Conservation Management Institute

Final Report: Vegetation Map for Brookhaven National Labs

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Introduction

In November 2000, the U.S. Department of Energy (DOE) set aside 530 acres of the Brookhaven National Laboratory (BNL) as the Upton Ecological and Research Reserve. This property will be managed through an interagency agreement between DOE and the U.S. Fish and Wildlife Service Long Island National Wildlife Refuge Complex. The Conservation Management Institute (CMI) at Virginia Tech has been involved with various investigations on the Wertheim National Wildlife Refuge as well as other government properties on Long Island. In June 2001, CMI was awarded a contract to map the vegetation of BNL.

Project Scope

The purpose this project was to classify and map the vegetation types found on the BNL and the Upton Reserve. This was accomplished through a combination of field investigation and remote sensing. The products of this project were:

1. A vegetation classification based on field surveys
2. A vegetation map using the developed classification
3. A CD with all products integrated in an ArcView 3.2 GIS
4. A summary report of field and mapping activities

In addition, tools for utilizing existing species-habitat relationships created by the New York Gap Analysis Project (NYGAP) are included. Also included are photographs taken in the field and a georeferenced digital copy of recent and historic aerial photography.

The mapping parameters followed for this project comply with Federal Geographic Data Commission requirements. The minimum mapping unit used for the project was approximately 0.5 ha and mapping class accuracy was targeted at 80% at a 90% confidence level.

Methods and Timeline

Preparatory GIS and Mapping Work

Initial GIS work involved gathering base data for interpretation and classification. We used USGS digital orthoquad photos (DOQ) (USGS Reston, VA) for both vegetation classification and delineation (Figure 1). These data are readily available for the entire lab and provide an appropriate level of detail and spatial accuracy to complete this type of vegetation mapping. These particular data were color-infrared and captured in 1998.

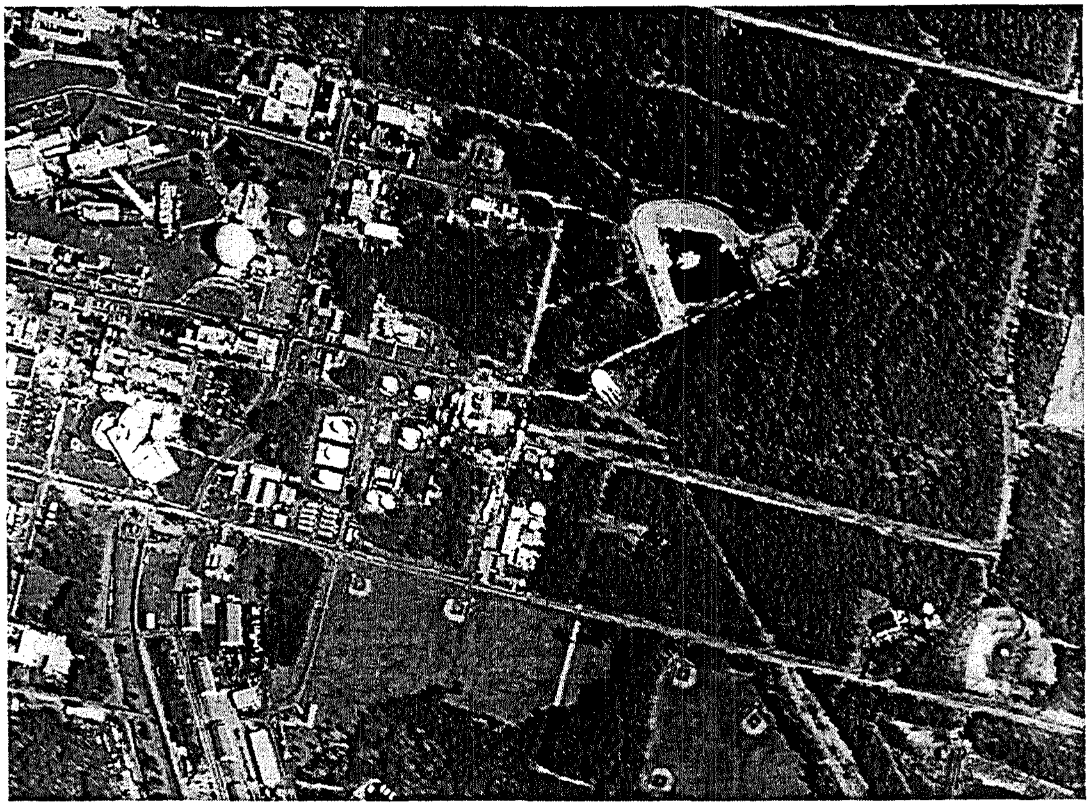

Figure 1. Example of the color-infrared digital orthoquad used to create the vegetation map for BNL.

We also researched previous vegetation studies performed on Long Island. This provided some needed background information as to which types we could expect on BNL.

Initial polygon delineation was completed on BNL before field investigation. Obvious polygons (e.g., well-defined blocks of forest, water, buildings, roads, etc.) were identified and attributed which allowed us to plan for more efficient use of field investigation time and resources.

Field Work

Field data were collected from September 11 through September 14 (not including September 12) 2001. Vegetation plots were allocated through a stratified random procedure using Alliance classes as the strata. Field crews navigated to the plot locations, identified by a UTM grid coordinate, using GPS and plot location maps. Vegetation plot data was recorded using a standard releve (Bonom 1989). Plot sizes are based upon the physiognomy of the vegetation (Mueller-Dombois and Ellenberg 1974).

Once the plot boundaries were established, and the site information recorded, all plant species occurring within the plot boundaries were listed according to the height strata (herbaceous, low shrub, mid-story, overstory). The amount of aerial vegetative cover was visually estimated using a modified Braun-Blanquet cover abundance scale. At the conclusion of the vegetation data collection, the immediate area surrounding the plot was surveyed, and any plant species identified that did not occur within the plot were noted. Multivariate statistics were used to quantitatively assess similarity and community assemblage. A more detailed description of vegetation sampling methods and classification procedures is provided in Appendix A.

Final Map Classification and GIS Building

Once the classification was available, photointerpreters could attribute each polygon with its appropriate vegetation class. Also delineated, as the photography would allow, were buildings, parking lots, and other structures. Corrections in delineations and classifications were made wherever necessary.

The resulting vegetation map was incorporated into an Arc View 3.2 GIS database. Other data such as the field data points and the DOQs were added. Field photographs were attached and hyperlinked.

The NYGAP has made species-habitat relationships freely available. We used these data along with the vegetation map to produce predicted species distributions for 215 species potentially occurring on the BNL. These data are accessed with a custom designed tool through the GIS interface.

Results

A total of 33 vegetation sample points were completed on BNL. These data revealed 11 classes of vegetation for the property. A total 16 classes were actually mapped (Figure 2) which included both vegetated and non-vegetated types (Table 1).

Table 1. Map classes found on Brookhaven National Labs

Vegetated	Non-vegetated
Pitch Pine-White Oak Forest	Building
Pitch Pine/Mixed Oak- Heath Forest	Disturbed
Planted White Pine Forest	Parking Lot
Black Cherry Forest	Road
Scarlet Oak–Heath Forest	Water
Successional	
Cattail Marsh	
Grass	
Red Maple – Blackgum Wet Forest	
Red Maple-Mesic Heath Forest. Forest	
Red Maple- Scarlet Oak Mesic Heath Forest	

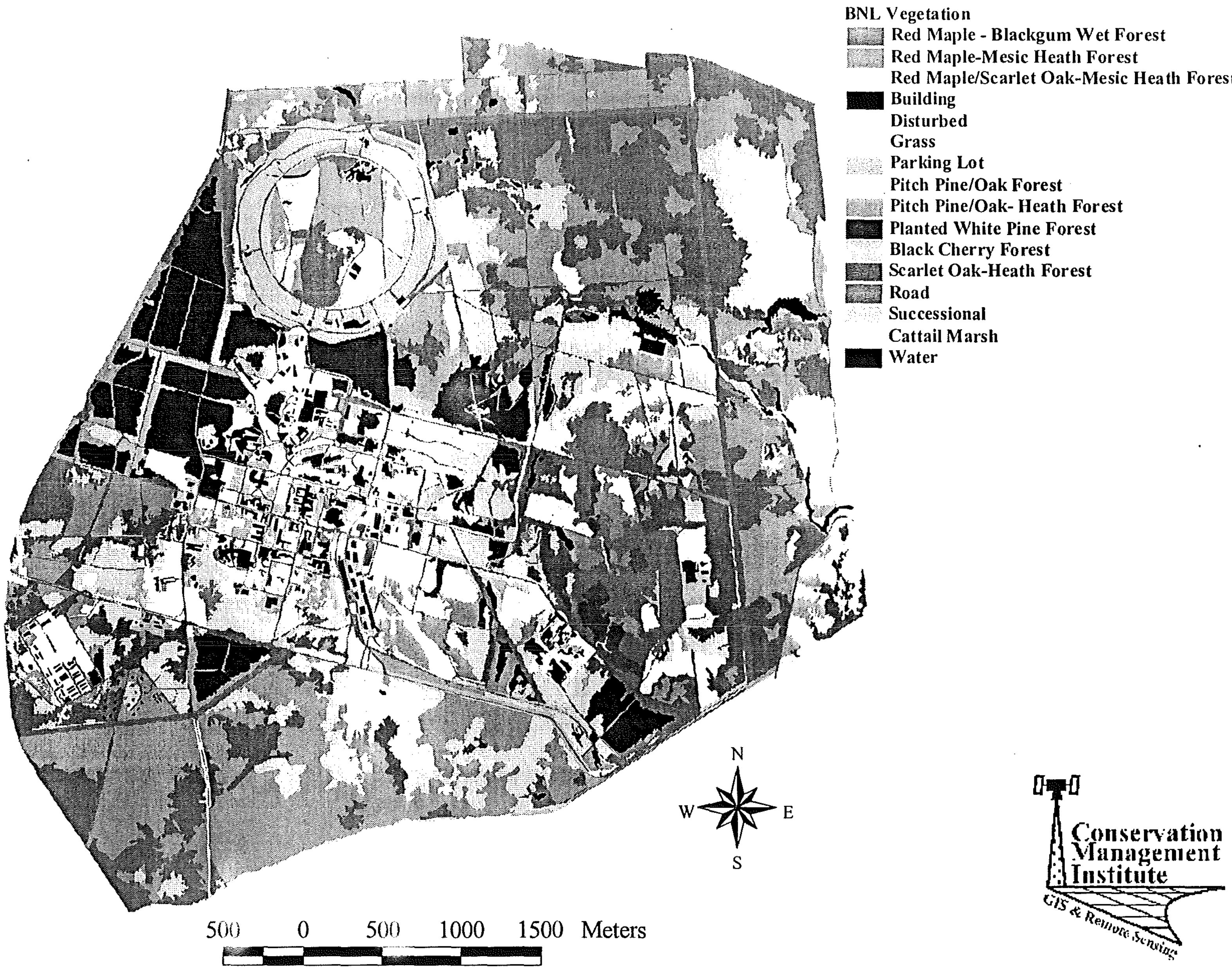

Figure 2. Vegetation Map of Brookhaven National Labs.

These types are described in greater detail and cross-walked to the National Vegetation Classification Standard (NVCS) (Appendix B) where possible.

Nearly 90% of the area within the BNL is forested. The majority of these types are pitch pine – white oak in *Pinus rigida/Quercus alba-Vaccinium palladium* Forest (23.6%) and *Pinus rigida-Quercus (alba, coccinea)-Vaccinium palladium* Forest (18.6%). The area and percent coverage for each map class is provided in Table 2.

Table 2. The area and percent of each vegetation class on BNL.

Vegetation Class	Area (ha)	Percent of Total Area
Pitch Pine- White Oak Forest	509.9	23.6
Pitch Pine/Mixed Oak- Heath Forest	400.5	18.6
Planted White Pine Forest	186.1	8.6
Black Cherry Forest	1.9	0.1
Scarlet Oak–Heath Forest	429.1	19.9
Successional	94.0	4.4
Cattail Marsh	5.2	0.2
Grass	162.0	7.5
Red Maple-Blackgum Wet Forest	17.3	0.8
Red Maple-Mesic Heath Forest. Forest	52.1	2.4
Red Maple- Scarlet Oak Mesic Heath Forest	54.3	2.5
Other (disturbed, non-vegetated)	244.1	11.3
Total	2156.5	

A species distribution tool, originally developed for the USFWS Eastern Virginia Rivers National Wildlife Refuge Complex, was adapted for use with the newly created vegetation map of BNL. This generates predicted species distributions using known species-habitat relationships and using them to identify possible overlap on BNL.

Species-habitat relationships are available from the recently completed New York Gap Analysis Project (NYGAP). This project was completed by Cornell University in 2000 (more information is available through the National GAP office at http://www.gap.uidaho.edu). Species-habitat information is available in spreadsheet format. We created a subset of species based in location records (also available from NYGAP) for the Coastal region of New York State, which encompasses the BNL. The habitat classifications used by NYGAP are somewhat more gross than those determined from this mapping effort. BNL vegetation map classes were cross-walked to the NYGAP classes (Table 3.) and used to further subset the species list for BNL. More complete descriptions of these types are found in Appendix C.

Table 3. Cross-walk between map types for BNL and land cover types from the NYGAP vegetation map.

BNL Map Class	NYGAP Habitat Code
Pitch Pine- White Oak Forest	Pitch pine-oak
Pitch Pine/Mixed Oak- Heath Forest	Pitch pine-oak
Planted White Pine Forest Forest	Pine plantation
Black Cherry Forest	Successional northern hardwoods
Scarlet Oak–Heath Forest	Appalachian oak-pine
Successional	Old field/pasture
Cattail Marsh	Emergent marsh/open fen
Grass	Golf course/ park lawn
Red Maple – Blackgum Wet Forest	Deciduous Wetland
Red Maple-Mesic Heath Forest. Forest	Deciduous Wetland
Red Maple- Scarlet Oak Mesic Heath Forest	Appalachian oak-pine
Building	Built
Disturbed	Built
Parking Lot	Built
Road	Built
Water	Open water

The resulting tables were reformatted for use with the species distribution tool. These tables were added to the Arc View GIS and a button was added to the View interface to access the data. This tool allows the user to select the desired taxa and then species. The predicted distribution of the species is depicted in the View.

Discussion

Overall, the mapping of BNL was very successful. The experience that CMI photointerpreters had at other properties on Long Island was helpful in completing this map accurately and efficiently.

Our methods of conducting a preliminary delineation, field classification, and final attribution steps provided and accurate map were appropriate given the short timeframe for fieldwork (further shortened by events in New York City on September 11th). We were able to classify and identify ubiquitous types and then concentrate field plots on more difficult and les-common types where information for classification was most needed.

A quantitative accuracy assessment was not conducted for this project. We feel that vegetation class accuracies are greater than 80% for mapped vegetation classes (likely all map classes). We were not able to access some areas of BNL (for security purposes) but are confident that any types not represented elsewhere on the property exist below the minimum mapping unit of 0.5 ha.

When using this product it is important to keep in mind that the base imagery used was captured in late January and early February of 1998. Changes on BNL since that time are not represented. Newer photography shows that some changes, mostly near buildings and parking lots, have occurred since that time. We have included both sets of data on the CD so the newer photos can be consulted before users enter the field. This procedure will avoid wasted time in heading for a particular area that has undergone change in the last 3 years.

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Appendix A. Detailed Description of Vegetation Plot Data Collection and Classification Procedures

Introduction

The field sampling methods that were used to collect plant community data were based upon phytosociological methods initially developed in Europe by Dr. Josiah Braun-Blanquet (Kent and Coker 1992, Mueller -Dombois and Ellenberg 1974, Shimwell 1971 among others). The purpose of the phytosociological method, as defined by Dr. Braun-Blanquet, was to describe and classify the world's plant communities based upon floristic composition, rather than physiognomic structure (Braun-Blanquet 1932).

The sampling method developed by Braun-Blanquet utilized a series of subjectively located sample plots, called releves, to describe and classify plant communities (Poore 1955, Shimwell 1971, Barbour et al. 1980, Bonham 1989, Kent and Coker 1992). Mueller-Dombois & Ellenberg, (1974) described three basic requirements that each sample plot (releve) must meet:

1. It should be large enough to contain all species belonging to the plant community.

2. The habitat should be uniform throughout the releve area as far as one can determine this.

3. The plant cover should be as homogeneous as possible. For example, it should not show large openings or should not be dominated by one species in one half of the sample area and by a second species in the other half.

Species were listed by height strata and the amount of aerial vegetative cover for each was visually estimated employing a cover/ abundance scale. Prior to the widespread use of computers, the releves would be listed in table format and similar samples were grouped into associations based upon the their similarity in species composition and abundance (Poore 1955, Mueller-Dombois and Ellenberg 1974). This subjective method, known as association table work, was used extensively in Europe in the first half of the twentieth century and proved to be a fairly reliable method of classifying and describing associations when used by experienced workers (Becking 1957, Shimwell 1971, Gauch 1982).

The original methods developed by Dr. Braun-Blanquet were modified and adapted throughout the twentieth century to meet specific needs of plant ecologists. Phytosociological methods have recently been used for a variety of purposes such as, vegetation mapping (The Nature Conservancy 1994), comparisons of community composition (Collins 1987), and determination of herbaceous vegetation composition (Daubenmire 1959) among others. Excellent reviews of the releve method, its development and modification, and introduction to North America can be found in Poore

(1955), Becking (1957), Shimwell (1971), Mueller-Dombois and Ellenberg (1974), and Kent and Coker (1992).

Plot Allocation

Plot allocation for the vegetation sampling effort at BNL was completed using the preliminary map. We stratified vegetated areas (predominantly forest and unknown from photography alone) by apparently similar types. Our study plan called for the placement of up to 50 individual plots if necessary (this number was determined from time and amount of funding available). We set a minimum number of 3 plots to represent each observed vegetation type. These plots were randomly placed within the target type, making sure that the actual plot location was at minimum 20 m from the delineated edge of the plot.

The result was 40 specific vegetation plot locations targeted for survey. We were able to survey 33 of these points as planned. We were unable to reach some points due to access restrictions or difficulty in getting to the points (e.g., passed water bodies, etc.). Based on our observations in the field, we felt that additional points were unnecessary.

Field Methods

Field crews navigated to the plot locations, identified by a UTM grid coordinate, using GPS and plot location maps. Plots were square and sizes were based upon the physiognomy of the vegetation (TableA1). Before recording plot data, site information was recorded on the appropriate data sheet (See attached data sheets). At each location, a representative photograph was taken from the NE corner of the plot

Once the plot boundaries were established all plant species occurring within the plot boundaries were listed on the data according to the height strata in Table A2. If a plant species was rooted outside but was overhanging the plot, it was considered to be in the plot. After each plant species was listed, the amount of aerial vegetative cover was visually estimated using a modified Braun-Blanquet cover abundance scale (Table A3). At the conclusion of the vegetation data collection, the immediate area surrounding the plot was surveyed, and any plant species that did not occur within the plot noted.

Table A1: Plot sizes determined through species-area curves.

Plot Size (m^2)	Physiognomic Class[1]	General description
9.0 (3m x 3m)	Herbaceous	Highly disturbed herbaceous communities consisting primarily of herbs, forbs and nonnative cool season grasses. Woody vegetation was less than two meters tall and sparse.
56.25 (7.5m x 7.5m)	Shrubland	Native, warm season grassland communities containing a significant amount of woody vegetation.
100 (10m x 10m)	Shrubland	Highly disturbed shrubland communities containing a significant woody component above 2 meters.
400 (20m x 20m)	Forest/Woodland	Communities that have aerial vegetative cover in excess of 25% above 5 meters

Table A2: Height strata used at FPMTC for surveying LCTA plots.

Strata	Height Range
Herbaceous	0 – 1 meter
Shrub	1 – 3 meters
Mid-story	3 – 6 meters
Overstory	6 + meters

Table A3: Braun-Blanquet cover abundance scale modified from Mueller-Dombois and Ellenberg (1974) and Daubenmire (1959).

Aerial Vegetative Cover	Braun Blanquet Class	Class midpoints
95 – 100 %	6	97.5
75 – 95 %	5	85
50 – 75 %	4	62.5
25 – 50 %	3	37.5
5 – 25 %	2	15.0
1 – 5 %	1	2.5
Cover less than 1 %/few individuals	+	0.5
Rare/solitary individual	r	

[1] Physiognomic class is based upon SNVCS developed by the Nature Conservancy (TNC 1994)

Quantitative Vegetation Classification

Once the field data were collected, the aerial vegetative cover for each observed species was calculated. This information was used to create the vegetation classifications.

Calculation Of Mean Aerial Vegetative Cover

Step 1: *Arrange field data in a samples-by species abundance data matrix.*

A samples-by species abundance data matrix is one of the most commonly utilized plant community data matrices (Gauch 1982, Gauch and Whittaker 1981). Raw field data is entered into a digital spreadsheet in the format found in Table A4. The class midpoints in Table A3 that correspond to the cover abundance for a particular species are used as the data. Each stratum is entered separately, thus resulting in samples-by-species abundance data matrix.

Table A4: Example samples-by-species data matrix.

PLOT # -->	1	2	3	4	5	6	7	8	9	10
Species										
Achillea millefolium			2.5	2.5	2.5	2.5			15	
Aira elegans									1	
Alium vineale		2.5	1	2.5						
Ambrosia artemisifolia		2.5	0.5						1	1
Andropogon gerardii	15				2.5		15	1		
Andropogon virginicus		37.5	15	2.5	2.5			2.5	37.5	62.5

Step 2: *Stratify raw data table by physiognomic class.*

The site information data sheet is used to classify each plot according to its physiognomic class. Raw data matrices are subsequently arranged into separate matrices based upon the physiognomic class of each plot.

Step 3: *Calculate mean cover of each species in each physiognomic class.*

To calculate the mean cover of each species, the class midpoints in each physiognomic class are summed and divided by the total number of plots corresponding to the class. The resultant figures reflect the mean aerial vegetative cover for every species in each of the physiognomic classes.

Multivariate Statistical Analysis

The vegetation class categorization is guided by multivariate statistical output. Multivariate analysis is used extensively in the field of community ecology and by definition, involves the examination of numerous variables simultaneously (Gauch 1982).

Our vegetation data is well suited for this type of analysis since each sample (plot) is composed of numerous plant species (variables).

Multivariate analysis of the vegetation data was used to assist in classifying the plant communities for vegetation mapping and the development of the final vegetation classification at BNL. Plant community classification, at its core, is the grouping of similar assemblages of plant species into classes for the purpose of communication and further study (Whittaker 1973). Clustering is commonly used to analyze plant community data. Clustering groups the samples (i.e. plots) based upon their similarity (Gauch and Whittaker 1981). These groups presumably represent distinct plant communities.

Step 1: *Data Reduction/Reorganization*

Before the actual multivariate analysis of the plot data, it is useful to segregate the often large data set into smaller more manageable data matrices. These smaller data matrices are based upon the physiognomic class of each sample (plot). These physiognomic classes are based upon the percentage of vegetative cover above 5 meters. A 'forest' is defined as having greater than 60 % cover, while'woodland' is defined as having vegetative cover between 25% and 60%. 'Sparse woodland' has vegetative cover of between 10% and 25% and area is considered 'open' if there is less than 10% vegetative cover. Once all of the plots are divided into separate data matrices, based upon physiognomic class, each matrix is analyzed separately.

Gauch (1982) recommends the use of nonhierarchical clustering (NHCL) techniques when working with large and/or unfamiliar ecological data for classifying vegetation communities. However, NHCL requires the investigator supply the number of clusters. To choose an ecologically realistic number of clusters for the NHCL procedure, two additional multivariate techniques, hierarchical clustering (HCL) and multidimensional scaling (MDS), are used to determine an ecologically realistic number of clusters within each data matrix.

Step 2: *Hierarchical Clustering and Multidimensional Scaling*[2]

Sample dissimilarity, using the percentage difference algorithm, was calculated for each physiognomic matrix. The samples were then hierarchically clustered by the unweighted pair-group method using arithmetic averages (van Tongeren 1987). This method of HCL is considered a sound method for the identification of plant communities (Gauch and Whittaker 1981, Gauch 1982, Krebs 1989). Dendrograms of the cluster analysis are generated and interpreted following the suggestions of Faith (1991).

Multidimensional scaling has been found to be a robust method for detecting pattern in community ecology (Minchin 1987, Austin 1991). Multidimensional scaling was used to further investigate the number of possible clusters in each of the physiognomic data matrices. As in HCL, the percentage difference algorithm was used to calculate sample

[2] Many standard statistical software packages such as SAS and Systat contain these analysis packages.

dissimilarity. The subsequent results of the MDS are plotted in a two-dimensional ordination space and the number of obvious groups representing community clusters noted.

Step 3: *Non-Hierarchical Clustering (NHCL)*

After determining an ecologically realistic number of potential clusters, NHCL was performed on each physiognomic matrix. The percentage difference algorithm was used to calculate species dissimilarity. The NHCL results were summarized and examined in separate Braun-Blanquet association tables that ostensibly represent individual plant associations (Mueller-Dombois and Ellenberg 1974, Gauch 1982).

Step 4: *Ecological Sense*

Further refinement of the association tables is necessary in some instances because the clusters do not make ecological sense. For instance, some tables may show combinations of species that have not previously been reported and whose recognized distributions did not overlap. The results were interpreted and final association tables created reflecting the further refinement.

Step 5: *Summarization*

The final tables ostensibly represented plant community associations. The composition for each community association was summarized by determining the mean vegetative cover as described above.

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Appendix B. Brookhaven National Labs Plant Associations Descriptions.

The descriptions provided here summarize the vegetation characteristics used to create the vegetation classification system for the BNL mapping project. Where possible, association crosswalks to the National Vegetation Classification Standard (NVC) are provided. In some cases, the types delineated here are more detailed than those available from the NVC (although still FGDC compliant) and the Alliance classification is referenced. Types considered to be "unnatural" are not included in the NVC, therefore no direct crosswalk is available.

Vegetation Communities of Brookhaven National Labs

Planted White Pine Forest (*Pinus strobus-Vaccinium palladium* Forest)

The **Planted White Pine Forest** association was dominated exclusively by white pine (*Pinus strobus*) in the 6+ meter stratum and 3-6 meter stratum. The mean aerial vegetative cover was 85% and 38.75 % respectively. The shrub strata (1-3 meter) was poorly developed and had very few individuals of any species. The herbaceous stratum was also poorly developed likely due to the shading caused by the dense overstory.

NVC Equivalent: I.A.8.N.b.14 (*Pinus strobus / Vaccinium pallidum* Forest)

Pitch Pine- White Oak Forest (*Pinus rigida-Quercus alba- Vaccinium palladium* Forest)

The **Pitch Pine/White Oak Forest** association was dominated exclusively by Pitch Pine in the 6+ meter strata with a mean aerial vegetative cover of 70%. The 3-6 meter stratum was dominated by both pitch pine and white oak with mean aerial cover of 38% and 45% respectively. Black oak was a common but low cover associate in the 3-6 meter strata. The shrub (1-3 meter) stratum was well developed and dominated by oak spp. The herbaceous (0-1 meter) stratum was typically dominated by blueberry spp. though its occurrence was haphazard and not complete. Common associates included, broad beech fern (*Pteridium aquilinum*), woodland sedge (*Carex pennsylvanica* ?), and Dangleberry (*Gaylussacia fondosa*). This association likely represents a less developed and/or more recently disturbed type relative to the Pitch Pine-Mixed Oak –Heath type discussed below.

NVC Equivalent: I.C.3.N.a.35 (*Pinus rigida - Quercus coccinea / Vaccinium pallidum - (Morella pensylvanica)* Forest)

Pitch Pine/ Mixed Oak- Heath Forest (*Pinus rigida/Quercus (coccinea, alba)-Quercus (coccinea,alba)-Vaccinium* palladium Forest)

Within this mapped type there were two associations identified from the field data. However the two associations were not distinguishable for the purposes of vegetation mapping and thus were combined into one type. Pitch Pine and a mixture of white oak, scarlet oak, and occasionally black oak dominated the overstory (6 + meter) in this association. The mid story (3-6 meter) was largely dominated by white and scarlet oak with an occasional pitch pine. The shrub stratum (1-3 meters) was rather sparse and consisted primarily of young oaks and an occasional high bush blueberry. The herbaceous (0-1 meter) was completely dominated by members of the Ericaceae family primarily *V. palladium.* This association is in a later stage of secondary succession than the previous type and will likely become exclusively dominated by oaks unless a disturbance, such as fire, takes place. Common associates included, broad beech fern (*Pteridium aquilinum*) and woodland sedge (*Carex pennsylvanica*),.

NVC Equivalent: I.C.3.N.a.35 (*Pinus rigida - Quercus coccinea / Vaccinium pallidum - (Morella pensylvanica)* Forest)

Scarlet Oak–Heath Forest (*Quercus coccinea-Vaccinium palladium/Gaylussacia baccata* Forest)

Scarlet oak was the exclusive overstory (6 + meter) dominant in this association with a mean aerial vegetation cover of 40%. White oak and pitch pine were low cover but somewhat common associates in this stratum. The midstory(3-6 meter) stratum was a low density mixture of scarlet oak white oak and black oak. Two members of the Ericaceae, Black Huckleberry and Blueberry dominated the herbaceous stratum (0-1meter) in this association. Other common associates were, woodland sedge and broad beech fern.

NVC Equivalent: I.B.2.N.a.100 (*Quercus coccinea - Quercus velutina / Sassafras albidum / Vaccinium pallidum* Forest)

Red Maple/Scarlet Oak-Mesic Heath Forest (*Acer rubrum/Quercus coccinea-Acer rubrum-Vaccinium corybosum-Vaccinium palladium* Forest)

Red maple (*Acer rubrum*) and Scarlet oak were overstory (6 + meters) co-dominants in this association with mean aerial vegetative covers of 44% and 38% respectively. The midstory (3 –6 meter) was largely composed of red maple with black gum (*Nyssa sylvatica*) occurring haphazardly. Highbush blueberry was the dominant species in the shrub Stratum (1-3 meters). The herbaceous stratum (1-3 meters) was dominated by high bush blueberry and *V. palladium*. Other common associates in this stratum were Greenbrier (*Smilax spp.*) and woodland sedge.

NVC Equivalent: I.B.2.N.g.2 (*Acer rubrum – Nyssa sylvatica* Saturated Forest Alliance)

Red Maple-Mesic Heath Forest (*Acer rubrum-Vaccinium corymbosum-Amelanchier spp.* Forest)

Red maple (*Acer rubrum*) was the dominant overstory species in this association with mean aerial vegetative in excess of 30%. The midstory (3 –6 meter) was also largely composed of red maple. Highbush blueberry and Serviceberry (*Amelanchier spp.*) were the two the dominant species in the shrub Stratum (1-3 meters). The herbaceous stratum (1-3 meters) was also dominated by Serviceberry with *Carex stricta* occurring with great frequency. Other common associates in this stratum were highbush blueberry and woodland sedge.

NVC Equivalent: I.B.2.N.g.2 (*Acer rubrum – Nyssa sylvatica* Saturated Forest Alliance)

Red Maple-Blackgum Wet Forest (*Acer rubrum-Nyssa sylvatica* Wet Forest)

Red maple (*Acer rubrum*) and Blackgum (*Nyssa sylvatica*) the dominate the overstory in this wet forest type. This type is likely similar in composition to Red Maple-Mesic Heath Forest except that periods of saturation are longer and complete surface drying seldom occurs.

Black Cherry Forest (*Prunus serotina* Forest)

This type was only observed in one area of BNL, but has been observed by CMI field crews on other Long Island properties. Black cherry is the most abundant species in the overstory and mid-story stratums (37.5% and 62.5% respectively). The presence of black locust suggests that this type emerges after disturbance, perhaps through cutting. The presence of *Quercus* spp. in the seedling layer suggests that, over time, this site will progress towards other types more predominant on BNL.

Cattail Marsh (*Typha (angustifolia, latifolia)* Freshwater Wetland)

The wettest portions of the river and pond areas are dominated by cattail. Quantitative data were not collected for these types on BNL due to depth of water. These types are easily distinguishable from the aerial photographs. Moisture-tolerant trees and shrubs are found along the edges of these areas.

Appendix C. Land cover Type Descriptions from the New York Gap Analysis Project

Introduction

In order to utilize the species-habitat associations available from the NYGAP, we had to crosswalk the habitat classes used to map classes created for this project. We accomplished this by examining the following vegetation descriptions for the NYGAP map and recoding them to BNL types. These descriptions include site factors, conspecifics, and National Vegetation Classification equivalents.

Vegetation Descriptions

Land Cover Type: **Evergreen plantation**

Type name: **Pine plantation**
Dominant species: red pine, white pine, scotch pine
Associated species: red maple, white ash, black cherry
Site factors: planted sites, on gentle slopes or flat areas
Distribution: statewide
Sources/similar communities: Pine plantation (Reschke 1990)
TNC alliance: Planted Pine Forest, *Pinus strobus* Forest (in part)

Land Cover Type: **Deciduous wetland**

Type name: **Red maple swamp**
Dominant species: red maple, black ash, American elm, swamp white oak, butternut, bitternut-hickory
Associated species: spicebush, red-osier dogwood, arrowwood, highbush-blueberry, black gum
Site factors: poorly drained sites
Distribution: statewide
Sources/similar communities: Red maple-hardwood swamp (Reschke 1990)
TNC alliance: Acer rubrum-Fraxinus pensylvanica Seasonally Flooded Forest, *Acer rubrum-Nyssa sylvatica* Saturated Forest, *Fraxinus nigra-Acer rubrum* Saturated Forest, *Acer rubrum* Saturated Woodland, *Acer rubrum* Seasonally Flooded Woodland

Land Cover Type: **Successional hardwoods**

Type name: **Successional northern hardwoods**
Dominant species: black cherry, red maple, black locust, quaking aspen, white pine, paper birch, gray birch, white ash, American elm, box elder, silver maple, pin cherry, eastern red cedar
Associated species: buckthorn, shadbush, green ash, tree-of-heaven, riverbank grape, poison ivy

Site factors; sites once cleared or otherwise disturbed that have reverted to woodland or forest cover
Distribution: statewide
Sources/similar communities: Successional northern hardwoods, Successional southern hardwoods, successional red cedar woodland (Reschke 1990)
TNC alliance: Betula papyrifera Forest, *Robinia pseudoacacia* Forest, *Amelanchier canadensis* Woodland, *Juniperus virginiana* Woodland, *Populus tremuloides* Woodland

Land Cover Type: **Appalachian oak-pine**

Type name: **Appalachian oak-pine**
Dominant species: red oak, black oak, white oak, chestnut oak, scarlet oak, white pine, pitch pine
Associated species: red maple, eastern hemlock, American beech, black cherry
Site factors: generally on well drained soils, often rocky or sandy
Distribution: Appalachian Plateau, Hudson Valley.
Sources/similar communities: Appalachian oak-pine forest, Shale talus slope woodland (Reschke 1990)
TNC alliance: Pinus strobus-Quercus (alba, rubra, velutina) Forest,*Quercus rubra-Quercus prinus* Woodland

Land Cover Type: **Pitch pine-oak**

Type name: **Pitch pine-oak-heath woodland**
Dominant species: pitch pine, white oak
Associated species: scarlet oak, black oak, scrub oak, huckleberry, blueberry
Site factors: well-drained sandy or rocky soils
Distribution: mainly in the Coastal Lowlands ecozone
Sources/similar communities: Pitch pine-oak-heath woodland (Reschke 1990)
TNC alliance: Pinus rigida/Quercus ilicifolia Woodland, *Pinus rigida/Vaccinium* Woodland

Type name: **Pitch pine-oak forest**
Dominant species: pitch pine, white oak, red oak, black oak, scarlet oak
Associated species: scrub oak, blueberry, black huckleberry
Site factors: well-drained sandy outwash plains, rocky ridgetops
Distribution: Hudson Valley and Coastal Lowlands ecozones
Sources/similar communities: Pitch pine-oak forest (Reschke 1990)
TNC alliance: Pinus rigida-Quercus (*velutina, prinus*) Forest

Type name: **Pitch pine-oak-heath rocky summit**
Dominant species: pitch pine, chestnut oak, scrub oak, common juniper
*Associated spec*ies: blueberry, sweetfern, black huckleberry, Pennsylvania sedge, poverty grass

Site factors: rocky ridgetops
Distribution: Hudson Valley ecozones
Sources/similar communities: Pitch pine-oak-heath-rocky summit (Reschke 1990)
TNC alliance: Pinus rigida/Quercus ilicifolia Woodland, *Pinus rigida/Vaccinium* Woodland

Type name: **Pitch pine-scrub oak barrens**
Dominant species: pitch pine, scrub oak
Associated species: sweetfern, blueberries, black huckleberry
Site factors: well-drained sandy soils
Distribution: Central Hudson, and Appalachian Plateau ecozones (Albany Pinebush)
Sources/similar communities: Pitch pine-scrub oak barrens (Reschke 1990)
TNC alliance: Pinus rigida/Quercus ilicifolia Woodland

Land Cover Type: **Old field/pasture**

Type name: **Old field/pasture**
Dominant species: goldenrods, Kentucky bluegrass, compressed bluegrass, timothy, quackgrass, smooth brome, sweet vernal grass, orchard grass, common chickweed, old-field cinquefoil, wild strawberry, ragweed, calico aster, New England aster
Associated species: gray dogwood, silky dogwood, arrowwood, staghorn sumac, eastern red cedar
Site factors: areas that have been cleared, plowed, and maintained as pasture for livestock or left abandoned with less than 50% shrub cover; also includes some areas of extensive lawns with scattered shrubs and trees.
Distribution: statewide
Sources/similar communities: Successional old field, Pastureland (Reschke 1990)
TNC alliance: Dactylis glomerata-Rumex acetosella Cultivated

Land Cover Type: **Emergent marsh/open fen /wet meadow**

Type name: **Emergent marsh/open fen**
Dominant species: bulrushes, cattails, bur-reed, reed canary grass, sedges, yellow pond lily, white water lily, sweetflag, rice cutgrass, cottongrass, common horsetail, marsh fern, cinnamon fern, skunk cabbage, marsh marigold
Associated species: red maple, eastern hemlock, red-osier dogwood, alder-leaf buckthorn
Site factors: wet areas, sometimes with peat and/or marl, flat or gently sloping
Distribution: statewide
Sources/similar communities: Deep emergent marsh, Shallow emergent marsh, Rich sloping fen, Marl fen (Reschke 1990),
TNC alliance: Calamagrostis canadensis Seasonally Flooded Herbaceous, *Typha spp. (Scirpus spp., Juncus spp.)* Seasonally Flooded Herbaceous, *Phalaris arundinacea* Seasonally Flooded Herbaceous, *Scirpus acutus- (Scirpus*

tabernaemontani) Semipermanently Flooded Herbaceous, *Carex stricta, Typha (angustifolia, latifolia) - (Scirpus spp.)* Semipermanently Flooded Herbaceous, *Phragmites australis* Semipermanently Flooded Herbaceous, *Nymphaea odorata -Nuphar spp.* Permanently Flooded Herbaceous

Land Cover Type: **Golf course/ park lawn**

Type name: **Golf course/ park lawn**
Dominant species: Kentucky bluegrass, fescues, other lawn grasses
Associated species: scattered introduced and native trees and shrubs
Site factors: flat or gently sloping areas predominately planted to grasses and forbs
Distribution: statewide
Sources/similar communities: Mowed lawn with trees, Mowed lawn (Reschke 1990)
TNC alliance: Planted Herbaceous Alliance

Land Cover Type: **Open water**

Type name: **Open fresh water**
Site factors: permanently flooded (fresh water) areas with little or no vegetation
Distribution: statewide

Land Cover Type: **Built**

Type name: **Roads**
Site factors: paved or unpaved roads
Distribution: statewide
Sources/similar communities: Unpaved road/path, Paved road/path (Reschke 1990)

Type name: **Urban**
Site factors: areas with high housing density
Distribution: statewide

Type name: **Suburban residential**
Site factors: areas with moderate housing density, usually mixed with tree or herbaceous cover
Distribution: statewide