values (*sensu* Curtis 1959) among each of the five groups identified range from 0.520 to 0.864 (mean = 0.675). In ecological and landscape-scale studies, homoteneity values greater than 0.600 are generally viewed as acceptable. High homoteneity values suggest greater uniformity in species composition among plots however, it is not independent of group size and values increase as the number of plots (in a group) decrease. For example, a group that had an unusually high value of 0.864 contained only two plots from a single site that represents an extremely rare and distinctive sea-level fen community type (CEGL006310). In Maryland, sea-level fens are threatened or have been destroyed by sea-level rise, ditching, nutrient loading (e.g., agricultural runoff), and invasive species (e.g., *Phragmites australis*). In 1993, Hirst and Wilson documented 11 sea-level fens in Maryland, all of which are small, remnant patches with few characteristic species remaining. The two plots in this dataset represent one of our best remaining stands and were included to merely document the existence of *Eleocharis rostellata - Cladium mariscoides – Eryngium aquaticum* var. *aquaticum* –Herbaceous Vegetation (CEGL006310) in Maryland.

Conversely, a somewhat low homoteneity value of 0.520 was calculated for five plots representing a group of graminoid-dominated seepage wetlands known from throughout the Coastal Plain where artificially maintained habitats (e.g., powerline rights-of-ways) meet small streams. Based on the floristic similarities and physical characteristics we assigned this group to the *Alnus serrulata – Magnolia virginiana / Andropogon glomeratus – Eupatorium pilosum – Rhynchospora gracilenta – Xyris torta* Shrubland (CEGL006499) of the USNVC. Occurrences of this community type have also been documented from the Coastal Plain and outer Piedmont of Virginia where the majority of "natural" sites occur on military base impact areas and are subject to frequent burning (G. Fleming pers. comm.). Although plot data from Virginia were not used in the analysis per se we reviewed compositional summary statistics from plots in Virginia (N = 7) and found a strong relationship to the Maryland plots (N = 5). Homoteneity values (MD = 0.520, VA = 0.527), species richness (MD = 45; VA = 46) and most constant and diagnostic species (i.e., *Andropogon glomeratus, Rhynchospora gracilenta, Dichanthelium scoparium, Scleria muehlenbergii*) were found to be virtually identical in Maryland and Virginia. However, we found that some of the plots express a considerable amount of variation in shrub and small tree cover while others contain virtually no woody species (i.e., plot UPAN010). This variation in stand structure can be attributed to different management frequencies among sites and is one of the reasons for poor group cohesion and a lower homoteneity value. Despite this variation in stand structure, overall vegetation composition was consistent among sites of different maintenance regimes (i.e., fire vs. mowing vs. herbicide applications) in Maryland and Virginia. In addition, many of the species reported are shade intolerant requiring open, sunny conditions to persist. Based on this information we believe habitats maintained by mowing or herbicide applications (at the appropriate time of the year) may serve as surrogates for habitats requiring openings created by fire.

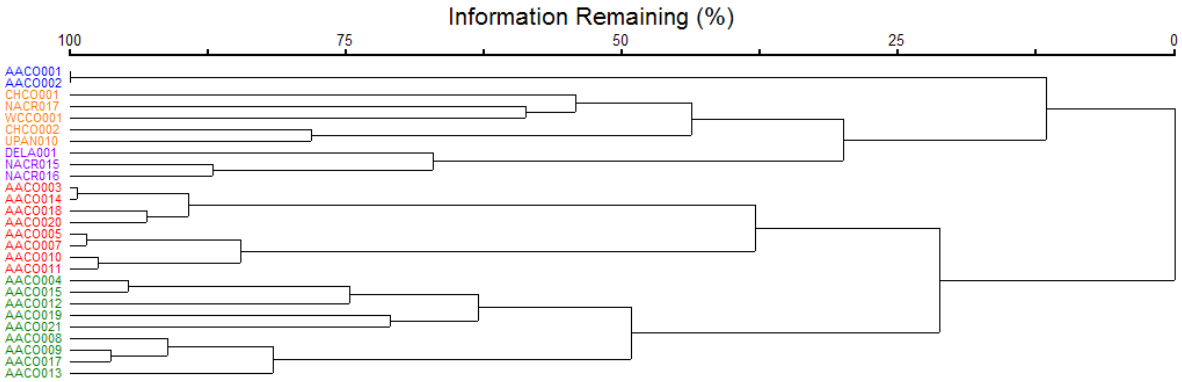

Figure 3. Dendrogram showing the five early successional herbaceous and/or shrub dominated wetland community types that emerged from cluster analysis using the Lance-Williams Flexible-Beta method (b = -0.25), cover class scores relativized by species maxima (Xmaxj), and Sorenson (Bray-Curtis) distance. Multi-Response Permutation Procedures (MRPP) test statistic (T) = -11.81; chance-corrected within-group (A) = 0.599; p = <0.000000001. Blue = Sea-Level Fen (CEGL006310); Orange = Coastal Plain Graminoid-Dominated Seepage Bog (CEGL006499); Purple = Peat Mat (CEGL006467); Red = Coastal Plain Emergent Millpond Bog (CEGL006853); Green = Coastal Plain Dwarf-Shrub Bog (CEGL006852).

A third group identified represents an acidic poor fen type restricted to the Delmarva Peninsula. Based on strong floristic characteristics we assigned this group to the *Cladium mariscoides – Eriocaulon decangulare* var. *decangulare – Eriophorum virginicum* Herbaceous Vegetation (CEGL006467) of the USNVC. Group membership was low (N=3) and represented by data from Delaware and Maryland. Subsequently, homoteneity values were high and calculated at 0.707 and supported by 7 species at 100% constancy among the group. Fidelity was also high (>75%) for 16 taxa reported in this group and is likely an artifact of these taxa predominately found on the outer Coastal Plain of Maryland and Delaware. Prior to this study, this community type was only known from a single 4.5 acre occurrence at Prime Hook NWR in Delaware (R. Coxe pers. comm.). Three additional patches of this vegetation purportedly occur at Prime Hook NWR but are very small and have not been sampled. Our study documents an additional Delaware occurrence near Cow Bridge Branch and an occurrence near the headwaters of Nassawango Creek in Maryland thus supporting a range extension of this community type.

The two remaining groups that emerged from cluster analysis represent two community types known only from the Magothy and Severn River watersheds in Anne Arundel County. Both of these community types represent new USNVC vegetation associations known only from Maryland despite strong floristic similarities to habitats in New Jersey. We have assigned the first community type to the *Chamaedaphne calyculata – Vaccinium macrocarpon / Rhynchospora alba / Sphagnum* spp. Dwarf Shrubland (CEGL006852). Group membership for this community type was moderate (N=9) and species richness among those plots low (20 taxa / 9 plots). Homoteneity values were calculated at 0.600. We assigned the second community type to the *Juncus pelocarpus – Rhynchospora alba – (Nymphaea odorata* ssp. *odorata)* Herbaceous Vegetation (CEGL006853). Group membership for this community type was also moderate (N=8) and species richness very low (11 taxa / 8 plots). Homoteneity values for plots assigned to the *Juncus pelocarpus – Rhynchospora alba – (Nymphaea odorata* ssp. *odorata)* Herbaceous Vegetation (CEGL006853) were calculated at 0.682.

Cluster analysis results (Fig. 4) from the 24 plot subset of forested wetlands yielded two different community types. These community types have been assigned to the *Acer rubrum – Nyssa sylvatica – Magnolia virginiana / Viburnum nudum* var. *nudum / Osmunda cinnamomea – Woodwardia areolata* Forest (CEGL006238) and the *Nyssa sylvatica - Magnolia virginiana - (Pinus rigida) / Rhododendron viscosum* var. *viscosum - Toxicodendron vernix / Smilax pseudochina* Woodland (CEGL006219) of the USNVC. Group membership among the two community types was 10 and 14 plots respectively. Results from MRPP and the compositional summary statistics (see Appendix II) indicate good agreement within each group of plots. Homoteneity values were calculated at 0.641 (CEGL006238) and 0.622 (CEGL006219).

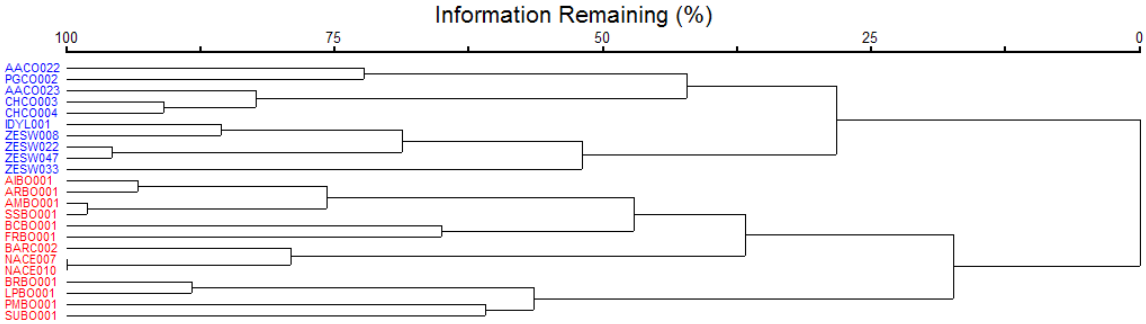

Figure 4. Dendrogram showing the two forested wetland community types that emerged from cluster analysis using the Lance-Williams Flexible-Beta method (b = -0.375), raw cover class scores, and Sorenson (Bray-Curtis) distance. Multi-Response Permutation Procedures (MRPP) test statistic (T) = -10.03; chance-corrected within-group (A) = 0.309; p = <0.00000088. The blue cluster represents the Coastal Plain Red Acidic Seepage Swamp (CEGL006238) community type. The red cluster represents the Fall-Line Terrace Gravel Bog (CEGL006219) community type.

In an effort to identify significant environmental variables and gradient relationships within each community type, we performed ordination analyses using NMS. Only those plots with complete environmental data (i.e., elevation, topographic, soil chemistry, and surface substrate) were used. Many of the 37 legacy plots used in this study were found to contain incomplete environmental data largely due to different sampling protocols and project objectives. A total of 28 plots contained complete environmental data and were subsequently partitioned into subsets based on the cluster analysis results (Figs. 2, 3, and 4) for independent ordination analyses. Fourteen of the 28 plots formed the first data subset and represented early successional, open-canopied wetland habitats dominated by herbs and shrubs. A second subset of data also contained 14 plots and included vegetation of mid-late successional forested wetland habitats. Captions beneath the ordination diagrams report the final stress of the ordination, final instability of the ordination, Monte Carlo test result, and percent variance represented by each axis, community type, and assigned USNVC community element global code (e.g., CEGL006310).

Following NMS, we calculated Pearson and Kendall's correlation scores for environmental variables on each axis (Tables 11 and 12). Significant correlations are overlaid as joint plot vectors on the ordination diagrams

(Figs. 5 and 6) with the angle and length of the vector indicating the direction and strength of the relationship (McCune and Grace 2002). Of the 32 total environmental variables, 18 are soil chemistry variables, 5 are soil texture variables, 8 are surface substrate variables, and one is a variable for species richness. The mean values of all environmental variables for each of the seven community types identified in this study are provided in Table 13.

A two-dimensional NMS ordination of 14 plots (open-canopied wetlands) yielded 6 significant ($r^2 \geq 0.250$) environmental correlates (Table 11). In the diagram (Fig. 5), plots of the Coastal Plain Dwarf-Shrub Peatland (CEGL006852) and Coastal Plain Emergent Millpond Bog (CEGL006853) community types are strongly correlated with percent organic matter (OM) and cation exchange capacity (CEC) and are positioned at the upper end of Axis 2. Mean values for percent organic matter in these community types (CEGL006852=71.5% OM; CEGL006853=53.7% OM) are high and directly related to the development of peat layers in these wetlands. In addition, this accumulation of organic matter serves as a reservoir for cation nutrients (e.g., calcium [Ca^{+2}], magnesium [Mg^{+2}], potassium [K^{+1}], sodium [Na^{+1}], hydrogen [H^{+1}], aluminum [Al^{+3}]) and aids in water capacity retention. Since cation exchange capacity is positively correlated with the amount of organic matter present in soils we consider these soil chemistry variables redundant. Soil pH is negatively correlated with Axis 2 with the vector radiating towards the bottom of the ordination. Further review of soil pH indicates the mean values for the Coastal Plain Dwarf-Shrub Peatland (CEGL006852=4.3 pH) and Coastal Plain Emergent Millpond Bog (CEGL006853=3.8 pH) community types are in fact lower than the Sea-Level Fen (CEGL006310=4.7 pH), Delmarva Poor Fen (CEGL006467=4.8 pH), and Coastal Plain Acidic Seepage Swale (CEGL006499=4.9 pH) community types and although complex may be related to accumulating peat layers and anaerobic conditions. Crum (1992) state that bog acidity can sometimes be attributed to the cation-exchange activities of Sphagnum peat and the dissociation of weak organic acids resulting from anaerobic decomposition. Furthermore, plots belonging to the Coastal Plain Dwarf-Shrub Peatland (CEGL006852) and especially the Coastal Plain Emergent Millpond Bog (CEGL006853) community types contain higher amounts of soluble sulfur (S) which also contributes to lower pH. Although sulfur is plentiful in the environment, extreme levels (mean soluble sulfur = 605 ppm) in plots assigned to the Coastal Plain Emergent Millpond Bog (CEGL006853) community type suggest another source. It is likely that sulfur is being released through anaerobic decomposition of organic matter at these sites is contributing to the elevated levels (Crum 1992).

Additionally plots representing the Coastal Plain Acidic Seepage Swale (CEGL006499) community type are positioned at the high end of a species richness gradient along Axis 1. This community type is considerably more taxa rich (mean species richness = 45 taxa) when compared to the range of the other four community types (mean species richness = 11-25 taxa). This may be an artifact of Coastal Plain Acidic Seepage Swales (CEGL006499) being associated with powerline rights-of-ways and other artificially maintained habitats with different disturbance frequencies.

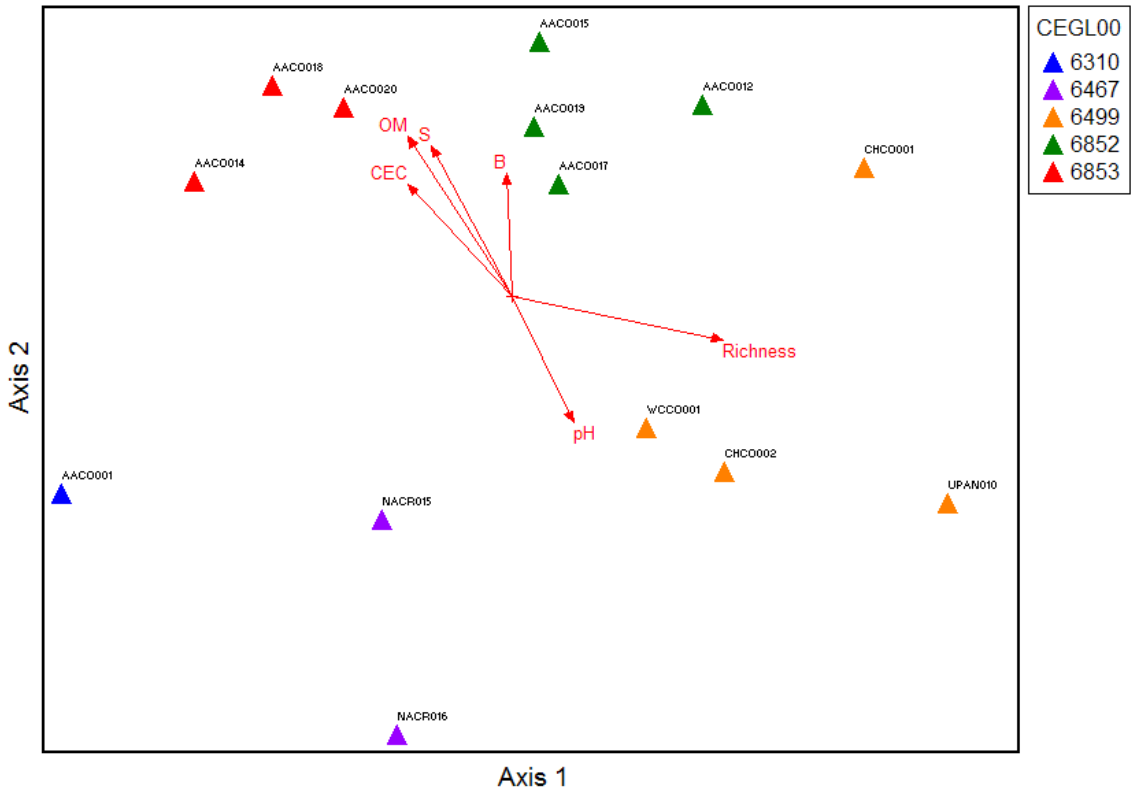

Figure 5. Ordination of 14 sample plots dominated by herbaceous vegetation in sample space with environmental variables overlaid as joint plot vectors (cutoff value $r^2 \geq 0.250$), using non-metric multidimensional scaling (NMS). The lines radiating from the centroid indicate the relative strength and direction of correlation of the most influential environmental variables (Richness, Cation Exchange Capacity [CEC], % Organic Matter [OM], pH) with the ordination. Final stress for two-dimensional solution = 12.31258. Final instability = 0.000001. Monte Carlo test: p = 0.0040. Percent variance represented: Axis 1 = 0.349, Axis 2 = 0.355, Total = 0.703. Blue = Sea-Level Fen (CEGL006310); Orange = Coastal Plain Acidic Seepage Swale (CEGL006499); Purple = Delmarva Poor Fen (CEGL006467); Red = Coastal Plain Emergent Millpond Bog (CEGL006853); Green = Coastal Plain Dwarf-Shrub Peatland (CEGL006852).

Table 11. Pearson and Kendall's correlation scores of significant ($r^2 \geq 0.250$) environmental variables in the data subset of the open-canopied herbaceous wetlands

Environmental Variable	Axis 1			Axis 2		
	r	r-sq	tau	r	r-sq	tau
Richness	0.688	0.474	0.758	-0.316	0.100	-0.143
CEC	-0.484	0.234	-0.429	0.502	0.252	0.253
pH	0.371	0.138	0.358	-0.532	0.283	-0.425
OM	-0.484	0.234	-0.275	0.601	0.362	0.363
N	-0.426	0.181	-0.526	0.296	0.088	0.216
S	-0.427	0.182	-0.165	0.582	0.338	0.341
P	-0.189	0.036	-0.223	-0.262	0.069	-0.223
Ca	-0.047	0.002	-0.033	0.145	0.021	0.033
Mg	0.105	0.011	-0.022	0.045	0.002	-0.022
CaMgRat	-0.182	0.033	-0.143	0.269	0.072	0.055
K	-0.425	0.181	-0.211	0.347	0.120	0.233
Na	-0.199	0.040	-0.231	0.268	0.072	0.099
B	-0.118	0.014	-0.058	0.526	0.277	0.431
Fe	-0.166	0.028	-0.055	0.113	0.013	0.231
Mn	0.072	0.005	0.024	-0.069	0.005	-0.071
Cu	-0.094	0.009	-0.133	-0.198	0.039	-0.110
Zn	-0.227	0.052	-0.231	0.323	0.104	0.099
Al	-0.418	0.175	-0.429	0.210	0.044	0.121
BaseSat	0.321	0.103	0.187	-0.163	0.027	-0.231
FertInd	0.098	0.010	-0.055	0.199	0.039	0.055
GravCob	0.399	0.159	0.320	0.170	0.029	0.087
LitterOM	0.143	0.020	0.023	-0.418	0.175	-0.297
Wood	0.151	0.023	0.058	0.230	0.053	0.145
Water	-0.187	0.035	-0.351	0.187	0.035	0.036
MineralS	-0.123	0.015	0.058	0.397	0.158	0.311
BryoLich	0.254	0.064	0.305	0.010	0.000	0.178

A two-dimensional NMS ordination of 14 plots (forested wetlands) yielded 14 significant ($r^2 \geq 0.200$) environmental correlates (Table 12). The diagram (Fig. 6) separates the Coastal Plain Acidic Swamp (CEGL006238) and Fall-Line Terrace Gravel Bog (CEGL006219) along Axis 2. Plots of the Coastal Plain Acidic Swamp (CEGL006238) are positioned at the end of a soil fertility gradient indicated by slightly higher levels of calcium (Ca) and magnesium (Mg) when compared to the Fall-Line Terrace Gravel Bog (CEGL006219) community type. In addition, cation exchange capacity (CEC) and fertility index (FertInd) also correlate with Axis 2 and likely a function of higher organic matter (OM) content in those settings (i.e., stream-bottoms, depressions). Species richness is also correlated along Axis 2 with plots of the Fall-Line Terrace Gravel Bog (CEGL006219) averaging 45 taxa per plot.

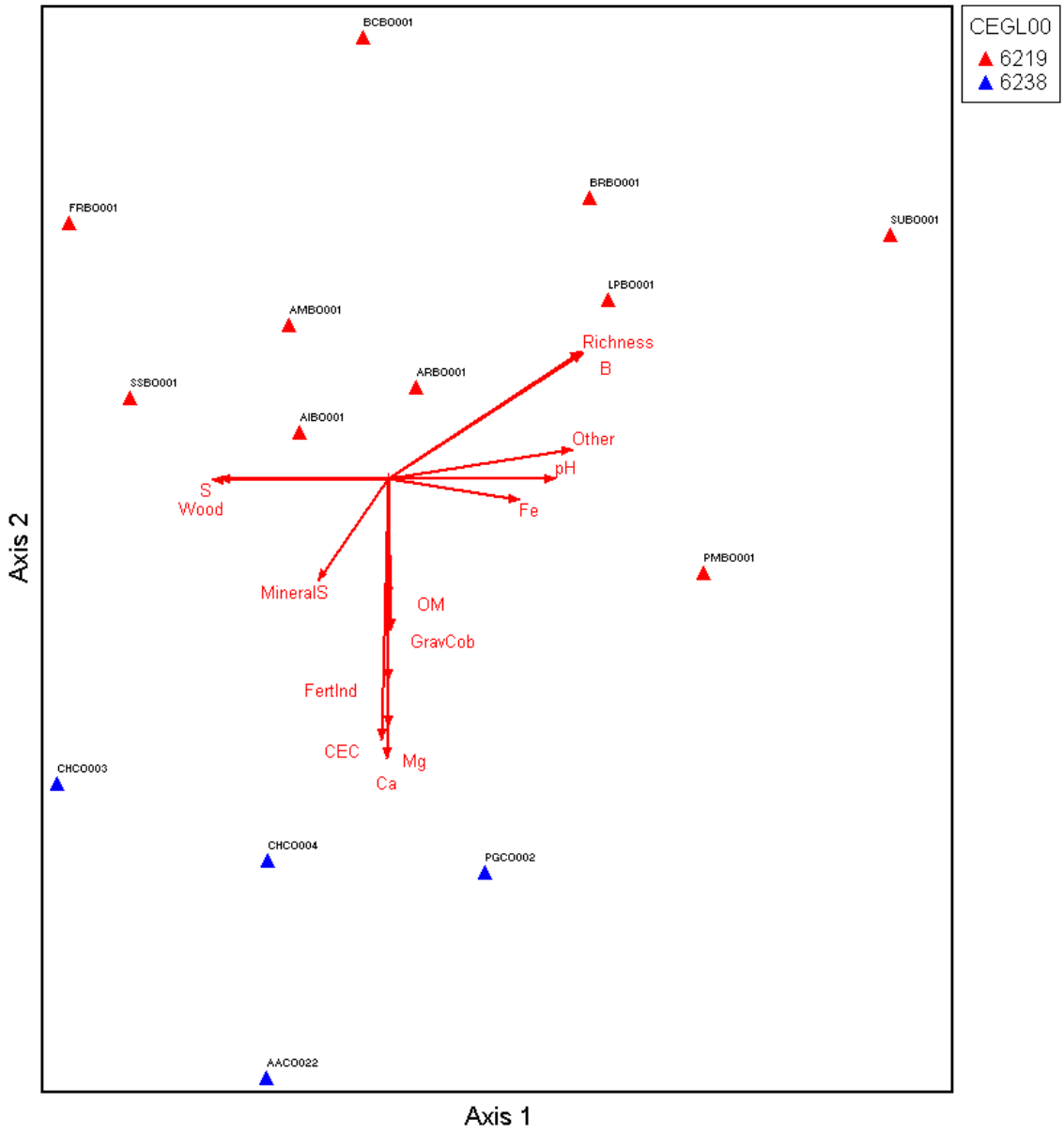

Figure 6. Ordination of 14 forested wetland plots in sample space with environmental variables overlaid as joint plot vectors (cutoff value $r^2 \geq 0.200$), using non-metric multidimensional scaling (NMS). The lines radiating from the centroid indicate the relative strength and direction of correlation of the most influential environmental parameters with the ordination. Final stress for two-dimensional solution = 11.97951. Final instability = 0.02818. Monte Carlo test: p = 0.0040. Percent variance represented: Axis 1 = 0.167, Axis 2 = 0.678, Total = 0.846. Blue = Coastal Plain Acidic Seepage Swamp (CEGL006238); Red = Fall-Line Terrace Gravel Bog (CEGL006219).

Table 12. Pearson and Kendall's correlation scores of significant ($r^2 \geq 0.200$) environmental variables in the data subset of the forested wetlands

Environmental Variable	Axis 1			Axis 2		
	r	r^2	tau	r	r^2	tau
Richness	0.483	0.233	0.371	0.623	0.388	0.483
CEC	-0.710	0.505	-0.341	-0.138	0.019	-0.231
pH	0.001	0.000	-0.022	0.562	0.316	0.354
OM	-0.482	0.232	0.033	-0.009	0.000	0.143
N	-0.213	0.046	0.033	0.163	0.026	0.143
S	-0.048	0.002	-0.088	-0.580	0.336	-0.420
P	-0.403	0.162	-0.190	-0.129	0.017	-0.078
Ca	-0.736	0.542	-0.552	-0.073	0.005	0.088
Mg	-0.693	0.480	-0.495	-0.054	0.003	-0.077
CaMgRat	0.037	0.001	0.055	0.016	0.000	0.033
K	-0.281	0.079	-0.233	0.039	0.001	0.144
Na	-0.280	0.078	-0.309	-0.206	0.043	-0.221
B	0.484	0.234	0.389	0.622	0.387	0.389
Fe	-0.216	0.047	-0.165	0.491	0.241	0.297
Mn	-0.160	0.026	-0.343	-0.015	0.000	0.160
Cu	0.102	0.010	-0.044	0.161	0.026	0.177
Zn	-0.062	0.004	0.033	-0.141	0.020	-0.121
Al	0.245	0.060	0.187	-0.116	0.014	-0.099
BaseSat	0.173	0.030	0.033	0.278	0.077	0.231
FertInd	-0.626	0.392	-0.407	-0.022	0.000	-0.033
Sand	0.233	0.054	0.389	0.101	0.010	0.056
Silt	0.032	0.001	-0.022	0.093	0.009	0.246
Clay	0.228	0.052	0.045	-0.098	0.010	0.136
BouldStn	-0.200	0.040	-0.112	-0.114	0.013	-0.048
GravCob	-0.544	0.296	-0.352	0.046	0.002	0.108
Gravel	0.357	0.127	0.187	0.034	0.001	0.033
LitterOM	-0.011	0.000	0.033	0.240	0.057	0.211
Wood	0.011	0.000	-0.148	-0.566	0.320	-0.489
Water	0.250	0.063	0.038	0.072	0.005	0.240
MineralS	-0.436	0.190	-0.305	-0.379	0.144	-0.153
Other	0.228	0.052	0.195	0.597	0.357	0.266
BryoLich	0.267	0.072	0.079	0.432	0.187	0.348

Table 13. Summary of mean environmental variables and physical characteristics for the 7 USNVC associations identified in this study.

USNVC Community Element Global Code (CEGL00)	6310	6467	6499	6852	6853	6219	6238
Number of Classified Plots	2	3	5	9	8	14	10
Species Richness	11	25	45	20	11	48	33
Average Plot Size (sq. m)	225	100	175	100	63	164	400
Elevation (ft)	43	14	29	18	32	7	30
Topographic Position	level	level depression	toe depression stream bottom	level depression	depression	toe	toe depression stream bottom
Soil Moisture Regime	hydric	hydric	subhydric hydric	subhydric hydric	hydric	hygric subhydric	subhydric hydric
SOIL CHEMISTRY - *Mehlich III method*							
Cation Exchange Capacity *(CEC)*	15.49	15.11	8.61	16.64	25.87	5.67	12.35
pH	4.7	4.8	4.9	4.3	3.8	4.8	4.9
Estimated Nitrogen Release (lb/A)	130.00	130.00	74.75	130.00	130.00	86.86	98.89
Soluble Sulfur (ppm)	160.00	16.50	36.25	112.50	605.00	28.43	51.61
Phosphorus (ppm)	17.00	12.50	14.75	7.75	19.00	12.21	17.19
Calcium (ppm)	323.00	478.00	321.75	573.00	527.67	225.07	524.81
Magnesium (ppm)	61.00	56.50	59.50	61.75	63.00	64.29	129.08
Calcium:Magnesium Ratio	5.30	7.56	5.38	7.18	9.50	3.87	4.03
Potassium (ppm)	39.00	32.00	18.00	41.25	43.00	26.07	42.17
Sodium (ppm)	144.00	32.50	76.75	119.50	141.67	29.29	42.94
Boron (ppm)	0.25	0.20	0.30	0.41	0.37	0.49	0.33
Iron (ppm)	347.00	286.00	322.75	368.25	364.67	251.21	261.53
Manganese (ppm)	2.00	10.50	3.75	5.50	11.67	11.86	13.00
Copper (ppm)	2.26	0.63	1.68	0.49	1.20	6.52	1.18
Zinc (ppm)	18.85	2.04	7.81	4.46	16.37	2.75	7.02
Aluminum (ppm)	1167.00	968.00	637.50	930.75	1396.33	465.00	452.89
Total Base Saturation *(TBS)* (%)	18.41	19.07	41.90	22.55	14.96	51.79	51.92
Fertility Index *(CEC*TBS/100)*	2.85	3.09	2.48	4.01	3.89	2.15	3.99
SOIL TEXTURE - *Particle Size Analysis*							
Organic Matter (%)	58.0	21.7	3.3	71.5	53.7	5.3	8.9
Gravel (> 2.0 mm) (%)	n/a	n/a	n/a	n/a	n/a	40.0	9.8
Sand (0.5 - 2.0 mm) (%)	n/a	n/a	n/a	n/a	n/a	77.9	71.2
Silt (.002 - .05 mm) (%)	n/a	n/a	n/a	n/a	n/a	13.5	14.4
Clay (< .002 mm) (%)	n/a	n/a	n/a	n/a	n/a	8.5	4.3
SURFACE SUBSTRATE							
Large Rocks (>10 cm) (% cover)	0	0	0	0	0	1	0
Small Rocks (.2-10 cm) (% cover)	0	0	0	0	0	1	4
Litter / Organic Matter (% cover)	90	99	91	89	96	77	65
Wood (% cover)	0	0	3	1	0	8	7
Water (% cover)	10	1	3	7	2	6	4
Exposed Mineral Soil (% cover)	0	0	4	3	2	2	5
Nonvascular (% cover)	0	0	33	25	0	26.78	17.50

Community Descriptions

Detailed community descriptions for the seven classified community types can be found on the following pages.

Sea-Level Fen

***Eleocharis rostellata – Cladium mariscoides – Eryngium aquaticum* var. *aquaticum* Herbaceous Vegetation**
Beaked spikerush – Twig-rush – Marsh rattlesnake master Herbaceous Vegetation

USNVC Global Element Code: Equivalent to CEGL006310

Maryland Summary: In Maryland, this "sea-level fen" community type is best developed just above the highest tide levels at the interface between brackish marshes and gently sloping uplands of sand and gravel substrates. Within this transition zone, acidic, nutrient-poor groundwater discharges from the bases of the upland slopes creating saturated areas. Stands in Maryland are small-patched and less than 1 ac in size. They typically contain peaty substrates and are sometimes bordered by mucky and shrubby "eutrophic" edges (Ludwig 1992, 1995). Stands are dominated by herbaceous species but may occasionally contain scattered individuals or clumps of *Morella cerifera, Baccharis halimifolia, Iva frutescens,* and *Juniperus virginiana*. The vegetation of stands sampled (n=2 samples) and observation data (Hirst and Wilson 1993) collected at ten sites in Maryland are strongly dominated by dense *Eleocharis rostellata* (mean cover = 9) forming near monotypic stands. *Cladium mariscoides* is also characteristic and constant in all stands at low cover (mean cover = 3). Other low cover associates include *Eryngium aquaticum* var. *aquaticum, Hibiscus moscheutos* ssp. *moscheutos, Centella erecta, Fuirena pumila, Fuirena squarrosa, Hydrocotyle umbellata, Oenothera fruticosa* var. *fruticosa, Osmunda regalis* var *spectabilis,* and *Hypericum virginicum.* All contemporary stands are threatened by invasion of *Phragmites australis.*

Constant Species (constancy >75%)	*Eleocharis rostellata, Cladium mariscoides, Hibiscus moscheutos* ssp. *moscheutos, Hydrocotyle umbellata, Oenothera fruticosa* var. *fruticosa, Rosa palustris, Osmunda regalis* var. *spectabilis, Hypericum virginicum*
Dominant Species (mean cover ≥ 6)	*Eleocharis rostellata*
Indicator Species (highest unscaled adj, DV)	*Eleocharis rostellata, Hibiscus moscheutos* ssp. *moscheutos, Hydrocotyle umbellata, Oenothera fruticosa* var. *fruticosa, Bidens mitis, Kosteletzkya virginica*
Rare and uncommon taxa	*Bidens mitis, Chamaecyparis thyoides, Juncus pelocarpus, Platanthera blephariglottis* var. *blephariglottis, Platanthera ciliaris*

Mean Species Richness: 11
Homoteneity: 0.864
Number of Plots: 2
Representative Plots: AACO001, AACO002

Maryland Distribution: This community type is known from one location in Anne Arundel County in the Chesapeake Bay drainage and ten locations in Worcester County in the Atlantic drainage (Hirst and Wilson 1993). Sites are extremely vulnerable to hydrological disturbances such as ditching as well as sea-level rise, nutrient enrichment via runoff, woody plant encroachment, and invasion of *Phragmites australis.*

Maryland Conservation Rank: S1

Global Summary: This association comprises "sea-level fens" of the central and north Atlantic coast. These are small-patch communities occurring at the edge of salt marshes adjacent to sandy or gravelly slopes where there is acidic, oligotrophic groundwater seepage. Although its association with salt marshes is diagnostic, it is only infrequently influenced by salt or brackish overwash during unusually high tides. The physiognomy is dominated by herbs, occasionally with some scattered shrubs or short trees. The diagnostic species include *Cladium mariscoides, Rhynchospora alba, Eleocharis rostellata, Drosera intermedia*, and *Schoenoplectus*

pungens (= Scirpus pungens). Other associated species may include *Symphyotrichum novi-belgii (= Aster novi-belgii), Carex exilis, Carex hormathodes, Carex leptalea* var. *harperi , Eleocharis fallax, Juncus canadensis, Juncus pelocarpus, Lysimachia terrestris, Rosa palustris, Vaccinium macrocarpon, Sanguisorba canadensis, Teucrium canadense*, and *Schoenoplectus americanus (= Scirpus americanus)* and *Eriocaulon decangulare* var. *decangulare* in the southern portion of the association range. Woody species occurring at low cover may include *Morella pensylvanica (= Myrica pensylvanica), Baccharis halimifolia, Juniperus virginiana, Iva frutescens*, and in the southern portion of the range, *Morella cerifera (= Myrica cerifera)*. Substrate is sedgy peat over sand or gravel.

Global Distribution: Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Delaware, Maryland, and Virginia.

Global Conservation Rank: G1

Plate 1. View of plot AACO001 at Cypress Creek, Anne Arundel County, Maryland. Sea-Level Fen with encroaching *Phragmites australis.* Photo: J.W. Harrison © Maryland Department of Natural Resources.

Delmarva Poor Fen

***Cladium mariscoides – Dichanthelium scabriusculum – Eriocaulon (compressum, decangulare) – Sarracenia purpurea* Herbaceous Vegetation**
Twig-rush – Tall swamp panic grass – (Flattened pipewort, Ten-angle pipewort) – Purple pitcher-plant Herbaceous Vegetation

USNVC Global Element Code: Equivalent to CEGL006467

Maryland Summary: Open, acidic fen of the outer Coastal Plain associated with seepage zones along small stream corridors and ancient stream oxbows. In Maryland, this early successional community type is currently known from only the Nassawango Creek watershed. Historically, this community type was likely always naturally limited in size and distribution on the Delmarva Peninsula. Headwater ditching, logging, millpond construction, and suppression of beaver activity and natural fire cycles required to maintain canopy openings have virtually eliminated this community from the landscape. Contemporary stands (n=2) are very small, ranging from 0.5 - 0.8 acres in size and have likely been impacted by historical mill construction further downstream from known locations. Substrates are very strongly acid (mean pH= 4.8) and consist of deep, mucky peats. These fens are characterized by a dense graminoid layer of *Cladium mariscoides* with admixtures of *Dichanthelium scabriusculum* and *Andropogon virginicus*. A continuous layer of *Sphagnum* mosses form a ground cover in which support species such as *Sarracenia purpurea, Drosera rotundifolia* var. *rotundifolia, Drosera intermedia, Eriocaulon compressum, Lycopodiella appressa, Pogonia ophioglossoides, Rhynchospora alba, Rhynchospora inundata, Calopogon tuberosus* var. *tuberosus,* and *Utricularia gibba*. Scattered shrubs of *Morella cerifera, Alnus serrulata, Clethra alnifolia* and small trees of *Acer rubrum, Taxodium distichum, Pinus serotina,* and *Chamaecyparis thyoides* may be present at low cover. Additional low cover associates characteristic of this community type include *Nymphaea odorata* ssp. *odorata, Fuirena squarrosa, Rhynchospora chalarocephala, Rhexia virginica, Juncus canadensis,* and *Hypericum virginicum.*

Constant Species (constancy >75%)	*Cladium mariscoides, Dichanthelium scabriusculum, Sarracenia purpurea, Eriocaulon compressum, Proserpinaca pectinata, Lycopodiella appressa, Drosera intermedia*
Dominant Species (mean cover ≥ 6)	*Cladium mariscoides, Dichanthelium scabriusculum, Sarracenia purpurea, Rhynchospora inundata, Andropogon virginicus*
Indicator Species (highest unscaled adj, DV)	*Dichanthelium scabriusculum, Rhynchospora inundata, Cladium mariscoides, Eriocaulon compressum, Rhynchospora fusca, Sarracenia purpurea*
Rare and uncommon taxa	*Dichanthelium roanokense, Dichanthelium scabriusculum, Eriocaulon compressum, Eriophorum virginicum, Juncus pelocarpus, Rhynchospora fusca, Rhynchospora alba, Rhynchospora inundata, Sarracenia purpurea, Sphagnum portoricense*

Mean Species Richness: 25
Homoteneity: 0.707
Number of Plots: 3
Representative Plots: NACR015, NACR016, DELA001 (Delaware plot)

Maryland Distribution: This community type has been documented from two locations in the Nassawango Creek watershed, Wicomico County.

Maryland Conservation Rank: S1

Global Summary: This unique community occurs on deep, mucky peat that forms in open-water depressions, impoundments, and seeps within a shrub-dominated swamp matrix. A relatively thick *Sphagnum* layer is characteristic of this community. *Cladium mariscoides* is the dominant herb. Associate herbaceous plant species include *Eriocaulon decangulare* var. *decangulare , Andropogon glomeratus* var. *hirsutior, Eriophorum virginicum, Bidens coronata, Sagittaria engelmanniana, Sagittaria latifolia* var. *latifolia, Rhynchospora alba, Spiranthes cernua, Eleocharis robbinsii, Dulichium arundinaceum, Lycopus amplectens, Bartonia paniculata* ssp. *paniculata , Woodwardia areolata, Bidens mitis, Juncus pelocarpus, Pogonia ophioglossoides*, and *Fuirena squarrosa*. Several insectivorous plants are also present within this community: *Sarracenia purpurea, Drosera rotundifolia, Drosera intermedia, Utricularia striata (= Utricularia fibrosa)*, and *Utricularia juncea*. Scattered shrubs, including *Smilax walteri, Smilax laurifolia, Clethra alnifolia, Alnus maritima* ssp. *maritima*, and *Vaccinium corymbosum*, are present along the edges of the peat mat community along with occasional *Acer rubrum* seedlings and saplings.

Global Distribution: Delaware and Maryland

Global Conservation Rank: G1

Plate 2. View of plot DELA001 at Doe Bridge Nature Preserve, Delaware. Photo: J.W. Harrison © Maryland Department of Natural Resources.

Coastal Plain Acidic Seepage Swale

***Alnus serrulata - Magnolia virginiana / Andropogon glomeratus - Eupatorium pilosum - Rhynchospora gracilenta - Xyris torta* Shrubland**
Smooth alder - Sweetbay / Bushy bluestem - Rough boneset – Slender beaksedge - Slender yellow-eyed-grass Shrubland

USNVC Global Element Code: CEGL006499

Maryland Summary: In Maryland, this community is an acidic fen characterized as a mosaic of shrubs with scattered herbaceous openings found perched over water tables of upland terraces above Coastal Plain headwater streams. Stands are always associated with gently sloping topography and acidic sand and gravel substrates over impervious clay lenses which impede drainage. Maryland stands are considered "semi-natural" because they occur in artificially maintained powerline right-of-ways. Historically, these communities would likely have been maintained by natural fire cycles. Contemporary woody plant management (i.e., mowing, herbicide applications) of powerline right-of-ways mimics this natural disturbance and is the primary factor in keeping these areas from succeeding to forests. The vegetation of Maryland stands is very heterogeneous in structure due to maintenance cycles but contain several compositional similarities. Among them are graminoids of *Andropogon glomeratus, Rhynchospora gracilenta, Panicum rigidulum, Panicum verrucosum,* and *Dichanthelium dichotomum* var. *dichotomum*. *Eupatorium pilosum, Dulichium arundinaceum, Hypericum canadense, Scirpus cyperinus, Carex lurida, Rhexia virginica, Juncus canadensis, Juncus effusus* ssp. *solutus, Thelypteris palustris* var. *pubescens,* and *Hypericum virginicum are* also characteristic in the herbaceous layers. The shrub layer commonly consists of *Acer rubrum, Rubus hispidus, Smilax rotundifolia, Aronia arbutifolia, Vaccinium corymbosum, Clethra alnifolia,* and *Ilex glabra.* Species reported with less frequency include *Eleocharis tortilis, Dichanthelium lucidum, Eleocharis obtusa, Sagittaria latifolia* var. *latifolia, Bartonia virginica, Euthamia caroliniana, Rhynchospora chalarocephala, Drosera intermedia, Drosera rotundifolia* var. *rotundifolia, Sarracenia purpurea, Scleria muhlenbergii, Rhynchospora capitellata, Juncus caesariensis, Dichanthelium scabriusculum, Xyris torta, Xyris difformis, Pogonia ophioglossoides, Eriocaulon decangulare* var. *decangulare , and Sclerolepis uniflora.*

Constant Species (constancy >75%)	*Andropogon glomeratus, Acer rubrum, Rhynchospora gracilenta, Rubus hispidus, Eupatorium pilosum, Smilax rotundifolia*
Dominant Species (mean cover ≥ 6)	*Juncus longii, Dichanthelium dichotomum* var. *dichotomum, Clethra alnifolia, Sphagnum magellanicum*
Indicator Species (highest unscaled adj, DV)	*Andropogon glomeratus, Dichanthelium scoparium, Rhynchospora gracilenta, Juncus longii, Dichanthelium dichotomum* var. *dichotomum, Sphagnum magellanicum, Scleria muehlenbergii*
Rare and uncommon taxa	*Juncus caesariensis, Juncus longii, Scleria muehlenbergii*

Mean Species Richness: 45
Homoteneity: 0.520
Number of Plots: 5
Representative Plots: CHCO001, CHCO002, NACR017, UPAN010, WCCO001

Maryland Distribution: This community type is supported by plot data from Charles, Prince Georges, Wicomico and Worcester Counties.

Maryland Conservation Rank: S2?

Global Summary: This seepage bog is currently known from the inner Coastal Plain from central and southern Maryland to southeastern Virginia. It occurs in saturated swales and headwater streams with extremely acidic, infertile soils, through which a constant supply of groundwater is discharged. The most "natural" occurrences of this vegetation are now restricted to military base impact areas and dedicated natural areas that are burned frequently. Compositionally identical vegetation is more common where artificially maintained powerline rights-of-way intersect small streams and swales. The vegetation is usually a patchy shrubland, although scattered small trees of *Acer rubrum, Nyssa sylvatica*, and *Pinus taeda* occur at a few sites. The principal shrubs are *Alnus serrulata, Magnolia virginiana, Toxicodendron vernix, Viburnum nudum* var. *nudum, Clethra alnifolia*, and *Aronia arbutifolia* (=*Photinia pyrifolia*). Small to large, graminoid-dominated herbaceous openings occur among the shrubs. Characteristic herbaceous patch-dominants are *Rhynchospora gracilenta, Rhynchospora capitellata, Andropogon glomeratus, Dichanthelium dichotomum* var. *dichotomum (= Dichanthelium lucidum), Scleria muehlenbergii, Eleocharis tortilis, Calamagrostis coarctata, Xyris torta, Fuirena squarrosa, Juncus canadensis*, and *Juncus longii*. Characteristic ferns and forbs include *Lycopodiella alopecuroides, Osmunda cinnamomea, Eupatorium pilosum, Viola primulifolia, Rhexia* spp., *Hypericum virginicum, Polygala lutea, Polygala cruciata* var. *aquilonia*, and *Pogonia ophioglossoides*. Areas of bare mineral soil are frequently carpeted by *Drosera rotundifolia* var. *rotundifolia, Drosera capillaris*, and *Utricularia subulata*.

Global Distribution: Virginia and Maryland

Global Conservation Rank: GNR, proposed G2G3?

Plate 3. View of a Coastal Plain Acidic Seepage Swale near Piney Branch, Charles County. Photo: W.M. Knapp © Maryland Department of Natural Resources.

Coastal Plain Dwarf-Shrub Peatland

***Chamaedaphne calyculata - Vaccinium macrocarpon / Rhynchospora alba / Sphagnum* spp. Dwarf Shrubland**
Leatherleaf – Large cranberry / White beaksedge / Peat moss Shrubland

USNVC Global Element Code: CEGL006852 (Provisional)

Maryland Summary: This early successional community type is a small, groundwater-fed acidic fen characterized by dwarf-shrubs and mucky peats. It occupies small seepage zones with abundant groundwater discharge along toe-slopes bordering small stream floodplains of the inner Coastal Plain. Historical remnants of this community type can also be found bordering former millponds that have filled in or along drainages impounded by road crossings. Stands (n=6) are very small, ranging from 0.2 – 8.7 acres in size. Substrates are extremely acid (mean pH= 4.3) and consist of deep, mucky peats.

The vegetation is characterized as a patchy mosaic of shrubs and herbs growing on moss (*Sphagnum* spp.) covered hummocks that give way to hollows of standing water and deep, mucky peats. Prominent shrubs are *Clethra alnifolia, Chamaedaphne calyculata, Vaccinium macrocarpon,* and *Vaccinium corymbosum.* Other characteristic shrubs include *Hypericum virginicum, Aronia arbutifolia, Rhododendron viscosum* var. *viscosum, Decodon verticillatus,* and *Rubus hispidus.* Small trees of *Acer rubrum, Pinus rigida, Liquidambar styraciflua, Ilex opaca* and *Magnolia virginica* may be scattered on hummocks or occupy drier edges of the fen. The most characteristic herbs are *Rhynchospora alba, Dichanthelium lucidum, Sarracenia purpurea, Drosera rotundifolia* var. *rotundifolia*, and *Osmunda cinnamomea.* Less frequent herbs reported *Rhexia virginica, Drosera intermedia, Arundinaria gigantea, Carex exilis, Rhynchospora capillacea*, and *Eriophorum virginicum.*

Constant Species (constancy >75%)	*Clethra alnifolia, Acer rubrum, Hypericum virginicum , Vaccinium corymbosum, Vaccinium macrocarpon, Chamaedaphne calyculata*
Dominant Species (mean cover ≥ 6)	*Clethra alnifolia, Acer rubrum, Vaccinium macrocarpon, Vaccinium corymbosum, Rhynchospora alba, Dichanthelium lucidum, Carex bullata*
Indicator Species (highest unscaled adj, DV)	*Vaccinium macrocarpon, Clethra alnifolia, Carex exilis, Rhynchospora alba*
Rare and uncommon taxa	*Carex bullata, Carex exilis, Chamaedaphne calyculata, Drosera rotundifolia, Juncus pelocarpus, Platanthera ciliaris, Rhynchospora alba, Sarracenia purpurea, Vaccinium macrocarpon*

Mean Species Richness: 20
Homoteneity: 0.600
Number of Plots: 9
Representative Plots: AACO004, AACO008, AACO009, AACO012, AACO013, AACO015, AACO017, AACO019, AACO021

Maryland Distribution: This community type is supported by plot data within the Magothy and Severn River drainages in Anne Arundel County.

Maryland Conservation Rank: S1

Global Summary: n/a

Global Distribution: Maryland

Global Conservation Rank: G1 proposed

Plate 4. View of plot AACO017 near Gumbottom Branch, Anne Arundel County, MD. Photo: J.W. Harrison © Maryland Department of Natural Resources.

Plate 5. Close-up photograph of Sphagnum covered hummock with *Sarracenia purpurea, Chamaedaphne calyculata* and *Vaccinium macrocarpon.* Photo: J.W. Harrison © Maryland Department of Natural Resources.

Coastal Plain Emergent Millpond Bog

***Juncus pelocarpus - Rhynchospora alba – (Nymphaea odorata* ssp. *odorata)* Herbaceous Vegetation**
Brown-fruit rush – White beaksedge – American water-lily Herbaceous Vegetation

USNVC Global Element Code: CEGL006853 (Provisional)

Maryland Summary: This early successional community type develops along drawdown edges or in the basins of shallow millponds, beaver ponds, and other impoundments of inner Coastal Plain stream drainages. It is currently known from four stream drainages associated with Main Creek and the Magothy River. This vegetation forms as a result of water-levels lowering to due a breach or dam failure. Substrates are extremely acidic (mean pH = 3.8) consisting mucky peats of variable depths. Stands are typically small patched with sizes ranging from 0.3- 1.41 acres.

The vegetation is patchy consisting of species such as *Nymphaea odorata* ssp. *odorata, Dulichium arundinaceum,* and *Decodon verticillatus* in low, mucky pockets. Dense mats of *Hypericum virginicum, Juncus pelocarpus, Rhynchospora alba, Eleocharis olivacea* var. *olivacea, Juncus canadensis, and Carex canescens* are commonly interspersed amongst these pockets. Shrubs and small trees of *Acer rubrum, Chamaedaphne calyculata, Clethra alnifolia, Vaccinium macrocarpon, Aronia arbutifolia, Alnus serrulata,* and *Magnolia virginiana* may occupy seepage edges, hummocks of tree bases, or be scattered throughout basins at low cover. Additional low-cover associates may include *Juncus effusus* ssp. *solutus, Utricularia subulata, Rhexia virginica, Carex atlantica, Glyceria obtusa, Xyris jupicai, Sphagnum rubellum,* and *Sphagnum recurvum.*

Constant Species (constancy >75%)	*Hypericum virginicum , Juncus pelocarpus, Decodon verticillatus, Rhynchospora alba*
Dominant Species (mean cover ≥ 6)	*Juncus pelocarpus, Decodon verticillatus, Nymphaea odorata* ssp. *odorata, Dulichium arundinaceum, Chamaedaphne calyculata*
Indicator Species (highest unscaled adj, DV)	*Juncus pelocarpus, Decodon verticillatus, Nymphaea odorata* ssp. *odorata, Dulichium arundinaceum, Carex canescens*
Rare and uncommon taxa	*Chamaedaphne calyculata, Juncus pelocarpus, Rhynchospora alba*

Mean Species Richness: 11
Homoteneity: 0.682
Number of Plots: 8
Representative Plots: AACO003, AACO005, AACO007, AACO010, AACO011, AACO014, AACO018, AACO020, AACO025 *(data not used in analysis)*

Maryland Distribution: This community type is supported by plot data along stream drainages of Main Creek and the Magothy River, Anne Arundel County.

Maryland Conservation Rank: S1

Global Summary: n/a

Global Distribution: Maryland and possibly NJ

Global Conservation Rank: GNR

Plate 6. View of plot AACO018 near Eagle Hill, Anne Arundel County, MD. Photo: W.M. Knapp © Maryland Department of Natural Resources

Plate 7. View of plot AACO014 near Eagle Hill, Anne Arundel County, MD. Photo: J.W. Harrison © Maryland Department of Natural Resources

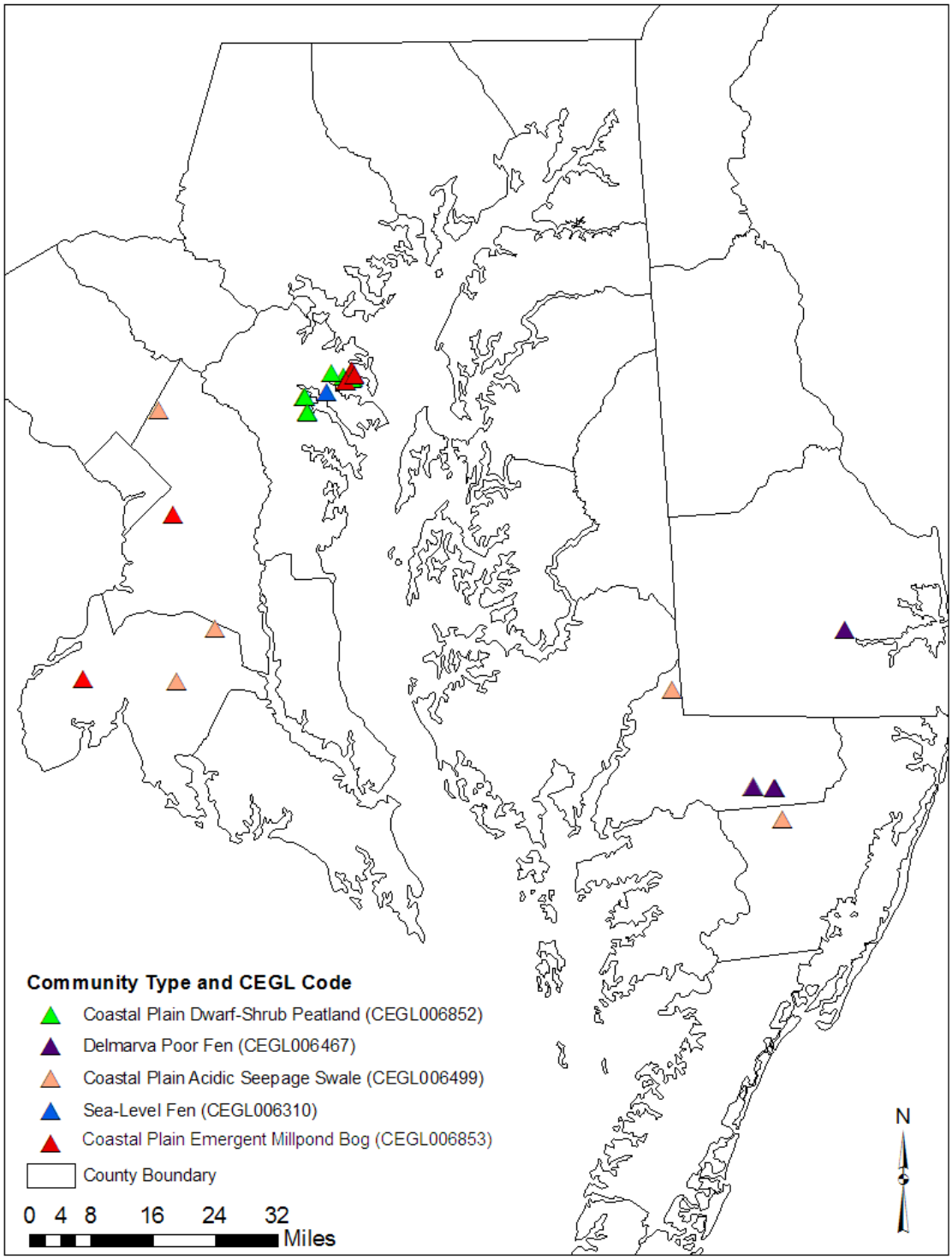

Figure 7. Map of study area and plot locations for five early successional community types.

Fall-Line Terrace Gravel Bog

***Nyssa sylvatica - Magnolia virginiana - (Pinus rigida) / Rhododendron viscosum* var. *viscosum* - *Toxicodendron vernix / Smilax pseudochina* Woodland**
Blackgum - Sweetbay - (Pitch Pine) / Swamp azalea - Poison-sumac / Bamboovine Woodland

USNVC Global Element Code: CEGL006219

Maryland (Global) Summary: This saturated woodland is known from a limited area at and just east of the Fall Line in Maryland, D.C., and Northern Virginia. It occurs on saturated, exposed Potomac Formation (Cretaceous age) gravels, sands, and clays of toe slopes of highly weathered, highly acidic, fluvial-estuarine terrace gravel deposits of Tertiary age. Irregular microtopography with abundant groundwater seepage forming braided channels, *Sphagnum*-covered hummocks, and mucky depressions is characteristic. Historic accounts of this vegetation describe these areas as "bogs" with *Magnolia virginiana* and various shrubs fringing and forming clumps within a more open center dominated by herbaceous plants. Historic vegetation included *Nyssa sylvatica, Toxicodendron vernix* (abundant), *Gaylussacia frondosa* (abundant), *Viburnum nudum* var. *nudum, Pinus rigida*, and *Eriocaulon decangulare* var. *decangulare* (abundant), *Lycopodiella appressa, Carex bullata, Asclepias rubra, Helianthus angustifolius, Rhynchospora gracilenta, Xyris torta, Pogonia ophioglossoides*, and *Utricularia* spp. Today, remaining examples exist mostly as open woodlands with very dense shrubs (averaging 80% cover) and very small, scattered herbaceous patches. *Nyssa sylvatica* is the most dominant species, followed by *Magnolia virginiana, Acer rubrum, Liriodendron tulipifera*, and *Ilex opaca* var. *opaca*. *Pinus rigida* occurs in about half the plots, sometimes with significant cover. Shrub cover includes *Rhododendron viscosum* var. *viscosum, Vaccinium corymbosum, Smilax rotundifolia, Gaylussacia frondosa, Viburnum nudum* var. *nudum, Eubotrys racemosus, Aronia arbutifolia* (*=Photinia pyrifolia*), *Ilex verticillata, Amelanchier canadensis, Ilex laevigata*, and *Toxicodendron vernix*. The only herbs that have significant cover are *Osmunda cinnamomea* and *Dichanthelium dichotomum* var. *dichotomum*, while many others have low cover. Regionally uncommon or rare "bog" species persisting at one or a few sites include *Solidago uliginosa* var. *uliginosa, Eurybia radula (= Aster radula), Eriocaulon decangulare* var. *decangulare, Juncus longii, Drosera intermedia, Asclepias rubra*, and *Kalmia angustifolia*. Historically, fire may have been an important factor in maintaining herbaceous patches and limiting the growth of shrubs and trees, but the geohydrologic conditions and effects of permanently saturated soils “root pruning” and giving rise to blowdowns of large trees (except *Pinus rigida* and *Nyssa sylvatica*) have been extensively observed to be prominent factors. Ice storms, which are frequent over time in the natural range of this community, also maintain an open mosaic in these wetlands. This community has always had a limited distribution in the Mid-Atlantic fall-line zone and has probably always been rare. Today, less than 20 sites remain in very small patches degraded by hydrologic disturbance, non-native invasive plants, woody succession, and various anthropogenic impacts. This community has similarities with the bog vegetation of the New Jersey Pine Barren region but is likely distinguished by species with southern affinities.

Constant Species (constancy >75%)	*Nyssa sylvatica, Acer rubrum, Magnolia virginiana*
Dominant Species (mean cover ≥ 6)	*Nyssa sylvatica, Acer rubrum, Magnolia virginiana, Rhododendron viscosum* var. *viscosum , Osmunda cinnamomea, Dichanthelium dichotomum* var. *dichotomum*
Indicator Species (highest unscaled adj, DV)	*Amelanchier canadensis, Dichanthelium dichotomum* var. *dichotomum, Lyonia ligustrina* var. *ligustrina, Ilex laevigata, Toxicodendron vernix, Rhododendron viscosum* var. *viscosum*
Rare and uncommon taxa	*Drosera filiformis, Eriocaulon decangulare* var. *decangulare , Gaylussacia dumosa, Juncus longii, Rhynchospora rariflora, Sarracenia purpurea, Asclepias rubra, Scleria muhlenbergii, Solidago uliginosa* var. *uliginosa*

Mean Species Richness: 48
Homoteneity: 0.622

Number of Plots: 14
Representative Plots: AIBO001, AMBO001, ARBO001, BARC002, BCBO001, BRBO001, FRBO001 (Virginia plot), LPBO001, NACE007, NACE010, OXBO001, PMBO001, SSBO001, SUBO001

Maryland Distribution: This community type is supported by plot data from Montgomery and Prince Georges County.

Global Distribution: Maryland, Virginia, and Washington D.C.

Maryland Conservation Rank: S1

Global Conservation Rank: G1

Plate 8. Fall-line terrace gravel bog, Prince Georges County, MD. Photo: Rod Simmons

Plate 9. View of "Powder Mill Bog #1", Prince George's County, MD. Photo taken by W.L. McAtee on 14 August 1909.

Plate 10. Photograph of "Powder Mill Bog #3", Prince George's County. Photo taken by W.L. McAtee on 14 August 1909.

Coastal Plain Acidic Seepage Swamp

***Acer rubrum - Nyssa sylvatica - Magnolia virginiana / Viburnum nudum* var. *nudum / Osmunda cinnamomea - Woodwardia areolata* Forest**
Red maple - Blackgum - Sweetbay / Southern wild raisin / Cinnamon fern - Netted chainfern Forest

USNVC Global Element Code: CEGL006238

Maryland Summary: This forested community type is a groundwater-fed acidic swamp associated with headwater streams of the Coastal Plain. Stands develop on toe-slopes and saturated stream bottoms with abundant groundwater discharge through permeable layers of sand and gravel. Substrates are very strongly acidic (mean pH = 4.9) and consist of moderately deep muck and gravels over mineral soil.

The canopy of this community type is dominated by *Acer rubrum* and *Nyssa sylvatica*. Other canopy associates may include *Quercus phellos, Liriodendron tulipifera, Pinus rigida,* and *Liquidambar styraciflua* which tend to increase with disturbance. The subcanopy and shrub layers are diverse and are characterized by *Magnolia virginiana, Vaccinium corymbosum, Viburnum nudum, Ilex opaca* var. *opaca, Ilex verticillata, Rhododendron viscosum* var. *viscosum, Lindera benzoin,* and *Eubotrys racemosus.* The herbaceous layer is characterized by ferns such as *Osmunda cinnamomea, Osmunda regalis* var. *spectabilis,* and *Woodwardia areolata*. Other herbaceous species commonly encountered include *Carex folliculata, Symplocarpus foetidus, Mitchella repens, Arisaema triphyllum, Medeola virginiana, Platanthera clavellata,* and mosses such as *Sphagnum palustre* and *Thuidium delicatulum.*

Constant Species (constancy >75%)	*Vaccinium corymbosum, Magnolia virginiana, Acer rubrum, Mitchella repens, Smilax rotundifolia*
Dominant Species (mean cover ≥ 6)	*Vaccinium corymbosum, Magnolia virginiana, Acer rubrum, Nyssa sylvatica*
Indicator Species (highest unscaled adj, DV)	*Symplocarpus foetidus, Lindera benzoin, Vaccinium corymbosum*
Rare and uncommon taxa	*Helonias bullata, Parnassia asarifolia, Thelypteris simulata, Sarracenia purpurea*

Mean Species Richness: 33
Homoteneity: 0.641
Number of Plots: 10
Representative Plots: AACO022, AACO023, CHCO003, CHCO004, IDYL001, PGCO002, ZESW008, ZESW022, ZESW033, ZESW047
Maryland Distribution: This community type is common on the Coastal Plain of Maryland and supported by plot data from Anne Arundel, Charles, Dorchester, and Prince Georges Counties.

Maryland Conservation Rank: S3S4

Global Summary: This acidic swamp forest of the eastern middle-latitude states is a nutrient-poor wetland forest occurring in groundwater-saturated stream bottoms and poorly drained depressions. Soils are typically moderately deep to deep muck over mineral soil, with pools of standing water at the surface. Acidic waters originate from groundwater seepage, with little to no overland seasonal flooding. Most sites can be characterized as groundwater slope wetlands with a flow-through hydrology. This community is characterized by *Acer rubrum* and *Nyssa sylvatica* in the canopy, which may be quite open in some examples. Canopy associates include *Magnolia virginiana, Liquidambar styraciflua*, and *Persea palustris*, plus occasional incidental *Liriodendron tulipifera* var. *tulipifera* or *Pinus taeda*. Upland trees may occur on drier hummocks. The shrub layer is characterized by *Vaccinium corymbosum*, as well as *Clethra alnifolia, Ilex verticillata, Ilex opaca, Viburnum nudum* var. *nudum, Lindera benzoin*, and *Rhododendron viscosum* var. *viscosum.* The herbaceous layer varies from dense to sparse and may include *Symplocarpus foetidus, Hypericum virginicum , Osmunda regalis* var. *spectabilis, Woodwardia areolata, Carex folliculata, Carex lonchocarpa, Carex collinsii, Carex atlantica, Bartonia paniculata* ssp. *paniculata , Parnassia asarifolia, Helonias bullata, Chelone glabra, Oxypolis rigidior*, and *Osmunda cinnamomea*. *Sphagnum* spp. and other mosses are common.

Global Distribution: New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, and Washington D.C.

Global Conservation Rank: G3?

Plate 11. Photograph of a Coastal Plain Acidic Seep Swamp (CEGL006238) in Cecil County, MD. Photo: J.W. Harrison © Maryland Department of Natural Resources

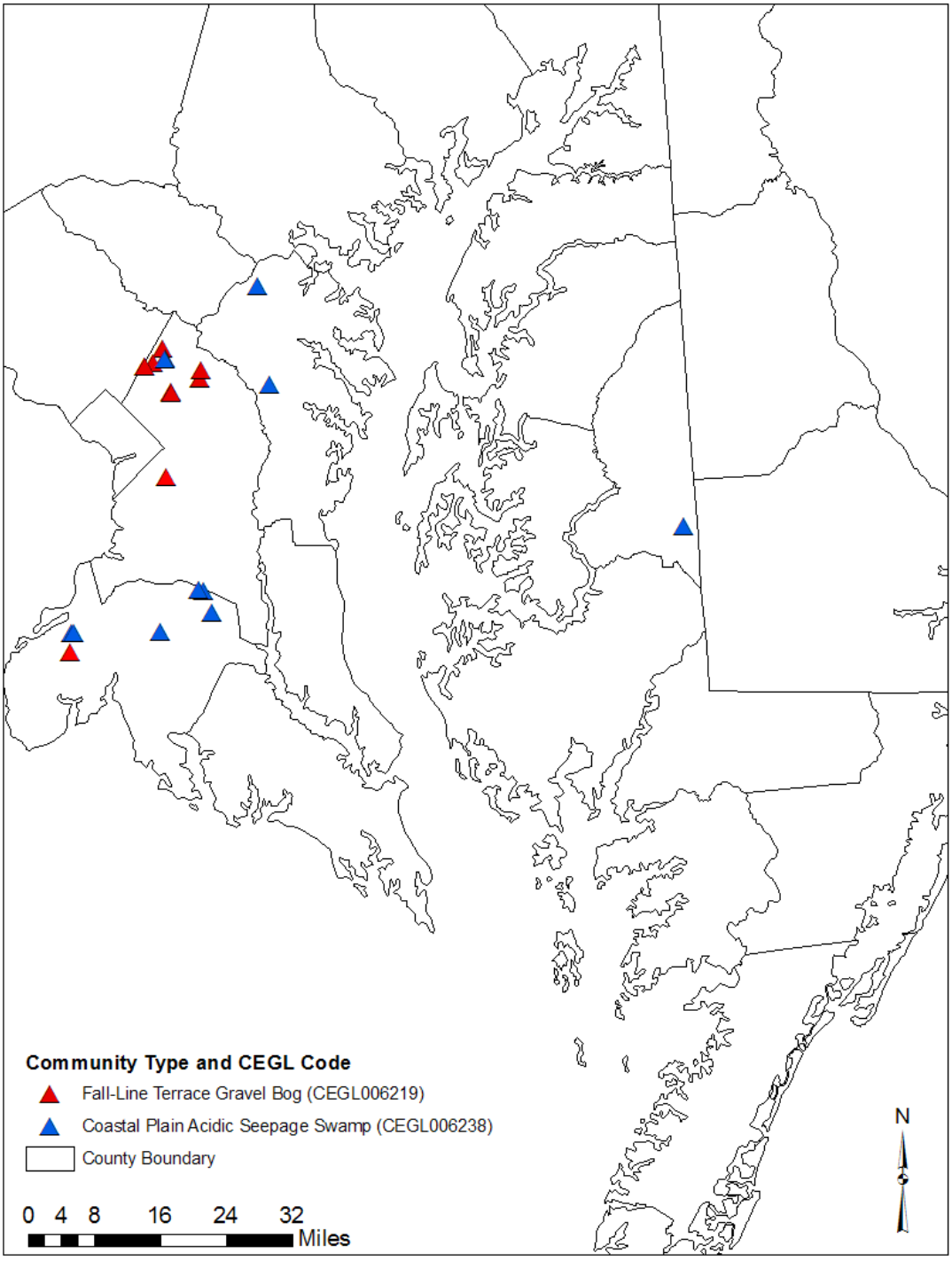

Figure 8. Map of study area and plot locations for two forested community types.

Conservation Implications

Current conservation norms determine protection priorities based on species level information. Although the conservation of rare, threatened, and endangered species is a reasonable endpoint, often these species occur in highly fragmented and human dominated landscapes. These habitat conditions may not allow the persistence of these species. This type of conservation is substantively attempting to maintain biodiversity through protecting these occurrences as umbrella endpoints. However, the conservation of biodiversity may be better served through the protection of rare and/or exemplary common examples of natural communities. Natural communities can play a much broader role by linking habitat and process information to specific species requirements. Potentially, the protection of natural communities will protect the full range of heterogeneity on the landscape, and thus biodiversity. Natural communities can have longer term viability than rare, threatened, and endangered species. Generally, a large scale stochastic event must occur to alter the structure and composition of natural communities at a site, while smaller scale events could eliminate a species from that same site.

Proper documentation and understanding of the biotic and abiotic factors that contribute to natural communities can lead to predictive ability of where these communities occur on the landscape, what species can be found within them, and what rarity and condition qualities exist. By creating a classification of Coastal Plain groundwater-fed wetland communities, this project has assisted in these factors.

The information obtained from this project will be used in planning and regulation by state agencies, federal agencies, municipalities, land trusts, and conservation groups concerned with protection of ecological values in the following ways:

1) Inventory information is used directly within the state's regulatory framework. The Wildlife and Heritage Service, Maryland Department of Natural Resources, serves as a clearing house of information on the status, location, and distribution of rare plant and animal species and exemplary natural communities in the state. The Wildlife and Heritage Service administers the state's Threatened and Endangered Species Act, which requires the compliance of state agencies, private land developers in the protection of threatened and endangered species with the state via permitting for proposed activities affecting said species.

The Wildlife and Heritage Service has long reviewed proposed activities of many state agencies, and is collaborating with the state's Water Resources Administration to review wetland permit applications. Water Resources' Water and Wetlands Program has adopted rules, which require that impacts on state-listed plant and animal species and exemplary natural communities tracked in databases must be considered for all major and minor projects.

2) Many of these wetlands are currently protected under COMAR as Wetlands of Special State Concern (WSSC) under Maryland's Nontidal Wetland Protection Act. The information obtained from this project will assist the Maryland Department of the Environment (MDE) in making better informed decisions regarding the protection of groundwater-fed seepage wetlands. Detailed natural community maps generated by this project may be used by MDE in a regulatory capacity.

3) Protection results through the dissemination of Natural Heritage information to traditional users of these data, including federal agencies, developers, consultants, private landowners, municipalities, and conservation groups. These groups request natural resource information in the early planning stages of local projects, and for longer term municipal zoning, development planning, and conservation priority setting.

4) This inventory also complements Section 104(b)(3) projects undertaken by the Nontidal Wetlands and Wetlands and Waterways Division in several ways. The Water Resources Division is currently developing a computerized database for accessing permitting information more efficiently. Natural Heritage information on unique wetland resources could be represented as a GIS data layer in this database. This would help create a better permit review context for applications received by the Service. Although this option is available, Wildlife and Heritage Service staff currently review wetlands permits and other applications and provide comments on the potential project impacts directly to the Nontidal Wetlands and Waterways Division. These

data will also aid in the development of watershed management plans. Inventory must be completed as one of the first steps in plan development.

5) The results from this project will be shared with the governments and conservation organizations of neighboring states with similar community types. These data will also be shared with NatureServe and The Nature Conservancy. The data will be compiled with the data from other states and analyzed with a regional perspective. This will increase the ability to recognize meaningful patterns and make classification decisions, which will in turn result in an improved context for making conservation and management decisions over a large and comprehensive landscape on the scale of natural community and species ranges.

6) The results of this project provide the necessary baseline data for long term monitoring for assessing the function of similar groundwater-fed wetlands by other wetland researchers. Reference wetlands are recommended as the best examples of each community type defined for continued research by EPA cooperators. This information will also be used to provide a critical reference by which to measure the success of mitigation efforts.

LITERATURE CITED

Brewer R. and M.T. McCann. 1982. Laboratory and field methods in ecology. Saunders College Publishing, Philadelphia, Pennsylvania.

Broersma, J. 1984. A vegetational survey of black hole creek, Anne Arundel County, Maryland. Unpublished report., Towson State University, Towson. Maryland.

Crum, H. 1992. A focus on peatlands and peat mosses. University of Michigan Press, Ann Arbor, Michigan.

Curtis, J.T. 1959. The Vegetation of Wisconsin: An Ordination of Plant Communities, University of Wisconsin Press, Madison, Wisconsin.

Ecological Society of America. 2004. Guidelines for describing associations and alliances of the U.S. National Vegetation Classification. Version 4.0.

ESRI [Environmental Research Systems Institute]. 2006. ArcGis 9.2 Software. Redlands, California.

Fleming, G.P., P.P. Coulling, K.D. Patterson, and K.M. McCoy. 2004. The natural communities of Virginia: classification of ecological community groups. Second approximation. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia.

Fleming, G.P. 2007. Ecological Communities of the Potomac Gorge in Virginia: composition, floristics, and environmental dynamics. Natural Heritage Tech. Rep. 07-12. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, Virginia. Unpublished report submitted to the National Park Service. 341 pp. plus appendices.

Grossman, D.H. D. Faber-Langendoen, A.S. Weakly, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K.D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The national vegetation classification system: development, status, and applications. The Nature Conservancy, Arlington, Virginia.

Gleason, H.A. and A. Cronquist. 1991. Manual of vascular plants of northeastern United States and adjacent Canada, second edition. New York Botanical Gardens, Bronx, New York. 910 pp.

Harrison, J.W. 2010. The Natural Communities of Maryland: 2010 Working list of Ecological Community Groups and Community Types. Maryland Department of Natural Resources, Wildlife and Heritage Service, Natural Heritage Program, Annapolis, Maryland.

Hirst, F. and R. Wilson. 1993. Unpublished data submitted to the Maryland Natural Heritage Program, Wildlife and Heritage Division, Maryland Department of Natural Resources, Annapolis, Maryland.

Hull, J.C. and D.F. Whigham. 1987. Vegetation patterns in six bogs and adjacent forested wetlands on the inner Coastal Plain of Maryland. In: Laderman, A.D., ed. 1987. Atlantic white cedar wetlands. Westview Press, Boulder, Colorado. 143-173 pp.

Jongman, R.H.G., C.J.F. ter Braak, and O.F.R. van Tongeren. 1995. Data analysis in community and landscape ecology, Cambridge University Press, Cambridge, Massachusetts.

Kruskal, J.B. 1964. Nonmetric multidimensional scaling: a numerical method. Psychometrika 29: 115–129.

Lance, G.N. and W.T. Williams. 1967. A general theory of classificatory sorting strategies: I. Hierarchical systems. Computer Journal 9: 373-380.

Ludwig, J.C. 1992. Delaware's sea-level fens: A report on a Natural Heritage survey. Unpublished report submitted to the Delaware Department of Natural Resources, Division of Parks and Recreation, Natural Heritage Program.

Ludwig, J.C. 1995. An overview of sea-level fens. Unpublished report. Virginia Division of Natural Heritage, Richmond, Virginia.

Maryland Department of Natural Resources, 2005. Maryland Wildlife Diversity Conservation Plan. Maryland Department of Natural Resources, Wildlife and Heritage Service, Annapolis, Maryland.

Maryland Natural Heritage Program. 2007. Rare, Threatened and Endangered Plants of Maryland. November 2007 edition. Maryland Department of Natural Resources, Wildlife and Heritage Service, Annapolis, Maryland.

Meininger, J. 1998. Forest Communities of Zekiah Swamp nontidal wetland of special State concern. Maryland Department of Natural Resources, Wildlife and Heritage Division, Annapolis, Maryland. Unpublished report submitted to the Maryland Department of the Environment. 19 pp.

McAtee, W.L. 1918. A sketch of the natural history of the District of Columbia. Bulletin of the Biological Society of Washington.

McCune, B. and J.B. Grace. 2002. Analysis of ecological communities. MJM Software Design, Gleneden Beach, Oregon.

McCune, B. and M.J. Mefford. 2006. PC-ORD. Multivariate analysis of ecological data, version 5.21. MjM Software, Gleneden Beach, Oregon.

McQueen, C.B. and R.E. Andrus. 2007. Sphagnaceae. 45-101 in Flora of North America vol. 27, ed. Flora of North America Editorial Committee. Oxford University Press, New York, New York.

Mehlich, A. 1984. Mehlich III soil test extraction modification of Mehlich II extractant. Communications in Soil Science and Plant Analysis 15: 1409-1416.

Mueller-Dombois, D. and H. Ellenberg. 1974. Aims and methods of vegetation ecology. John Wiley & Sons, Inc., New York. 547 pp.

NatureServe, 2010. NatureServe Explorer website: An online encyclopedia of life [web application]. Version 7.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed 6/1/2010)

Peet, R.K., T.R. Wentworth, and P.S. White. 1998. A flexible, multipurpose method for recording vegetation composition and structure. Castanea 63: 262-274.

Schmidt, M.F. 1993. Maryland's geology. Tidewater publications, Centreville, Maryland.

Shreve, F., M.A. Chrysler, F.H. Blodgett, and F.W. Besley. 1910. The plant life of Maryland. Johns Hopkins Press, Baltimore, Maryland. 533 pp.

Sipple, W.S. and W.A. Klockner. 1980. A unique wetland in Maryland. Castanea 45: 60–69.

Simmons, R. & M. Strong. 2002. Unpublished plot data submitted to the Wildlife and Heritage Service, Maryland Department of Natural Resources, Annapolis, Maryland.

Sokal, R.R. and F.J. Rohlf. 1995. Biometry. Third edition. W.H. Freeman & Co., New York.

Smith, N., S. Mori, A. Henderson, D.W. Stevenson, and S.V. Heald. 2004. Flowering Plants of the Neotropics The New York Botanical Gardens, Princeton, New Jersey. p. xvii.

Tiner, R.W. and D.G. Burke. 1995. Wetlands of Maryland. U.S. Fish and Wildlife Service, Ecological Services, Region 5, Hadley, Massachusetts. 193 pp.

Weakley, A.S. 2010. Flora of the southern and mid-atlantic States. Working draft, February 19, 2010. University of North Carolina Herbarium, North Carolina Botanical Gardens, Chapel Hill, North Carolina.

Wilson, R. 2004. Unpublished plot data submitted to the Wildlife and Heritage Service, Maryland Department of Natural Resources, Annapolis, Maryland.

USDA, NRCS. 2010. The PLANTS Database (http://plants.usda.gov, 1 June 2010). National Plant Data Team, Greensboro, North Carolina.

APPENDIX I. LIST OF 343 VASCULAR AND NONVASCULAR PLANT TAXA REPORTED FROM 51 VEGETATION SAMPLE PLOTS. Taxa listed in alphabetical order by family. 1 = infraspecific identification for these taxa could not be determined due to time of year constraints or data source limitations; 2 = names follow Gleason and Cronquist (1991); † = exotic species

TAXON	COMMON NAME	GRANK	SRANK	No. of Plots
LYCOPHODIOPHYTA				
LYCOPODIACEAE				
Dendrolycopodium obscurum (Linnaeus) A. Haines	Common tree clubmoss			6
Lycopodiella alopecuroides (Linnaeus) Cranfill	Foxtail clubmoss			1
Lycopodiella appressa (Chapman) Cranfill	Southern bog clubmoss			5
Lycopodium sp.	A clubmoss			1
SELAGINELLACEAE				
Selaginella apoda (Linnaeus) Spring	Meadow spike-moss			1
POLYPODIOPHYTA				
BLECHNACEAE				
Woodwardia areolata (Linnaeus) T. Moore	Netted chain fern			15
Woodwardia virginica (Linnaeus) J.E. Smith	Virginia chain fern			6
DRYOPTERIDACEAE				
Dryopteris sp. [1]				1
OSMUNDACEAE				
Osmundastrum cinnamomeum (Linnaeus) C. Presl	Cinnamon fern			26
Osmunda regalis Linnaeus var. *spectabilis* (Willdenow) Gray	Royal fern			13
THELYPTERIDACEAE				
Thelypteris noveboracensis (Linnaeus) Nieuwland	New York fern			3
Thelypteris palustris Schott var. *pubescens* (Lawson) Fernald	Marsh fern			10
Thelypteris simulata (Davenport) Nieuwland	Bog fern	G5	S2	1
WOODSIACEAE				
Deparia acrostichoides (Swartz) M. Kato	Silvery spleenwort			1
PINOPHYTA				
CUPRESSACEAE				
Chamaecyparis thyoides (Linnaeus) Britton, Sterns, & Poggenburg	Atlantic white-cedar	G4	S3	2
Juniperus virginiana Linnaeus var. *virginiana*	Eastern redcedar			5
Taxodium distichum (Linnaeus) L.C. Richard	Baldcypress			2
PINACEAE				
Pinus rigida P. Miller	Pitch pine			13

Pinus serotina Michaux	Pond pine			2
Pinus taeda Linnaeus	Loblolly pine			3
Pinus virginiana P. Miller	Virginia pine			10
Tsuga canadensis (Linnaeus) Carrière	Eastern hemlock			1

MAGNOLIOPHYTA

ADOXACEAE

Sambucus canadensis Linnaeus	Common elderberry			7
Viburnum dentatum Linnaeus var. *dentatum*	Southern arrow-wood			6
Viburnum dentatum Linnaeus var. *lucidum* Aiton	Northern arrow-wood			9
Viburnum nudum Linnaeus	Possum-haw			19

ANACARDIACEAE

Rhus copallinum Linnaeus var. *copallinum*	Winged sumac			1
Toxicodendron radicans (Linnaeus) Kuntze var. *radicans*	Poison ivy			13
Toxicodendron vernix (Linnaeus) Kuntze	Poison sumac			7

ANNONACEAE

Asimina triloba (Linnaeus) Dunal	Pawpaw			1

APIACEAE

Cicuta maculata Linnaeus var. *maculata*	Water-hemlock			2
Eryngium aquaticum Linnaeus var. *aquaticum*	Marsh rattlesnake-master			1
Oxypolis rigidior (Linnaeus) Rafinesque	Cowbane			4

APOCYNACEAE

Asclepias incarnata Linnaeus var. *pulchra* (Ehrhart ex Willdenow) Persoon	Swamp milkweed			1
Asclepias rubra Linnaeus	Red milkweed	G4G5	S1	1

AQUIFOLIACEAE

Ilex crenata Thunberg †	Japanese holly			2
Ilex glabra (Linnaeus) A. Gray	Inkberry			1
Ilex laevigata (Pursh) A. Gray	Smooth winterberry			8
Ilex opaca Aiton var. *opaca*	American holly			25
Ilex verticillata (Linnaeus) A. Gray	Winterberry			22

ARALIACEAE

Aralia nudicaulis Linnaeus	Wild sarsaparilla			3
Hedera helix Linnaeus var. *helix* †	English ivy			1
Hydrocotyle umbellata Linnaeus	Marsh water-pennywort			2

ASTERACEAE

Bidens frondosa Linnaeus	Devil's beggar-ticks			1
Bidens mitis (Michaux) Sherff	Small-fruit beggar-ticks	G4?	S1	1
Doellingeria umbellata (P. Miller) Nees	Flat-top white aster			1
Erechtites hieraciifolia (Linnaeus) Rafinesque ex de Condolle	Pilewort			2
Eupatorium hyssopifolium Linnaeus	Hyssopleaf thoroughwort			1
Eupatorium leucolepis (De Candolle) Torrey & Gray	Savanna thoroughwort	G5	S2S3	1

Eupatorium perfoliatum Linnaeus	Common boneset			1
Eupatorium pilosum Walter	Vervain thoroughwort			10
Eupatorium rotundifolium Linnaeus	Roundleaf thoroughwort			1
Eupatorium serotinum Michaux	Late thoroughwort			2
Eupatorium sp.	A boneset			1
Eurybia radula (Aiton) Nesom	Rough-leaved aster	G5	S1	1
Euthamia caroliniana (Linnaeus) Greene ex. Porter & Britton	Slender goldenrod			3
Euthamia graminifolia (Linnaeus) Greene	Flat-topped goldenrod	G5		3
Eutrochium dubium (Willdenow ex Poiret) E.E. Lamont	Three-nerved joe-pye weed			1
Eutrochium fistulosum (Barrett) E.E. Lamont	Hollow joe-pye weed			3
Iva frutescens Linnaeus[1]	Marsh-elder	G5		1
Sclerolepis uniflora (Walter) Britton, Sterns, & Poggenburg	One-flower sclerolepis	G4	S2	2
Solidago canadensis Linnaeus[1]	Canada goldenrod			1
Solidago fistulosa Miller	Pine barrens goldenrod			1
Solidago juncea Aiton	Early goldenrod			1
Solidago latissimifolia Miller	Elliott's goldenrod			1
Solidago rugosa P. Miller[1]	Rough-stemmed goldenrod			8
Solidago uliginosa Nuttall var. *uliginosa*	Bog goldenrod	G4G5T4T5	S3	5
Symphyotrichum lanceolatum (Willd.) Nesom var. *lanceolatum*	Panicled aster			1
Symphyotrichum lateriflorum (Linnaeus) A.& D. Löve var. *lateriflorum*	Starved aster			1
Symphyotrichum novi-belgii (Linnaeus) Nesom[1]	New York aster			2
Symphyotrichum racemosum (Elliott) Nesom var. *racemosum*	Small white aster			1
Vernonia noveboracensis (Linnaeus) Michaux	New York ironweed			2
BALSAMINACEAE				
Impatiens capensis Meerburgh	Spotted jewelweed			1
BETULACEAE				
Alnus maritima (Marshall) Muhlenberg ssp. *maritima*	Seaside alder	G3	S3.1	1
Alnus serrulata (Aiton) Willdenow	Smooth alder			8
Betula nigra Linnaeus	River birch			2
Carpinus caroliniana Walter var. *caroliniana*	American hornbeam			2
CAPRIFOLIACEAE				
Lonicera japonica Thunberg †	Japanese honeysuckle			5
CELASTRACEAE				
Euonymus americanus Linnaeus	American strawberry-bush			4
Euonymus fortunei (Turczaninow) Handel-Mazzetti †	Winter-creeper			1
CLETHRACEAE				
Clethra alnifolia Linnaeus	Sweet pepper-bush			23
CONVOLVULACEAE				
Cuscuta gronovii Willdenow ex J.A. Schultes	Gronovius' dodder			1
CORNACEAE				
Cornus florida Linnaeus	Flowering dogwood			1

DROSERACEAE				
Drosera intermedia Hayne	Spoon-leaved sundew			12
Drosera rotundifolia var. *rotundifolia* Linnaeus	Roundleaf sundew	G5T5	S3	6
EBENACEAE				
Diospyros virginiana Linnaeus	Persimmon			1
ERICACEAE				
Chamaedaphne calyculata (Linnaeus) Moench	Leatherleaf	G5	S1	12
Eubotrys racemosa (Linnaeus) Nuttall	Fetterbush	G5	S5	17
Gaultheria procumbens Linnaeus	Wintergreen			1
Gaylussacia frondosa (Linnaeus) Torrey & Gray ex Torrey	Dangleberry			9
Kalmia angustifolia Linnaeus	Sheep-laurel	G5	S3S4	1
Kalmia latifolia Linnaeus	Mountain-laurel			3
Lyonia ligustrina (Linnaeus) De Candolle var. *ligustrina*	Maleberry			11
Monotropa uniflora Linnaeus	Indian-pipe	G5	S5	1
Rhododendron periclymenoides (Michaux) Shinners	Wild azalea			1
Rhododendron viscosum (Linnaeus) Torrey var. *viscosum*	Swamp azalea			28
Vaccinium caesariense Mackenzie	New Jersey blueberry			1
Vaccinium corymbosum Linnaeus	Highbush blueberry			33
Vaccinium fuscatum Aiton	Hairy highbush blueberry			4
Vaccinium macrocarpon Aiton	Large cranberry	G4	S3	11
Vaccinium pallidum Aiton	Early lowbush blueberry			3
FABACEAE				
Albizia julibrissin Durazzini †	Silk tree			1
Apios americana Medicus	American groundnut			3
Chamaecrista nictitans (Linnaeus) Moench var. *nictitans*	Wild sensitive-plant			1
Desmodium paniculatum (Linnaeus) De Candolle var. *paniculatum*	Narrow-leaf tick-trefoil			1
Trifolium pratense Linnaeus †	Red clover			1
FAGACEAE				
Castanea pumila (Linnaeus) P. Miller	Allegheny chinkapin			1
Fagus grandifolia Ehrhart var. *caroliniana* (Loudon) Fernald & Rehder	American beech			9
Quercus alba Linnaeus	White oak			9
Quercus coccinea Muenchhausen	Scarlet oak			9
Quercus falcata Michaux	Southern red oak			4
Quercus michauxii Nuttall	Swamp chestnut oak			1
Quercus montana Willdenow	Chestnut oak			1
Quercus nigra Linnaeus	Water oak			1
Quercus pagoda Rafinesque	Cherrybark oak			1
Quercus phellos Linnaeus	Willow oak			16
Quercus rubra Linnaeus var. *rubra*	Northern red oak			2
GENTIANACEAE				
Bartonia paniculata (Michaux) Muhlenberg ssp. *paniculata*	Twining bartonia	G5	S3	1
Bartonia virginica (Linnaeus) Britton, Sterns & Poggenburg	Yellow screwstem			3

HALORAGACEAE				
Proserpinaca pectinata Lamarck	Comb-leaved mermaid-weed			4
HAMAMELIDACEAE				
Liquidambar styraciflua Linnaeus	Sweetgum			20
HYPERICACEAE				
Hypericum canadense Linnaeus	Canadian St. John's-wort			4
Hypericum mutilum Linnaeus var. *mutilum*	Slender St. John's-wort			4
Hypericum sp.	A St. John's-wort			1
Hypericum virginicum Linnaeus	Virginia Marsh St. John's wort			27
LAMIACEAE				
Lycopus americanus Muhlenberg ex Bartram	American bugleweed			4
Lycopus virginicus Linnaeus	Virginia bugleweed			7
LAURACEAE				
Lindera benzoin L. benzoin (Linnaeus) Blume	Spicebush			9
Sassafras albidum (Nuttall) Nees	Sassafras			3
LENTIBULARIACEAE				
Utricularia gibba Linnaeus	Humped bladderwort			1
Utricularia sp.	A bladderwort			1
Utricularia subulata Linnaeus	Zigzag bladderwort	G5	S3	2
LINACEAE				
Linum sp.	A flax			1
Linum striatum Walter	Ridged yellow flax			4
LYTHRACEAE				
Decodon verticillatus (Linnaeus) Elliott	Swamp loosestrife			9
MAGNOLIACEAE				
Liriodendron tulipifera Linnaeus var. *tulipifera*	Tulip-poplar			14
Magnolia virginiana Linnaeus	Sweetbay			30
MALVACEAE				
Hibiscus moscheutos Linnaeus ssp. *moscheutos*	Eastern rose-mallow			2
Kosteletzkya pentacarpos (Linnaeus) Ledebour	Virginia seashore mallow			1
MELASTOMATACEAE				
Rhexia mariana Linnaeus var. *mariana*	Maryland meadow-beauty			1
Rhexia virginica Linnaeus [2]	Virginia meadow-beauty			11
MORACEAE				
Morus alba Linnaeus †	White mulberry			1
MYRICACEAE				
Morella cerifera (Linnaeus) Small	Southern bayberry			2

MYRSINACEAE				
Lysimachia quadrifolia Linnaeus	Whorled loosestrife			1
NYSSACEAE				
Nyssa sylvatica Marshall	Black Gum			26
OLEACEAE				
Chionanthus virginicus Linnaeus	Fringetree			7
Fraxinus pennsylvanica Marshall	Green ash			2
ONAGRACEAE				
Ludwigia alternifolia Linnaeus	Alternate-leaved seedbox			4
Oenothera fruticosa Linnaeus var. *fruticosa*	Sundrops			2
OXALIDACEAE				
Oxalis stricta Linnaeus	Upright yellow wood-sorrel			1
PHYTOLACCACEAE				
Phytolacca americana Linnaeus	Common pokeweed			1
PLATANACEAE				
Platanus occidentalis Linnaeus	Sycamore			1
POLYGALACEAE				
Polygala cruciata Linnaeus var. *aquilonia* Fernald & Schubert	Crossleaf milkwort	G5	S2	1
POLYGONACEAE				
Persicaria arifolia (Linnaeus) Haraldson	Halberd-leaf tearthumb			5
Persicaria hydropiperoides (Michaux) Small	Mild water-pepper			1
Persicaria punctata (Elliott) Small	Dotted smartweed			1
Persicaria sagittata (Linnaeus) Gross ex Nakai	Arrow-leaved tearthumb			2
Persicaria longiseta (de Bruijn) Kitagawa †	Long-bristled smartweed			2
Persicaria virginiana (Linnaeus) Gaetner	Virginia knotweed			1
RANUNCULACEAE				
Ranunculus bulbosus Linnaeus	Bulbous buttercup			1
Ranunculus sp.	A buttercup			1
RHAMNACEAE				
Rhamnus cathartica Linnaeus	European buckthorn			1
ROSACEAE				
Amelanchier canadensis (Linnaeus) Medicus	Canada serviceberry			14
Amelanchier sp.	A serviceberry			1
Aronia arbutifolia (Linnaeus) Persoon	Red chokeberry			22
Aronia prunifolia (Marshall) Rehder	Purple chokeberry	G4G5Q	S3	1
Fragaria virginiana Duchesne	Wild strawberry			1
Malus sp.	A crabapple			1
Potentilla canadensis Linnaeus var. *canadensis*	Canada cinquefoil			1

Prunus serotina Ehrhart var. *serotina*	Wild black cherry			7
Pyrus calleryana Decaisne	Bradford pear			1
Rosa multiflora Thunberg †	Multiflora rose			1
Rosa palustris Marshall	Swamp rose			7
Rubus allegheniensis Porter ex Bailey	Alleghany blackberry			3
Rubus flagellaris Willdenow	Northern dewberry			1
Rubus hispidus Linnaeus	Bristly dewberry			26
Rubus sp.	A blackberry			1
Spiraea alba Du Roi	Narrow-leaved meadowsweet			1
Spiraea tomentosa Linnaeus	Hardhack steeplebush			1
RUBIACEAE				
Cephalanthus occidentalis Linnaeus	Common buttonbush			1
Galium tinctorium Linnaeus[1]	Southern three-lobed bedstraw			3
Mitchella repens Linnaeus	Partridge-berry			21
SALICACEAE				
Salix nigra Marshall	Black willow			1
SAPINDACEAE				
Acer rubrum Linnaeus[1]	Red maple			46
SARRACENIACEAE				
Sarracenia flava Linnaeus †	Yellow pitcher-plant			1
Sarracenia purpurea Linnaeus[2]	Purple pitcher-plant	G5	S2	10
SAURURACEAE				
Saururus cernuus Linnaeus	Lizard's-tail			3
SAXIFRAGACEAE				
Parnassia asarifolia Ventenat	Kidneyleaf grass-of-parnassus	G4	S1	1
SYMPLOCACEAE				
Symplocos tinctoria (Linnaeus) L'Heritier	Horse-sugar	G5	S3	1
URTICACEAE				
Boehmeria cylindrica (Linnaeus) Swartz	False nettle			4
VIOLACEAE				
Viola cucullata Aiton	Marsh blue violet			6
Viola lanceolata Linnaeus var. *lanceolata*	Narrow-leaved violet			1
Viola primulifolia Linnaeus	Primrose-leaved violet			9
VITACEAE				
Parthenocissus quinquefolia (Linnaeus) Planchon	Virginia creeper			8
Vitis aestivalis Michaux[1]	Summer grape			2
Vitis labrusca Linnaeus	Fox grape			3
Vitis sp.	A grape			1

LILIOPSIDA

ALISMATACEAE

Sagittaria engelmanniana J. G. Smith	Engelmann's arrowhead	G5?	S2	2
Sagittaria latifolia Willdenow var. *latifolia*	Hairy broadleaf arrowhead			3

ARACEAE

Arisaema triphyllum (Linnaeus) Schott[1]	Jack-in-the-pulpit			7
Peltandra virginica (Linnaeus) Schott	Arrow-arum			1
Symplocarpus foetidus (Linnaeus) Salisbury ex W.P.C. Barton	Skunk-cabbage			11

COLCHICACEAE

Uvularia sessilifolia Linnaeus	Sessile-leaf bellwort			3

CYPERACEAE

Carex abscondita Mackenzie	Thicket sedge			1
Carex alata Torrey	Broadwing sedge			1
Carex albicans Willdenow ex Sprengel	Bellow-beaked sedge			1
Carex albolutescens Schweinitz	Greenish-white sedge			2
Carex atlantica Bailey	Atlantic sedge			11
Carex bullata Schkuhr ex Willdenow	Button sedge	G5	S3	5
Carex canescens Linnaeus[1]	Silvery sedge			6
Carex collinsii Nuttall	Collins' sedge			1
Carex crinita Lamarck var. *crinita*	Long hair sedge			3
Carex debilis Lamarck	White-edge sedge			3
Carex digitalis Willdenow[1]	Slender wood sedge			2
Carex exilis Dewey	Coast sedge	G5	S1	3
Carex folliculata Linnaeus	Long sedge			11
Carex intumescens Rudge var. *intumescens*	Bladder sedge			5
Carex leptalea Wahlenberg var. *harperi* (Fernald) Weatherby & Griscom	Bristly-stalk sedge			3
Carex lonchocarpa Willdenow	A sedge			1
Carex longii Mackenzie	Greenish-white sedge			2
Carex lurida Wahlenberg	Sallow sedge			7
Carex platyphylla Carey	Broad-leaved sedge			2
Carex radiata (Wahlenberg) Small	Stellate sedge			1
Carex seorsa Howe	Weak stellate sedge			7
Carex striata Michaux var. *brevis* L.H. Bailey	A sedge			1
Carex stricta Lamarck	Tussock sedge			3
Carex swanii (Fernald) Mackenzie	Swan sedge			1
Carex venusta Dewey	Dark green sedge	G4	S2	1
Cladium mariscoides (Muhlenberg) Torrey	Twig rush			5
Cyperus strigosus Linnaeus	Straw-colored flatsedge			2
Dulichium arundinaceum (Linnaeus) Britton	Three-way sedge			11
Eleocharis microcarpa Torrey var. *filiculmis* Torrey	Small-fruited spikerush			1
Eleocharis obtusa (Willdenow) Schultes	Blunt spikerush			2
Eleocharis olivacea Torrey var. *olivacea*	Capitate spikerush			2
Eleocharis rostellata (Torrey) Torrey	Beaked spikerush	G5	S2?	2
Eleocharis tenuis (Willdenow) J.A. Schultes var. *pseudoptera* (Weatherby) Svenson	Slender spikerush			1
Eleocharis tortilis (Link) Schultes	Twisted spikerush	G5	S3	4

Eleocharis tuberculosa (Michaux) Roemer & Schultes	Long-tubercled spikerush			3
Eriophorum virginicum Linnaeus	Tawny cotton-grass	G5	S3	2
Fimbristylis autumnalis (Linnaeus) Roemer & Schultes	Slender fimbry			1
Fuirena squarrosa Michaux	Hairy umbrella-sedge			4
Rhynchospora alba (Linnaeus) Vahl	Northern white beaksedge	G5	S3	14
Rhynchospora capitellata (Michaux) Vahl	Brownish beaksedge			10
Rhynchospora cephalantha Gray var. *cephalantha*	Bunched beaksedge	G5	S1	2
Rhynchospora chalarocephala Fernald & Gale	Loose-headed beaksedge			4
Rhynchospora fusca (Linnaeus) Aiton	Brown beakrush			1
Rhynchospora glomerata (Linnaeus) Vahl var. *glomerata*	Clustered beaksedge	G5	S3	1
Rhynchospora gracilenta A. Gray	Slender beaksedge			8
Rhynchospora inundata (Oakes) Fernald	Drowned hornedrush	G4?	S1	2
Rhynchospora macrostachya Gray	Tall horned beaksedge			1
Rhynchospora microcephala (Britton) Britton ex Small	Tiny-headed beakrush	G5	S2S3	2
Schoenoplectus purshianus (Fernald) M.T. Strong	Weakstalk bulrush			1
Scirpus cyperinus (Linnaeus) Kunth	Woolgrass			5
Scirpus polyphyllus Vahl	Leafy bulrush			4
Scleria muehlenbergii Steudel	Pitted nutrush	G5	(S1*)	1
Scleria reticularis Michaux	Reticulated Nutrush	G4	S2	1
DIOSCOREACEAE				
Dioscorea sp.	A wild yam			1
Dioscorea villosa Linnaeus	Common wild yam	G4G5	S4S5	13
ERIOCAULACEAE				
Eriocaulon compressum Lamarck	Flattened pipewort	G5	S2	3
Eriocaulon decangulare Linnaeus var. *decangulare*	Ten-angled pipewort	G5	S2	3
JUNCACEAE				
Juncus acuminatus Michaux	Sharp-fruited rush			2
Juncus caesariensis Coville	New Jersey rush	G2	S1	1
Juncus canadensis J. Gay ex Laharpe	Canada rush			11
Juncus debilis Gray	Weak rush			4
Juncus effusus Linnaeus ssp. solutus (Fernald & Wiegel) Hamet-Ahti	Soft rush			9
Juncus longii Fernald	Long's rush	G3Q	S1	4
Juncus pelocarpus E. Meyer	Brown-fruited rush	G5	S1	8
Juncus scirpoides Lamarck var. *scirpoides*	Scirpus-like rush			1
Juncus subcaudatus Beauvois ex Poiret	Short-tailed rush			6
Juncus tenuis Willdenow	Slender rush			2
LILIACEAE				
Medeola virginiana Linnaeus	Indian cucumber-root			12
MELANTHIACEAE				

Helonias bullata Linnaeus	Swamp-pink	G3	S2	1
Veratrum virginicum (Linnaeus) Aiton	Virginia bunchflower	G5	S3	1
NYMPHAEACEAE				
Nymphaea odorata Aiton ssp. *odorata*	American water-lily			9
ORCHIDACEAE				
Calopogon tuberosus (Linnaeus) Britton var. *tuberosus*	Tuberous grass-pink	G5T5	S1	2
Cypripedium acaule Aiton	Pink lady's-slipper			2
Goodyera pubescens (Willdenow) R. Brown	Downy rattlesnake-plantain			1
Platanthera ciliaris (Linnaeus) Lindley	Yellow fringed orchid	G5	S2	1
Platanthera clavellata (Michaux) Luer	Small green wood orchid			9
Platanthera cristata (Michaux) Lindley	Crested fringed orchid	G5	S3	1
Platanthera lacera (Michaux) G. Don	Ragged fringed orchid			1
Pogonia ophioglossoides (Linnaeus) Ker-Gawler	Rose pogonia	G5	S3	5
Spiranthes cernua (Linnaeus) Richard	Nodding ladies'-tresses			2
Tipularia discolor (Pursh) Nuttall	Cranefly orchid			1
POACEAE				
Agrostis perennans (Walter) Tuckerman	Autumn bentgrass			2
Agrostis stolonifera Linnaeus	Spreading bentgrass			1
Andropogon glomeratus (Walter) Britton, Sterns & Poggenburg var. *glomeratus*	Bushy bluestem			9
Andropogon virginicus Linnaeus	Broomsedge			6
Arthraxon hispidus (Thunberg) Makino var. *hispidus* †	Joint-head arthraxon			1
Arundinaria tecta (Walter) Muhlenberg	Giant cane	G5	S2	2
Calamagrostis canadensis (Michaux) Palisot de Beauvois var. *canadensis*	Blue joint reedgrass	G5T5	S3	1
Calamagrostis coarctata (Torrey) Eaton	Nuttall's reedgrass			4
Chasmanthium laxum (Linnaeus) Yates	Slender spikegrass			9
Cinna arundinacea Linnaeus	Wood reedgrass			6
Dactylis glomerata Linnaeus †	Orchard grass			1
Dichanthelium acuminatum (Swartz) Gould & C.A. Clark[1]	Woolly panic grass			2
Dichanthelium clandestinum (Linnaeus) Gould	Deer-tongue panic grass			3
Dichanthelium dichotomum (Linnaeus) Gould var. *dichotomum*	Small-fruited panic grass			13
Dichanthelium dichotomum (Linnaeus) Gould var. *roanokense* (Ashe) LeBlond	A panic grass			1
Dichanthelium ensifolium (Baldwin ex Elliott) Gould	Small-leaved panic grass			5
Dichanthelium lucidum (Ashe) LeBlond	A panic grass			5
Dichanthelium scabriusculum (Elliott) Gould & C.A. Clark	Tall swamp panic grass	G4	S1	4
Dichanthelium scoparium (Lamarck) Gould	Velvet panic grass			2
Dichanthelium sp.	A panic grass			1
Dichanthelium sphaerocarpon (Elliott) Gould	Roundfruit panic grass			1
Elymus virginicus Linnaeus	Virginia wild rye			1
Glyceria obtusa (Muhlenberg) Trinius	Coastal mannagrass			5
Glyceria striata (Lamarck) A.S. Hitchcock var. *striata*	Fowl mannagrass			9
Leersia oryzoides (Linnaeus) Swartz	Rice cutgrass			3
Leersia virginica Willdenow	Virginia cutgrass			9
Microstegium vimineum (Trinius) A. Camus †	Japanese stiltgrass			3
Panicum anceps Michaux [2]	Beaked panic grass			1

Panicum dichotomiflorum Michaux var. *dichotomiflorum*	Fall witch grass			1
Panicum rigidulum Bosc ex Nees [2]	Tall flat panic grass			4
Panicum verrucosum Muhlenberg	Warty panicgrass			5
Paspalum laeve Michaux var. *leave*	Smooth field paspalum			1
Schedonorus pratensis (Hudson) P. Beauvois †	Meadow fescue			1
Schizachyrium scoparium (Michaux) Nash var. *scoparium*	Little bluestem			1
Setaria pumila (Poiret) Roemer & J.A. Schultes ssp. *pumila* †	Yellow foxtail			1
RUSCACEAE				
Maianthemum canadense Desfontaines	Canada mayflower			5
Maianthemum racemosum (Linnaeus) Link ssp. *racemosum*	Solomon's plume			1
SMILACACEAE				
Smilax glauca Walter	Whiteleaf greenbrier			17
Smilax pseudochina Linnaeus	Coastal carrionflower			9
Smilax rotundifolia Linnaeus	Common greenbrier			27
SPARGANIACEAE				
Sparganium americanum Nuttall	American burreed			1
TYPHACEAE				
Typha latifolia Linnaeus	Broad-leaved cattail			1
XYRIDACEAE				
Xyris difformis Chapman	Bog yellow-eyed-grass			3
Xyris fimbriata Elliott	Fringed yellow-eyed-grass	G5	S1	1
Xyris jupicai Richard †	Richard's yellow-eyed-grass			3
Xyris torta Smith	Twisted yellow-eyed-grass			2
BRYOPHYTA				
MNIACEAE				
Mnium sp.	A moss			1
PORELLACEAE				
Porella sp.	A liverwort			1
POLYTRICHACEAE				
Polytrichum commune Hedwig				2
SPHAGNACEAE				
Sphagnum cuspidatum Hoffman	A peat moss			4
Sphagnum henryense Warnstorf	A peat moss			1
Sphagnum inundatum Russow	A peat moss			1
Sphagnum lescurii Sullivant	A peat moss			1
Sphagnum magellanicum Bridel	A peat moss			1
Sphagnum palustre Linnaeus	A peat moss			6
Sphagnum portoricense Hampe	A peat moss			2
Sphagnum recurvum P. Beauvois	A peat moss			2
Sphagnum rubellum Wilson	A peat moss			2

THUIDIACEAE

Thuidium delicatulum (Hedwig) Schimper 4

APPENDIX II. COMPOSITIONAL SUMMARY STATISTICS FOR 7 COMMUNITY TYPES

Table 14. Floristic composition of the Sea Level Fen community type (CEGL006310).

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Eleocharis rostellata	2	4	2	9	+++++	100	100	100	100	3200
Cladium mariscoides	5	4	2	3	-	100	40	40	13	20
Hibiscus moscheutos ssp. *moscheutos*	2	1	2	2	+	100	100	100	22	200
Hydrocotyle umbellata	2	1	2	2	+	100	100	100	22	200
Oenothera fruticosa var. *fruticosa*	2	1	2	2	+	100	100	100	22	200
Rosa palustris	7	1	2	2	+	100	29	29	6	57
Osmunda regalis var. *spectabilis*	13	2	2	2	0	100	15	15	3	15
Hypericum virginicum	27	2	2	2	0	100	7	7	2	7
Bidens mitis	1	1	1	2	+	50	100	50	11	100
Kosteletzkya virginica	1	1	1	2	+	50	100	50	11	100
Nymphaea odorata ssp. *odorata*	9	4	1	2	- -	50	11	6	1	1
Eryngium aquaticum var. *aquaticum*	1	1	1	1	0	50	100	50	6	50
Acer rubrum	46	6	1	1	- - - - -	50	2	1	0	0
Mean Species Richness	**11**									
Homoteneity	**0.864**									
Number of Plots	**2**									

Table 15. Floristic composition of the Coastal Plain Dwarf-Shrub Peatland (CEGL006852) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Clethra alnifolia	23	4	9	6	++	100	39	39	26	157
Acer rubrum	46	6	9	6	0	100	20	20	13	20
Hypericum virginicum	27	2	9	2	0	100	33	33	7	33
Vaccinium corymbosum	33	4	8	3	-	89	24	22	7	11
Vaccinium macrocarpon	11	4	7	6	++	78	64	49	33	198
Chamaedaphne calyculata	12	5	7	6	+	78	58	45	30	91
Rhynchospora alba	14	4	6	6	++	67	43	29	19	114
Aronia arbutifolia	22	3	6	3	0	67	27	18	6	18
Pinus rigida	13	4	5	4	0	56	38	21	9	21
Rhododendron viscosum var. *viscosum*	28	4	5	3	-	56	18	10	3	5
Liquidambar styraciflua	20	4	4	4	0	44	20	9	4	9
Sarracenia purpurea	10	3	4	3	0	44	40	18	6	18
Drosera rotundifolia var. *rotundifolia*	6	2	4	2	0	44	67	30	7	30
Toxicodendron radicans var. *radicans*	13	2	4	2	0	44	31	14	3	14
Rubus hispidus	26	2	4	2	0	44	15	7	2	7
Osmunda cinnamomea	26	5	4	2	- - -	44	15	7	2	1
Magnolia virginiana	30	5	4	2	- - -	44	13	6	1	1
Dichanthelium lucidum	5	4	3	6	++	33	60	20	13	80
Carex exilis	3	2	3	4	++	33	100	33	15	133
Decodon verticillatus	9	4	3	4	0	33	33	11	5	11
Pinus virginiana	10	2	3	3	+	33	30	10	3	20
Drosera intermedia	12	2	3	2	0	33	25	8	2	8
Ilex opaca var. *opaca*	25	4	3	1	- - -	33	12	4	0	1
Carex bullata	5	4	2	6	++	22	40	9	6	36
Arundinaria gigantea	2	2	2	4	++	22	100	22	10	89
Sphagnum cuspidatum	4	2	2	2	0	22	50	11	2	11
Rhexia virginica	11	2	2	2	0	22	18	4	1	4

Table 15 – Continued.

Amelanchier canadensis	14	2	2	2	0	22	14	3	1	3
Ilex verticillata	22	4	2	1	- - -	22	9	2	0	0
Sphagnum recurvum	2	3	1	5	++	11	50	6	3	22
Dichanthelium sp.	1	2	1	3	+	11	100	11	4	22
Dichanthelium ensifolium	5	2	1	3	+	11	20	2	1	4
Rhynchospora capillacea	1	1	1	2	+	11	100	11	2	22
Utricularia sp.	1	1	1	2	+	11	100	11	2	22
Cicuta maculata var. *maculata*	2	1	1	2	+	11	50	6	1	11
Eriophorum virginicum	2	1	1	2	+	11	50	6	1	11
Glyceria obtusa	5	1	1	2	+	11	20	2	0	4
Carex canescens	6	2	1	2	0	11	17	2	0	2
Woodwardia virginica	6	2	1	2	0	11	17	2	0	2
Solidago rugosa	8	2	1	2	0	11	13	1	0	1
Thelypteris palustris var. *pubescens*	10	2	1	2	0	11	10	1	0	1
Lyonia ligustrina var. *ligustrina*	11	2	1	2	0	11	9	1	0	1
Andropogon virginicus	6	3	1	2	-	11	17	2	0	1
Woodwardia areolata	15	4	1	2	- -	11	7	1	0	0
Carex striata var. *brevis*	1	1	1	1	0	11	100	11	1	11
Desmodium paniculatum	1	1	1	1	0	11	100	11	1	11
Eleocharis tenuis var. *pseudoptera*	1	1	1	1	0	11	100	11	1	11
Eupatorium rotundifolium	1	1	1	1	0	11	100	11	1	11
Peltandra virginica	1	1	1	1	0	11	100	11	1	11
Platanthera ciliaris	1	1	1	1	0	11	100	11	1	11
Rhexia mariana var. *mariana*	1	1	1	1	0	11	100	11	1	11
Sarracenia flava	1	1	1	1	0	11	100	11	1	11
Schizachyrium scoparium var. *scoparium*	1	1	1	1	0	11	100	11	1	11
Spiraea alba	1	1	1	1	0	11	100	11	1	11
Polytrichum commune	2	1	1	1	0	11	50	6	1	6
Apios americana	3	1	1	1	0	11	33	4	0	4
Galium tinctorium	3	1	1	1	0	11	33	4	0	4

Table 15 – Continued.

Leersia oryzoides	3	1	1	1	0	11	33	4	0	4
Xyris jupicai	3	1	1	1	0	11	33	4	0	4
Panicum verrucosum	5	1	1	1	0	11	20	2	0	2
Persicaria arifolia	5	1	1	1	0	11	20	2	0	2
Cinna arundinacea	6	1	1	1	0	11	17	2	0	2
Carex lurida	7	1	1	1	0	11	14	2	0	2
Platanthera clavellata	9	1	1	1	0	11	11	1	0	1
Alnus serrulata	8	2	1	1	-	11	13	1	0	1
Rhynchospora capitellata	9	2	1	1	-	11	11	1	0	1
Carex atlantica	11	2	1	1	-	11	9	1	0	1
Osmunda regalis var. *spectabilis*	13	2	1	1	-	11	8	1	0	0
Juncus pelocarpus	8	3	1	1	- -	11	13	1	0	0
Juncus canadensis	11	3	1	1	- -	11	9	1	0	0
Eubotrys racemosus	17	3	1	1	- -	11	6	1	0	0
Nymphaea odorata ssp. *odorata*	9	4	1	1	- - -	11	11	1	0	0
Viburnum nudum	19	3	1	1	- -	11	5	1	0	0
Dulichium arundinaceum	11	4	1	1	- - -	11	9	1	0	0
Liriodendron tulipifera	14	4	1	1	- - -	11	7	1	0	0
Nyssa sylvatica	26	5	1	1	- - - -	11	4	0	0	0
Mean Species Richness	**20**									
Homoteneity	**0.600**									
Number of Plots	**9**									

Table 16. Floristic composition of the Coastal Plain Emergent Millpond Bog (CEGL006853) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Hypericum virginicum	27	2	8	3	+	100	30	30	10	59
Juncus pelocarpus	8	3	7	6	+++	88	88	77	51	613
Decodon verticillatus	9	4	6	6	++	75	67	50	33	200
Rhynchospora alba	14	4	6	5	+	75	43	32	18	64
Nymphaea odorata ssp. *odorata*	9	4	5	6	++	63	56	35	23	139
Dulichium arundinaceum	11	4	5	6	++	63	45	28	19	114
Chamaedaphne calyculata	12	5	5	6	+	63	42	26	17	52
Acer rubrum	46	6	5	5	-	63	11	7	4	3
Carex canescens	6	2	5	3	+	63	83	52	17	104
Drosera intermedia	12	2	4	3	+	50	33	17	6	33
Vaccinium macrocarpon	11	4	4	3	-	50	36	18	6	9
Clethra alnifolia	23	4	4	2	- -	50	17	9	2	2
Juncus canadensis	11	3	2	5	++	25	18	5	3	18
Carex atlantica	11	2	2	2	0	25	18	5	1	5
Eleocharis olivacea var. *olivacea*	2	3	1	4	+	13	50	6	3	13
Juncus effusus ssp. *solutus*	9	2	1	4	++	13	11	1	1	6
Aronia arbutifolia	22	3	1	2	-	13	5	1	0	0
Magnolia virginiana	30	5	1	2	- - -	13	3	0	0	0
Sphagnum rubellum	2	1	1	1	0	13	50	6	1	6
Utricularia subulata	2	1	1	1	0	13	50	6	1	6
Xyris jupicai	3	1	1	1	0	13	33	4	0	4
Boehmeria cylindrica	4	1	1	1	0	13	25	3	0	3
Glyceria obtusa	5	1	1	1	0	13	20	3	0	3
Sphagnum recurvum	2	3	1	1	- -	13	50	6	1	2
Dichanthelium ensifolium	5	2	1	1	-	13	20	3	0	1
Rhexia virginica	11	2	1	1	-	13	9	1	0	1

Table 16 – Continued.

Andropogon virginicus	6	3	1	1	- -	13	17	2	0	1
Mean Species Richness	**11**									
Homoteneity	**0.682**									
Number of Plots	**8**									

Table 17. Floristic composition of the Delmarva Poor Fen (CEGL006467) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Cladium mariscoides	5	4	3	8	++++	100	60	60	53	960
Dichanthelium scabriusculum	4	3	3	7	++++	100	75	75	58	1200
Sarracenia purpurea	10	3	3	6	+++	100	30	30	20	240
Eriocaulon compressum	3	1	3	3	++	100	100	100	33	400
Proserpinaca pectinata	4	1	3	2	+	100	75	75	17	150
Lycopodiella appressa	5	1	3	2	+	100	60	60	13	120
Drosera intermedia	12	2	3	2	0	100	25	25	6	25
Rhynchospora inundata	2	2	2	6	++++	67	100	67	44	1067
Andropogon virginicus	6	3	2	6	+++	67	33	22	15	178
Nymphaea odorata ssp. *odorata*	9	4	2	3	-	67	22	15	5	7
Calopogon tuberosus var. *tuberosus*	2	1	2	2	+	67	100	67	15	133
Myrica cerifera	2	1	2	2	+	67	100	67	15	133
Pinus serotina	2	1	2	2	+	67	100	67	15	133
Pogonia ophioglossoides	5	1	2	2	+	67	40	27	6	53
Rhynchospora chalarocephala	4	2	2	2	0	67	50	33	7	33
Alnus serrulata	8	2	2	2	0	67	25	17	4	17
Rhexia virginica	11	2	2	2	0	67	18	12	3	12
Juncus canadensis	11	3	2	2	-	67	18	12	3	6
Hypericum virginicum	27	2	2	2	0	67	7	5	1	5
Clethra alnifolia	23	4	2	2	- -	67	9	6	1	1
Acer rubrum	46	6	2	2	- - - -	67	4	3	1	0
Rhynchospora fusca	1	2	1	5	+++	33	100	33	19	267
Eleocharis tuberculosa	3	2	1	4	++	33	33	11	5	44
Dichanthelium dichotomum var. *roanokense*	1	1	1	2	+	33	100	33	7	67
Eupatorium leucolepis	1	1	1	2	+	33	100	33	7	67
Sphagnum lescurii	1	1	1	2	+	33	100	33	7	67
Utricularia gibba	1	1	1	2	+	33	100	33	7	67
Chamaecyparis thyoides	2	1	1	2	+	33	50	17	4	33
Sphagnum portoricense	2	1	1	2	+	33	50	17	4	33

Table 17 – Continued.

Fuirena squarrosa	4	2	1	2	0	33	25	8	2	8
Drosera rotundifolia var. *rotundifolia*	6	2	1	2	0	33	17	6	1	6
Andropogon glomeratus	9	2	1	2	0	33	11	4	1	4
Rhynchospora alba	14	4	1	2	- -	33	7	2	1	1
Vaccinium corymbosum	33	4	1	2	- -	33	3	1	0	0
Alnus maritima ssp. *maritima*	1	1	1	1	0	33	100	33	4	33
Eleocharis microcarpa var. *filiculmis*	1	1	1	1	0	33	100	33	4	33
Iva frutescens	1	1	1	1	0	33	100	33	4	33
Xyris fimbriata	1	1	1	1	0	33	100	33	4	33
Eriophorum virginicum	2	1	1	1	0	33	50	17	2	17
Sclerolepis uniflora	2	1	1	1	0	33	50	17	2	17
Symphyotrichum novi-belgii	2	1	1	1	0	33	50	17	2	17
Taxodium distichum	2	1	1	1	0	33	50	17	2	17
Euthamia caroliniana	3	1	1	1	0	33	33	11	1	11
Hypericum mutilum	4	1	1	1	0	33	25	8	1	8
Calamagrostis coarctata	4	2	1	1	-	33	25	8	1	4
Panicum rigidulum	4	2	1	1	-	33	25	8	1	4
Dulichium arundinaceum	11	4	1	1	- - -	33	9	3	0	0
Nyssa sylvatica	26	5	1	1	- - - -	33	4	1	0	0
Mean Species Richness	**25**									
Homoteneity	**0.707**									
Number of Plots	**3**									

Table 18. Floristic composition of the Coastal Plain Acidic Seepage Swale (CEGL006499) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Andropogon glomeratus	9	2	5	5	+++	100	56	56	31	444
Acer rubrum	46	6	5	4	- -	100	11	11	5	3
Rhynchospora gracilenta	8	2	4	4	++	80	50	40	18	160
Rubus hispidus	26	2	4	3	+	80	15	12	4	25
Eupatorium pilosum	10	2	4	2	0	80	40	32	7	32
Smilax rotundifolia	27	4	4	2	- -	80	15	12	3	3
Juncus effusus ssp. *solutus*	9	2	3	4	++	60	33	20	9	80
Panicum rigidulum	4	2	3	3	+	60	75	45	15	90
Thelypteris palustris var. *pubescens*	10	2	3	3	+	60	30	18	6	36
Dulichium arundinaceum	11	4	3	3	-	60	27	16	5	8
Hypericum canadense	4	1	3	2	+	60	75	45	10	90
Panicum verrucosum	5	1	3	2	+	60	60	36	8	72
Scirpus cyperinus	5	1	3	2	+	60	60	36	8	72
Carex lurida	7	1	3	2	+	60	43	26	6	51
Rhexia virginica	11	2	3	2	0	60	27	16	4	16
Juncus canadensis	11	3	3	2	-	60	27	16	4	8
Hypericum virginicum	27	2	3	2	0	60	11	7	1	7
Aronia arbutifolia	22	3	3	2	-	60	14	8	2	4
Vaccinium corymbosum	33	4	3	2	- -	60	9	5	1	1
Juncus longii	4	3	2	6	+++	40	50	20	13	160
Dichanthelium dichotomum var. *dichotomum*	13	4	2	6	++	40	15	6	4	25
Clethra alnifolia	23	4	2	6	++	40	9	3	2	14
Dichanthelium scoparium	2	2	2	5	+++	40	100	40	22	320
Pinus taeda	3	2	2	4	++	40	67	27	12	107
Eleocharis tortilis	4	3	2	4	+	40	50	20	9	40
Juncus acuminatus	2	2	2	3	+	40	100	40	13	80
Sphagnum palustre	6	3	2	3	0	40	33	13	4	13
Dichanthelium lucidum	5	4	2	3	-	40	40	16	5	8
Liquidambar styraciflua	20	4	2	3	-	40	10	4	1	2

Table 18 – Continued.

Eleocharis obtusa	2	1	2	2	+	40	100	40	9	80
Sagittaria latifolia var. *latifolia*	2	1	2	2	+	40	100	40	9	80
Bartonia virginica	3	1	2	2	+	40	67	27	6	53
Euthamia caroliniana	3	1	2	2	+	40	67	27	6	53
Leersia oryzoides	3	1	2	2	+	40	67	27	6	53
Boehmeria cylindrica	4	1	2	2	+	40	50	20	4	40
Linum striatum	4	1	2	2	+	40	50	20	4	40
Ludwigia alternifolia	4	1	2	2	+	40	50	20	4	40
Glyceria obtusa	5	1	2	2	+	40	40	16	4	32
Eleocharis tuberculosa	3	2	2	2	0	40	67	27	6	27
Rosa palustris	7	1	2	2	+	40	29	11	3	23
Rhynchospora chalarocephala	4	2	2	2	0	40	50	20	4	20
Carex seorsa	7	2	2	2	0	40	29	11	3	11
Drosera intermedia	12	2	2	2	0	40	17	7	1	7
Dioscorea villosa	13	2	2	2	0	40	15	6	1	6
Smilax glauca	17	2	2	2	0	40	12	5	1	5
Sarracenia purpurea	10	3	2	2	-	40	20	8	2	4
Woodwardia areolata	15	4	2	2	- -	40	13	5	1	1
Rhododendron viscosum var. *viscosum*	28	4	2	2	- -	40	7	3	1	1
Galium tinctorium	3	1	2	1	0	40	67	27	3	27
Sphagnum magellanicum	1	3	1	6	+++	20	100	20	13	160
Scleria muehlenbergii	1	2	1	5	+++	20	100	20	11	160
Eleocharis olivacea var. *olivacea*	2	3	1	5	++	20	50	10	6	40
Gaylussacia frondosa	9	4	1	5	+	20	11	2	1	4
Ilex glabra	1	2	1	4	++	20	100	20	9	80
Panicum dichotomiflorum var. *dichotomiflorum*	1	2	1	4	++	20	100	20	9	80
Rhynchospora capitellata	9	2	1	4	++	20	11	2	1	9
Agrostis stolonifera	1	2	1	3	+	20	100	20	7	40
Cephalanthus occidentalis	1	2	1	3	+	20	100	20	7	40
Fimbristylis autumnalis	1	2	1	3	+	20	100	20	7	40
Sphagnum inundatum	1	2	1	3	+	20	100	20	7	40

Table 18 – Continued.

Dichanthelium ensifolium	5	2	1	3	+	20	20	4	1	8
Dichanthelium scabriusculum	4	3	1	3	0	20	25	5	2	5
Asclepias incarnata	1	1	1	2	+	20	100	20	4	40
Calamagrostis canadensis var. *canadensis*	1	1	1	2	+	20	100	20	4	40
Carex sp. *1*	1	1	1	2	+	20	100	20	4	40
Carex lonchocarpa	1	1	1	2	+	20	100	20	4	40
Cuscuta gronovii var. *gronovii*	1	1	1	2	+	20	100	20	4	40
Dactylis glomerata	1	1	1	2	+	20	100	20	4	40
Eupatorium dubium	1	1	1	2	+	20	100	20	4	40
Eupatorium perfoliatum var. *perfoliatum*	1	1	1	2	+	20	100	20	4	40
Eupatorium sp.	1	1	1	2	+	20	100	20	4	40
Juncus caesariensis	1	1	1	2	+	20	100	20	4	40
Juncus scirpoides var. *scirpoides*	1	1	1	2	+	20	100	20	4	40
Linum sp.	1	1	1	2	+	20	100	20	4	40
Lycopodiella alopecuroides	1	1	1	2	+	20	100	20	4	40
Lysimachia quadrifolia	1	1	1	2	+	20	100	20	4	40
Panicum anceps	1	1	1	2	+	20	100	20	4	40
Paspalum laeve var. *leave*	1	1	1	2	+	20	100	20	4	40
Polygala cruciata var. *aquilonia*	1	1	1	2	+	20	100	20	4	40
Quercus nigra	1	1	1	2	+	20	100	20	4	40
Rhus copallinum var. *copallinum*	1	1	1	2	+	20	100	20	4	40
Rhynchospora glomerata var. *glomerata*	1	1	1	2	+	20	100	20	4	40
Rhynchospora macrostachya	1	1	1	2	+	20	100	20	4	40
Rubus sp.	1	1	1	2	+	20	100	20	4	40
Sagittaria latifolia var. *pubescens*	1	1	1	2	+	20	100	20	4	40
Schoenoplectus purshianus	1	1	1	2	+	20	100	20	4	40
Setaria pumila ssp. *pumila*	1	1	1	2	+	20	100	20	4	40
Solidago fistulosa	1	1	1	2	+	20	100	20	4	40
Sphagnum henryense	1	1	1	2	+	20	100	20	4	40
Spiraea tomentosa	1	1	1	2	+	20	100	20	4	40
Typha latifolia	1	1	1	2	+	20	100	20	4	40

Table 18 - Continued.

Viola lanceolata var. *lanceolata*	1	1	1	2	+	20	100	20	4	40
Carex albolutescens	2	1	1	2	+	20	50	10	2	20
Carex longii	2	1	1	2	+	20	50	10	2	20
Chamaecyparis thyoides	2	1	1	2	+	20	50	10	2	20
Cyperus strigosus	2	1	1	2	+	20	50	10	2	20
Erechtites hieraciifolia var. *hieraciifolia*	2	1	1	2	+	20	50	10	2	20
Fraxinus pennsylvanica	2	1	1	2	+	20	50	10	2	20
Persicaria sagittata	2	1	1	2	+	20	50	10	2	20
Polytrichum commune	2	1	1	2	+	20	50	10	2	20
Rhynchospora microcephala	2	1	1	2	+	20	50	10	2	20
Sagittaria engelmanniana	2	1	1	2	+	20	50	10	2	20
Sclerolepis uniflora	2	1	1	2	+	20	50	10	2	20
Sphagnum portoricense	2	1	1	2	+	20	50	10	2	20
Sphagnum rubellum	2	1	1	2	+	20	50	10	2	20
Spiranthes cernua	2	1	1	2	+	20	50	10	2	20
Symphyotrichum novi-belgii	2	1	1	2	+	20	50	10	2	20
Taxodium distichum	2	1	1	2	+	20	50	10	2	20
Utricularia subulata	2	1	1	2	+	20	50	10	2	20
Xyris torta	2	1	1	2	+	20	50	10	2	20
Apios americana	3	1	1	2	+	20	33	7	1	13
Carex crinita var. *crinita*	3	1	1	2	+	20	33	7	1	13
Dichanthelium clandestinum	3	1	1	2	+	20	33	7	1	13
Xyris difformis	3	1	1	2	+	20	33	7	1	13
Xyris jupicai	3	1	1	2	+	20	33	7	1	13
Juncus debilis	4	1	1	2	+	20	25	5	1	10
Lycopus americanus	4	1	1	2	+	20	25	5	1	10
Proserpinaca pectinata	4	1	1	2	+	20	25	5	1	10
Lycopodiella appressa	5	1	1	2	+	20	20	4	1	8
Pogonia ophioglossoides	5	1	1	2	+	20	20	4	1	8
Persicaria arifolia	5	1	1	2	+	20	20	4	1	8
Eriocaulon decangulare var. *decangulare*	3	2	1	2	0	20	33	7	1	7

Table 18 – Continued.

Lycopus virginicus	7	1	1	2	+	20	14	3	1	6
Fuirena squarrosa	4	2	1	2	0	20	25	5	1	5
Sphagnum cuspidatum	4	2	1	2	0	20	25	5	1	5
Platanthera clavellata	9	1	1	2	+	20	11	2	0	4
Viola primulifolia	9	1	1	2	+	20	11	2	0	4
Drosera rotundifolia var. *rotundifolia*	6	2	1	2	0	20	17	3	1	3
Viburnum dentatum	6	2	1	2	0	20	17	3	1	3
Woodwardia virginica	6	2	1	2	0	20	17	3	1	3
Alnus serrulata	8	2	1	2	0	20	13	3	1	3
Chasmanthium laxum	9	2	1	2	0	20	11	2	0	2
Carex folliculata	11	2	1	2	0	20	9	2	0	2
Andropogon virginicus	6	3	1	2	-	20	17	3	1	2
Rhynchospora alba	14	4	1	2	- -	20	7	1	0	0
Osmunda cinnamomea	26	5	1	2	- - -	20	4	1	0	0
Magnolia virginiana	30	5	1	2	- - -	20	3	1	0	0
Carex abscondita	1	1	1	1	0	20	100	20	2	20
Eupatorium serotinum	2	1	1	1	0	20	50	10	1	10
Vernonia noveboracensis	2	1	1	1	0	20	50	10	1	10
Saururus cernuus	3	2	1	1	-	20	33	7	1	3
Carex atlantica	11	2	1	1	-	20	9	2	0	1
Quercus phellos	16	2	1	1	-	20	6	1	0	1
Ilex opaca var. *opaca*	25	4	1	1	- - -	20	4	1	0	0
Nyssa sylvatica	26	5	1	1	- - - -	20	4	1	0	0
Mean Species Richness	**45**									
Homoteneity	**0.520**									
Number of Plots	**5**									

Table 19. Floristic composition of the Fall-Line Terrace Gravel Bog (CEGL006219) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Nyssa sylvatica	26	5	14	6	+	100	54	54	36	108
Magnolia virginiana	30	5	14	6	+	100	47	47	31	93
Acer rubrum	46	6	14	6	0	100	30	30	20	30
Rhododendron viscosum var. *viscosum*	28	4	13	6	++	93	46	43	29	172
Osmunda cinnamomea	26	5	13	6	+	93	50	46	31	93
Smilax rotundifolia	27	4	13	5	+	93	48	45	25	89
Ilex opaca var. *opaca*	25	4	12	5	+	86	48	41	23	82
Amelanchier canadensis	14	2	12	4	++	86	86	73	33	294
Ilex verticillata	22	4	12	4	0	86	55	47	21	47
Dichanthelium dichotomum var. *dichotomum*	13	4	11	6	++	79	85	66	44	266
Vaccinium corymbosum	33	4	11	5	+	79	33	26	15	52
Eubotrys racemosus	17	3	11	4	+	79	65	51	23	102
Viburnum nudum	19	3	11	4	+	79	58	45	20	91
Aronia arbutifolia	22	3	11	4	+	79	50	39	17	79
Mitchella repens	21	2	11	3	+	79	52	41	14	82
Rubus hispidus	26	2	11	3	+	79	42	33	11	66
Smilax glauca	17	2	11	2	0	79	65	51	11	51
Lyonia ligustrina var. *ligustrina*	11	2	10	4	++	71	91	65	29	260
Quercus phellos	16	2	10	4	++	71	63	45	20	179
Liriodendron tulipifera	14	4	9	5	+	64	64	41	23	83
Quercus coccinea	9	2	9	4	++	64	100	64	29	257
Liquidambar styraciflua	20	4	9	3	-	64	45	29	10	14
Gaylussacia frondosa	9	4	8	5	+	57	89	51	28	102
Ilex laevigata	8	2	8	4	++	57	100	57	25	229
Viburnum dentatum var. *lucidum*	9	2	8	2	0	57	89	51	11	51
Dioscorea villosa	13	2	8	2	0	57	62	35	8	35
Pinus rigida	13	4	7	5	+	50	54	27	15	54
Toxicodendron vernix	7	2	7	4	++	50	100	50	22	200
Viola primulifolia	9	1	7	2	+	50	78	39	9	78
Prunus serotina var. *serotina*	7	2	7	2	0	50	100	50	11	50

Table 19 – Continued.

Chasmanthium laxum	9	2	7	2	0	50	78	39	9	39
Rhynchospora capitellata	9	2	7	2	0	50	78	39	9	39
Smilax pseudochina	9	2	7	2	0	50	78	39	9	39
Chionanthus virginicus	7	3	6	4	+	43	86	37	16	73
Quercus alba	9	3	6	4	+	43	67	29	13	57
Pinus virginiana	10	2	6	3	+	43	60	26	9	51
Carex folliculata	11	2	6	3	+	43	55	23	8	47
Juncus subcaudatus var. *subcaudatus*	6	1	6	2	+	43	100	43	10	86
Lycopus virginicus	7	1	6	2	+	43	86	37	8	73
Solidago rugosa	8	2	6	2	0	43	75	32	7	32
Leersia virginica	9	2	6	2	0	43	67	29	6	29
Eupatorium pilosum	10	2	6	2	0	43	60	26	6	26
Carex atlantica	11	2	6	2	0	43	55	23	5	23
Woodwardia areolata	15	4	5	3	-	36	33	12	4	6
Solidago uliginosa var. *uliginosa*	5	1	5	2	+	36	100	36	8	71
Lycopodium obscurum	6	1	5	2	+	36	83	30	7	60
Sambucus canadensis	7	1	5	2	+	36	71	26	6	51
Fagus grandifolia	9	2	5	2	0	36	56	20	4	20
Glyceria striata var. *striata*	9	2	5	2	0	36	56	20	4	20
Juncus effusus ssp. *solutus*	9	2	5	2	0	36	56	20	4	20
Medeola virginiana	12	2	5	2	0	36	42	15	3	15
Woodwardia virginica	6	2	4	3	+	29	67	19	6	38
Osmunda regalis var. *spectabilis*	13	2	4	3	+	29	31	9	3	18
Toxicodendron radicans var. *radicans*	13	2	4	3	+	29	31	9	3	18
Euonymus americanus	4	1	4	2	+	29	100	29	6	57
Quercus falcata	4	1	4	2	+	29	100	29	6	57
Oxypolis rigidior	4	2	4	2	0	29	100	29	6	29
Vaccinium fuscatum	4	2	4	2	0	29	100	29	6	29
Carex seorsa	7	2	4	2	0	29	57	16	4	16
Rhynchospora gracilenta	8	2	4	2	0	29	50	14	3	14
Thelypteris palustris var. *pubescens*	10	2	4	2	0	29	40	11	3	11
Juniperus virginiana	5	1	4	1	0	29	80	23	3	23

Table 19 – Continued.

Kalmia latifolia	3	2	3	3	+	21	100	21	7	43
Alnus serrulata	8	2	3	3	+	21	38	8	3	16
Carex leptalea var. *harperi*	3	1	3	2	+	21	100	21	5	43
Carex stricta	3	1	3	2	+	21	100	21	5	43
Eupatorium fistulosum	3	1	3	2	+	21	100	21	5	43
Sassafras albidum	3	1	3	2	+	21	100	21	5	43
Vitis labrusca	3	1	3	2	+	21	100	21	5	43
Juncus debilis	4	1	3	2	+	21	75	16	4	32
Lonicera japonica	5	1	3	2	+	21	60	13	3	26
Maianthemum canadense	5	1	3	2	+	21	60	13	3	26
Aralia nudicaulis	3	2	3	2	0	21	100	21	5	21
Calamagrostis coarctata	4	2	3	2	0	21	75	16	4	16
Carex intumescens	5	2	3	2	0	21	60	13	3	13
Andropogon glomeratus	9	2	3	2	0	21	33	7	2	7
Rhexia virginica	11	2	3	2	0	21	27	6	1	6
Symplocarpus foetidus	11	2	3	2	0	21	27	6	1	6
Carex bullata	5	4	3	2	- -	21	60	13	3	3
Hypericum virginicum	27	2	3	2	0	21	11	2	1	2
Euthamia graminifolia	3	1	3	1	0	21	100	21	2	21
Rubus allegheniensis	3	1	3	1	0	21	100	21	2	21
Hypericum mutilum	4	1	3	1	0	21	75	16	2	16
Scirpus polyphyllus	4	1	3	1	0	21	75	16	2	16
Rosa palustris	7	1	3	1	0	21	43	9	1	9
Platanthera clavellata	9	1	3	1	0	21	33	7	1	7
Eleocharis tortilis	4	3	2	5	++	14	50	7	4	29
Agrostis perennans	2	1	2	2	+	14	100	14	3	29
Betula nigra	2	1	2	2	+	14	100	14	3	29
Carex crinita var. *crinita*	3	1	2	2	+	14	67	10	2	19
Dichanthelium clandestinum	3	1	2	2	+	14	67	10	2	19
Pogonia ophioglossoides	5	1	2	2	+	14	40	6	1	11
Eriocaulon decangulare var. *decangulare*	3	2	2	2	0	14	67	10	2	10
Fuirena squarrosa	4	2	2	2	0	14	50	7	2	7

Table 19 – Continued.

Juncus longii	4	3	2	2	-	14	50	7	2	4
Lindera benzoin	9	2	2	2	0	14	22	3	1	3
Juncus canadensis	11	3	2	2	-	14	18	3	1	1
Clethra alnifolia	23	4	2	2	- -	14	9	1	0	0
Cypripedium acaule	2	1	2	1	0	14	100	14	2	14
Juncus tenuis	2	1	2	1	0	14	100	14	2	14
Rhynchospora cephalantha var. *cephalantha*	2	1	2	1	0	14	100	14	2	14
Uvularia sessilifolia	3	1	2	1	0	14	67	10	1	10
Xyris difformis	3	1	2	1	0	14	67	10	1	10
Linum striatum	4	1	2	1	0	14	50	7	1	7
Ludwigia alternifolia	4	1	2	1	0	14	50	7	1	7
Scirpus cyperinus	5	1	2	1	0	14	40	6	1	6
Microstegium vimineum	3	2	2	1	-	14	67	10	1	5
Cinna arundinacea	6	1	2	1	0	14	33	5	1	5
Carex lurida	7	1	2	1	0	14	29	4	0	4
Parthenocissus quinquefolia	8	1	2	1	0	14	25	4	0	4
Viola cucullata	6	2	2	1	-	14	33	5	1	2
Sarracenia purpurea	10	3	1	4	+	7	10	1	0	1
Aronia prunifolia	1	1	1	2	+	7	100	7	2	14
Asclepias rubra	1	1	1	2	+	7	100	7	2	14
Doellingeria umbellata	1	1	1	2	+	7	100	7	2	14
Gaultheria procumbens	1	1	1	2	+	7	100	7	2	14
Rhamnus cathartica	1	1	1	2	+	7	100	7	2	14
Salix nigra	1	1	1	2	+	7	100	7	2	14
Solidago canadensis	1	1	1	2	+	7	100	7	2	14
Solidago latissimifolia	1	1	1	2	+	7	100	7	2	14
Vaccinium caesariense	1	1	1	2	+	7	100	7	2	14
Persicaria sagittata	2	1	1	2	+	7	50	4	1	7
Vernonia noveboracensis	2	1	1	2	+	7	50	4	1	7
Andropogon virginicus	6	3	1	2	-	7	17	1	0	1
Albizia julibrissin	1	1	1	1	0	7	100	7	1	7
Arthraxon hispidus var. *hispidus*	1	1	1	1	0	7	100	7	1	7

Table 19 – Continued.

Aster radula var. *radula*	1	1	1	1	0	7	100	7	1	7
Bartonia paniculata ssp. *paniculata*	1	1	1	1	0	7	100	7	1	7
Carex alata	1	1	1	1	0	7	100	7	1	7
Carex venusta	1	1	1	1	0	7	100	7	1	7
Castanea pumila var. *pumila*	1	1	1	1	0	7	100	7	1	7
Chamaecrista nictitans var. *nictitans*	1	1	1	1	0	7	100	7	1	7
Cornus florida	1	1	1	1	0	7	100	7	1	7
Dichanthelium sphaerocarpon	1	1	1	1	0	7	100	7	1	7
Diospyros virginiana	1	1	1	1	0	7	100	7	1	7
Elymus virginicus	1	1	1	1	0	7	100	7	1	7
Euonymus fortunei	1	1	1	1	0	7	100	7	1	7
Eupatorium hyssopifolium	1	1	1	1	0	7	100	7	1	7
Schedonorus pratensis	1	1	1	1	0	7	100	7	1	7
Goodyera pubescens	1	1	1	1	0	7	100	7	1	7
Hedera helix var. *helix*	1	1	1	1	0	7	100	7	1	7
Kalmia angustifolia	1	1	1	1	0	7	100	7	1	7
Malus sp.	1	1	1	1	0	7	100	7	1	7
Melanthium virginicum	1	1	1	1	0	7	100	7	1	7
Monotropa uniflora	1	1	1	1	0	7	100	7	1	7
Morus alba	1	1	1	1	0	7	100	7	1	7
Oxalis stricta	1	1	1	1	0	7	100	7	1	7
Phytolacca americana	1	1	1	1	0	7	100	7	1	7
Platanthera lacera	1	1	1	1	0	7	100	7	1	7
Platanus occidentalis	1	1	1	1	0	7	100	7	1	7
Potentilla canadensis var. *canadensis*	1	1	1	1	0	7	100	7	1	7
Pyrus calleryana	1	1	1	1	0	7	100	7	1	7
Quercus montana	1	1	1	1	0	7	100	7	1	7
Ranunculus bulbosus	1	1	1	1	0	7	100	7	1	7
Rosa multiflora	1	1	1	1	0	7	100	7	1	7
Rubus flagellaris	1	1	1	1	0	7	100	7	1	7
Scleria reticularis	1	1	1	1	0	7	100	7	1	7
Selaginella apoda	1	1	1	1	0	7	100	7	1	7

Table 19 – Continued.

Solidago juncea	1	1	1	1	0	7	100	7	1	7
Sparganium americanum	1	1	1	1	0	7	100	7	1	7
Symphyotrichum lanceolatum var. *lanceolatum*	1	1	1	1	0	7	100	7	1	7
Symphyotrichum lateriflorum var. *lateriflorum*	1	1	1	1	0	7	100	7	1	7
Thelypteris simulata	1	1	1	1	0	7	100	7	1	7
Tipularia discolor	1	1	1	1	0	7	100	7	1	7
Trifolium pratense	1	1	1	1	0	7	100	7	1	7
Tsuga canadensis	1	1	1	1	0	7	100	7	1	7
Carex albolutescens	2	1	1	1	0	7	50	4	0	4
Carex longii	2	1	1	1	0	7	50	4	0	4
Cyperus strigosus	2	1	1	1	0	7	50	4	0	4
Erechtites hieraciifolia var. *hieraciifolia*	2	1	1	1	0	7	50	4	0	4
Eupatorium serotinum	2	1	1	1	0	7	50	4	0	4
Ilex crenata	2	1	1	1	0	7	50	4	0	4
Persicaria longiseta	2	1	1	1	0	7	50	4	0	4
Rhynchospora microcephala	2	1	1	1	0	7	50	4	0	4
Spiranthes cernua	2	1	1	1	0	7	50	4	0	4
Vitis aestivalis	2	1	1	1	0	7	50	4	0	4
Xyris torta	2	1	1	1	0	7	50	4	0	4
Apios americana	3	1	1	1	0	7	33	2	0	2
Bartonia virginica	3	1	1	1	0	7	33	2	0	2
Vaccinium pallidum	3	1	1	1	0	7	33	2	0	2
Quercus rubra var. *rubra*	2	2	1	1	-	7	50	4	0	2
Hypericum canadense	4	1	1	1	0	7	25	2	0	2
Lycopodiella appressa	5	1	1	1	0	7	20	1	0	1
Panicum verrucosum	5	1	1	1	0	7	20	1	0	1
Carex debilis	3	2	1	1	-	7	33	2	0	1
Saururus cernuus	3	2	1	1	-	7	33	2	0	1
Dichanthelium ensifolium	5	2	1	1	-	7	20	1	0	1
Viburnum dentatum	6	2	1	1	-	7	17	1	0	1
Dulichium arundinaceum	11	4	1	1	- - -	7	9	1	0	0

Table 19 – Continued.

Mean Species Richness	**48**
Homoteneity	**0.622**
Number of Plots	**14**

Table 20. Floristic composition of the Coastal Plain Acidic Seepage Swamp (CEGL006238) community type.

SPECIES	TOTAL FREQ	TOTAL MEAN COVER	Frequency	Mean Cover	Relative Cover	Constancy	Fidelity	Diagnostic Value	Adj DV (scaled)	Adj DV (unscaled)
Vaccinium corymbosum	33	4	10	6	++	100	30	30	20	121
Magnolia virginiana	30	5	10	6	+	100	33	33	22	67
Acer rubrum	46	6	10	6	0	100	22	22	14	22
Mitchella repens	21	2	10	3	+	100	48	48	16	95
Smilax rotundifolia	27	4	10	3	-	100	37	37	12	19
Nyssa sylvatica	26	5	9	6	+	90	35	31	21	62
Ilex opaca var. *opaca*	25	4	9	5	+	90	36	32	18	65
Rhododendron viscosum var. *viscosum*	28	4	8	5	+	80	29	23	13	46
Osmunda cinnamomea	26	5	8	5	0	80	31	25	14	25
Symplocarpus foetidus	11	2	8	4	++	80	73	58	26	233
Ilex verticillata	22	4	8	4	0	80	36	29	13	29
Woodwardia areolata	15	4	7	5	+	70	47	33	18	65
Lindera benzoin	9	2	7	4	++	70	78	54	24	218
Viburnum nudum	19	3	7	4	+	70	37	26	11	52
Arisaema triphyllum	7	2	7	2	0	70	100	70	16	70
Medeola virginiana	12	2	7	2	0	70	58	41	9	41
Rubus hispidus	26	2	7	2	0	70	27	19	4	19
Parthenocissus quinquefolia	8	1	6	2	+	60	75	45	10	90
Osmunda regalis var. *spectabilis*	13	2	6	2	0	60	46	28	6	28
Liquidambar styraciflua	20	4	5	5	+	50	25	13	7	25
Eubotrys racemosus	17	3	5	4	+	50	29	15	7	29
Toxicodendron radicans var. *radicans*	13	2	5	2	0	50	38	19	4	19
Quercus phellos	16	2	5	2	0	50	31	16	3	16
Sphagnum palustre	6	3	4	5	++	40	67	27	15	107
Clethra alnifolia	23	4	4	5	+	40	17	7	4	14
Thuidium delicatulum	4	2	4	3	+	40	100	40	13	80
Carex folliculata	11	2	4	3	+	40	36	15	5	29
Liriodendron tulipifera	14	4	4	3	-	40	29	11	4	6
Platanthera clavellata	9	1	4	2	+	40	44	18	4	36

Table 20 – Continued.

Viburnum dentatum	6	2	4	2	0	40	67	27	6	27
Viola cucullata	6	2	4	2	0	40	67	27	6	27
Fagus grandifolia	9	2	4	2	0	40	44	18	4	18
Glyceria striata var. *striata*	9	2	4	2	0	40	44	18	4	18
Smilax glauca	17	2	4	2	0	40	24	9	2	9
Thelypteris noveboracensis	3	2	3	4	++	30	100	30	13	120
Quercus alba	9	3	3	3	0	30	33	10	3	10
Lycopus americanus	4	1	3	2	+	30	75	23	5	45
Persicaria arifolia	5	1	3	2	+	30	60	18	4	36
Cinna arundinacea	6	1	3	2	+	30	50	15	3	30
Leersia virginica	9	2	3	2	0	30	33	10	2	10
Dioscorea villosa	13	2	3	2	0	30	23	7	2	7
Carex digitalis	2	1	2	2	+	20	100	20	4	40
Carex platyphylla	2	1	2	2	+	20	100	20	4	40
Carpinus caroliniana	2	1	2	2	+	20	100	20	4	40
Dichanthelium acuminatum	2	1	2	2	+	20	100	20	4	40
Vaccinium pallidum	3	1	2	2	+	20	67	13	3	27
Maianthemum canadense	5	1	2	2	+	20	40	8	2	16
Carex debilis	3	2	2	2	0	20	67	13	3	13
Sambucus canadensis	7	1	2	2	+	20	29	6	1	11
Carex intumescens	5	2	2	2	0	20	40	8	2	8
Thelypteris palustris var. *pubescens*	10	2	2	2	0	20	20	4	1	4
Lonicera japonica	5	1	2	1	0	20	40	8	1	8
Smilax pseudochina	9	2	2	1	-	20	22	4	0	2
Amelanchier sp.	1	1	1	2	+	10	100	10	2	20
Asimina triloba	1	1	1	2	+	10	100	10	2	20
Bidens frondosa	1	1	1	2	+	10	100	10	2	20
Deparia acrostichoides	1	1	1	2	+	10	100	10	2	20
Lichen sp.	1	1	1	2	+	10	100	10	2	20
Persicaria punctata	1	1	1	2	+	10	100	10	2	20

Table 20 – Continued.

Quercus michauxii	1	1	1	2	+	10	100	10	2	20
Symplocos tinctoria	1	1	1	2	+	10	100	10	2	20
Impatiens capensis	1	2	1	2	0	10	100	10	2	10
Ilex crenata	2	1	1	2	+	10	50	5	1	10
Sagittaria engelmanniana	2	1	1	2	+	10	50	5	1	10
Vitis aestivalis	2	1	1	2	+	10	50	5	1	10
Uvularia sessilifolia	3	1	1	2	+	10	33	3	1	7
Quercus rubra var. *rubra*	2	2	1	2	0	10	50	5	1	5
Microstegium vimineum	3	2	1	2	0	10	33	3	1	3
Pinus taeda	3	2	1	2	0	10	33	3	1	3
Saururus cernuus	3	2	1	2	0	10	33	3	1	3
Lycopodium obscurum	6	1	1	2	+	10	17	2	0	3
Sphagnum cuspidatum	4	2	1	2	0	10	25	3	1	3
Carex seorsa	7	2	1	2	0	10	14	1	0	1
Alnus serrulata	8	2	1	2	0	10	13	1	0	1
Solidago rugosa	8	2	1	2	0	10	13	1	0	1
Carex atlantica	11	2	1	2	0	10	9	1	0	1
Chionanthus virginicus	7	3	1	2	-	10	14	1	0	1
Aronia arbutifolia	22	3	1	2	-	10	5	0	0	0
Pinus rigida	13	4	1	2	- -	10	8	1	0	0
Carex albicans	1	1	1	1	0	10	100	10	1	10
Carex collinsii	1	1	1	1	0	10	100	10	1	10
Carex radiata	1	1	1	1	0	10	100	10	1	10
Carex swanii	1	1	1	1	0	10	100	10	1	10
Carex sp.	1	1	1	1	0	10	100	10	1	10
Dioscorea sp.	1	1	1	1	0	10	100	10	1	10
Dryopteris sp. *1*	1	1	1	1	0	10	100	10	1	10
Fragaria virginiana	1	1	1	1	0	10	100	10	1	10
Helonias bullata	1	1	1	1	0	10	100	10	1	10
Hypericum sp.	1	1	1	1	0	10	100	10	1	10

Table 20 – Continued.

Lycopodium sp.	1	1	1	1	0	10	100	10	1	10
Maianthemum racemosum ssp. *racemosum*	1	1	1	1	0	10	100	10	1	10
Mnium sp.	1	1	1	1	0	10	100	10	1	10
Parnassia asarifolia	1	1	1	1	0	10	100	10	1	10
Platanthera cristata	1	1	1	1	0	10	100	10	1	10
Persicaria hydropiperoides	1	1	1	1	0	10	100	10	1	10
Persicaria virginiana	1	1	1	1	0	10	100	10	1	10
Porella sp.	1	1	1	1	0	10	100	10	1	10
Quercus pagoda	1	1	1	1	0	10	100	10	1	10
Ranunculus sp.	1	1	1	1	0	10	100	10	1	10
Rhododendron periclymenoides	1	1	1	1	0	10	100	10	1	10
Symphyotrichum racemosum	1	1	1	1	0	10	100	10	1	10
Vitis sp.	1	1	1	1	0	10	100	10	1	10
Cicuta maculata var. *maculata*	2	1	1	1	0	10	50	5	1	5
Fraxinus pennsylvanica	2	1	1	1	0	10	50	5	1	5
Persicaria longiseta	2	1	1	1	0	10	50	5	1	5
Boehmeria cylindrica	4	1	1	1	0	10	25	3	0	3
Scirpus polyphyllus	4	1	1	1	0	10	25	3	0	3
Glyceria obtusa	5	1	1	1	0	10	20	2	0	2
Juniperus virginiana	5	1	1	1	0	10	20	2	0	2
Carex lurida	7	1	1	1	0	10	14	1	0	1
Viola primulifolia	9	1	1	1	0	10	11	1	0	1
Dichanthelium ensifolium	5	2	1	1	-	10	20	2	0	1
Chasmanthium laxum	9	2	1	1	-	10	11	1	0	1
Viburnum dentatum var. *lucidum*	9	2	1	1	-	10	11	1	0	1
Pinus virginiana	10	2	1	1	-	10	10	1	0	1
Juncus canadensis	11	3	1	1	- -	10	9	1	0	0
Mean Species Richness	**33**									
Homoteneity	**0.641**									
Number of Plots	**10**									

APPENDIX III. STATE AND GLOBAL CONSERVATION RANKS

The following are definitions of the state and global rankings of rare species utilized in this report. Originally developed and instituted by The Nature Conservancy, an international conservation organization, the global and state ranking system is used by all 50 state Natural Heritage Programs and numerous Conservation Data Centers in other countries in this hemisphere. Because they are assigned based upon standard criteria, the ranks can be used to assess the range-wide status of a species as well as the status within portions of the species' range. The primary criterion used to define these ranks is the number of known distinct occurrences with consideration given to the total number of individuals at each locality. Additional factors considered include the current level of protection, the types and degree of threats, ecological vulnerability, and population trends. Global and state ranks are used in combination to set inventory, protection, and management priorities for species both at the state as well as regional level.

GLOBAL RANK

G1 Highly globally rare. Critically imperiled globally because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extinction.

G2 Globally rare. Imperiled globally because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3 Either very rare and local throughout its range or distributed locally (even abundantly at some of its locations) in a restricted range (e.g., a single western state, a physiographic region in the East) or because of other factors making it vulnerable to extinction throughout its range; typically with 21 to 100 estimated occurrences.

G4 Apparently secure globally, although it may be quite rare in parts of its range, especially at the periphery.

G5 Demonstrably secure globally, although it may be quite rare in parts of its range, especially at the periphery.

GH No known extant occurrences (i.e., formerly part of the established biota, with the expectation that it may be rediscovered).

GU Possibly in peril range-wide, but its status is uncertain; more information is needed.

GX Believed to be extinct throughout its range (e.g., passenger pigeon) with virtually no likelihood that it will be rediscovered.

G? The species has not yet been ranked.

_Q Species containing a "Q" in the rank indicates that the taxon is of questionable or uncertain taxonomic standing (i.e., some taxonomists regard it as a full species, while others treat it at an infraspecific level).

_T Ranks containing a "T" indicate that the infraspecific taxon is being ranked differently than the full species.

STATE RANK

S1 Highly State rare. Critically imperiled in Maryland because of extreme rarity (typically 5 or fewer estimated occurrences or very few remaining individuals or acres in the State) or because of some factor(s) making it especially vulnerable to extirpation. Species with this rank are actively tracked by the Natural Heritage Program.

S2 State rare. Imperiled in Maryland because of rarity (typically 6 to 20 estimated occurrences or few remaining individuals or acres in the State) or because of some factor(s) making it vulnerable to becoming extirpated. Species with this rank are actively tracked by the Natural Heritage Program.

S3 Watch List. Rare to uncommon with the number of occurrences typically in the range of 21 to 100 in Maryland. It may have fewer occurrences but with a large number of individuals in some populations, and it may be susceptible to large-scale disturbances. Species with this rank are not actively tracked by the Natural Heritage Program.

S3.1 A "Watch List" species that is actively tracked by the Natural Heritage Program because of the global significance of Maryland occurrences. For instance, a G3 S3 species is globally rare to uncommon, and although it may not be currently threatened with extirpation in Maryland, its occurrences in Maryland may be critical to the long term security of the species. Therefore, its status in the State is being monitored.

S4 Apparently secure in Maryland with typically more than 100 occurrences in the State or may have fewer occurrences if they contain large numbers of individuals. It is apparently secure under present conditions, although it may be restricted to only a portion of the State.

S5 Demonstrably secure in Maryland under present conditions.

SA Accidental or a vagrant in Maryland.

SE Established, but not native to Maryland; it may be native elsewhere in North America.

SH Historically known from Maryland, but not verified for an extended period (usually 20 or more years), with the expectation that it may be rediscovered.

SP Potentially occurring in Maryland or likely to have occurred in Maryland (but without persuasive documentation).

SR Reported from Maryland, but without persuasive documentation that would provide a basis for either accepting or rejecting the report (e.g., no voucher specimen exists).

SRF Reported falsely (in error) from Maryland, and the error may persist in the literature.

SU Possibly rare in Maryland, but of uncertain status for reasons including lack of historical records, low search effort, cryptic nature of the species, or concerns that the species may not be native to the State. Uncertainty spans a range of 4 or 5 ranks as defined above.

SX Believed to be extirpated in Maryland with virtually no chance of rediscovery.

S? The species has not yet been ranked.

_B This species is a migrant and the rank refers only to the breeding status of the species. Such a migrant may have a different rarity rank for non-breeding populations.

FEDERAL STATUS
This is the status of a species as determined by the U.S. Fish and Wildlife Service's Office of Endangered Species, in accordance with the Endangered Species Act. Definitions for the following categories have been modified from 50 CRF 17.

LE Taxa listed as endangered; in danger of extinction throughout all or a significant portion of their range.

LT Taxa listed as threatened; likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

PE Taxa proposed to be listed as endangered.

PT Taxa proposed to be listed as threatened.

C Candidate taxa for listing for which the Service has on file enough substantial information on biological vulnerability and threat(s) to support proposals to list them as endangered or threatened.

STATE STATUS
This is the status of a species as determined by the Maryland Department of Natural Resources, in accordance with the Nongame and Endangered Species Conservation Act. Definitions for the following categories have been taken from Code of Maryland Regulations (COMAR) 08.03.08.

E Endangered; a species whose continued existence as a viable component of the State's flora or fauna is determined to be in jeopardy.

I In Need of Conservation; an animal species whose population is limited or declining in the State such that it may become threatened in the foreseeable future if current trends or conditions persist.

T Threatened; a species of flora or fauna which appears likely, within the foreseeable future, to become endangered in the State.

X Endangered Extirpated; a species that was once a viable component of the flora or fauna of the State, but for which no naturally occurring populations are known to exist in the State.

* A qualifier denoting the species is listed in a limited geographic area only.

APPENDIX IV. SAMPLE DATA FORMS

The following pages are sample data forms used by the Maryland Natural Heritage Program for collecting vegetation and ecological data in order to classify natural communities.