NBS/NPS VEGETATION MAPPING PROGRAM

Vegetation Classification of Rock Creek Park

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In memoriam:
Virginia Crouch was also instrumental in this effort. During her time as a botanist with the DC Natural Heritage Program she assisted with the 1997 field inventory for this project. Her previous work experience at Rock Creek Park and her detailed knowledge of the regional flora was invaluable to this effort. Her sense of humor and her botanical expertise will be missed.

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Vegetation Classification and Mapping of Rock Creek National Park Using a National Framework

INTRODUCTION

A detailed description and map of the vegetation of Rock Creek Park was developed using the National Vegetation Classification System developed by The Nature Conservancy in conjunction with the Federal Geographic Data Committee and the Ecological Society of America Vegetation Subcommittee. The final product, a 1:12000 scale map with descriptions of the component types and all relating metadata files, will be evaluated for its potential to provide needed vegetation information in a format that is useful for the various operations of the National Park Service, including natural resource managers, planners, acquisition specialists, contaminants specialists, and biologists (a similar product is currently being applied at Assateague National Seashore (The Nature Conservancy 1995)). In addition, the product was also developed at Rock Creek Park to provide the natural resource managers with baseline information about the site. Although current information existed about the flora of the park (Fleming and Kanal 1995) and the locations of rare species, the map and descriptions of the park's vegetation (Anderson et al. 1977) were significantly outdated due to natural changes in the vegetation over the past 20 years. In addition, the vegetation of several outlying areas of the park had not yet been described. The Park Service desired a current map and description of the vegetation and a means of comparing and evaluating the park's resources in context of a regional and national vegetation classification. Information on community composition and rarity can help to inform decisions on management of particular areas and natural communities within the park. Such information is critical to ensure the persistence of the native plant and animal species in the park in light of human use, invasion of exotic species, deer browse, beaver activity, and other disturbances to the habitats.

The Nature Conservancy, in partnership with the network of Natural Heritage Programs, has developed a classification of vegetation of the United States (Grossman et al. 1998). This system has been adopted by the Federal Geographic Data Committee and the Ecological Society of America Vegetation Subcommittee as the national vegetation mapping standard, the National Vegetation Classification System (NVCS). Although the two systems (Grossman et al. 1988 and the NVCS) are nearly identical, The Nature Conservancy continues to refine the classification through an active review process with the state Natural Heritage Programs and academics. The basic unit of either system, the association, is roughly equivalent in scale to the plant association of European phytosociologists. The association is a unit of vegetation that is more or less homogeneous in composition and structure and occurs on uniform habitat. Above this level in the classification is the alliance, a group of associations sharing one or more dominant or characteristic species. Alliances are generally more wide-ranging geographically than are associations, although many monotypic alliances have been classified. Where the component associations of an alliance have not been classified, an association is assigned the same name as the alliance and noted as "provisional".

Although associations are defined by the plants that comprise them, they are in fact communities of all the component organisms of that association, including animals, protozoans, bacteria, and fungi. Associations are classified from a national perspective, and are assigned global rarity ranks as well as ranking specifications to be applied to individual occurrences of associations across their range. A map of associations occurring at a site can provide information about the abundance and distribution of each type, the significance of the individual occurrences, and also provides surrogate information about the location and abundance of individual species characteristic of the association.

In accordance with the standards for this national mapping effort, the vegetation of Rock Creek Park was mapped to the association level using a 0.5 hectare minimum mapping unit on 1:12000 color-infrared stereo photography flown in October 1996 (leaves on).

METHODS

Planning

Field work follows the methodology developed by The Nature Conservancy in conjunction with the NBS/NPS Vegetation Mapping Program (The Nature Conservancy 1994). The following is a summary of these methods as applied to Rock Creek Park.

Rock Creek Park is considered to be of "small size", one in which the sample area includes the entire park. Decisions regarding number of plots and plot placement by environmental stratification were based on the whole park (by comparison, in large parks, the plot placement and stratification is focused on only a section of the park, and results extrapolated to the whole).

A preliminary list of vegetation alliances that were known or suspected to occur in the Piedmont and Chesapeake Bay areas was generated based on the Eastern Regional Classification (Sneddon et al. 1996). This classification was used during a reconnaissance visit by photointerpreters, ecologists, and park staff to match aerial photo signatures with vegetation on the ground. Preliminary names were assigned to these types and their aerial photo signatures were noted. Extensively disturbed areas and developed areas were assigned labels that describe the predominant landscape feature, e.g., "mown field", "built up areas", etc. In addition, gaps in the forest canopy (often dominated by vines) were designated as "canopy openings". A minimum mapping unit of 0.25 hectare (rather than the standard 0.5 hectare) was used for these openings to address the park's interest in monitoring and controlling encroachment of forest gaps by exotic plant species.

The preliminary photointerpretation of all photos of the park was completed by Aerial Information Systems, Inc. The resulting polygon map was then used by park staff to choose plot locations. Plots were allocated to each vegetation type that had been mapped (15 types) and replicate plots were to be assigned over the environmental range of the type. For example, mixed oak forests were sampled on slopes of varying degree and aspect; streamside vegetation was sampled at various points along the stream. Where the environmental variability of the types was unknown, samples were geographically dispersed. Replicate plots were not assigned equably among all vegetation types; vegetation types that were known or suspected to be

relatively more variable were assigned more plots. In addition, photo signatures were very similar for several of the forest types. Plots were allocated to variants of vegetation types of the same signature based on the collective knowledge of the refuge staff and on apparent environmental variablity.

Field methods

Plots were subjectively placed so as to be most representative of the mapped vegetation unit. All mapped vegetation types were sampled over a range of environmental variation. Additional plots were taken where the vegetation type documented in the field was unclassified or less well known. For example, the ash floodplain map unit polygons were targeted specifically for field verification. This vegetation types was later classified as part of the *Platanus occidentalis - Fraxinus pennsylvanica* Forest Association.

Plot sizes ranged from 20 x 20 m for forests and woodlands, 10 x 10 m for shrublands, and 5 x 5 m for herbaceous vegetation. In some cases, where the polygons were too narrow to reasonably accomodate standard plot sizes, the plots were adjusted accordingly, e.g., 10 x 20 m plots were often used in sampling narrow bands of floodplain forest in the park. The vegetation was visually divided into strata, and all the species of each stratum were listed and percent cover estimated. Additional species within the vegetation unit or polygon that occurred outside of sampled plots were listed separately. Species that were not identifiable in the field were collected for later identification. In addition to floristic information, the following environmental information was recorded on field forms: soil profile description, flooding regime, soil moisture regime, slope, aspect and evidence of disturbance. Latitude and longitude of each plot was recorded using a GPS unit. The vegetation profile in cross-section was sketched by hand to represent the location and setting of the plot. Seventy-seven vegetation plots in total were sampled for this project.

Data analysis

Park plot data (77 plots) were entered by Rock Creek Park staff into The Nature Conservancy's PLOTS Database System (1997) on a Microsoft Access platform. Species were assigned standardized codes and names based on the PLANTS database developed by National Resources Conservation Service (NRCS) in cooperation with the Biota of North America Program (BONAP). For the vegetation analysis, portions of the Rock Creek Park data set were copied onto spreadsheets in a format compatible with PC-ORD Multivariate Analysis package (McCune and Mefford 1997). Plots that represented cultivated types or exotics-dominated sites were excluded from the analysis. Several outliers (plots that are very dissimilar from all the others) were identified using Sorenson and Euclidian formulas in PC-ORD and were excluded from the primary analyses. The remaining data set of 67 plots was analyzed with Detrended Correspondence Analysis/DCA (Hill and Gauch 1980) and Two-Way Indicator Species Analysis/TWINSPAN (Hill 1979). DCA ordinates both species and samples simultaneously along preceived gradients (e.g. that may indicate moisture gradient, elevation, etc.). TWINSPAN successively divides the plots into groups that are similar in species composition. The initial results indicated that some plots were artificially clustering based on high percent

cover of several exotic species. The data set was further modified to exclude these exotics and the revised data were re-analyzed with DCA and TWINSPAN.
These groups were compared with the National Vegetation Classification (Grossman et al. 1998) and matched to existing Alliances and/or Associations where appropriate.

Environmental data on soil characteristics, slope, aspect and topography for each plot were used to interpret the results. The soil survey, geologic map and topographic maps were also used in the interpretation. Plot information on flooding regime was incomplete but could be extrapolated from the polygon and plot locations delineated on air photos and topographic maps. Environmental data were analyzed using the ordination program CANOCO in PC-ORD. However, due to the small size of the study area, the relatively uniform topography of the park and some incomplete and inconsistent data on soil types and hydrology, the CANOCO results provided little additional information for the classification.

RESULTS.

Initial DCA and TWINSPAN analysis identified four vegetation groups, all of which were forest types: 1) the dry chestnut oak - black gum group, 2) a black cherry-pine-oak group, 3) a broadly defined beech - oak group and 4) a floodplain or mesic tulip poplar - boxelder group (see Appendix A). Data from the two latter groups were then analyzed separately (as two data sets) for more detailed resolution (see Appendix B and C). The tulip poplar - boxelder group subdivided into floodplain versus upland groups based on the presence or absence (or low cover value) of sycamore. Plots in this upland subset were seen as more closely aligned with group 3 above and the floodplain plots were kept within group 4 above. Additional analysis of the beech - oak group (group 3) indicated a generalized category to include mixed oak - beech - tulip poplar plus two variants or subtypes: a.) a drier oak forest sub-type and b.) a mesic tulip poplar - beech subtype. These groups represent potential alliances, associations or sub-associations at the national vegetation classification level. The results of this analysis were compared with existing classifications and matched to the national classification types as much as possible.

Comparison with forest types described in the National Vegetation Classification (Grossman et al. 1998) indicated that the four primary groups above did match four existing Alliances. However, there was not enough evidence to assign the variants of the mixed oak-beech-tulip poplar group (group 3) to separate alliances. The variants were considered to be relatively small patches within the matrix of the of the "parent" forest type. However, detailed information from the field forms did help to define two additional Alliances that were not recognized in the TWINSPAN or DCA analysis due to the small number of plots in each. These were a tulip poplar monoculture (group 5) and a Virginia pine - mixed oak forest (group 6). The final classification is presented on page 7. Variants of the beech-white oak forest are not included in the classification but are described in the text. Of the six Alliances recognized at the park, one forest type, the Loblolly pine-mixed oak forest (*Pinus taeda-Quercus (alba, falcata, stellata)* Forest) had not been previously described at Rock Creek Park or in the Eastern Regional Classification (Sneddon et al. 1994).

Vegetation descriptions include geographic range, environmental description, USFWS wetland system (Cowardin et al. 1979), most abundant species, diagnostic species, conservation rank (global rarity rank), confidence level of classification and of rarity rank and references. In addition, corresponding plots from Rock Creek Park are listed for each type with field form plot number. Conservation rank is on a scale from G1 to G5 with G1 being globally rare, and G5 being widespread and common. Confidence level of classification was rated on a scale of 1 to 3, with 1 being the highest level of confidence. New types that were undocumented in the literature or where data was sparse were given the lowest confidence rank of 3, indicating that they are classified at the alliance level only, pending further regional classification work.

All plot locations for Rock Creek Park will be transferred to the base map. When the map locations are received, the classification of each plot will be compared to the mapped unit to determine where discrepancies occur. The map will then be further checked against additional field notes and experience of the primary field worker to correct any known errors. The final results of the photointerpretation based on the the vegetation analysis and classification will later be transferred into GIS. Although we have high confidence in the accuracy of the information collected and in the map in general, a rigorous methodical accuracy assessment is beyond the scope of this project.

DISCUSSION

Rock Creek Park runs along the fall line, separating the Piedmont Plateau and the Atlantic Coastal Plain provinces. The vegetation reflects affinities to both of these provinces and is closely aligned with vegetation types described in the nearby states of Maryland, New Jersey, Pennsylvania, and Virginia. All of the natural communities at Rock Creek Park are classified as forest types ("Forest Class" in the national vegetation classification heirarchy). No natural woodland, shrubland or herbaceous communities were identified. Six forest alliances each represented by a single association were described at the park; these are outlined in the Vegetation Classification on page 7. Several variants were noted within these types but these were not sufficiently different to warrant recognition at the association level. Plots that were dominated by shrubs or vines fell within the cultivated or disturbance categories and were not considered as natural vegetation. This community was described and mapped at the request of Park personnel.

The Beech - white oak / mayapple forest association (*Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest Association) was the most widespread across the park. This association included five of the forest types previously defined by Anderson (1977). In contrast, the chestnut oak / black huckleberry association (*Quercus (prinus, velutina*) / *Gaylussacia baccata* Forest Association) was restricted primarily to hilltops. Uncommon in the park were remnants of the Virginia pine - oak forest indicated on the 1977 maps (Anderson et al. 1977). In twenty years most of these areas had succeeded to hardwood forest. The floodplain forests, occurring only along narrow stream corridors in the park, were all classified as one type, the Sycamore - green ash association (*Platanus occidentalis - Fraxinus pennsylvanica* Forest Association). The Coastal Plain influence was evidenced at sites such as Fort Totten and Barnard Hill where a loblolly pine - mixed oak forest association (*Pinus taeda -Quercus (alba, falcata, stellata)* Forest) occurs. This type not previously described from Rock Creek Park.

Although uncommon in the park, this association is widespread on the coastal plain from New Jersey, Maryland, Virginia, and south.

The global ranks of most or all of the vegetation types at Rock Creek Park have not been clearly defined as data on the extent of these communities is incomplete. None of the associations are considered to be very rare as they have been documented from a number of locations. Data from this project will help to further refine the rangewide descriptions, extent and the global ranks of all of these vegetation associations.

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VEGETATION CLASSIFICATION

Following is the vegetation classification for Rock Creek Park, set within the hierarchy of the National Vegetation Classification System (Grossman et al. 1998). A vegetation key to facilitate field identification of the types and a description of each vegetation type at Rock Creek Park are provided in later sections of this report.

I. Forest
IB. Deciduous forest
IB2. Cold-deciduous forest
IB2N. Natural/seminatural vegetation*

IB2Na. Lowland or submontane broad-leaved cold-deciduous forest

Fagus grandifolia - Quercus alba Forest Alliance
***Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest (CEGL006075)**

Liriodendron tulipifera Forest Alliance
***Liriodendron tulipifera* Forest [Provisional]**

Quercus prinus - (Q. coccinea, Q. velutina) Forest Alliance
***Quercus (prinus, velutina) / Gaylussacia baccata* Forest (CEGL006282)**

IB2Ne. Seasonally flooded cold-deciduous forest

Platanus occidentalis - (Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum) Temporarily Flooded Forest Alliance
***Platanus occidentalis - Fraxinus pennsylvanica* Forest (CEGL006036)**

IC. Mixed evergreen-deciduous forest
IC2. Mixed broad-leaved evergreen cold-deciduous forest
IC2Na. Mixed needle-leaved evergreen cold-deciduous forest

Pinus taeda - Quercus (alba, falcata, stellata) Forest Alliance
***Pinus taeda - Quercus (alba, falcata, stellata)* Forest [Provisional]**

Pinus virginiana - Quercus (alba, stellata, falcata, velutina)
***Pinus virginiana - Quercus* (*alba*, *stellata*, *falcata*, *velutina*) Forest (CEGL006171)**

IV. Shrubland
IVB. Deciduous Shrubland
IVB2. Cold-deciduous Shrubland
IVB2a. Temperate deciduous Shrubland
Alliance undefined
***Rubus allegheniensis / Ampelopsis brevipedunculata* Shrubland**

*The heirarchy includes a level separating natural/seminatural vegetation from cultivated/managed vegetation. All but one of the descriptions in this report are of natural/seminatural vegetation and this level is implied in all of the above associations as indicated by the letter "N" in the formation label (e.g. IC2Na).

FIELD KEY TO THE PLANT COMMUNITIES OF ROCK CREEK PARK

This is a preliminary key. It has not yet been tested in the field at Rock Creek Park. The key will be tested at a later date and may be revised to facilitate use and accuracy of assigning correct association names to field points. Note that species included in an association name may be absent from a given plot or from all points in the park (due to the fact that associations are named based on the rangewide characteristics rather than local descriptions). For example, some of the floodplain forests in Rock Creek Park, classified as "sycamore - green ash forest", are co-dominated by sycamore, tulip poplar and red maple and contain no green ash.

Also note that the dominant association at the park is the beech - white oak / mayapple forest (*Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest Association) including the two variants described. Therefore, if one is on upland terrain in the park the vegetation is most likely to be of this type.

Go to key #

1a. Vegetation dominated by trees (height 2m or taller); forested **2**

1b. Vegetation characterized by shrubs (>25% cover) < 2m tall, or vines .....
Blackberry / Porcelain berry Shrubland
***Rubus allegheniensis / Ampelopsis brevipedunculata* Shrubland**

2a. Tree layer with evergreen component; at least >10% cover in canopy or sub-canopy is needle-leaved **3**

3a. Evergreen component is predominantly loblolly pine (*Pinus taeda*). Black cherry (*Prunus serotina*) and willow oak (*Quercus phellos)* usually present. Currently known only from Fort Totten Area (low probability that it occurs at other locations in the park). Other diagnostic features: sweet gum (*Liquidambar styraciflua*) may be present; beech (*Fagus grandifolia*) is absent or infrequent...

Loblolly pine - mixed oak forest
***Pinus taeda - Quercus (alba, falcata, stellata)* Forest [Provisional]**

3b. Evergreen component is Virginia pine. Occurs with mixed hardwoods (e.g., oaks, beech) .....

Virginia Pine - oak forest
***Pinus virginiana - Quercus (alba, stellata, falcata, velutina)* Forest Association**

2b. Vegetation predominantly deciduous; less than 10% canopy or subcanopy cover in pine.....**4**

4a. Soils wet at some point of the year (saturated or seasonally flooded). May be dry part of the year.....**5**

5a. On floodplain or stream banks. Sycamore (*Platanus occidentalis*) and boxelder (*Acer negundo*) present (sycamore may be widely scattered). Beech (*Fagus grandifolia*) and holly (*Ilex opaca*) absent. Other diagnostic species include river birch (*Betula nigra*), mild water-pepper (*Polygonum hydropiperoides*) and nettles (*Laportea canadensis*).....

Sycamore - green ash forest (floodplain forest)
***Platanus occidentalis - Fraxinus pennsylvanica* Forest**

5b. Not restricted to stream courses. Tulip poplar dominant in canopy, > 60-70% cover (essentially a monoculture); other tree species sparse, comprising less than 20% cover. Mesic to seasonally wet soils. Shrub layer variable.....

Tulip poplar forest
***Liriodendron tulipifera* Forest [Provisional]**

4b. Soils not influenced by water table.....**6**

6a. Oaks dominant; tulip poplar infrequent.....**7**

7a. Chestnut oak (*Quercus prinus*) dominant; black cherry and sweet gum (*Liquidambar*) absent. Black gum (*Nyssa sylvatica*) and black huckleberry (*Gaylussacia baccata*) typical. Herb layer sparse. Well-drained soils of hilltops (or upper slopes).....

Chestnut oak forest
***Quercus (prinus, velutina) / Gaylussacia baccata* Forest**

7b. Not as above; canopy dominated by mix of red, black, chestnut and/or white oaks. Tulip poplar < 10 % cover. Beech may be present in sub-canopy or shrub layer (or absent).....**8**

8a. Black cherry (*Prunus serotina*) and willow oak (*Quercus phellos)* present. Sweet gum (*Liquidambar*) and loblolly pine (*Pinus taeda*) characteristic. Currently known only from Fort Totten Area (low probability that it occurs at other locations in the park.

Loblolly pine - mixed oak forest
***Pinus taeda - Quercus (alba, falcata, stellata)* Forest**
[Provisional]

8b. Not as above; mixed oak species dominant, black cherry absent or very uncommon. Maple-leaved viburnum typical. Tulip poplar absent to sparse. Well-drained soils of upper slopes and hilltops.

MIXED OAK / BEECH VARIANT of
Beech -white oak / mayapple forest
Fagus grandifolia - Quercus alba / Podophyllum peltatum
Forest

6b. Oaks not dominant in canopy or mixed with tulip poplar. Beech present >10% cover, co-dominant with other hardwoods (tulip poplar, oaks, etc.).....**9**

9a. Beech and tulip poplar co-dominant (canopy and sub-canopy). Spicebush (*Lindera benzoin*) frequent. Hornbeam (*Carpinus caroliniana*) is characteristic but may be absent. Occurs on lower slopes and ravines.

BEECH - TULIP POPLAR VARIANT of
Beech -white oak / mayapple forest
***Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest**

9b. Not as above. Canopy and sub-canopy is co-dominated by white oak (*Quercus alba*), tulip poplar, and beech. Other oak species present. Holly and flowering dogwood typical but often sparse. Maple-leaved viburnum present. Intergrades with the two variants described for this type.

Beech -white oak / mayapple forest (CLASSIC TYPE)
***Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest**

VEGETATION DESCRIPTION FOR ROCK CREEK PARK

Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest (CEGL006075)

COMMON NAME	Beech - White Oak / Mayapple Forest
SYNONYM	Coastal plain mixed oak - beech forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane broad-leaved cold-deciduous forest
ALLIANCE	*Fagus grandifolia - Quercus alba* Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 1

RANGE
This association occurs in New York, New Jersey, Delaware, Maryland, and Pennsylvania and may also occur in Massachusetts and Virginia.

ENVIRONMENTAL DESCRIPTION
This forest association occurs on mesic to dry-mesic slopes or gentle gradients. Soils are typically well-drained, acidic sandy loams. The soils may be derived from parent material of relatively greater fertility. This association is found primarily on or in close proximity to the coastal plain. In Rock Creek Park this association occurs primarily in areas mapped as Manor and Glenelg loam, deep well-drained to excessively drained soils underlain by acid crystalline rocks (Smith 1976). Some locations of this vegetation type also occurred on Neshaminy soils in the Glover Archbold section of the park. These soils are underlain by semibasic or mixed basic and acidic rocks; this may play a role in the proliferation of non native species at this site.

USFWS WETLAND SYSTEM Not applicable.

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	*Fagus grandifolia, Quercus alba, Carya spp., Liriodendron tulipifera*

Sub-canopy	*Ilex opaca, Cornus florida*
Shrub layer	*Viburnum acerifolium*
Herbaceous	*Podophyllum peltatum, Polystichum acrostichoides, Uvularia* spp., *Parthenocissus quinquefolia Polygonatum biflorum.*

Rock Creek Park

Strata	Species
Canopy	*Fagus grandifolia, Quercus alba, Liriodendron tulipifera*
Sub-canopy	*Ilex opaca, Cornus florida*
Shrub layer	*Viburnum acerifolium*
Herbaceous	*Uvularia* spp., *Parthenocissus quinquefolia, Polygonatum biflorum, Polystichum acrostichoides*

DIAGNOSTIC SPECIES
Fagus grandifolia, Quercus alba, Ilex opaca, Viburnum acerifolium

VEGETATION DESCRIPTION
Rangewide, this dry-mesic to mesic forest is co-dominated by oaks (*Quercus* spp.), beech (*Fagus grandifolia*), hickory (*Carya* spp.), tulip poplar (*Liriodendron tulipifera*) and sweetgum (*Liquidambar styraciflua*). A sparse sub-canopy of flowering dogwood (*Cornus florida*) and American holly (*Ilex opaca*) is usually present. The shrub layer is characterized by maple-leaved viburnum (*Viburnum acerifolium*). Typical herbs include mayapple (*Podophyllum peltatum*), bellwort (*Uvularia* spp.), Virginia creeper (*Parthenocissus quinquefolia*), pink lady's slipper (*Cypripedium acaule*), Solomon's seal (*Polygonatum biflorum*), partridgeberry (*Mitchella reprens*), jack-in-the-pulpit (*Arisaema triphyllum*) and Indian pipes (*Monotropa uniflora*). The herb layer may be lush to depauperate.

In Rock Creek Park this forest is dominated by white oak (*Quercus alba*), beech (*Fagus grandiflora*) and tulip poplar (*Liriodendron tulipifera*) in the canopy and sub-canopy. Associates include other oak species (*Quercus rubra*, *Q. velutina, Q. prinus, Q. falcata*), hickories (*Carya* spp.) and black gum (*Nyssa sylvatica*). Sweetgum (*Liquidambar styraciflua*) is rarely present in this community as it occurs in the park. Flowering dogwood (*Cornus florida*) is common and American holly (*Ilex opaca*) is characteristic but sparse. Maple-leaved viburnum (*Viburnum acerifolium*) is nearly always present, often forming a well-defined shrub layer. Herb composition may be fairly diverse and ranges from sparse to dense depending on soil type, disturbance history and moisture levels. Mayapple (*Podophyllum peltatum*), jack-in-the-pulpit (*Arisaema atrorubens*), and poison ivy (*Toxicodendron radicans*) are typical associates. Christmas fern (*Polystichum ascrostichoides*) may be locally abundant, typically on hillsides. Other associates include cucumber root (*Medeola virginiana*), squawroot (*Conopholis americana*), sweet cicely (*Osmorhiza claytonii*), false solomons seal (*Smilacina racemosa*), wild yam (*Dioscorea villosa*), tick-trefoil (*Desmodium* sp.), partridgeberry (*Mitchella repens*) and others. Non-native species such as garlic mustard (*Alliaria officianalis*), Japanese honeysuckle (*Lonicera japonica*), and bittersweet (*Celastrus orbiculatus*) are common to abundant in some locations.

Two variants of the classic Beech - white oak / mayapple forest association could be discerned from the data. These relate to the soil moisture regime; the mixed oak/beech variant occurring on drier sites and the beech-Tulip poplar variant occurring on more mesic sites.

MIXED OAK / BEECH VARIANT:
This is a dry-mesic forest of slopes and hilltops. In comparison to the typical examples of the beech - white oak/mayapple forest association, this mixed oak - beech variant is characterized by greater percent cover of oaks and less dominance by tulip poplar. The canopy is co-dominated by a mix of red oak (*Quercus rubra*), black oak (*Q. velutina*), and white oak (*Q. alba*) and chestnut oak (*Q. prinus*). Beech usually occurs in the sub-canopy as a co-dominant with oaks, red maple (*Acer rubrum*), black gum (*Nyssa* sylvatica) and hickory (*Carya* spp.). Maple-leaved viburnum (*Viburnum acerifolium*) is common but spicebush (*Lindera benzoin*), hornbeam (*Carpinus caroliniana*) and jack-in-the-pulpit (*Arisaema atrorubens*) are conspicuously lacking or sparse, a feature which distinguishes this variant from the typical beech - white oak/mayapple association. This variant occurs on well drained mid- to upper level slopes. Included in this association are the chestnut oak – oak type defined by Anderson et al. (1977, Rock Creek Park) and the mixed oak forest (Robichaud and Buell 1973, New Jersey). The oak - hickory forest of Maryland's western shore described by Shreve et al. (1910), in part, is included in this association; tulip poplar and beech were noted as frequent components. This type also appears to be similar to the Appalachian oak-hickory forest of New York (Reschke 1990). This variant is closely related to the *Quercus alba* (*Q. rubra, Carya* spp.) Forest Alliance (Grossman et al. 1998) but additional data and rangewide assessment would be necessary to determine if the two are synonymous.

BEECH - TULIP POPLAR VARIANT:
This variant of the beech - white oak / mayapple association is characterized by a dominance of tulip poplar (*Liriodendron tulipifera*) and beech (*Fagus grandiflora*) in the canopy and sub-canopy. Associates include red maple (*Acer rubrum*), black gum (*Nyssa sylvatica*), hickory (*Carya tomentosa*), flowering dogwood (*Cornus florida*) and hornbeam (*Carpinus caroliniana*) in the canopy or sub-canopy. Hornbeam is quite characteristic of this community; it is more prevalent in this variant than in the typical beech - white oak / mayapple association. Oaks (Quercus spp.), sycamore (*Platanus occidentalis*) and boxelder (*Acer negundo*) may be present as well but usually in low abundance. Spicebush (*Lindera benzoin*) and viburnums (*Viburnum prunifolium, V. acerifolium, V. dilitatum* and others) are common in the shrub layer. The herb layer may be diverse, with many of the components of the typical beech - white oak / mayapple association. Jack-in-the-pulpit (*Arisaema atrorubens*) is usually more prevalent in this variant. The beech - tulip poplar forest occurs on mesic mid- to lower slopes, often in proximity to streams but not on the floodplain itself. This may be related to or transitional to the *Fagus grandifolia* Temporarily Flooded Alliance (Grossman et al. 1998). Rangewide assessment of that alliance is incomplete.

NOTEWORTHY SPECIES

CONSERVATION RANK G?

RANK JUSTIFICATION
The *Fagus grandiflora* - *Quercus alba* Forest is described as widespread and relatively common Alliance (Sneddon et al. 1996). The association has not been assigned a conservation rank but is not likely to be uncommon or rare. Further analysis is needed to determine the rank of this forest type.

COMMENTS
The mixed hardwood upland forest described by Jorling (1969, Rock Creek Park) is synonymous with this association. Five forest types described by Anderson et al. (1977, Rock Creek Park) including the oak-beech, tulip tree-beech, tulip tree-oak, tulip tree-locust pine, and chestnut oak-hickory-beech associations fall within the *Fagus grandifolia – Quercus alba / Podophyllum peltatum* Forest Association. Portions of the dry-mesic inland mixed oak forest of New Jersey (Breden 1989) including sites described by Robichaud and Buell (1973) and Lord and Boerner (1981) are contained in this association. Also included are the mesophytic oak-hickory forest of the western shore of Maryland (Shreve 1910); the *Liriodendron tulipifera* - *Quercus* spp. - *Fagus grandifolia* forest (Clancy 1996, Delaware), in part; Pennsylvania's mesic-central forest (Smith 1983), in part; and Long Island's oak, mixed dicot-dogwood forest and the mixed mesophytic forest (Greller 1977) which is encompassed by Reschke's oak-tulip tree forest (1990, New York).

The term "mixed mesophytic" has been frequently used (e.g., Bromley 1935, Greller 1977, Rawinski 1989) to describe this and other associations in this alliance due to similarities in species composition with the Mixed Mesophytic Forest (see Braun 1950) of the central Appalachian mountains and vicinity. However, the classic Mixed Mesophytic Forest (or *Liriodendron tulipifera* - *Tilia american* var. *heterophylla* - *Aesculus flava* - *Acer saccharum* Forest Alliance in Grossman et al. 1998) is distinguished by an exceptionally high diversity of canopy and understory species and the presence of basswood (*Tilia americana* var. *heterophylla*) and buckeye (*Aesculus flava*) (Braun 1950). Although there are similarities in canopy and subcanopy associates (e.g., beech, white oak, red oak, tulip poplar, dogwood, maple-leaved viburnum and spicebush), the alliance represented at Rock Creek Park and other locations in the northeast (particularly on the coastal plain) lacks both the characteristic indicator tree species (*Tilia* spp. and *Aesculus flava*) and is considerably less diverse in species composition than the classic Mixed Mesophytic Forest.

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PLOTS
(Groups refer to notation in TWINSPAN analysis)

GROUP 1 - MIXED OAK - BEECH VARIANT (less mesic, more oak) 9, 10, 11 (borderline with group 2), 13, 20, 22, 31, 33, 34, 56, 86

GROUP 2 - Beech-white oak/mayapple forest association (classic type) 15, 16, 17, 18, 19 (around forest opening), 27, 29, 32, 35, 57, 81, 83

GROUP 3 - BEECH - TULIP POPLAR (more mesic variant) 4, 5, 21, 23*, 24, 25* (* related to floodplain forest), 28, 30, 37, 51 (weedy), 52, 53, 61

Liriodendron tulipifera Forest [Provisional]

COMMON NAME Tulip poplar forest

SYNONYM

TNC SYSTEM Terrestrial

PHYSIOGNOMIC CLASS I. Forest

PHYSIOGNOMIC SUBCLASS IB. Deciduous forest

PHYSIOGNOMIC GROUP IB2. Cold-deciduous forest

FORMATION IB2Na. Lowland or submontane cold-deciduous forest

ALLIANCE *Liriodendron tulipifera* Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
Widespread. Most common in the central and southern Appalachians but also occurs on the Coastal Plain and in the Piedmont. Occurs in Alabama, Georgia, Tennessee, Kentucky, North Carolina, South Carolina, Virginia, and probably other locations as well.

ENVIRONMENTAL DESCRIPTION
Rangewide this association occurs along streams and on upland mountain benches. At Rock Creek Park, the association occurs on mesic, mid-slope to low-slope sites that were cleared and/or cultivated. Sample plots representing this association occur primarily on areas mapped as Manor loam (Smith 1976), soils that are deep, well-drained and underlain by acidic rock. There may be other locations for this association that were not sampled which occur on different soil types.

USFWS WETLAND SYSTEM Not applicable.

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	*Liriodendron tulipifera, Acer rubrum, Robinia pseuodoacacia*
Sub-canopy	*Acer negundo*
Shrub layer	
Herbaceous	

Rock Creek Park

Strata	Species
Canopy	*Liriodendron tulipifera*
Sub-canopy	*Acer negundo*
Shrub layer	*Lindera benzoin, Rubus allegheniensis, Rosa multiflora, Ampelopsis brevipedunculata*
Herbaceous	*Ranunculus ficaria*

DIAGNOSTIC SPECIES
Liriodendron tulipifera

VEGETATION DESCRIPTION
This is a provisional association characterized by a dominance of tulip poplar (*Liriodendron tulipifera*). Rangewide, associates include red maple (*Acer rubrum*), locust (*Robinia pseudoacacia*), boxelder (*Acer negundo*), sugar maple (*Acer saccharum*) and black birch (*Betula lenta*). Sweetgum (*Liquidambar styraciflua*) is common in Coastal Plain and Piedmont locations. Red oak (*Quercus rubra*), hickories (*Carya* spp.) and pine (*Pinus strobus, P. virginiana*) are typical associates in the Central Appalachians. Vines can be abundant including grape (*Vitis* spp.), greenbriar (*Smilax* spp.), and Virginia creeper (*Parthenocissus quinquefolia*).

In Rock Creek Park, this association is dominated by tulip poplar (*Liriodendron tulipifera*) with no co-dominants in the canopy. It is essentially a tulip poplar monoculture, with tulip poplar and/or box elder (*Acer negundo*) in the sub-canopy. Spicebush (*Lindera benzoin*) and blackberry (*Rubus allegheniensis*) are present in the shrub layer. These sites tend to be weedy and non-native species such as multiflora rose (*Rosa multiflora*) and porcelain berry (*Ampelopsis brevipedunculata*) and lesser celandine (*Ranunculus ficaria*) may be prevalent. Only sites that wereexclusively dominated by tulip poplar were assigned to this association. Sites that were dominated by tulip poplar but that contained at least 25% other hardwoods in the canopy or sub-canopy were considered to be early successional examples of the *Fagus grandifolia - Quercus alba / Podophyllum peltatum* Forest Association or the *Platanus occidentalis - Fraxinus pensylvanica* Forest Association.

NOTEWORTHY SPECIES

CONSERVATION RANK GW (not of conservation interest)

RANK JUSTIFICATION
Successional forest following cropping or clearcut logging or other severe disturbance (including fire).

COMMENTS
Portions of the tulip tree association described by Anderson et al.(1977) are included in this association.

REFERENCES

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PLOTS

3, 38, 62

Quercus (prinus, velutina) / Gaylussacia baccata Forest (CEGL006282)

COMMON NAME	Chestnut oak - black oak / huckleberry forest
SYNONYM	Chestnut oak forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane cold-deciduous forest
ALLIANCE	*Quercus prinus - (Quercus coccinea, Q. velutina)* Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE
This association occurs across all or most of New England south to New York, New Jersey, Delaware, Pennsylvania, and the District of Columbia and is likely to be present in Virginia and Maryland as well. Further analysis is necessary to determine if occurrences containing a notable component of *Nyssa sylvatica* (Delaware, Pennsylvania, and District of Columbia, and probably Maryland) are distinct enough to be defined as a separate association within this alliance.

ENVIRONMENTAL DESCRIPTION
This forest association occurs on ridgetops, convex upper slopes, and south-facing slopes. Soils are rocky, well-drained acidic, sandy-loams with a poorly developed organic layer. Bedrock may be close to or at the surface. Surface runoff and erosion is common; Anderson et al. (1977) noted this as a management concern at the park.

USFWS WETLAND SYSTEM Not applicable.

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	*Quercus prinus, Q. velutina, Q. coccinea*
Sub-canopy	*Acer rubrum, Carya* spp., *Sassafras albidum*
Shrub layer	*Gaylussacia baccata, Vaccinium pallidum, Kalmia latifolia*

Rock Creek Park

Strata	Species
Canopy	*Quercus prinus, Nyssa sylvatica*
Sub-canopy	*Amelanchier arborea, Sassafras albidum*
Shrub layer	*Vaccinium pallidum, Gaylussacia baccata,*
Herbaceous	(sparse)

DIAGNOSTIC SPECIES
Quercus prinus, Vaccinium pallidum, Gaylussacia baccata

VEGETATION DESCRIPTION
Rangewide, this is a dry oak / heath forest dominated by chestnut oak (*Quercus prinus*) or co-dominated by chestnut oak, black oak (*Q. velutina*) and scarlet oak (*Q. coccinea*). Other associates include red maple (*Acer rubrum*), serviceberry (*Amelanchier arborea*), pignut (*Carya glabra*), black gum (*Nyssa sylvatica*), sassafras (*Sassafras albidum*), black locust (*Robinia pseudoacacia*), pine (*Pinus* spp.) and other oaks (*Quercus* spp.). Ericaceous shrubs such as mountain laurel (*Kalmia latifolia*), black huckleberry (*Gaylussacia baccata*) and blueberry (*Vaccinium pallidum*, *V. stamineum*) are characteristic. The sparse herb layer may include wintergreen (*Gaultheria procumbens*), Indian pipes (*Monotropa uniflora*), poverty grass (*Danthonia spicata*) and other species.

In Rock Creek Park this forest association is characterized by a dominance of chestnut oak (*Quercus prinus*) and black gum (*Nyssa sylvatica*) and an absence or sparse cover of white oak (*Quercus alba*). Red oak (*Quercus rubra)* and/or black oak (*Quercus velutina*) and red maple (*Acer rubrum*) are often present but sparse. Sassafras (*Sassafras albidum*) and serviceberry (*Amelanchier arborea*) are typical in the sub-canopy or tall shrub layer and vines such as greenbrier (*Smilax glauca* and *S. rotundifolia*) and grape (*Vitis* spp.) are common. Characteristic shrubs include heaths such as blueberry (*Vaccinium pallidum*), huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*) and azalea (*Rhododendron periclymenoides*). The herbaceous layer tends to be sparse or absent.

NOTEWORTHY SPECIES

CONSERVATION RANK G3G5

RANK JUSTIFICATION
Further data are needed to define the range and extent of this association range and the corresponding rank.

COMMENTS
The chestnut oak forests (Anderson et al. 1977) previously described from Rock Creek Park are included in the *Quercus (prinus, velutina) / Gaylussacia baccata* Forest association. The oak-hilltop forest (Breden 1989, New Jersey); the xeric central hardwood (broadleaf) forest (Smith 1983, Pennsylvania), in part; the chestnut-oak forest (Reschke 1990, New York), in part; and the oak-mountain laurel forest (Greller 1977, New York) are contained within this association.

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PLOTS

2, 8, 14, 48, 49

Platanus occidentalis - Fraxinus pennsylvanica Forest (CEGL006036)

COMMON NAME	Sycamore - Green ash Forest
SYNONYM	Floodplain Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Decidous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
FORMATION	IB2Nd. Temporarily flooded cold-deciduous forest
ALLIANCE	*Platanus occidentalis* - (*Fraxinus pennsylvanica, Celtis laevigata, Acer saccharinum)* Temporarily Flooded Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 1

RANGE
This association ranges from Rhode Island to Connecticut, New York, Delaware, Pennsylvania, and Maryland.

ENVIRONMENTAL DESCRIPTION
This association occurs along stream banks, low terraces and other low-lying areas subject to temporary or irregular flooding. Soils range from gravel and coarse sand along the edges of the major streams to deep silt loams on the broader floodplains and upper banks of the stream. At Rock Creek Park, this association occurs primarily on areas mapped as Codorus silt loam, a moderately well-drained to somewhat poorly-drained soil of Piedmont floodplains (Smith 1976). Smaller deposits of sand and gravel are contained within this type. The floodplain areas in the park tend to be small in area; Smith (1976) noted that most map units of the Codorus silt loams in the Washington D.C. area averaged about 30 – 40 acres. The soils tend to be strongly acidic and are characterized by a dark silt loam layer (about 8 inches) underlain by a deeper, yellow-brown soil layer. Woody debris typically covers 15 percent of the ground surface, leaf litter layer may be thin to absent.

USFWS WETLAND SYSTEM Palustrine System

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	*Platanus occidentalis, Fraxinus pennsylvanica*

Sub-canopy	*Acer negundo*
Shrub layer	*Lindera benzoin*
Herbaceous	

Rock Creek Park

Strata	Species
Canopy	*Platanus occidentalis*,
Sub-canopy	*Acer negundo*
Shrub layer	*Lindera benzoin*
Herbaceous	*Alliaria officianalis, Impatiens capensis*

DIAGNOSTIC SPECIES (at Rock Creek Park)
Platanus occidentalis, *Acer negundo, Impatiens capensis, Polygonum hydropiperoides*

VEGETATION DESCRIPTION
This association is classified as a forest type but canopy cover ranges from 50 to 90 percent cover. It appears exclusively on floodplains and adjacent areas. The canopy is typically dominated by sycamore (*Platanus occidentalis*) and green ash (*Fraxinus pennsylvanica*) although box elder (*Acer negundo*), American elm (*Ulmus americana*), black walnut (*Juglans nigra*), sweet gum (*Liquidambar styraciflua*) and other species may be common associates or co-dominants with the sycamore.

At Rock Creek Park this association is characterized by sycamore (*Platanus occidentalis*) in the canopy and box elder (*Acer negundo*) in the canopy and/or sub-canopy. Red maple (*Acer rubrum*) and tulip poplar (*Liriodendron tulipifera*) are often co-dominant with the sycamore. Green ash (*Fraxinus pennsylvanica*), white ash *(F. americana*), and hickory (*Carya tomentosa, Carya glabra*) are frequent associates. Bladdernut (*Staphylea trifolia*) and river birch (*Betula nigra*) are occasional associates within the park. The shrub layer may be dominated by spicebush (*Lindera benzoin*) with black haw (*Viburnum prunifolium*) occurring less frequently. Characteristic herbaceous species include jewelweed (*Impatiens capensis*), mild water-pepper (*Polygonum hydropiperoides*), jack-in-the-pulpit (*Arisaema atrorubens*), enchanter's nightshade (*Circea quadrisulcata*), skunk cabbage (*Symplocarpus foetidus*), poison ivy (*Toxicodendron radicans*) and others. Jorling (1969) also describes wood nettle (*Laportea canadensis*) as a prominent herb in the floodplains. Weedy non-native species such as garlic mustard (*Alliaria officianalis*), lesser celandine (*Ranunculus* ficaria), English ivy (*Hedera helix*), stilt grass (*Microstegium vimineum*), multiflora rose (*Rosa multiflora*), and Japanese honeysuckle (*Lonicera japonica*) may be frequent.

NOTEWORTHY SPECIES

CONSERVATION RANK G?

RANK JUSTIFICATION
Rank has not been determined but total acreage (rangewide) is limited. Good quality examples are uncommon. Threats include development and filling, alteration in flooding

regimes, excessive beaver activity and encroachment by aggressive non-native plant species. Further data are needed to define the rank.

COMMENTS

The floodplain forest habitat described by Jorling (1969, Rock Creek Park) is synonymous with this association. The "high phase" and "low phase" floodplain types described by Anderson et al. (1977, Rock Creek Park) and the *Platanus occidentalis-Acer negundo/Lindera benzoin* floodplain forest (Clancy 1996, Delaware) are included in this association. Portions of the river swamps of Maryland's western shore area (Shreve et al.1910) and the floodplain forests of New York (Reschke 1990) and Pennsylvania (Smith 1991), in part, are included in this association.

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PLOTS

1, 6, 7, 12, 25, 26?, 54, 55, 59, 60, 65, 67, 72, 73

Pinus taeda - Quercus (alba, falcata, stellata) Forest [Provisional]

COMMON NAME	Loblolly pine - mixed oak forest
SYNONYM	
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IC. Mixed evergreen deciduous forest
PHYSIOGNOMIC GROUP	IC2. Mixed broad-leaved evergreen cold-deciduous forest
FORMATION	IC2Na. Mixed needle-leaved evergreen cold-deciduous forest
ALLIANCE	*Pinus taeda - Quercus (alba, falcata, stellata)* Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 3

RANGE
This alliance has been described from Texas, Louisiana, Arkansas, and north to Virginia, Maryland and Delaware. Further clasification is needed to define the associations within this alliance and their corresponding ranges.

ENVIRONMENTAL DESCRIPTION
Throughout the range, associations of this alliance occur on dry sand or sand loam, clay loam, or silty clay loams. Soils are often coarse textured, shallow and droughty. This vegetation occurs on mid to lower slopes on broad flats or in sheltered ravines. At Rock Creek Park the association occurs exclusively on areas mapped as Joppa soils (Smith 1976), which are well-drained to excessively drained gravelly sandy loams of the coastal plain.

USFWS WETLAND SYSTEM Terrestrial

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	diverse; no dominant species
Sub-canopy	
Shrub layer	
Herbaceous	

Rock Creek Park

Strata	Species
Canopy	diverse; no dominant species
Sub-canopy	
Shrub layer	
Herbaceous	(sparse or patchy)

DIAGNOSTIC SPECIES
Rangewide: *Pinus taeda, Quercus falcata, Q. alba, Q. stellata, Carya* spp. At Rock Creek Park: *Prunus serotina, Liquidambar styraciflua, Quercus stellata, Quercus falcata, Quercus phellos, Pinus taeda*

VEGETATION DESCRIPTION
This association has not been defined yet and is based on the alliance classification. Virginia pine (*Pinus virginiana*) and loblolly pine (*Pinus taeda*) are usually present, generally less abundant in more mature stands. Turkey oak (also known as southern red oak, *Quercus falcata*) is characteristic but other oaks are also present including white oak (*Q. alba*), post oak (*Q. stellata*), black oak (*Q. velutina*), scarlet oak (*Q. coccinea*), blackjack oak (*Q. marilandica*) and willow oak (*Q. phellos*). Other less prevalent associates include black gum (*Nyssa sylvatica*), hickory (*Carya glabra, Carya tomentosa*), pitch pine (*Pinus rigida*), sweet gum (*Liquidambar styraciflua*), redbud (*Cercis canadensis*) and flowering dogwood (*Cornus florida*). Ericaceous shrubs are common including blueberry (*Vaccinium* spp.), huckleberry (*Gaylussacia* spp.), azalea (*Rhododendron nudiflorum*) and mountain laurel (*Kalmia latifolia*). Typical herbs and vines are wintergreen (*Gaultheria procumbens*), partridgeberry (*Mitchella* repens), Virginia creeper (*Parthenocissus quinquefolia*) and greenbriar (*Smilax* spp.).

At Rock Creek Park this forest is distinguished by the relatively high diversity of tree species, including a number of species that are infrequent at other locations throughout the park. No single species is dominant in the canopy. This community is characterized by the presence of black cherry (*Prunus serotina*), sweet gum (*Liquidambar styraciflua)*, loblolly pine (*Pinus taeda*)*,* blackjack oak (*Q. marilandica*), chestnut oak (*Q. prinus*), post oak (*Q. stellata*) and turkey oak (*Q. falcata*). Willow oak (*Q. phellos*) is typical in the sub-canopy or shrub layer. Other oaks, hickory (*Carya tomentosa*), and tulip poplar (*Liriodendron tulipifera*) may be present. Beech (*Fagus grandifolia*) tends to be sparse or absent. Typical shrubs & vines include Pennsylvania blackberry (*Rubus pensilvanicus*), greenbrier (*Smilax glauca, S. rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), arrow-wood (*Viburnum dentatum*), poison ivy (*Toxicodendron radicans*) and grape (*Vitis* spp). The herb layer tends to be patchy. Seedlings of many of the canopy tree species are represented in the herb layer.

This association was identified at several points within the Fort Totten and Barnard Hill areas at the eastern extent of Rock Creek Park that falls within the Coastal Plain province. The association is closely aligned with the location of Joppa soils in the park. This vegetation type was not described from any other areas of the park and is probably limited to the coastal plain. Long (1911, New Jersey) noted that *Liquidambar styraciflua* and *Quercus*

phellos were species by which the coastal plain could be clearly delineated from the Piedmont in this vicinity.

Neither Jorling (1969) nor Anderson et al. (1977) describe this vegetation type within Rock Creek Park but the Fort Totten and Barnard Hill areas were not included in their studies. The pine forest described by Anderson et al. (1977) is not the same as this association. Shreve et al. (1910) did describe a similar forest type from Prince George County, Maryland which abuts Washington D.C. This was characterized by loblolly pine (*Pinus taeda*), Virginia pine (*Pinus virginiana*), white oak (*Quercus alba*), black oak (*Q. velutina),* spanish oak (or turkey oak, *Q. falcata*), and post oak (*Q. stellata*). Black jack oak (*Q. marilandica*) was noted as present but less abundant than other oaks, beech (*Fagus grandiflora*) was also present. Shreve et al. (1910) described the forest as in early development due to the presence of early successional species such as the pines, black cherry, and sassafras. These descriptions appear to be closely related to the forest type that currently occurs at sites within Fort Totten and Barnard Hill. Past disturbance regime of Rock Creek sites is further implied from a related forest association in New Jersey (Lord and Boerner 1981) where areas with more recent disturbance (e.g., forest margins and jeep trails) contained the greater frequency of *Prunus serotina* and *Sassafras albidum.*

Currently, the association level classification for this forest type at Rock Creek Park has not been determined. The Rock Creek type is related to and may be the same as the *Pinus taeda - Quercus falcata / Gaylussacia baccata* Forest Association (loblolly pine - turkey oak / black huckleberry forest) that has been described from the Coastal Plain of Chesapeake Bay within this Alliance. Additional information and classification is needed to more precisely assign the Rock Creek park type at the association level.

At Rock Creek Park this Loblolly pine - mixed oak forest (*Pinus taeda - Quercus (alba, falcata, stellata)* Forest [Provisional]) occurs in association with the *Quercus (prinus, velutina) / Gaylussacia baccata* Forest Association.

NOTEWORTHY SPECIES

CONSERVATION RANK G?

RANK JUSTIFICATION Further data are needed to define this association and its rank.

COMMENTS
This is included in the broadly-defined oak-pine forest (Braun 1950) that ranges from New Jersey to Mississippi. The southern coastal plain mixed oak forest subtype of the mesic coastal plain forest (Breden 1989, New Jersey) and the *Pinus taeda - Quercus phellos – Liquidambar* forest (Rawinski 1989, Delaware) are similar and possibly synonymous with this association. The pine-oak forest (Shreve et al. 1910) described from Maryland's western shore district is similar or synonymous with this association. The southern mixed hardwood forest of Ware (1970, Virginia) is also related to this association.

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PLOTS

41, 43, 44, 45, 46, 47

Pinus virginiana - Quercus (alba, stellata, falcata, velutina) Forest Association (CEGL006171)

COMMON NAME	Virginia pine - oak forest
SYNONYM	
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IC. Mixed evergreen deciduous forest
PHYSIOGNOMIC GROUP	IC2. Mixed broad-leaved evergreen cold-deciduous forest
FORMATION	IC2Na. Mixed needle-leaved evergreen cold-deciduous forest
ALLIANCE	*Pinus virginiana - Quercus (alba, stellata, falcata, velutina*) Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 3

RANGE
This association occurs in Pennsylvania, Virginia, West Virginia, Tennessee, Georgia and Alabama, and probably Maryland.

ENVIRONMENTAL DESCRIPTION
This association occurs on middle to upper slope positions at elevations below 3,000 feet. At Rock Creek Park this vegetation type occurs on well-drained soils of hilltops.

USFWS WETLAND SYSTEM Not applicable

MOST ABUNDANT SPECIES

Globally

Strata	Species
Canopy	*Pinus virginiana and Quercus alba, stellata, falcata* and/or *Q. velutina*
Sub-canopy	*Quercus* spp
Shrubs	ericads (e.g., *Vaccinium pallidum, V. stramineum, Gaylussacia* spp., *Kalmia latifolia, Rhododendron* spp.)
Herbaceous	(sparse)

Rock Creek Park

Strata	Species
Canopy	*Pinus virginiana, Quercus prinus, Q. velutina, Liriodendron tulipifera*
Sub-canopy	*Quercus velutina, Q. rubra, Q. alba*
Shrubs	*Viburnum acerifolium* and ericaceous species
Herbaceous	(sparse)

DIAGNOSTIC SPECIES
Pinus virginiana, Liriodendron tulipifera

VEGETATION DESCRIPTION
This broadly-defined association is an early to mid-successional forest characterized by the presence of Virginia pine (*Pinus virginiana*) in the canopy. Younger stands have greater percent cover of pine, more mature stands contain less than 30% cover of pine. Oaks (*Quercus rubra, Q. velutina, Q. prinus*) are usually co-dominant with the pine, but tulip poplar (*Liriodendron tulipifera*) and beech (*Fagus grandifolia*) may be present as well. Over time these areas succeed to hardwood forests dominated by oak, beech and tulip poplar.

At Rock Creek Park, this association contains sparse to moderate cover of Virginia pine (*Pinus virginiana*). Historically, table mountain pine (*Pinus pungens*) was an infrequent component of this association but this species has since diminished or died out in the park. Associates include oaks (*Quercus rubra, Q. velutina, Q. prinus*), tulip poplar (*Liriodendron tulipifera*), and beech (*Fagus grandifolia*). Maple-leaved viburnum (*Viburnum acerifolium*) is typical in the shrub layer and herbs tend to be sparse. Species composition in the shrub and herb layers is consistent with the surrounding forest types of the *Fagus grandifolia – Quercus alba / Podophyllum peltatum* association and the *Quercus (prinus, velutina) / Gaylussacia baccata* association.

NOTEWORTHY SPECIES

CONSERVATION RANK G?

RANK JUSTIFICATION
This is a successional forest type.

COMMENTS
In 1977 (Anderson et al. 1977) this association was not uncommon at the park. Now, twenty years later, almost all of these areas have succeeded to hardwood forest. Only a few plots were assigned to this type. These contained a substantial component of pine and could not be clearly assigned to one of the existing hardwood forest types. Plots that contained a small percent of pine and a better developed hardwood canopy and sub-canopy were assigned to either the *Fagus grandifolia - Quercus alba / Podophyllum peltatum* association or the *Quercus (prinus, velutina) / Gaylussacia baccata* association.

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PLOTS

81, 84, 85

Rubus allegheniensis / Ampelopsis brevipedunculata Shrubland

COMMON NAME Blackberry / Porcelain berry Shrubland

SYNONYM

TNC SYSTEM Terrestrial

PHYSIOGNOMIC CLASS IV. Shrubland

PHYSIOGNOMIC SUBCLASS IV.B. Deciduous Shrubland

PHYSIOGNOMIC GROUP IV.B.2. Cold-deciduous Shrubland

FORMATION IV.B.2.a. Temperate deciduous Shrubland

ALLIANCE Alliance undefined

CLASSIFICATION CONFIDENCE LEVEL 3

RANGE
This community is is an early seral stage and has only been identified at Rock Creek National Park. Similar groupings of species are likely to occur in other parts of the eastern United States.

ENVIRONMENTAL DESCRIPTION
This shrubland alliance occurs in openings in the forest – either along ecotones between forest stands and open areas dominated by graminoids, or in small gaps within a forest matrix. These small patches of shrubland occur on many soil types, although the species present changes somewhat with soils. Fewer exotic plants are found on more acidic soils. However, the size of the opening and the length of time since the disturbance that created it are more important factors affecting species composition in these early successional associations.

USFWS WETLAND SYSTEM Not applicable.

MOST ABUNDANT SPECIES

Rock Creek Park

Strata	Species
Sub-canopy	(Sparse to absent)
Shrub layer	*Ampelopsis brevipedunculata, Rosa mulitflora, Rubus allegheniensis, Celastrus orbiculatus, Smilax* spp., *Fagus grandifolia, Liriodendron tulipifera, Prunus serotina, Ulmus rubra,Lindera benzoin*
Herbaceous	(Sparse to Patchy)

DIAGNOSTIC SPECIES
Rubus allegheniensis, Smilax spp., exotics

VEGETATION DESCRIPTION
In Rock Creek Park, this is an early successional association that is dominated by exotic vegetation, especially porcelain berry (*Ampelopsis brevipedunculata*) and multiflora rose (*Rosa multiflora*) with other native and non-native vines – Asian bittersweet *(Celastrus orbiculatus*), English Ivy (*Hedera helix*), Japanese honeysuckle (*Lonicera japonica*), greenbriar (*Smilax* spp.), poison ivy (*Toxicodendron radicans*), and/or grape (*Vitis* spp.). Usually these vines will be growing over blackberry (*Rubus allegheniensis*), wineberry (*Rubus phoenicolasius*), spicebush (*Lindera benzoin*), and/or seedlings of tulip poplar (*Liriodendron tulipifera*), cherry (*Prunus* spp.), or slippery elm (*Ulmus rubra*). Two variants of this association were evident within Rock Creek Park. These relate to position within the forest: blackberry shrublands are along ecotones between forest stands and open areas like meadows or mowed lawns, while forest gaps are totally surrounded by forest.

BLACKBERRY SHRUB VARIANT:
This is a shrubland of edges. Typically blackberry (*Rubus allegheniensis*)and/or multiflora rose (*Rosa mulitflora*) are covered densely by porcelain berry (*Ampelopsis brevipedunculata*) mixed with other vines. Rarely native or non-native tree seedlings are struggling to survive under the heavy vine cover. Most often the tree species are early successional species – cherry (*Prunus* spp.), elm (*Ulmus rubra*), mulberry (*Morus* spp.), tree-of-heaven (*Ailanthus altissima*), princess tree (*Paulonia tomentosa*), or catalpa (*Catalpa bignoniodes*). Usually the vine cover is too dense to allow herbaceous growth, but occasionally composites (Asteraceae) manage to survive.

FOREST GAP VARIANT:
This variant is more variable than the blackberry shrubland, in that the relative age, size, soils, and aspect have a pronounced effect on the species present. Gaps that are younger or more mesic tend to be dominated by exotics, while older, drier openings have more tree seedlings and shrubs – especially beech (*Fagus grandifolia*), oak species (*Quercus* spp.), tulip (*Liriodendron tulipifera*), spicebush (*Linders benzoin*), or mountain laurel (*Kalmia latifolia*). Gaps that have mountain luarel almost never have exotics, probably due to the acid soils.

NOTEWORTHY SPECIES

CONSERVATION RANK GW

RANK JUSTIFICATION
This community is not of conservation interest at this time.

COMMENTS

PLOTS
58 (forest gap variant)

UNASSIGNED PLOTS

The following plots could not be assigned to natural community alliances or associations. They represent areas dominated by non-natural vegetation or non-native weedy species.

36
66
70
71
74
78
79
80
82

GLOSSARY

canopy - the layer formed by treetops; may be divided into separate strata to describe different heights (e.g., canopy and sub-canopy)

characteristic species - a species that occurs in many of the examples of a particular vegetation community; not related to abundance or dominance; the species may be sparse to abundant.

co-dominant - a species with relatively high abundance or percent cover shares dominance with one or several other species; typically refers to a given strata (e.g., beech, red oak and tulip poplar are codominant in the canopy)

cover (often expressed as percent cover) - aerial projection of the amount of ground surface that is covered or shadowed by a plant or a strata (e.g., shrub strata or layer)

dominant - species with the most abundant or highest percent cover; often comprising over 50% cover overall or in a given strata

ericaceous - plants belonging to the heath family (see "heath")

exotic - term used to describe a species that is not naturally occurring or native to the area (e.g., Rock Creek Park or vicinity); introduced; escaped from cultivation.

hardwood - deciduous, non-coniferous tree

heath - member of the heath family (Ericaceae); includes a number of common shrubs such as blueberry, huckleberry, azalea and mountain laurel and some herbs such as wintergreen (*Gaultheria procumbens*).

herb - a non-woody plant; an herbaceous plant

herbaceous layer - ground layer or strata comprised primarily of non-woody vegetation (herbs)

hydric - areas with wet or seasonally flooded soils; wetland soils

mesic - areas with moist, well-drained soils; neither hydric (e.g., wet, saturated, seasonally flooded) nor xeric (dry, droughty)

strata - layer of vegetation; commonly defined strata are: canopy, sub-canopy, shrub (tall shrub over 2 meters, short shrub less than 2 meters), herbaceous and vine

subcanopy - the layer formed by treetops below the canopy layer

xeric - describing areas with dry, well-drained soils

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Appendices

Appendix A. Results of TWINSPAN Analysis of 67 plots from Rock Creek Park.
(dominant exotics were deleted for this analysis)

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TWO-WAY ORDERED TABLE

GROUP          A   B   |                    C                    |          D
               A   B   |   C′                  C″                |   D′          D″
               44 4444 | 311448 88882281112351335 1133562235 122 | 62555627 6 5566127
             2889 1567 | 9134346 5145793189227034645678891801570 4 161523523237 49052637

Magnol tri  ---4 ---- | ------ | -------5---------------------- | ----------- | -------
Galluss bac 4-25 -1-- | -1---- | ------------------------------- | ----------- | -------
Kalm latif  25-- ---- | 22---- | ----1--------11----1---------- | ----------- | -------
Liquidam st –11- 555- | ------ | ------------------------------- | ----------- | -------
Pinus taeda ---- -4-- | 2----- | ------------------------------- | ----------- | -------
Prunus pens ---- -12- | ---2-- | ---1-----1--------------------- | ----------- | -------
Quercus fal --11 24-2 | -----2 | ------------25------------------ | ----------- | -------
Quercus phe ---1 1111 | ---211 | ------------------------------- | ----------- | -------
Rubus pensy ---- -444 | ------ | ------------------------------- | ----------- | -------
Amelanc arb 1141 -1-1 | 1111-5 | --11-----1------11---1---2---2- | ----------- | -------
Polygona bi ---- -211 | -11-1- | ---1-----1----1--1------------- | ----------- | -------
Quercus pri 5555 -522 | 4-55144 | 2---4-24-44-1-1---------1----1-- | ----------- | ---4---
Sassafr alb 1442 51-1 | 214115- | 2--1-12--2-1-1-------11-------- | ----------- | -------
Vaccin pall 5144 -1-2 | -421--4 | 14422--1-1--111-------------11- | ----------- | -------
Pinus virg  -1-- -2-4 | ------ | 445---2------------------------ | ----------- | -------
Rhodo nudic 2125 ---- | 42---- | 2--2-1---1---111-1----4--1----- | ----------1 | -------
Nyssa sylva 5254 4424 | 4152125 | 214254-124524221412-5-5442242-1- | ----1---42- | --2----
Prunus sero –121 4425 | -21551 | 11-2111--11-1-112-1---11--1-421- | 2-1-------21 | -------
Quercus coc ---- -2-1 | --41-- | -------5--4----------5--------- | ----------- | -------
Quercus vel 1112 42-1 | 244--- | 11---4---4--4424--1---1-21-4144 | -2--------1 | -------
Robinia pse ---- 1142 | ---12- | --------------1---------------- | -1--------- | -------
Galium apar ---- ---- | ------ | --------1--------11--2--------1 | ----------- | -------
Sanguin can ---- ---- | -1---- | ----------------11-1--11----1-1 | ----------- | -------
Cornus amom ---- ---- | ------ | ---1---1112-21----2--1--1----11 | ----------- | -------
Euonymus am ---- ---- | ------ | --1-1-------2----11-1-1------1- | ----------- | -------
Galium circ ---- ---- | ------ | ----11--11------------11-1-1--- | ----------- | -------
Melamp lin  ---- ---- | 1----- | 21221--11111-----2---11111--11- | ----------- | -------
Des nudum   ---- ---- | ------ | 12-22-----1----2---------------- | ----------- | -------
Quercus spp ---- ---- | 1----- | --1---11--12--------1-1-------- | ----------- | -------
Castan dent 11-- ---- | -1---- | 1--111-1--11-----1---1------1-- | ----------- | -------
Mitch repen -1-- -2-- | 1----- | 144512----1------------1-11---1- | ----------- | -------
Viburn acer 12-- ---- | 2-55--2 | 5545445454242244542221542 44-2441 | ----1--1--- | ---1---
Rubus phen  ---- ---- | -1---1 | 2----1---------1-----------12-1 | -----1----- | -------
Smilac race ---- -12- | 1-1-1-- | 111-111-1111111121111-11111-111- | --11------1 | -------
Tiarella am ---- ---- | ------ | ----42---1-1--------2---------- | -1--------- | -------
Cornus flor ---- -2-- | 5145441 | 4542245444422212-122142-4-1-252- | 2142----42-- | --2----
Ilex opaca  ---- 21-2 | 1111111 | 2121-1-1-1-1------1---11211-2411 | --2----1--- | -------
Quercus alb -12- ---2 | 4514525 | 251524142-15-44544-44-24-----1-2 | --2-------4 | -------
Quercus rub 1112 -2-1 | 45--4-2 | 11-444---5-544-41-------2--5-41 | 4---------- | ------1
Dioscor vil ---- ---- | 11----- | ---2---2-21--1-1--1--11--1-1--- | ---------1- | -------
Osmorh cla  ---- ---- | 1-1---1 | 11---21211111--1--21111--1--1-11 | -1-1------- | -------
Arisaem tri ---- ---- | ------ | ----------------21----------2 | ----------- | ------2
Carya cordi ---- ---- | ------ | -1--1----1-------1----------1 | ----------1 | ------1
Euonymus sp ---- ---- | ------ | ----------------1--------4--1-- | ----------2 | -------
Polyst acro ---- 1--- | ------ | ---11----------1111--1-2211111 | 1-1-11------ | ---1---
Carya spp   ---- ---1 | --1--- | ------1-1-1-----1-1----111----- | ----1------ | ---1---
Carya tomen -1-1 -11- | 4-2-224 | 4-1--245542---15-41-2-241-2-4544 | --2-2--412- | 1-44----
Euonymus fo ---- ---- | -----1 | 1-1--------------------1---4---- | -1--1-1----- | -------
Rubus spp   ---- 1--- | -----1 | -1-----1-----1--------11-------- | -------1--- | -------
Vibur dent  ---- 1242 | --1-22 | 2--1-244-1-1----21--544-11--21- | 1----2----4- | 1--2----
Acer ruburm 451- 4124 | 454---2 | 424212-215552544522114421-1--112 | 4451421-2--4 | --2-5552
Fraxinus sp ---- ---- | 1---21- | 11--------------11-----21------- | ---21-1---- | -------
Parthenocis ---- 5141 | 1-24121 | 1211121411112212111111--11111111 | 111-11241-11 | 1-1111-2
Podoph pelt ---- ---- | -41--- | ---1111211211-5-2211121-42-1111 | 5--121----1- | 1---1--1
Carex spp   -1-- -1-- | -11--- | ---1-------------------------1 | ----------- | --1---1
Smilax glau 111- 2212 | -4-1-1 | 11--------1---------------1--1-1 | --1---1--1- | --1----
```

```
Smilax rotu --11 5111 |–41425 1112--12-1--5----12-24-2-----1-1 |-11---1--2- |-14-1-
Actino pauc ---- |--- |------ |1--111---1-1----1--1---------- |----11----- |------
Amphic brac ---- |--- |------ |4---24---11--11-2--------1----- |--------2-- |--1----
Euonymus at ---- |--- |------ |--------4------------1--------- |----------- |---1---
Fagus grand 12-- |--- 554--45 55555422144425555555-4-55551455 |-5455-444-2 |------
Fraxinus am ---- |--1- |-1-44- 4--2------1---14--1--------421-- |4---------- |------2
Hamame virg ---- |--- |------ |---------44--11-------5-------- 1--------5-- |------
Vibur dili  ---- 2--- |-----2 |--114211---1-1-------521-----15 |-----1---2- |---212-
Arisaem atr ---- 1--- |------ |--1--1-1--111--12--2-221421411- |212221-12-- 1111111-
Carpi carol ---- |--- |-----4 |----2--2--2-2---1124-12422--4-2 |-------2--- |--52-45
Liriod tuli 11-- |--5- 414112- 5555455124425-1-1555554455554445 554555555515 4-4554--
Viola spp   ---- |--- |------ |---111--------11-------11-----1 |----1-----1 |11-1---
Berber thu  ---- |--1- |------ 11--11----1------11-121-----2--1 |--1--1--122 |--1---1
Carya glabr ---- |1-2 |--41-- |1-1---4111-24-1--112-1--2-----1 |--4---12--- 1-11---4
Ostrya virg ---- |--- |------ |-------------11-------------11- |----------2 |------
Acer saccha ---- |--- |----2- |----4-2---1-------------------- |--21--2---- |------
Lonicera sp ---- 1--- |------ |-----------4---1--------------- 4---------- |------
Prunus spp  ---- 1--- |---2-- |-2-1141-2------2------4-------- 1--1--224--- |--1---2
Lindera ben ---- |--- |1122-- 4421154522144-11-452555544254211 524424544545 42555524
Unk grasses --1- |1-- |---221 |1--1-1-------------1-111-2----- |1-1-----2-1 |-211-1-
Acer plat   ---- 5-2- |--11-1 |---1112-11--1-1--1--1-----12-—2 |--252112--- |------
Rubus alleg ---- 4--- |-1-522 11--1-------------11--------1--1 |-----2---55 |------
Vitis spp   --21 |112 |-1121- |-1------11----1---1--11-1-1---2 |42---5---2- |------
Berber vul  ---- |--- |------ |--------1--1-----------111----- |--2----1-1- |------
Vinca minor ---- |--- |------ |---------------------------4---- |-------4--- |------
Smilax spp  ---- |--- 11----- |------------------------------- 4---------- |------
Tox radican ---- 5151 |--1-11 1-2-12111-21-214-22112-111222412 444521125212 2-1141-4
Ulmus rubra ---- 1-4- |------ |------------------------------- 4-2-------2- 2------
Fraxi penns ---- |1-- |------ |----------------1------1-1-5-2- |-1-----1-44 1--41-2-
Juniperus   ---- |--- |------ |-----------------------1-4----- |----------4 |-4-----
Viburnum sp ---- |--- |---1-1 |----------------------------1-- |-----1----1 2------
Vibur plica ---- |--- |2---2- |----1------------------1---2--1 |2--22--2--- 1-11---2
Cirsium qua ---- |--- |------ |-----2----------1--2---1-1-1--- |--114411-11 1----1--
Crataegus   ---- |--- |------ |----------------------------1--- 14---------- |------
Dusche ind  ---- |--- |---211 |2----1----------1--2--1-------1 1--4114241-2 2-2--1-1
Geum canade ---- |--- |------ 11----1--------1---------------1 |-1--144---1 1--1---1
Acer negun  ---- |--1- |------ |-------------------11--1-1-1111 1512-144552- 5555-445
Glecho hed  ---- |--- |------ |----------------1-------------- |----1--41-4 2-21----
Impati cape ---- |--- |------ |-------------------1---------- 11---1--222- 112-1112
Morus rubra ---- 1--1 |------ |------------------------------- |------41--- 4------
Ulmus ameri ---- |--- |------ |-------------------------1----- |----------2 |------4
Plata occid ---- |--- |------ |-----------------2------------- |--4-------- 55-44425
Polyg hydro ---- |--- |------ |------------------------------- |----------- -4441-1-
Vibru pruni ---- |--- |-1---- |----4-11-1----2-1--------1----- |------22--- |---42-2
            0000 0000 0000000 0000000000000000000000000000000 111111111111 11111111
            0000 0000 1111111 1111111111111111111111111111111 000000000000 11111111
            0000 1111 0000000 1111111111111111111111111111111 000000000011 00000001
                      0011111 0000000000000000011111111111111 0001111111   0000111
                              00000001111111111000000000001111   0000011
                              000011100000011110000000001111
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KEY TO GROUPS

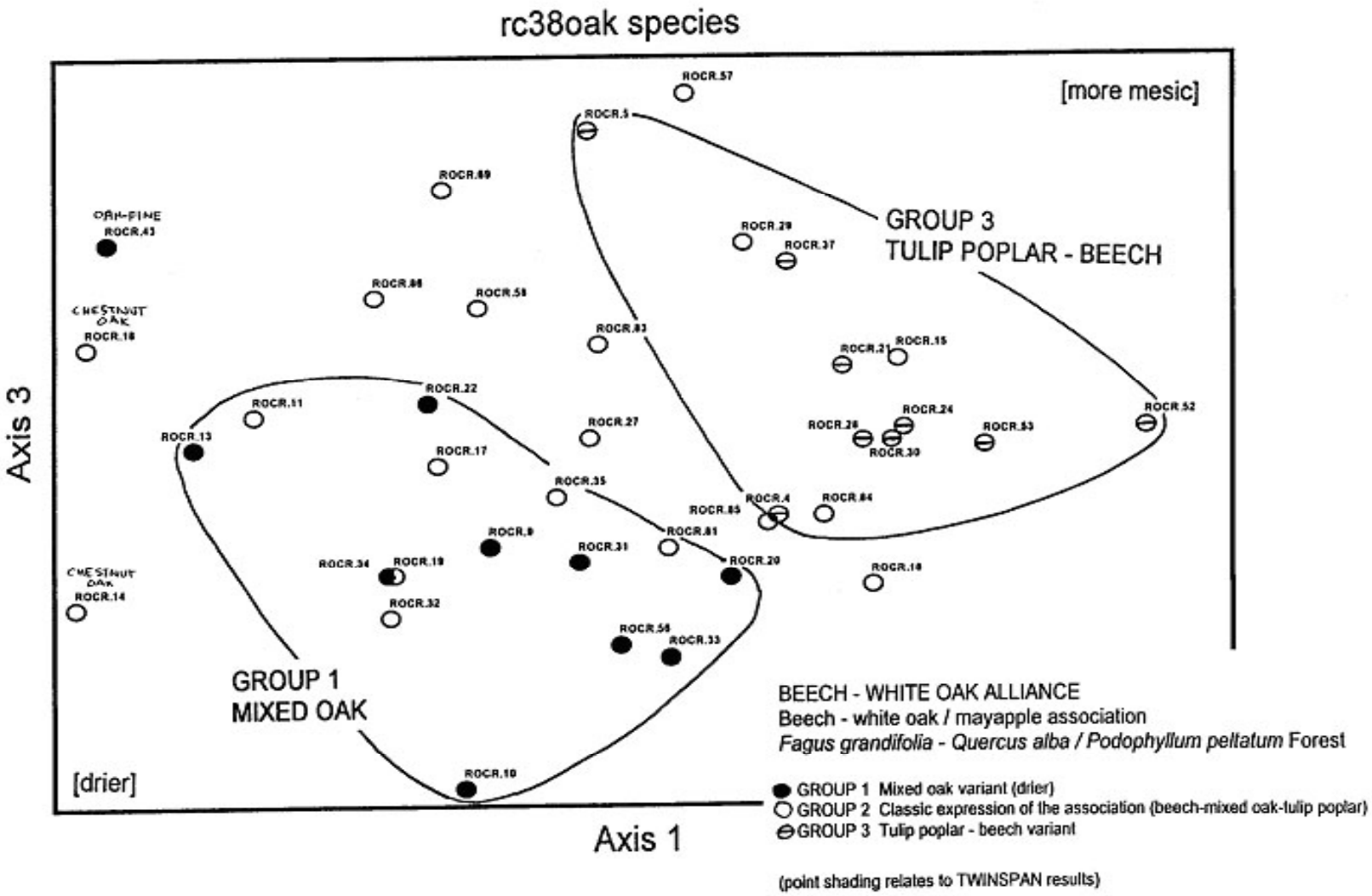
A. Quercus prinus – Nyssa Group

B. Pinus taeda – Prunus serotina Group

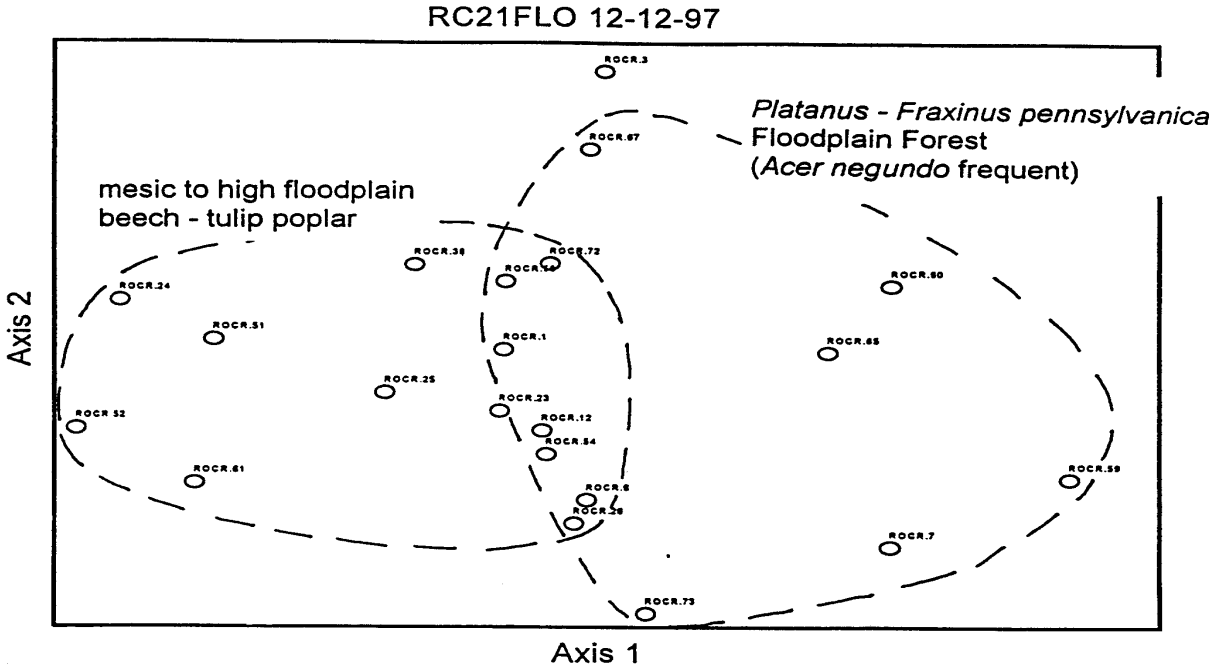
C. Quercus alba – Fagus Group
   - C′ mixed Group; includes misassigned plots that fit with Group B
   - C″ Quercus alba – Fagus with Viburnum acerifolium and Linera benzoin

D. Liriodendron – Acer negundo Group
   - D′ with prevalent Fagus component
   - D″ Platanus prevalent; Fagus absent

Appendix B. Detrended Correspondence Analysis (DCA) of 38 mixed oak forest plots.
Interpretation of groupings partially derived from TWINSPAN analysis on these plots.



Appendix C. DCA Analysis of 21 mesic or floodplain tulip poplar-beech-mixed oak forest. Includes plots from Group D and mesic end of group C" in Appendix A.



Appendix D. List of Plots and Corresponding Vegetation Associations

Plot Code	Air Photo Number	Vegetation Association
ROCR.1	09-17	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.2	09-09	Quercus (prinus, velutina) / Gaylussacia baccata Forest
ROCR.3	10-17	Liriodendron tulipifera Forest
ROCR.4	09-17	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.5	09-17	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.6	10-15	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.7	10-15	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.8	09-09	Quercus (prinus, velutina) / Gaylussacia baccata Forest
ROCR.9	09-09	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.10	09-09	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.11	09-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.12	10-17	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.13	09-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.14	09-11	Quercus (prinus, velutina) / Gaylussacia baccata Forest
ROCR.15	09-09	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.16	09-09	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.17	09-17	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.18	10-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.19	09-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.20	10-15	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.21	10-15	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.22	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.23	10-16	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.24	10-15	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.25	10-15	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.26	10-15	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.27	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.28	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.29	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.30	09-17	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.31	09-07	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.32	09-07	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.33	07-05	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.34	07-05	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.35	09-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.36	10-15	Unassigned
ROCR.37	09-17	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.38	09-13	Liriodendron tulipifera Forest
ROCR.41	11-13	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.43	12-01	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.44	12-01	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.45	12-01	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.46	12-01	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.47	12-01	Pinus taeda - Quercus (alba, falcata, stellata) Forest
ROCR.48	12-01	Quercus (prinus, velutina) / Gaylussacia baccata Forest

ROCR.49	12-01	Quercus (prinus, velutina) / Gaylussacia baccata Forest
ROCR.51	05-04	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.52	05-04	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.53	05-04	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.54	05-04	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.55	05-02	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.56	05-02	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.57	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.58	09-13/15	Rubus allegheniesis / Ampelopsis brevipedunculata Shrubland
ROCR.59	02-04	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.60	10-13	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.61	04-03	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.62	04-03	Liriodendron tulipifera Forest
ROCR.65	10-13	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.66	10-17	Unassigned
ROCR.67	10-11	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.69	10-13	Unassigned
ROCR.70	10-13	Unassigned
ROCR.71	13-15	Unassigned
ROCR.72	10-13	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.73	09-17	Platanus occidentalis - Fraxinus pennsylvanica Forest
ROCR.74	09-07	Unassigned
ROCR.77	09-11	Unassigned
ROCR.78	09-11	Unassigned
ROCR.79	09-11	Unassigned
ROCR.80	09-07	Unassigned
ROCR.81	09-09	Pinus virginiana - Quercus (alba, stellata, falcata, velutina) Forest
ROCR.82	09-09	Unassigned
ROCR.83	09-13	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest
ROCR.84	10-13	Pinus virginiana - Quercus (alba, stellata, falcata, velutina) Forest
ROCR.85	10-13	Pinus virginiana - Quercus (alba, stellata, falcata, velutina) Forest
ROCR.86	09-11	Fagus grandifolia - Quercus alba / Podophyllum peltatum Forest