

**Natural vegetation of the Carolinas:
Classification and description of
Piedmont alluvial plant communities of the Cape Fear River Basin**

A report prepared for the Ecosystem Enhancement Program, North Carolina Department of Environment and Natural Resources in partial fulfillments of contract D07042.

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Version 2.
October 2007

Abstract

Despite the ecological significance of bottomland plant communities, there is relatively little documentation or understanding of bottomland vegetation types in North Carolina or elsewhere on the southeastern Piedmont. Our understanding of these brown-water bottomlands is based primarily on qualitative data, and there has been no previous comprehensive, data-based classification and description of these community types. In this report we present a classification based on sixty plots collected in the Cape Fear River watershed during 2006. Vegetation types were derived using hierarchical cluster analysis, and non-metric multidimensional scaling (NMS) was used to help differentiate and characterize the resultant groups. We identify eight vegetation groups. While some of these groups fit well within currently recognized community-type concepts, others deviate sharply from established types and point to a need for refinement of currently recognized community concepts. These eight groups are discussed below, each with a description of composition, related community concepts, and correlated environmental variation.

I. Introduction

Few pristine riparian ecosystems remain in the Southeastern United States (Noss *et al* 1995). While historically floodplains have been home to diverse and highly productive plant communities, many of these landscapes have been converted to agriculture, damaged by impoundments, or otherwise altered, degraded, or destroyed. Knowledge of the vegetation composition and structure of these communities can inform management decisions and direct restoration projects. However, despite their ecological significance, the bottomland communities of Piedmont rivers have not previously been well documented and quantitatively described.

This report documents the composition and structure of the bottomland vegetation found in sixty vegetation plots sampled in the Cape Fear River basin. The goals for this project are to define and characterize the riparian vegetation types of the Piedmont region of the Cape Fear Basin, and to use the results to develop proposals for revision or elaboration of the types recognized in the U.S. National Vegetation Classification and the North Carolina Natural Heritage Program's Classification of the Natural Communities of North Carolina. It is our goal and expectation that the classification and description of vegetation types found within the Cape Fear River basin will provide better targets for restoration activities in this area.

II. Background

Previously described Piedmont brown-water river communities include thirteen communities in the U.S. National Vegetation Classification (NatureServe 2007) and eight communities in the NC Natural Heritage Program classification of natural communities (Schafale and Weakley 1990). However, these classifications are primarily based on qualitative data with little or no quantitative data supporting their descriptions. The currently recognized vegetation types of Piedmont brown-water rivers are presented in Appendix 1 of this document.

III. Field data

In the summer of 2006, sixty plots were established and recorded in the Piedmont portion of the Cape Fear River watershed. Vegetation was sampled following the North Carolina Vegetation Survey Protocol described in Peet *et al* 1998. Plots were oriented with the long axis parallel to the longitudinal axis of the river. Sample sites were stratified by geographic location within the basin, bedrock composition, geomorphic position, and upstream area drained (as a proxy for stream order). Moving across the floodplain away from the river channel, the four geomorphic positions used in this analysis include: (1) channel shelf, (2) levee, (3) backswamp, and (4) terrace. Channel shelf is defined as any site inside of a levee landform, normally located along the river channel itself. The levee is a slightly raised position running parallel to the longitudinal axis of the river and is drier than the surrounding geomorphic positions. The backswamp is beyond the levee and usually a wetter site where standing water is possible for extended periods of time. The terrace was defined as a flat site still within the floodplain, but farther from the channel and at a higher elevation than the backswamp position, and as such escapes most flooding. Beyond the upper terraces, the floodplain transitions into upland sites. All plots were located within the twenty-year floodplain of the nearest creek, determined using floodplain maps and the local vegetation composition with hydrophytic species indicating an area inside the floodplain. Soil samples were collected at each site and analyzed for texture and nutrients.

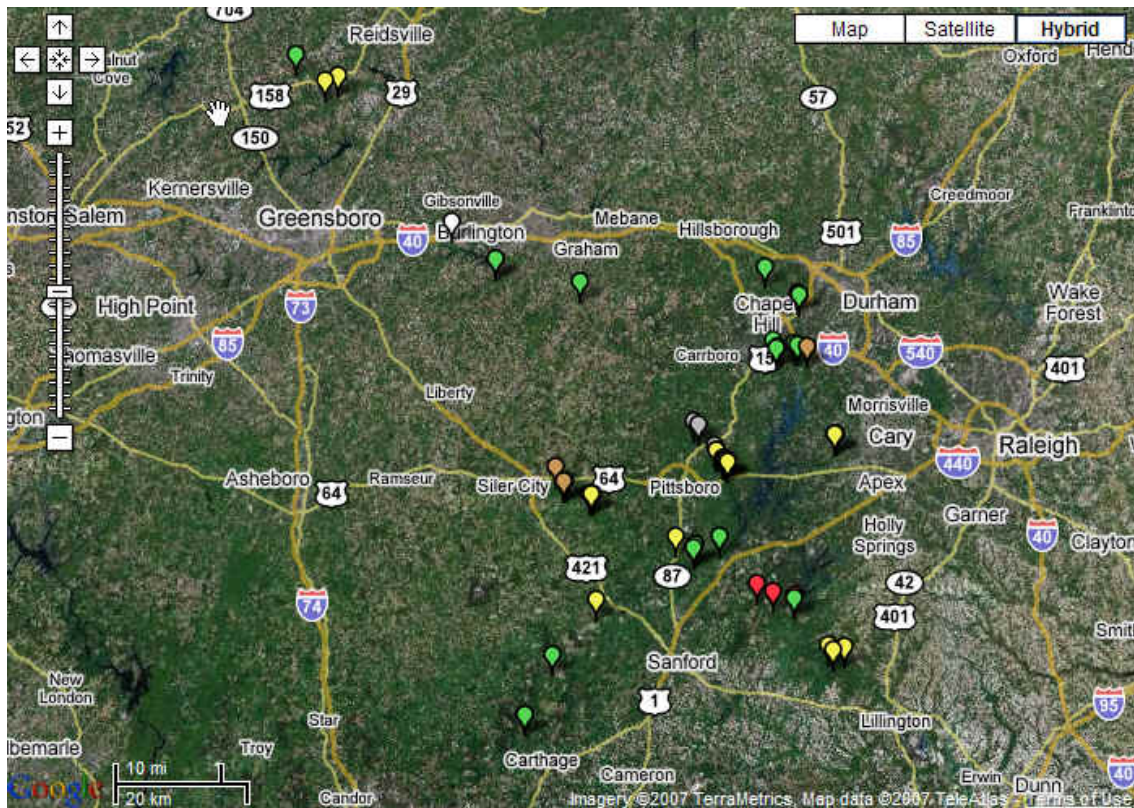


Figure 1. Locations of the 60 new plots established in 2006. To use the interactive features of this map visit: http://vegbank.org/vegbank/views/map_userplots.jsp?latlongfile=http://cvs.bio.unc.edu/maps/74-points.csv

IV. Analytical Methods

Data were analyzed using PC-ORD (version 5). Group selection was based on hierarchical cluster analysis using Sorenson distance to calculate a dissimilarity matrix and flexible beta ($\beta = -0.25$) for group linkage. Non-metric multidimensional scaling (NMS) ordination was used to help differentiate between and describe groups identified by the cluster analysis. All ordinations were derived using Sorenson distance measure.

V. Results

Cluster analysis suggested recognition of eight groups presented in this report: one herbaceous community and seven forested communities. The herbaceous community is the first break in the dendrogram produced using all plots (Figure 1). These plots were removed from further analyses. Although a different level of division into clusters would have been possible, eight clusters resulted in groups with approximately the same degree of compositional distinctness as is typically recognized in the US NVC. The next cut, recognizing a ninth group, divides the *Platanus-Celtis-Fraxinus/Acer negundo* forest vegetation type discussed below into two groups. The two groups resulting from this division, however, diverge solely based upon a few species that are more common in nutrient-rich sites; recognition of two groups here would require a different level of compositional distinctness than is normally recognized in the US NVC. Instead, we recognize compositional variability within the group that is related to the quality of the substrate. Recognizing a tenth group divides the oak-dominated bottomlands into two types; once again, these groups do not appear to have the appropriate level of distinctness for recognition in the US NVC. Future data collection will help determine the appropriateness of dividing this group.

A community characterization and description of each vegetation group is presented below. Vegetation type names are based on the naming system used in the U.S. National Vegetation Classification (NatureServe 2007; Jennings et al 2006). Names reflect species with high constancy and high cover; a “-“ separates species within the same vertical strata, whereas a “/” separates species of a different strata. Each community type presented in this document is compared with currently recognized concepts from the current NVC and from NHP’s third approximation (Appendix 2). A floristic table is presented for each; the tables include prevalent species found in each group, ranked by constancy and average cover class values within the group. Average cover class was calculated using the geometric mean of the true cover range for each cover class; these values were then averaged and converted back to cover classes. Constancy, the percent of plots within a group in which a given species is present, is reported (e.g., a species present in all plots within a group has a constancy value of 100%). Homogeneity, mean constancy of the prevalent species within a group, is also calculated for each group to indicate the degree of compositional variability among plots belonging to a described community type. A summary of soil data by vegetation type is presented in Appendix 3.

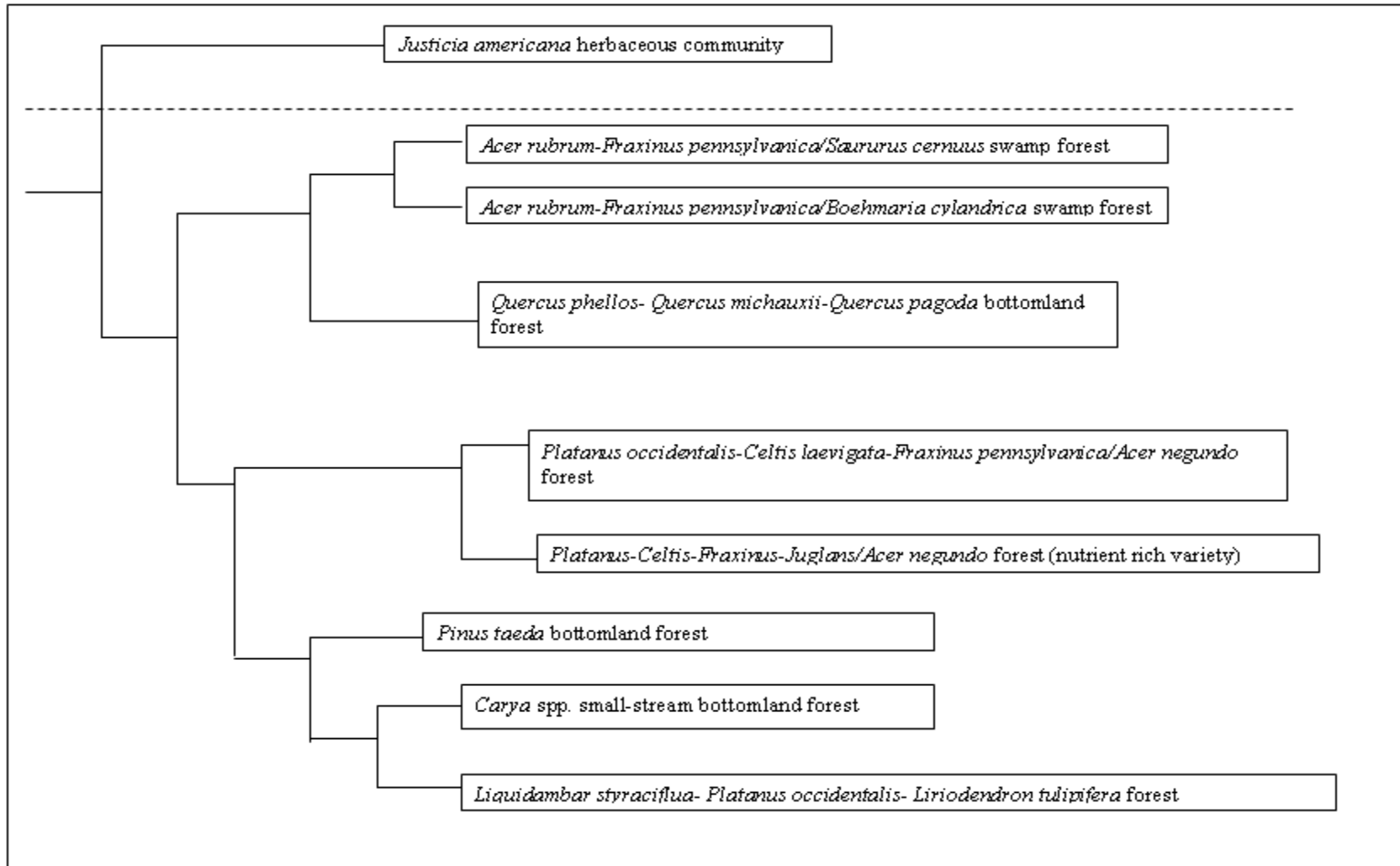


Figure 1: Classification of Piedmont brownwater-bottomland vegetation types. Dendrogram produced in cluster analysis using flexible beta ($\beta = -0.25$) for group linkage.

The vegetation types presented here are largely driven by geomorphic position. The geomorphic landscape of most Piedmont brown-water rivers, however, is not well developed due to the resistant metamorphic and granitic bedrock dominant in this region. The resulting landscape is dominated by comparatively narrow floodplains where geomorphic positions are not as well developed as in the Coastal Plain. The Triassic Basin region of the Piedmont, however, is characterized by sedimentary bedrock, allowing wider floodplains and a better developed geomorphic landscape as rivers travel through this region; the larger floodplains of this region result in more variation between the environmental settings of each geomorphic position. Several vegetation types presented below are associated with floodplains of a particular width, moving along a continuum from narrow floodplains found along smaller streams on resistant bedrock to larger floodplains found within the Triassic Basins. Within landscape position, compositional variation of the groups presented below is driven largely by successional status and substrate quality.

A. Red maple- Green Ash forests

The two types recognized here appear in backswamps of the alluvial landscape; they are found in relatively wide floodplains that have available for the development of these semi-permanently flooded sites.

1) *Acer rubrum*-*Fraxinus pennsylvanica*/*Saururus cernuus* swamp forest. The mostly closed canopy of this vegetation type is heavily dominated by both *Acer rubrum* and *Fraxinus pennsylvanica*, in addition to other common bottomland trees including *Liquidambar styraciflua*, *Quercus phellos*, and *Ulmus rubra* (Appendix 4). The sparse shrub stratum is primarily composed of *Ilex decidua*, and the relatively robust vine layer is dominated by *Toxicodendron radicans*, *Campsis radicans*, and *Smilax* spp. The herbaceous stratum is dominated by *Saururus cernuus*. This vegetation type is found in the backswamp geomorphic landscape position in the Triassic Basins. Ordination results indicate that this type is also associated with high-clay content in the A horizon and relatively infertile soils. This vegetation type fits within the NHP's Piedmont swamp forest but has no good fit within currently recognized communities in the NVC (see Appendix 2), perhaps reflecting the stronger linkage to potential vegetation in the NHP classification

2) *Acer rubrum*-*Fraxinus pennsylvanica*/*Boehmeria* swamp forest. This type is distinguished from the preceding vegetation type by having a more open canopy and an herbaceous stratum composed primarily of *Boehmeria cylindrica* (Appendix 5). The herbaceous stratum of this type is often heavily invaded by exotic species such as *Microstegium vimineum*, which contributes almost one-fourth of the total herb cover. The environmental variables associated with this type are similar to those described above. However, this type is found outside of the Triassic Basins in areas where a relatively wide floodplain has developed despite bedrock constraints. The soils of this group also include a higher clay component in the B horizon compared with the soils of the Triassic Basin type. This type also fits within the Piedmont swamp forest recognized in NHP's third approximation and has no good fit within the currently recognized NVC types (Appendix 2).

B. Oak-bottomlands

This type is similar to certain common bottomland hardwood vegetation types of the Coastal Plain where the geomorphic landscape is better developed when compared with the Piedmont region. The oak-dominated bottomlands of Piedmont brown-water rivers most commonly occur in the flat Triassic Basins and other areas of relatively wide floodplains within the Piedmont, which allow for a better developed geomorphic landscape more similar to those of the Coastal Plain.

3) *Quercus phellos-Quercus michauxii-Quercus pagoda* bottomland forest. This closed canopy forest is dominated by bottomland oak species (*Q. phellos*, *Q. michauxii*, and *Q. pagoda*) in addition to other common bottomland species, including *Liquidambar styraciflua*, *Acer rubrum*, and *Fraxinus pennsylvanica* (Appendix 6). *Quercus alba*, *Quercus lyrata*, and *Quercus nigra* are also present in some plots of this group. The shrub stratum is primarily a mix of *Carpinus caroliniana* and *Ilex decidua*. This vegetation type is correlated with the backswamp geomorphic position and nutrient poor soils. This group had a tendency to split in the cluster analysis, probably indicating a drier variety and a wetter variety. Plot data collected in the summer of 2007 may help to determine the appropriateness of lumping or splitting the bottomland oak groups. The group presented here fits within the NVC community type *Quercus pagoda - Quercus phellos - Quercus lyrata - Quercus michauxii / Chasmanthium latifolium* Forest (CEGL 007356; Appendix 2). The group described here is a little more narrowly defined, although further work in other drainage systems may lead to the convergence of these two concepts. This group fits within the Piedmont swamp forest described by NHP, but is a more narrowly circumscribed group with the oak species occupying the dominant canopy position. This suggests that the NHP type is perhaps too broad in composition, whereas the NVC types may be too narrow in geographic setting, as this type appears to occur outside of the Triassic Basins.

C. Levee communities

The hardwood levee communities presented here are found at the geomorphic high near the channel in relatively nutrient-rich sites of the floodplain.

4) *Platanus-Celtis-Fraxinus/Acer negundo* forest. The closed canopy of this vegetation type includes dominants such as *Platanus occidentalis*, *Celtis laevigata*, and *Fraxinus pennsylvanica*, and *Liquidambar styraciflua* (Appendix 7). The shrub stratum is composed of a mix of *Lindera benzoin*, *Carpinus caroliniana*, *Aesculus sylvatica* and *Ilex decidua*. This vegetation type is associated with streamside levees with nutrient-rich soils characterized by high calcium content. In the cluster analyses, this group often was divided into two subgroups, that correlate with soil nutrients. One of the two subgroups tends to have richer soils and more cover contributed by species such as *Juglans nigra*, *Carya cordiformis*, *Aesculus sylvatica* and *Acer floridanum* (Appendix 8). The larger group recognized here most closely matches *Platanus occidentalis - Celtis laevigata - Fraxinus pennsylvanica / Lindera benzoin - Ilex decidua / Carex retroflexa* Forest (CEGL007730) of the NVC. This group is not currently recognized as occurring in North Carolina, although it is recognized as having the potential to occur in North. The group recognized here diverges from the NVC group primarily because of coastal plain species that are listed as possible canopy species in the NVC type and not commonly found in Piedmont bottomlands (e.g., *Populus deltoides* and *Carya aquatica*).

5) *Liquidambar styraciflua-Platanus occidentalis-Liriodendron tulipifera* forest. This vegetation type appears to be an early successional bottomland forest, indicated by the dominance of fast-growing bottomland tree species (Appendix 9). Eighty percent of the plots that form this group were located below the fall line; as the Cape Fear River spills out onto the softer rock of the Coastal Plain, the floodplain is often wider. The geographic clustering of four plots that are the core of this group may reflect increased pressure to convert bottomland habitat to human use; in particular, areas where the floodplain has developed larger geomorphic structures are well-suited for farming. In addition to named dominants, other common canopy species include *Betula nigra* and *Acer rubrum*, with *Ilex opaca*, *Ostrya virginiana*, *Cornus florida*, and *Ulmus alata* contributing to a subcanopy stratum. This group fits within the broad *Platanus occidentalis* - (*Liquidambar styraciflua*, *Liriodendron tulipifera*) Temporarily Flooded Forest Alliance described in the NVC and within the Piedmont levee forest described in the third approximation (Appendix 2). The type described here, however, is more narrowly circumscribed than either currently recognized type.

6) *Liquidambar styraciflua-Pinus taeda-Ostrya virginiana-Acer floridanum* bottomland forest. This vegetation type is also described based upon three plots in a restricted geographic area; all three plots are located along the Haw River in Chatham County North Carolina. This may also reflect historical land-use, with these plots representing an early successional stage of a levee community; however, these plots also have a large cover contribution from species that are not common in early successional stands, such as a variety of hickory species. Further data collection will allow for a better interpretation of this community in the future. The canopy dominants include *Pinus taeda*, *Liquidambar styraciflua*, and *Fraxinus pennsylvanica* (Appendix 10), in addition to a variety of *Carya* species including *C. caroliniana-septrionalis*, *C. cordiformis*, and *C. glabra*. Subcanopy dominants including *Acer floridanum*, *Ostrya virginiana*, and *Ilex opaca*. The shrub layer in these plots is often dominated by the exotic invasive *Elaeagnus umbellata*. The soils of these sites are relatively low in nutrients when compared to the soils of other vegetation types associated with the levee geomorphic position.

D. Small-stream forested bottomlands

7) *Fagus - Carya* small-stream bottomland forest. Dominant *Carya* species of this vegetation type include *C. ovata*, *C. cordiformis*, and *C. alba*, in addition to smaller cover contributions from bottomland species such as *Juglans nigra*, *Fraxinus pennsylvanica*, *Celtis leavigata*, and *Liriodendron tulipifera* (Appendix 11). Subcanopy species include *Cornus florida*, *Acer floridanum*, and *Ulmus alata*. This group occurs often on sites with mafic bedrock and along smaller streams; ordinations reveal a generally high calcium content of the B-horizon in these soils, perhaps reflecting nutrient contributions from the bedrock. Because geomorphic features are not as well developed in the small stream floodplains, there also appears to be more mixing of typical upland species and bottomland species in the group, is suggested by the presence of *Fagus grandifolia* and *Quercus alba* at relatively high cover and constancy in this group. This type appears not to fit well within any extant NVC type though it has clear affinities with the *Fagus grandifolia - Acer barbatum / Asimina triloba / Toxicodendron radicans / Carex blanda* Forest (CEGL007321), and falls within the rather generic bin of Piedmont Bottomland Forest in the NHP's third approximation (Appendix 2).

E. Herbaceous communities

8) *Justicia americana* herbaceous community. This community occurs on rocky bottomed rivers and is heavily dominated by herbaceous cover from water willow, *Justicia americana* (Appendix 12). Occasional tree cover is contributed by overhanging bottomland species that may include *Platanus occidentalis*, *Fraxinus pennsylvanica*, and *Betula nigra*. This group closely matches the community type of the same name in the NVC (CEGL004286) and the Rocky Bar and Shore community (water willow subtype) in the NHP's third approximation (Appendix 2).

VI. Discussion and future directions

The community characterization presented above is based upon data collected within the Piedmont portion of the Cape Fear River watershed. However, floristic composition of bottomland communities may vary from watershed to watershed. Plot data from surrounding watersheds will help determine the general applicability of the preliminary classification across the river basins of the North Carolina Piedmont and may help determine the appropriate level of coarseness for conservation purposes. To this end, in the summer of 2007, plot data will be collected in the Piedmont portions of the Neuse, Tar-Pamlico, and Yadkin-Pee Dee river basins. Additionally, extant Carolina Vegetation Survey plot data from these basins will be incorporated into the larger dataset. These data will also help determine appropriate proposals for revisions in both the U.S. National Vegetation Classification and the N.C. Natural Heritage Program's classification schemes.

VII. Literature Cited

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Appendix 1. Currently recognized bottomland vegetation types of Piedmont brownwater rivers. NVC-recognized communities are presented with their unique identification numbers (CEGL codes).

National Vegetation Classification	
Association name	ID number
Acer rubrum var. trilobum / Viburnum nudum var. nudum / Osmunda cinnamomea - Saururus cernuus - Impatiens capensis Forest	CEGL004426
Acer rubrum var. trilobum - Liriodendron tulipifera / Ilex opaca var. opaca / Osmunda cinnamomea Forest	CEGL004551
Betula nigra - Platanus occidentalis / Alnus serrulata / Boehmeria cylindrica Forest	CEGL007312
Fagus grandifolia - Acer barbatum / Asimina triloba / Toxicodendron radicans / Carex blanda Forest	CEGL007321
Fagus grandifolia - Quercus spp. / Kalmia latifolia - Hamamelis virginiana / Galax urceolata Forest	CEGL004549
Justicia americana Herbaceous Vegetation	CEGL004286
Liquidambar styraciflua - Liriodendron tulipifera / Linder benzoin / Arisaema triphyllum ssp. triphyllum Forest	CEGL004418
Liriodendron tulipifera / Asimina triloba / Arundinaria gigantea ssp. gigantea Forest	CEGL004419
Nyssa biflora - Quercus nigra - Quercus laurifolia - Pinus taeda / Ilex opaca - Carpinus caroliniana Forest	CEGL007350
Peltandra virginica - Saururus cernuus - Carex crinita / Climacium americanum Herbaceous Vegetation	CEGL007696
Pinus taeda Temporarily Flooded Forest	CEGL007142
Platanus occidentalis - Liquidambar styraciflua / Carpinus caroliniana - Asimina triloba Forest	CEGL006036
Quercus pagoda - Quercus phellos - Quercus lyrata - Quercus michauxii / Chasmanthium latifolium Forest	CEGL007356
Natural Heritage Program's Classification of the Natural Communities of North Carolina, Third Approximation (Schafale and Weakley 1990)	
Sand and Mud Bar	
Rocky Bar and Shore	
Piedmont/Mountain Levee Forest	
Piedmont/Mountain Swamp Forest	
Piedmont/Mountain Bottomland Forest	
Floodplain Pool	
Piedmont/Mountain Semipermanent Impoundment	
Piedmont/Low Mountain Alluvial Forest	

Appendix 2. Vegetation types presented in this report are compared with currently recognized types in the National Vegetation Classification and Natural Heritage Program Third Approximation (Schafale and Weakley 1990). Types are matched at three levels: “<” indicates a concept is narrower than a currently defined concept, “=” indicates two concepts are approximately equal, and “>” indicates a concept is broader than a currently defined type. Certainty is ranked on a scale of three with 1 being least certain and 3 being most certain. Group numbers follow those presented in the text of the document.

group	certainty	N	Matthews' community type		NVC community type		NHP community type
1	3	2	<i>Acer rubrum-Fraxinus pennsylvanica/Saururus cernuus</i> swamp forest			no good match	< Piedmont swamp forest
2	3	2	<i>Acer rubrum-Fraxinus pennsylvanica/Boehmeria</i> swamp forest			no good match	< Piedmont swamp forest
3	2	12	<i>Quercus phellos- Quercus michauxii-Quercus pagoda</i> bottomland forest	<	7356	<i>Quercus pagoda - Quercus phellos - Quercus lyrata - Quercus michauxii / Chasmanthium latifolium</i> Forest	< Piedmont swamp forest
4	3	23	<i>Platanus-Celtis-Fraxinus/Acer negundo</i> forest	= or >	7730	<i>Platanus occidentalis - Celtis laevigata - Fraxinus pennsylvanica / Lindera benzoin - Ilex decidua / Carex retroflexa</i> Forest (not currently recognized in NC)	< Piedmont levee forest
5	2	5	<i>Liquidambar styraciflua-Platanus occidentalis- Liriodendron tulipifera</i> forest	<		<i>Platanus occidentalis - (Liquidambar styraciflua Liriodendron tulipifera)</i> Temporarily Flooded Forest Alliance	< Piedmont levee forest
6	2	3	<i>Pinus taeda</i> bottomland forest			no good match	< Piedmont bottomland forest
7	2	7	<i>Carya</i> spp. small-stream bottomland forest			no good match	< Piedmont bottomland forest
8	3	5	<i>Justicia americana</i> herbaceous community	=	4286	<i>Justicia americana</i> herbaceous vegetation	= Rocky Bar and Shore (water willow subtype)

Appendix 3: Average soil nutrient and textural components by vegetation group. Group numbering follows that presented in the text of this document. Soil variables presented include pH, percent base saturation (BS), total cation exchange capacity (TEC), organic matter (OM), ppm of various macro- and micronutrients, and percent clay, silt and sand.

Group	pH	BS	TEC	OM	N	P	Ca	Mg	K	Na	Fe	Mn	Cu	Zn	Al	Clay	Silt	Sand
1	5.2	54	17.04	8.52	57.25	39.38	1248	307	106.25	41.75	327	183	2.31	6.96	630	36.6	53.2	10.3
2	4.7	42	12.72	8.77	58.56	13.63	788	136	73.63	31.25	384	82	1.80	4.53	651	39.0	36.8	24.2
3	4.8	43	14.19	6.61	53.71	20.65	832	227	79.33	42.02	237	158	1.96	4.58	689	24.2	51.9	23.9
4	5.3	58	17.57	6.34	52.49	20.67	1531	250	53.14	30.60	195	128	2.99	9.03	479	22.2	48.5	29.3
5	5.3	59	12.42	5.55	49.28	16.70	1145	200	47.05	23.10	157	128	1.58	4.24	446	14.7	37.4	47.9
6	5.2	54	7.50	3.29	35.25	16.42	484	122	42.08	30.08	167	151	1.48	4.95	406	7.1	25.4	67.5
7	5.3	58	14.14	7.17	53.00	17.04	1274	226	75.07	27.93	174	137	2.16	4.93	538	18.6	51.4	30.0

Appendix 4: Floristic table for group 1, *Acer rubrum*-*Fraxinus pennsylvanica*/*Saururus cernuus* swamp forest. See text for description of constancy, average cover class, and homogeneity. Species list was cut off at average richness for the group.

number of plots:	2		
average richness:	38		
homogeneity:	71		
number	species	constancy	average cover class
1	<i>Saururus cernuus</i>	100	8
2	<i>Fraxinus pennsylvanica</i>	100	7
3	<i>Acer rubrum</i>	100	6
4	<i>Quercus phellos</i>	100	6
5	<i>Liquidambar styraciflua</i>	100	5
6	<i>Ilex decidua</i>	100	4
7	<i>Ulmus rubra</i>	100	4
8	<i>Toxicodendron radicans</i>	100	3
9	<i>Boehmeria cylindrica</i>	100	2
10	<i>Campsis radicans</i>	100	2
11	<i>Carex typhina</i>	100	2
12	<i>Commelina virginica</i>	100	2
13	<i>Ludwigia palustris</i>	100	2
14	<i>Panicum virginianum</i>	100	2
15	<i>Pilea pumila</i>	100	2
16	<i>Smilax rotundifolia</i>	100	2
17	<i>Quercus lyrata</i>	50	7
18	<i>Ulmus americana</i>	50	6
19	<i>Celtis laevigata</i>	50	5
20	<i>Nyssa sylvatica</i>	50	5
21	<i>Quercus michauxii</i>	50	5
22	<i>Carya ovata</i>	50	4
23	<i>Murdannia keisak</i>	50	4
24	<i>Smilax walteri</i>	50	4
25	<i>Carex lupulina</i>	50	3
26	<i>Carex tribuloides</i>	50	3
27	<i>Impatiens capensis</i>	50	3
28	<i>Ulmus alata</i>	50	3
29	<i>Acalypha rhomboidea</i>	50	2
30	<i>Betula nigra</i>	50	2
31	<i>Bromus pubescens</i>	50	2
32	<i>Carex crinita var crinita</i>	50	2
33	<i>Carex intumescens var intumescens</i>	50	2
34	<i>Carex stipata</i>	50	2
35	<i>Cornus amomum</i>	50	2
36	<i>Dichanthelium dichotomum</i>	50	2
37	<i>Elephantopus carolinianus</i>	50	2
38	<i>Festuca subverticillata</i>	50	2

Appendix 5: Floristic table for group 2, *Acer rubrum*-*Fraxinus pennsylvanica*/*Boehmeria* swamp forest.

number of plots:	2		
average richness:	62		
homogeneity:	72		
number	species	constancy	average cover class
1	<i>Fraxinus pennsylvanica</i>	100	7
2	<i>Acer rubrum</i>	100	7
3	<i>Microstegium vimenum</i>	100	6
4	<i>Boehmeria cylindrica</i>	100	6
5	<i>Liquidambar straciflua</i>	100	5
6	<i>Viburnum raf</i>	100	4
7	<i>Ulmus rubra</i>	100	4
8	<i>Toxicodendron radicans</i>	100	4
9	<i>Carex tribuloides</i>	100	4
10	<i>Lonicera japonica</i>	100	3
11	<i>Solidage ceasia</i>	100	2
12	<i>Smilax rotundifolia</i>	100	2
13	<i>Sambucus canadensis</i>	100	2
14	<i>Rubus argutus</i>	100	2
15	<i>Rosa multiflora</i>	100	2
16	<i>Ranunculus abortivus</i>	100	2
17	<i>Quercus phellos</i>	100	2
18	<i>Pilea pumila</i>	100	2
19	<i>Parthenocissus quinquefolia</i>	100	2
20	<i>Mikania scandens</i>	100	2
21	<i>Geum canadense</i>	100	2
22	<i>Galium aparine</i>	100	2
23	<i>Carya ovata</i>	100	2
24	<i>Carex crinita var. crinita</i>	100	2
25	<i>Campsis radicans</i>	100	2
26	<i>Bignonia capreolata</i>	100	2
27	<i>Amphicarpaea bracteata</i>	100	2
28	<i>Platanus occidentalis</i>	50	6
29	<i>Cinna arundinacea</i>	50	6
30	<i>Betula nigra</i>	50	6
31	<i>Salix nigra</i>	50	5
32	<i>Murdania keisak</i>	50	5
33	<i>Lindera benzoin</i>	50	5
34	<i>Festuca subverticillata</i>	50	5
35	<i>Cornus foemina</i>	50	5
36	<i>Carpinus caroliniana</i>	50	5
37	<i>Agrostis peremans</i>	50	5
38	<i>Ulmus americana</i>	50	4
39	<i>Juncus effusus</i>	50	4
40	<i>Impatiens capensis</i>	50	4
41	<i>Elymus virginiana var. virginiana</i>	50	4
42	<i>Carex stipata</i>	50	4
43	<i>Carex lurida</i>	50	4
44	<i>Carex amphibola</i>	50	4

45	<i>Smilax walterii</i>	50	3
46	<i>Ilex decidua</i>	50	3
47	<i>Vitis rotundifolia</i>	50	2
48	<i>Vitis aestivalis</i>	50	2
49	<i>Solidago gigantea</i>	50	2
50	<i>Smilax glauca</i>	50	2
51	<i>Sceptridium dissectum</i>	50	2
52	<i>Ranunculus recurvatus</i>	50	2
53	<i>Quercus michauxii</i>	50	2
54	<i>Prunus serotina</i>	50	2
55	<i>Poa cuspidata</i>	50	2
56	<i>Phytolacca americana</i>	50	2
57	<i>Phryma leptostachya</i>	50	2
58	<i>Persicaria virginiana</i>	50	2
59	<i>Persicaria sagittata</i>	50	2
60	<i>Persicaria punctata</i>	50	2
61	<i>Peltandra virginica</i>	50	2
62	<i>Mimulus ringens</i> var. <i>ringens</i>	50	2

Appendix 6: Floristic table for group 3, *Quercus phellos*-*Quercus michauxii*-*Quercus pagoda* bottomland forest.

number of plots:	12		
average richness:	67		
homogeneity:	66		
number	species	constancy	average cover class
1	<i>Acer rubrum</i>	100	6
2	<i>Fraxinus pennsylvanica</i>	100	6
3	<i>Liquidambar styraciflua</i>	100	6
4	<i>Ilex decidua</i>	100	5
5	<i>Toxicodendron radicans</i>	100	5
6	<i>Ligustrum sinense</i>	100	3
7	<i>Bignonia capreolata</i>	100	2
8	<i>Lonicera japonica</i>	100	2
9	<i>Parthenocissus quinquefolia</i>	100	2
10	<i>Quercus phellos</i>	92	7
11	<i>Ulmus alata</i>	92	6
12	<i>Ulmus rubra</i>	92	6
13	<i>Campsis radicans</i>	92	2
14	<i>Carpinus caroliniana</i>	85	6
15	<i>Quercus michauxii</i>	85	5
16	<i>Smilax rotundifolia</i>	85	4
17	<i>Viburnum prunifolia</i>	85	4
18	<i>Galium tinctorium</i>	85	2
19	<i>Rubus argutus</i>	85	2
20	<i>Trachelospermum difforme</i>	85	2
21	<i>Viola sp.</i>	85	2
22	<i>Vitis rotundifolia</i>	85	2
23	<i>Microstegium vimineum</i>	77	4
24	<i>Arisaema triphyllum</i>	77	2
25	<i>Boehmeria cylindrica</i>	77	2
26	<i>Carex tribuloides</i>	77	2
27	<i>Poa cuspidata</i>	77	2
28	<i>Nyssa sylvatica</i>	69	5
29	<i>Euonymus americana</i>	69	2
30	<i>Juncus coriaceous</i>	69	2
31	<i>Viburnum rafinesquianum</i>	69	2
32	<i>Quercus pagoda</i>	62	6
33	<i>Carya ovata</i>	62	5
34	<i>Carex debilis</i>	62	4
35	<i>Carex flaccosperma</i>	62	2
36	<i>Dichanthelium dichotomum var. ramulosum</i>	62	2
37	<i>Quercus alba</i>	54	6
38	<i>Ilex verticillata</i>	54	3
39	<i>Glyceria striata var. striata</i>	54	2
40	<i>Lycopus virginicus</i>	54	2
41	<i>Mitchella repens</i>	54	2

42	<i>Scutellaria integrifolia</i>	54	2
43	<i>Smilax bona-nox</i>	54	2
44	<i>Solidago caesia</i>	54	2
45	<i>Quercus nigra</i>	46	6
46	<i>Ilex opaca</i>	46	5
47	<i>Athyrium asplenioides</i>	46	2
48	<i>Carex caroliniana</i>	46	2
49	<i>Carex typhina</i>	46	2
50	<i>Chasmanthium latifolium</i>	46	2
51	<i>Commelina virginica</i>	46	2
52	<i>Dichanthelium commutatum var. commutatum</i>	46	2
53	<i>Polystichum acrostichoides</i>	46	2
54	<i>Rosa multiflora</i>	46	2
55	<i>Saururus cernuus</i>	46	2
56	<i>Solidago rugosa</i>	46	2
57	<i>Liriodendron tulipifera</i>	38	6
58	<i>Quercus lyrata</i>	38	5
59	<i>Cornus florida</i>	38	4
60	<i>Carex amphibola</i>	38	3
61	<i>Carex crinita var. crinita</i>	38	2
62	<i>Carex intumescens</i>	38	2
63	<i>Carex radiata</i>	38	2
64	<i>Hypericum hypericoides</i>	38	2
65	<i>Prunus serotina</i>	38	2
66	<i>Sanicula canadensis var. canadensis</i>	38	2
67	<i>Smilax glauca</i>	38	2

Appendix 7: Floristic table for group 4, *Platanus-Celtis-Fraxinus/Acer negundo* forest.

number of plots:	23		
average richness:	63		
homoteneity:	66		
number	species	constancy	cover class
1	<i>Acer negundo</i>	100	6
2	<i>Celtis leavigata</i>	100	6
3	<i>Lonicera japonica</i>	100	2
4	<i>Parthenocissus quinquefolia</i>	100	2
5	<i>Smilax bona-nox</i>	100	2
6	<i>Toxicodendron radicans</i>	100	2
7	<i>Liquidambar styraciflua</i>	96	6
8	<i>Fraxinus pennsylvanica</i>	91	6
9	<i>Ulmus rubra</i>	91	6
10	<i>Ligustrum sinense</i>	91	5
11	<i>Vitis rotundifolia</i>	91	4
12	<i>Platanus occidentalis</i>	87	6
13	<i>Lindera benzoin</i>	87	5
14	<i>Bignonia capreolata</i>	87	2
15	<i>Acer floridanum</i>	83	7
16	<i>Carpinus caroliniana</i>	83	6
17	<i>Carex amphibola</i>	83	2
18	<i>Persicaria virginiana</i>	83	2
19	<i>Smilax rotundifolia</i>	83	2
20	<i>Microstegium vimineum</i>	78	7
21	<i>Carya cordiformis</i>	78	5
22	<i>Verbesina alternifolia</i>	78	3
23	<i>Boehmeria cylindrica</i>	78	2
24	<i>Verbesina occidentalis</i>	78	2
25	<i>Galium aparine</i>	74	2
26	<i>Carex blanda</i>	70	2
27	<i>Matalea sp.</i>	70	2
28	<i>Viola sp.</i>	70	2
29	<i>Liriodendron tulipifera</i>	65	6
30	<i>Aesculus sylvatica</i>	65	4
31	<i>Carex gracilescens</i>	65	4
32	<i>Ilex decidua</i>	65	4
33	<i>Solidago caesia</i>	65	2
34	<i>Ulmus alata</i>	61	6
35	<i>Ilex opaca</i>	61	4
36	<i>Campsis radicans</i>	57	2
37	<i>Carex tribuloides</i>	57	2
38	<i>Symphoricarpos orbiculatus</i>	57	2
39	<i>Glechoma hederacea</i>	52	6
40	<i>Carex radiata</i>	52	5
41	<i>Geum canadense</i>	52	2
42	<i>Juglans nigra</i>	48	6

43	<i>Chasmanthium latifolium</i>	48	4
44	<i>Laportea canadensis</i>	48	4
45	<i>Euonymous americana</i>	48	2
46	<i>Osmorhiza longistylis</i>	48	2
47	<i>Oxalis sp.</i>	48	2
48	<i>Ranunculus abortivus</i>	48	1
49	<i>Asimina triloba</i>	43	6
50	<i>Elaeagnus umbellata</i>	43	5
51	<i>Cornus florida</i>	43	4
52	<i>Dichantheium commutatum var. commutatum</i>	43	3
53	<i>Botrypus virginianus</i>	43	2
54	<i>Clematis virginiana</i>	43	2
55	<i>Polystichum acrostichoides</i>	43	2
56	<i>Rubus argutus</i>	43	2
57	<i>Staphylea trifolia</i>	43	2
58	<i>Elymus virginicus var. virginicus</i>	39	4
59	<i>Amphicarpaea bracteata</i>	39	2
60	<i>Arisaema dracontium</i>	39	2
61	<i>Arisaema triphyllum</i>	39	2
62	<i>Elymus villosus</i>	39	2
63	<i>Poa cuspidata</i>	39	2

Appendix 8: Floristic table for nutrient rich subgroup of group 4, *Platanus-Celtis-Fraxinus/Acer negundo* forest.

number of plots:	11		
average richness:	60		
homoteneity:	67		
number	species	constancy	average cover class
1	<i>Acer negundo</i> var <i>negundo</i>	100	7
2	<i>Celtis laevigata</i>	100	7
3	<i>Platanus occidentalis</i> var <i>occidentalis</i>	100	7
4	<i>Juglans nigra</i>	100	6
5	<i>Toxicodendron radicans</i>	100	3
6	<i>Carex amphibola</i>	100	2
7	<i>Lonicera japonica</i>	100	2
8	<i>Parthenocissus quinquefolia</i>	100	2
9	<i>Smilax bonanox</i>	100	2
10	<i>Acer floridanum</i>	91	7
11	<i>Liquidambar styraciflua</i>	91	6
12	<i>Verbesina occidentalis</i>	91	2
13	<i>Lindera benzoin</i> var <i>pubescens</i>	82	6
14	<i>Ulmus rubra</i>	82	6
15	<i>Fraxinus pennsylvanica</i>	82	5
16	<i>Verbesina alternifolia</i>	82	4
17	<i>Vitis rotundifolia</i>	82	3
18	<i>Bignonia capreolata</i>	82	2
19	<i>Persicaria virginiana</i>	82	2
20	<i>Microstegium vimineum</i>	73	7
21	<i>Carya cordiformis</i>	73	6
22	<i>Ligustrum sinense</i>	73	5
23	<i>Liriodendron tulipifera</i>	73	5
24	<i>Boehmeria cylindrica</i>	73	2
25	<i>Galium aparine</i>	73	2
26	<i>Matalea</i> sp.	73	2
27	<i>Smilax rotundifolia</i>	73	2
28	<i>Solidago caesia</i> var <i>caesia</i>	73	2
29	<i>Laportea canadensis</i>	64	5
30	<i>Chasmanthium latifolium</i>	64	4
31	<i>Carex gracilescens</i>	64	3
32	<i>Carex blanda</i>	64	2
33	<i>Elymus villosus</i>	64	2
34	<i>Oxalis</i> sp.	64	2
35	<i>Symphoricarpos orbiculatus</i>	64	2
36	<i>Viola</i> sp.	64	2
37	<i>Carex radiata</i>	55	6
38	<i>Glechoma hederacea</i>	55	6
39	<i>Aesculus sylvatica</i>	55	5
40	<i>Carpinus caroliniana</i>	55	5
41	<i>Ilex opaca</i>	55	4

42	<i>Staphylea trifolia</i>	55	4
43	<i>Festuca subverticillata</i>	55	2
44	<i>Menispermum canadense</i>	55	2
45	<i>Osmorhiza longistylis</i>	55	2
46	<i>Ranunculus abortivus</i>	55	2
47	<i>Ilex decidua</i>	45	4
48	<i>Commelina virginica</i>	45	2
49	<i>Cryptotaenia canadensis</i>	45	2
50	<i>Pilea pumila</i>	45	2
51	<i>Rosa multiflora</i>	45	2
52	<i>Asimina triloba</i>	36	6
53	<i>Ulmus alata</i>	36	6
54	<i>Ulmus americana var americana</i>	36	5
55	<i>Dichanthelium commutatum var communtatum</i>	36	4
56	<i>Elymus virginicus var. virginicus</i>	36	3
57	<i>Amphicarpaea bracteata</i>	36	2
58	<i>Arisaema dracontium</i>	36	2
59	<i>Botrypus virginianus</i>	36	2
60	<i>Carex tribuloides</i>	36	2

Appendix 9: Floristic table for of group 5, *Liquidambar styraciflua*-*Platanus occidentalis*-*Liriodendron tulipifera* forest.

number of plots:	5		
average richness:	69		
homoteneity:	71		
number	species	constancy	average cover class
1	<i>Liquidambar styraciflua</i>	100	7
2	<i>Platanus occidentalis</i> var <i>occidentalis</i>	100	6
3	<i>Liriodendron tulipifera</i>	100	6
5	<i>Carpinus caroliniana</i>	100	6
4	<i>Microstegium vimineum</i>	100	5
6	<i>Polystichum acrostichoides</i>	100	3
7	<i>Ligustrum sinense</i>	100	2
8	<i>Bignonia capreolata</i>	100	2
9	<i>Botrypus virginianus</i>	100	2
10	<i>Campsis radicans</i>	100	2
11	<i>Prunus serotina</i> var <i>serotina</i>	100	2
12	<i>Vitis rotundifoliar</i>	100	2
13	<i>Celtis laevigata</i>	100	2
14	<i>Euonymous americana</i>	100	2
15	<i>Parthenocissus quinquefolia</i>	100	2
16	<i>Toxicodendron radicansr</i>	100	2
17	<i>Viola</i> sp.	100	2
18	<i>Lonicera japonica</i>	100	2
19	<i>Toxicodendron radicansr</i>	100	2
26	<i>Ilex decidua</i>	100	2
21	<i>Ilex opaca</i>	80	6
22	<i>Betula nigra</i>	80	6
23	<i>Ostrya virginiana</i>	80	6
24	<i>Cornus florida</i>	80	6
33	<i>Ulmus alata</i>	80	6
20	<i>Vitis rotundifoliar</i>	80	4
25	<i>Acer rubrum</i>	80	4
31	<i>Asimina triloba</i>	80	4
27	<i>Rubus argutus</i>	80	2
28	<i>Polygonatum biflorum</i> var. <i>biflorum</i>	80	2
29	<i>Sanicula canadensis</i> var <i>candensis</i>	80	2
30	<i>Mitchella repens</i>	80	2
32	<i>Matalea</i> sp.	80	1
34	<i>Lindera benzoin</i> var <i>pubescens</i>	60	6
56	<i>Ulmus rubra</i>	60	6
50	<i>Quercus nigra</i>	60	5
60	<i>Fagus grandifolia</i> var <i>caroliniana</i>	60	4
35	<i>Carex amphibola</i>	60	3
46	<i>Acer negundo</i> var <i>negundo</i>	60	3
36	<i>Amphicarpaea bracteata</i>	60	2
37	<i>Boehmaria cylandrica</i>	60	2

38	<i>Carex oxylepis</i>	60	2
39	<i>Galium triflorum</i>	60	2
40	<i>Hexastylis arifolia</i>	60	2
41	<i>Ophioglossum pycnostichum</i>	60	2
42	<i>Oxalis sp.</i>	60	2
43	<i>Carex radiata</i>	60	2
44	<i>Quercus alba</i>	60	2
45	<i>Acer floridanum</i>	60	2
47	<i>Carya cordiformis</i>	60	2
48	<i>Dichanthelium commutatum var communtatum</i>	60	2
49	<i>Poa cuspidata</i>	60	2
51	<i>Sceptridium biternatum</i>	60	2
52	<i>Smilax glauca</i>	60	2
53	<i>Smilax walteri</i>	60	2
54	<i>Arisaema triphyllum</i>	60	2
55	<i>Pinus taeda</i>	40	7
57	<i>Thelypteris noveboracensis</i>	40	6
58	<i>Cercis canadensis var candensis</i>	40	4
59	<i>Morus rubra</i>	40	4
61	<i>Vaccinium elliottii</i>	40	3
62	<i>Carex gracilescens</i>	40	2
63	<i>Geum canadense</i>	40	2
64	<i>Goodyera pubescens</i>	40	2
65	<i>Persicaria virginiana</i>	40	2
66	<i>Sassafras albidum</i>	40	2
67	<i>Smilax rotundifolia</i>	40	2
68	<i>Verbesina alternifolia</i>	40	2
69	<i>Xanthorhiza simplicissima</i>	40	2
70	<i>Carex laxiculmis</i>	40	2

Appendix 10: Floristic table for of group 6, *Liquidambar styraciflua*-*Pinus taeda*-*Ostrya virginiana*-*Acer floridanum* bottomland forest.

number of plots:	3		
average richness:	83		
homoteneity:	82		
number	species	constancy	average cover class
1	<i>Ostrya virginiana</i>	100	7
2	<i>Acer floridanum</i>	100	6
3	<i>Elaeagnus umbellata</i>	100	6
4	<i>Liquidambar styraciflua</i>	100	6
5	<i>Pinus taeda</i>	100	6
6	<i>Aesculus sylvatica</i>	100	5
7	<i>Carpinus caroliniana</i>	100	5
8	<i>Fraxinus pennsylvanica</i>	100	5
9	<i>Ilex opaca</i>	100	5
10	<i>Polystichum acrostichoides</i>	100	5
11	<i>Ulmus alata</i>	100	5
12	<i>Carya cordiformis</i>	100	4
13	<i>Microstegium vimineum</i>	100	4
14	<i>Nyssa sylvatica</i>	100	4
15	<i>Quercus rubra var rubra</i>	100	4
16	<i>Verbesina alternifolia</i>	100	4
17	<i>Vitis rotundifolia</i>	100	4
18	<i>Ilex decidua</i>	100	3
19	<i>Bignonia capreolata</i>	100	2
20	<i>Carex amphibola</i>	100	2
21	<i>Carex blanda</i>	100	2
22	<i>Carex radiata</i>	100	2
23	<i>Dichanthelium commutatum var communtatum</i>	100	2
24	<i>Dichanthelium laxiflorum</i>	100	2
25	<i>Euonymous americana</i>	100	2
26	<i>Hexastylis arifolia</i>	100	2
27	<i>Houstonia purpurea var. purpurea</i>	100	2
28	<i>Hypericum hypericoides</i>	100	2
29	<i>Juncus coriaceus</i>	100	2
30	<i>Juniperus virginiana var virginiana</i>	100	2
31	<i>Lonicera japonica</i>	100	2
32	<i>Mitchella repens</i>	100	2
33	<i>Parthenocissus quinquefolia</i>	100	2
34	<i>Poa cuspidata</i>	100	2
35	<i>Polygonatum biflorum var. biflorum</i>	100	2
36	<i>Scleria oligantha</i>	100	2
37	<i>Smilax bonanox</i>	100	2
38	<i>Smilax rotundifolia</i>	100	2
39	<i>Smilax walteri</i>	100	2
40	<i>Solidago arguta</i>	100	2

41	<i>Toxicodendron radicans</i>	100	2
42	<i>Trachelospermum difforme</i>	100	2
43	<i>Viburnum rafenesquianum</i>	100	2
44	<i>Ligustrum sinense</i>	100	1
45	<i>Carya carolinae-septentrionalis</i>	67	8
46	<i>Carya glabra var glabra</i>	67	5
47	<i>Chasmanthium latifolium</i>	67	4
48	<i>Chasmanthium sessiliflorum var. sessiliflorum</i>	67	4
49	<i>Salvia lyrata</i>	67	4
50	<i>Viburnum prunifolium</i>	67	4
51	<i>Bromus pubescens</i>	67	3
52	<i>Amphicarpaea bracteata</i>	67	2
53	<i>Celtis laevigata</i>	67	2
54	<i>Commelina virginica</i>	67	2
55	<i>Dichanthelium boscii</i>	67	2
56	<i>Dichanthelium yadkinense</i>	67	2
57	<i>Dioscorea villosa</i>	67	2
58	<i>Elymus hystrix var hystrix</i>	67	2
59	<i>Elymus villosus</i>	67	2
60	<i>Galium aparine</i>	67	2
61	<i>Galium latifolium</i>	67	2
62	<i>Hamamelis virginiana var virginiana</i>	67	2
63	<i>Juniperus virginiana var virginiana</i>	67	2
64	<i>Lespedeza cuneata</i>	67	2
65	<i>Luzula echinata</i>	67	2
66	<i>Matalea sp.</i>	67	2
67	<i>Oxalis sp.</i>	67	2
68	<i>Potentilla sp.</i>	67	2
69	<i>Quercus nigra</i>	67	2
70	<i>Quercus phellos</i>	67	2
71	<i>Smilax glauca</i>	67	2
72	<i>Symphoricarpos orbiculatus</i>	67	2
73	<i>Verbesina occidentalis</i>	67	2
74	<i>Zizia aurea</i>	67	2
75	<i>Rubus argutus</i>	67	1
76	<i>Sanicula canadensis var candensis</i>	67	1
77	<i>Viola sp.</i>	67	1
78	<i>Acer rubrum</i>	33	6
79	<i>Quercus stellata</i>	33	5
80	<i>Tilia americana var. heterophylla</i>	33	5
81	<i>Carex gracilescens</i>	33	4
82	<i>Prunus serotina var serotina</i>	33	4
83	<i>Cornus florida</i>	33	3

Appendix 11: Floristic table for of group 7, *Carya* spp. small-stream bottomland forest.

number of plots:	7		
average richness:	93		
homoteneity:	74		
number	species	constancy	average cover class
1	<i>Microstegium vimineum</i>	100	7
2	<i>Carya ovata</i>	100	6
3	<i>Cornus florida</i>	100	5
4	<i>Fraxinus pennsylvanica</i>	100	5
5	<i>Juglans nigra</i>	100	5
6	<i>Ulmus alata</i>	100	5
7	<i>Ulmus rubra</i>	100	5
8	<i>Acer negundo</i> var <i>negundo</i>	100	4
9	<i>Celtis laevigata</i>	100	4
10	<i>Lonicera japonica</i>	100	4
11	<i>Vitis rotundifolia</i>	100	4
12	<i>Toxicodendron radicans</i>	100	3
13	<i>Boehmeria cylandrica</i>	100	2
14	<i>Botrypus virginianus</i>	100	2
15	<i>Euonymus americana</i>	100	2
16	<i>Geum canadense</i>	100	2
17	<i>Oxalis</i> sp.	100	2
18	<i>Parthenocissus quinquefolia</i>	100	2
19	<i>Polystichum acrostichoides</i>	100	2
20	<i>Smilax bona-nox</i>	100	2
21	<i>Viburnum prunifolium</i>	100	2
22	<i>Viola</i> sp.	100	2
23	<i>Carya cordiformis</i>	86	6
24	<i>Lindera benzoin</i> var <i>pubescens</i>	86	6
25	<i>Liriodendron tulipifera</i>	86	6
26	<i>Acer rubrum</i>	86	5
27	<i>Fagus grandifolia</i> var <i>caroliniana</i>	86	5
28	<i>Liquidambar styraciflua</i>	86	5
29	<i>Quercus alba</i>	86	5
30	<i>Chasmanthium latifolium</i>	86	4
31	<i>Juniperus virginiana</i> var <i>virginiana</i>	86	4
32	<i>Ilex opaca</i>	86	3
33	<i>Prunus serotina</i> var <i>serotina</i>	86	3
34	<i>Rosa multiflora</i>	86	3
35	<i>Amphicarpaea bracteata</i>	86	2
36	<i>Campsis radicans</i>	86	2
37	<i>Dichanthelium commutatum</i> var <i>communtatum</i>	86	2
38	<i>Ligustrum sinense</i>	86	2
39	<i>Polygonatum biflorum</i> var. <i>biflorum</i>	86	2
40	<i>Rubus argutus</i>	86	2
41	<i>Sanicula canadensis</i> var <i>candensis</i>	86	2
42	<i>Solidago caesia</i> var <i>caesia</i>	86	2

43	<i>Acer floridanum</i>	71	6
44	<i>Carex radiata</i>	71	5
45	<i>Carex amphibola</i>	71	3
46	<i>Arisaema triphyllum</i>	71	2
47	<i>Bignonia capreolata</i>	71	2
48	<i>Carex blanda</i>	71	2
49	<i>Galium triflorum</i>	71	2
50	<i>Persicaria virginiana</i>	71	2
51	<i>Potentilla indica</i>	71	2
52	<i>Ranunculus abortivus</i>	71	2
53	<i>Saururus cernuus</i>	71	2
54	<i>Smilax glauca</i>	71	2
55	<i>Smilax rotundifolia</i>	71	2
56	<i>Verbesina occidentalis</i>	71	2
57	<i>Carpinus caroliniana</i>	57	6
58	<i>Carya alba</i>	57	6
59	<i>Quercus shumardii</i> var. <i>shumardii</i>	57	6
60	<i>Elaeagnus umbellata</i>	57	5
61	<i>Quercus phellos</i>	57	5
62	<i>Symphoricarpos orbiculatus</i>	57	4
63	<i>Betula nigra</i>	57	3
64	<i>Verbesina alternifolia</i>	57	3
65	<i>Agrimonia microcarpa</i>	57	2
66	<i>Anemonella thalictroides</i>	57	2
67	<i>Carex gracilescens</i>	57	2
68	<i>Carex oxylepis</i>	57	2
69	<i>Cryptotaenia canadensis</i>	57	2
70	<i>Elymus hystrix</i> var. <i>hystrix</i>	57	2
71	<i>Erechtites hieracifolia</i> var. <i>hieracifolia</i>	57	2
72	<i>Festuca subverticillata</i>	57	2
73	<i>Galium circaeans</i> var. <i>circaeans</i>	57	2
74	<i>Glyceria striata</i> var. <i>striata</i>	57	2
75	<i>Hexastylis arifolia</i>	57	2
76	<i>Ophioglossum pycnostichum</i>	57	2
77	<i>Passiflora lutea</i> var. <i>lutea</i>	57	2
78	<i>Pilea pumila</i>	57	2
79	<i>Ruellia caroliniensis</i>	57	2
80	<i>Sceptridium dissectum</i>	57	2
81	<i>Elymus virginicus</i> var. <i>virginicus</i>	43	6
82	<i>Cercis canadensis</i> var. <i>canadensis</i>	43	5
83	<i>Platanus occidentalis</i> var. <i>occidentalis</i>	43	5
84	<i>Nyssa sylvatica</i>	43	4
85	<i>Circaea canadensis</i> ssp. <i>Canadensis</i>	43	3
86	<i>Ilex decidua</i>	43	3
87	<i>Carya glabra</i> var. <i>glabra</i>	43	2
88	<i>Carex tribuloides</i>	43	2
89	<i>Clematis virginiana</i>	43	2
90	<i>Commelina communis</i>	43	2

91	<i>Dioscorea quaternata</i>	43	2
92	<i>Galium aparine</i>	43	2
93	<i>Impatiens capensis</i>	43	2

Appendix 12: Floristic table for of group 8, *Justicia americana* herbaceous community.

number of plots:	5		
average richness:	17		
homoteneity:	60		
number	species	constancy	average cover class
1	<i>Justicia americana</i>	100	6
2	<i>Fraxinus pennsylvanica</i>	80	4
3	<i>Murdannia keisak</i>	80	3
4	<i>Eclipta prostrata</i>	80	3
5	<i>Persicaria virginiana</i>	80	2
6	<i>Ulmus alata</i>	60	3
7	<i>Acer negundo var. negundo</i>	60	3
8	<i>Platanus occidentalis var occidentalis</i>	60	2
9	<i>Microstegium vimineum</i>	60	2
10	<i>Boehmeria cylindrica</i>	60	2
11	<i>Betula nigra</i>	60	2
12	<i>Saururus cernuus</i>	40	3
13	<i>Calamagrostis cinnoides</i>	40	3
14	<i>Toxicodendron radicans</i>	40	2
15	<i>Solidago gigantea</i>	40	2
16	<i>Salix nigra</i>	40	2
17	<i>Pluchea camphorata</i>	40	2