

**Natural vegetation of the Carolinas:
Classification and description of
montane non-alluvial wetlands of the southern Appalachian region**

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Abstract

The ecological significance and anthropogenic value of montane non-alluvial wetlands is well known. However, there is relatively little understanding of or quantitative documentation of these southern Appalachian vegetation types. In particular, our understanding of montane, peat-forming wetlands is based primarily on qualitative data, and there has been no previous comprehensive classification and description of these community types. In this paper, we present a community classification based on 127 plots collected in the Blue Ridge Physiognomic Province. Communities were delimited using hierarchical cluster analysis, and non-metric multidimensional scaling was subsequently used to help differentiate and describe groups identified by the cluster analysis. We identify twelve vegetation groups. Although some of these groups fit well within currently recognized community concepts, others deviate sharply from established types and point to a need for definition of new types and/or significant refinement of currently recognized. These twelve groups are discussed below, each with a description of composition, related community concepts, and environmental context.

I. Introduction

The non-alluvial wetlands of the Southern Appalachian region, particularly peat-forming wetlands (generally mires, though locally referred to as bogs), are essentially unique to the region and largely unstudied. The location of these wetland types and the delicate nature of the habitats make them a challenge to study. Earlier qualitative surveys of such sites revealed that a majority of these wetlands contain rare and threatened plant species. Moreover, many have been significantly degraded by agriculture, pasturage, road construction, urbanization, and tourist development (Weakley and Schafale 1994). The presence of rare and threatened species within these sites, along with the unique character of these wetlands and their rapid decline, makes them of particular concern for identification, protection, and conservation.

Plant community composition of peat-forming wetlands in the southern Appalachian region is poorly understood. Weakley and Schafale (1994) provide a qualitative summary of these wetland types based on a series of species lists for entire wetlands. No previous work has documented composition quantitatively or at the scale of local ecological variation within a wetland area. The U.S. National Vegetation Classification (NatureServe 2007) currently recognizes twenty-eight non-alluvial wetland communities as likely occurring in the North Carolina mountains, and the North Carolina Natural Heritage program recognizes eighteen such communities (Schafale 2002; see Appendix 1 for lists of previously recognized community types). However, these classifications were primarily based on qualitative data with little or no quantitative data supporting their descriptions. In most cases little information has been available as to how to recognize these communities, where they fit in the landscape, and how they relate to each other.

This report documents the composition and structure of the montane non-alluvial wetlands found within 127 vegetation plots sampled within the Blue Ridge Physiognomic

Province. The goals of this project were to validate, characterize, and as necessary refine the vegetation types of montane non-alluvial wetlands of the Blue Ridge Province, and to use the results to develop proposals for formal revision or elaboration of the vegetation types recognized in the U.S. National Vegetation Classification (NVC) and North Carolina Natural Heritage Program's (NHP) classification (Schafale 2002). More specifically, the primary focus of this project was to characterize the range of 'bog' vegetation and capture the variability of vegetation found within these community types located throughout the Blue Ridge Physiographic Province. It is our intent and expectation that this classification and description of vegetation will provide improved targets for wetland management and restoration activities.

II. Field data

New plot data.

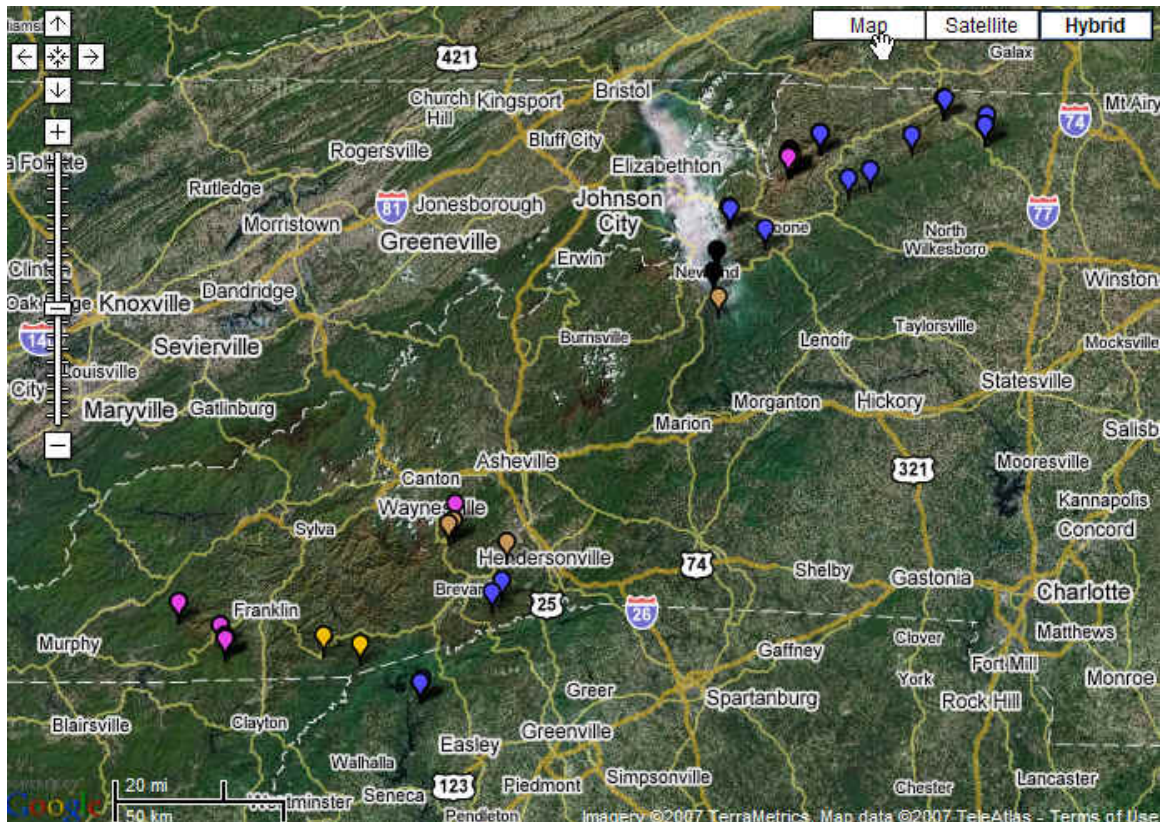


Figure 1. Locations of the 64 new plots established in 2006. To use the interactive features of this map visit:

http://vegbank.org/vegbank/views/map_userplots.jsp?latlongfile=http://cvs.bio.unc.edu/maps/74-points.csv

In the summer of 2006 we established 64 vegetation plots at a total of 40 sites located across the Blue Ridge Physiognomic Province (Figure 1). Collection sites span 15 counties in North Carolina, plus Pickens County, South Carolina (Table 1).

Vegetation was sampled following the North Carolina Vegetation Survey (CVS) Protocol described in Peet *et al* 1998. Plots sampled were 10 x 10m in size, each with 4 nested quadrats. Plots were positioned to capture homogenous examples of representative vegetation found within each wetland. Sample sites were stratified by geographic location within the Province. Soil samples were collected at each site and analyzed for texture and nutrients.

State-County	Number of Plots
NC-Alleghany	7
NC-Ashe	6
NC-Avery	4
NC-Burke	2
NC-Clay	2
NC-Henderson	3
NC-Jackson	7
NC-Macon	4
NC-Transylvania	6
NC-Watauga	19
SC-Pickens	4
Total	64

Table 1. Locations and number of vegetation plots used in the analysis

Carolina Vegetation Survey data.

To provide a more comprehensive understanding of the variation in vegetation composition found throughout the Blue Ridge Physiognomic Province, field data collected by the Carolina Vegetation Survey during 1993-2000 were merged with data collected specifically for this project during summer 2006. CVS plots sometimes contained multiple 10x10 m modules, but otherwise were similar to the plots collected in 2006. Multiple modules were averaged and treated as a single module. The CVS plots used were distributed across montane North Carolina, with a few additional plots collected in Tennessee and South Carolina.

III. Analytical Methods

Data were analyzed using PC-ORD (Version 5), following guidance provided by McCune and Grace 2002) Group selection was based on hierarchical cluster analysis using the Sorenson metric to calculate a dissimilarity matrix and the flexible beta ($\beta = 0.25$) technique for group linkage. Non-metric multidimensional scaling (NMS) ordination and Indicator Species Analysis (ISA) were used to help differentiate and describe identified by the cluster analysis. All ordinations were based on the Sorenson distance metric.

Twelve groups were selected to represent the variation in vegetation types recognized in this report. While a different number of groups could have been selected, the twelve groups recognized were considered to possess equivalent degrees of compositional distinctiveness. Appendix 2 presents the dendrogram produced in cluster analysis using flexible beta ($\beta = -0.25$) for group linkage.

IV. Results

Cluster analysis revealed twelve groups with similar compositional distinctiveness. Those groups are presented in this report. A characterization and description of each vegetation group is presented below in a fashion conforming to the Ecological Society of American guidelines for associations and alliances in the National Vegetation Classification (Jennings et al. 2006). Vegetation type names are based upon the naming system used in the U.S. National Vegetation Classification (NatureServe 2007). Names reflect species with high constancy and high cover; a “-” separates species within the same vertical stratum, whereas a “/” separates species of different strata. Each of the 12 community types here recognized is compared with currently recognized community concepts from NVC and the N.C. Natural Heritage classification (Appendix 2).

A floristic summary table is presented for each group in the appendices of this document. These tables include the prevalent species found in each group, ranked by constancy and average cover class values within the group (prevalent species are defined as the most constant species in the type, with the number matching the mean species number per 100 m² plot in the type). Average cover class was calculated taking the geometric mean of the true cover range for each cover class, averaging them, and then converting back to the cover class. Constancy, which is the percent of plots within a group in which a given species is present, is reported. Homogeneity, mean constancy of the most prevalent species within a group, is also calculated for each group to indicate the degree of compositional variability among plots belonging to a described community type. A summary of soil data by vegetation type is presented in Appendix 3.

Currently, twenty-eight non-alluvial wetland community types recognized by the NVC are thought to occur or do occur in North Carolina or nearby in adjacent states (Appendix 1). For North Carolina alone, Schafale (2002) recognizes eighteen non-alluvial wetland community types (Appendix 1). The following section will discuss the currently recognized community concepts and how they relate to quantitative plot data collected by CVS between 1993 and 2000 and by Wichmann and Boyer in 2006.

To add in organization and understanding, these types have been sub-divided into three ecological groups: 1) Forested Bogs, 2) Shrub and Herbaceous Bogs and 3) Seeps. Within the Shrub and Herbaceous Bogs, two sub-categories are recognized: 2a) Mafic and 2b) Granitic Blanket Bog.

Forested Bogs

Currently five community types recognized in the NVC and two types recognized by Schafale (2002) fall within Forested Bogs. Two groups recognized in this analysis

can be described as forested bogs. However, more analysis will likely lead to the recognition of more types in this ecological group.

Bog Forest (G1): *Acer rubrum* / *Kalmia latifolia* / *Carex folliculata*, *Sphagnum* spp.
Swamp Forest Bog (Appendix 5).

The open or closed canopy of this vegetation type is dominated by *Acer rubrum*, and *Pinus strobus* or *Pinus rigida* may co-dominate. The patchy shrub stratum is primarily composed of *Kalmia latifolia* and may include *Rhododendron maximum*, *Viburnum cassinoides*, *Amelanchier* sp., *Ilex verticillata*, *Leucothoe fontanesiana*, and/or *Lyonia ligustrina*. The herbaceous stratum usually occurs in dense patches with *Sphagnum* species and sedges dominating. *Carex folliculata* is common. Other characteristic herbs include *Symplocarpus foetidus*, *Dalibarda repens*, *Hydrocotyle americana*, and *Helonias bullata*. Ferns such as *Osmunda cinnamomea* and *Thelypteris noveboracensis* are common. This vegetation type is found primarily at lower elevations (<1,000ft). This vegetation type is distinguished from the Swamp Forest Bog type (G2) primarily by the dense herb stratum and lack of mucky patches.

The Bog Forest type (G1) accounts for a large number of plots (14), exhibiting various structure and stratum densities. It is likely that this group will be split into at least 2 types upon further analysis. The vegetation type described here fits within Schafale's (2002) concept, Swamp Forest-Bog Complex (Typic Subtype), which is much broader than the type defined here. Two vegetation types recognized in the NVC fit within the concept described here. The first NVC type, *Tsuga canadensis* – *Acer rubrum* – (*Liriodendron tulipifera*, *Nyssa sylvatica*) / *Rhododendron maximum* / *Sphagnum* spp. Forest (CEGL007565) fits well within the concept we've described here with some minor differences in characteristic species. The second NVC type, *Pinus rigida* / *Toxicodendron vernix* / *Gaylussacia baccata* / *Symplocarpus foetidus* Woodland (CEGL003667) corresponds with the plots with an abundant presence of *Symplocarpus foetidus*.

Swamp Forest (G2): *Acer rubrum* – *Pinus strobus* / *Kalmia latifolia* – *Viburnum cassinoides* – *Rhododendron maximum*.) / *Thelypteris noveboracensis* – *Sphagnum* spp.
Forested Bog (Appendix 6).

The canopy of this community type is generally closed and dominated by *Acer rubrum* and *Pinus strobus*. *Tsuga canadensis* and *Magnolia fraseri* may also contribute to canopy cover. The shrub layer typically occurs in scattered patches of *Kalmia latifolia*, *Viburnum cassinoides*, and *Rhododendron maximum*. The herb stratum is composed of a mosaic of forest herbs and wetland herbs. Typical forest herbs indicative of this type include *Medeola virginica*, *Mitchella repens*, and *Hexastylis* spp. The vine *Smilax rotundifolia* is a significant and annoying component of this vegetation type. Ferns such as *Thelypteris noveboracensis* and *Osmunda cinnamomea* are common. Sedges such as *Carex folliculata* and *C. intumescens* occur but typically do not dominate. This vegetation type is found primarily at lower elevations (<1,000ft). This vegetation type is distinguished from the Bog Forest type primarily due to patchy nature of the herb

stratum and the abundance of forest-type herbs typically dispersed throughout the community.

Swamp Forest (G2) here accounts for a large number of plots, many of which were collected by CVS prior to 2006. Further analysis of plots collected by CVS may lead to refinement and or splitting of this concept. This vegetation type fits within Schafale's (2002) Swamp Forest-Bog Complex (Typic Subtype), which is broader than the type described here. One NVC community types is somewhat similar to the vegetation type described here: *Tsuga canadensis* – *Acer rubrum* – (*Liriodendron tulipifera*, *Nyssa sylvatica*) / *Rhododendron maximum* / *Sphagnum* spp. Forest (CEGL007565).

Additional candidate types: Three additional Forest Bog vegetation types recognized by NCV and one type recognized by Schafale (2002) currently do not fit within the two community concepts described above. Upon further sampling and analysis these vegetation types may be become recognized. Each vegetation type recognized and not currently within the types described above is described below. An indication of their presence in North Carolina is given.

Pinus strobus - *Acer rubrum* / *Spiraea alba* var. *latifolia* / *Sanguisorba canadensis* Woodland (CEGL004994).

This community type was not encountered during 2006. It is currently known only from "The Glades," in Grayson County, Virginia (NatureServe 2007). It is unlikely that examples of this type will be found in North Carolina. However, plots sharing some attributes of this community do occur suggesting that perhaps the concept needs to be broadened.

Liquidambar styraciflua - *Acer rubrum* / *Carex* spp. - *Sphagnum* spp. Forest (CEGL007338)

This community type is known from Cades Cove in Great Smoky Mountains National Park (NatureServe 2007). This is a relatively low-elevation type where soils are conspicuously more fertile than in most North Carolina types. Plots sharing attributes with this community type were recognized in sites sampled during 2006. It is possible that at least one site sampled from Buck Forest in Transylvania County, NC should be classified here. Generally, vegetation fitting this community type was not observed in 2006.

Picea rubens - (*Tsuga canadensis*) / *Rhododendron maximum* Saturated Forest (CEGL006277)

This community type can be found in the Valley of Long Hope Creek in Ashe County, North Carolina. At least two plots sampled in 2006 fit well within the description of this community type. These plots are currently placed within Group 3 (see

below), but may be split out upon further analysis of Group 2. Some plots collected by CVS prior to 2006 may also fit within this concept.

Swamp Forest-Bog Complex (Spuce Subtype); Schafale (2002)

This community type contains examples of boggy vegetation having *Picea rubens* as a major canopy dominant (Shafale 2002) and is largely synonymous with C EGL006277 described above. This vegetation type is found in the Valley of Long Hope Creek but was not sampled in 2006. It is possible that this vegetation was sampled prior to 2006 by CVS and that further analysis will reveal such.

Shrub and Herbaceous Bogs

High Elevation Herbaceous Bog (G3): *Rosa palustris* / *Carex echinata* – *Carex leptalea* – *Vaccinium macrocarpon* – *Eriophorum virginicum* – *Solidago patula* / *Sphagnum* species High Elevation Herb Bog (Appendix 7).

This vegetation type describes herb-dominated *Sphagnum* bogs found at high elevations in the Valley of Long Hope Creek in Watauga County, North Carolina. The tree and shrub strata are lacking, though *Rosa palustris* is always present as a small shrub, never getting above 1 meter in height. The herbaceous layer is thick with characteristic herbs including *Carex echinata*, *Carex leptalea*, *Packera aurea*, *Rhynchosproa alba*, *Solidago patula* var. *patula*, *Drosera rotundifolia*, *Parnassia asarifolia*, and *Houstonia serpitifolia*. Other common herbs include, *Rhynchospora capitellata*, *Juncus effuses*, and *Oxypolis rigidior*. The *Sphagnum* layer is thick and usually contains more than one species.

This vegetation type concept fits within the NVC concept *Carex atlantica* - *Rhynchospora alba* - *Parnassia asarifolia* / *Sphagnum warnstorffii* Herbaceous Vegetation (CEGL004157). Shafale's (2002) Southern Appalachian Bog (Long Hope Valley Herb Subtype) also fits the concept described here. This community type is extremely rare and apparently confined to Long Hope Valley.

Low Elevaton Herbaceous Bog (G4): *Spiraea tomentosa* - *Vernonia noveboracensis* – *Scirpus expansus* – *Juncus* spp. Bog (Appendix 8).

This vegetation type corresponds to those bogs which occur in the valleys of rolling hills characteristic of the lower elevations of Ashe and Alleghany Counties, North Carolina. This community type is dominated by herbaceous species and lacks a canopy and a shrub component. The shrub *Spiraea tomentosa* is typically present but is never dense and never more than 1.5 meters tall. Occasionally, *Alnus serrulata* may be present in small clumps. Dominant herb species include *Rubus hispidus*, *Scirpus expansus*, *Juncus* spp., *Vernonia noveboracensis*, *Hypericum canadense*, and *Oxypolis ridigior*. The fern *Osmunda cinnamomea* may be present. The sedge *Carex atlantica* is usually abundant while *Carex echinata* and *Carex leptalea* are present but never abundant as they often are in Southern Appalachian Bogs. The characteristic Southern Appalachian bog

species *Solidago patula* var. *patula*, *Eriophorum virginicum*, *Rhyncospora capitellata* are sometimes present.

This vegetation type here fits within the broadly defined NVC concept of *Carex* (*atlantica*, *echinata*, *leptalea*, *lurida*) - *Solidago patula* Herbaceous Vegetation (CEGL004156). The NVC type *Carex atlantica* - *Solidago patula* var. *patula* - *Lilium grayi* / *Sphagnum bartlettianum* Herbaceous Vegetation (CEGL004158) is closely related to and perhaps overlaps the type recognized here. It is likely that further analysis will lead to splitting the concept recognized here to better match these two previously recognized NVC types. Schafale (2002) does not contain a good match for this vegetation type, though two of his community concepts (subtypes) show elements of the vegetation type recognized here. The first, Southern Appalachian Bog (Low Elevation Subtype) differs primarily in that Schafale's concept recognizes a shrub stratum that is largely absent from the type recognized here. The second, Southern Appalachian Bog (Typic Herb Subtype), differs in that Schafale's concept allows for northern plant species to be present which are typically not found within the concept recognized here. Schafale's concepts are still in draft form and it is likely that one of his concepts will ultimately match the type recognized here.

Mafic Fen (G5): *Cladium mariscoides* – *Solidago uliginosa* – *Triantha glutinosa* - *Sanquisorba canadensis* Mafic Fen (Appendix 9).

This community type is dominated by graminoid species. *Sphagnum* spp. are present beneath the herbaceous stratum, but do not form thick mats. Dominant species include *Cladium mariscoides*, *Solidago uliginosa*, *Parnassia grandifolia*, *Triantha glutinosa*, *Carex atlantica*, *Carex leptalea*, *Rhyncospora capitellata*. Ferns such as *Osmunda regalis* var. *spectabilis* and *Osmunda cinnamomea* may be abundant in some areas and occasional woody shrubs such as *Alnus serrulata* and *Kalmia latifolia*, may occur as small clumps or around the margins of this community. This type is currently known only from Bluff Mountain in Ashe County, North Carolina.

This community type fits very well within the NVC type *Cladium mariscoides* - *Sanguisorba canadensis* / *Sphagnum subsecundum* Herbaceous Vegetation as well as Schafale's Southern Appalachian Fen (Bluff Mountain Subtype).

Granitic Blanket Bog (G6) *Acer rubrum* - *Pinus virginiana* / *Danthonia epilis* - *Rhyncospora grandiflora* Blanket Bog (Appendix 10).

The granitic blanket bog is an unusual community type restricted to Poe Creek State Forest in Pickens County, South Carolina where it occurs on slightly convex granite outcrops. The community generally has an open canopy but woody encroachment from surrounding forests is common. *Acer rubrum* and *Pinus virginiana* dominate on the edges. The shrub layer is largely lacking but may contain *Vaccinium* species. The herb layer is dominated by a thick layer of *Sphagnum* spp. and a diversity of herbaceous species reminiscent of Coastal Plain communities such as *Danthonia epilis*, *Rhyncospora grandiflora*, and *Sarracenia jonesii*. This community type does not fit any of the community types described for the NVC or by Schafale (2002).

Mosaic Bog (G7): *Viburnum cassinoides* – *Kalmia latifolia* – *Lyonia ligustrina* / *Osmunda cinnamomea* - *Carex echinata* – *Solidago patula* Mosaic Bog (Appendix 11).

The mosaic bog is characterized by shrubs that may dominate or occur in patchy zones interspersed within a dense herbaceous stratum. Typical dominant shrubs include *Viburnum cassinoides*, *Kalmia latifolia*, *Lyonia ligustrina*, and *Rhododendron maximum*. *Ilex verticillata* or *Ilex collina* may occasionally dominate. Typical herbs include *Carex echinata*, *Solidago patula*, *Symphytotricum* species, and *Houstonia serpyllifolia*. The fern *Osmunda cinnamomea* often dominates in large clumps. The bryophyte layer of *Sphagnum* species is abundant and thick.

Beaver Influenced Bog (G8) *Lyonia ligustrina* / *Salix sericea* – *Galium* spp. – *Persicaria sagittata* / *Sphagnum* spp. Bog (Appendix 12).

This vegetation group accounts for vegetation that has an abundance of ruderal species and low diversity, suggesting past disturbance. The vegetation structure may be dense with shrubs or very open and herbaceous. Dominant shrubs include *Lyonia ligustrina* and *Salix sericea*. Typical herb species include *Persicaria sagittata*, *Epilobium coloratum*, *Galium* spp, *Carex echinata*, *Carex leptalea*, and *Gratiola viscidula*. *Carex* spp. (Section Ovales) are common and separate this group from other sedge-dominated vegetation types also containing *Carex echinata* and *Carex leptalea*. This group accounts for a large number of plots and it is likely that further analysis will split this concept primarily based on structure.

Additional candidate types:

Nine additional vegetation concepts recognized within the current NCV do not fit within the community types described above. Our current understanding of their presence in North Carolina is explained below. Further analysis may lead us to recognize some of these types.

Rhododendron maximum / *Sphagnum* spp. Shrubland (CEGL003849).

This community type has not been sampled in North Carolina but it is present in Pineola Bog. This community type is scheduled to be sampled in 2007. The type applies to thickets of *Rhododendron maximum* that occur in saturated conditions with patches of *Sphagnum* species.

Rhododendron (maximum, catawbiense) - *Ilex collina* - *Salix sericea* / *Carex trisperma* - *Eriophorum virginicum* Shrubland (CEGL003913).

This community type applies to non-alluvial wetland vegetation found at high elevations that typically occur as a mosaic of shrub and herbaceous dominated vegetation (NatureServe 2007). Affinities with this community type were recognized in sites sampled during 2006. This community type definitely occurs within the Valley of Long

Hope Creek and possibly in plots already sampled there. It is also possible that vegetation found in the Amphibolite Mountains group (G7) will be grouped here after further analysis.

Alnus serrulata - Rhododendron arborescens / Sarracenia oreophila - Rhynchospora rariflora Shrubland (CEGL003914)

This community type is known only from Towns County, Georgia and Clay County, North Carolina. It has not been sampled by CVS. However, the site from North Carolina is scheduled to be sampled with additional field work in effort to characterize this community type and assess its distinctiveness.

Alnus serrulata - Kalmia carolina - Rhododendron catawbiense - Spiraea alba / Carex folliculata - Lilium grayi Shrubland (CEGL003915)

This type seems to correspond to a broadly defined and poorly understood community concept. Examples of this vegetation type show up in several sample sites. However, it is not clear at this point that any site fits well within this concept. This type is essentially a placeholder for vegetation that does not otherwise fit in the classification and should probably will be proposed for elimination after the other types are better described and revised to more fully represent the range of variation.

Alnus serrulata - Rhododendron viscosum - Rhododendron maximum / Juncus gymnocarpus - Chelone cuthbertii Shrubland (CEGL003916)

This type defined seems to be broad, poorly defined, and needing revision. Although plots assignable to this vegetation type occurred at several sample sites, it is not clear at this point that any site fits well enough to justify the recognition of the type.

Alnus serrulata - Viburnum nudum var. nudum - Chamaedaphne calyculata / Woodwardia areolata - Sarracenia rubra ssp. jonesii Shrubland (CEGL003918).

This type is known from the broad basin of the French Broad River. Further field work is needed to evaluate and characterize this vegetation type.

Sparganium americanum - Epilobium leptophyllum Herbaceous Vegetation (CEGL004510).

At least two plots sampled during 2006 seem to fit within this type but are currently grouped within the Beaver Influenced Bog group (G4). It is likely that further analysis will separate these samples and relate them to the established NVC concept. This vegetation type is commonly found as a component of non-alluvial wetland associated with recent beaver activity.

Juncus effusus - *Chelone glabra* - *Scirpus* spp. Southern Blue Ridge Beaver Pond Herbaceous Vegetation (CEGL008433)

This concept is not currently well defined by the NVC, but based on the name it seems that some plots sampled during 2006 fit within this concept. These plots are currently grouped with the Beaver Influenced Bog concept (G4). Further analysis will likely result in recognition of this type.

Carex leptalea - *Parnassia grandifolia* - *Rhynchospora alba* Herbaceous Vegetation (CEGL004997).

This community type is thought to potentially occur on Bluff Mountain in North Carolina. It describes calcareous seepages associated with stream or spring heads and often is located in open areas of gravel and muck (NatureServe 2007). No vegetation occurrences that fit well within this concept were locatable in 2006 and no vegetation previously sampled by CVS readily fits within the defined range of variation of this type. However, it would not be surprising if vegetation attributable to this type was located in North Carolina in the amphibolite mountains of Ashe and Watauga Counties, especially on Bluff Mountain or within the Valley of Long Hope Creek.

Seeps

Currently four community types recognized in the NVC and two types recognized by Schafale (2002) can be considered Seeps.

High-elevation Seepage Wetland (G9): *Acer rubrum* - *Betula alleghaniensis* / *Aesculus flava* / *Thalictrum* sp.- (*Rudbeckia laciniata* - *Trautvetteria caroliniensis*) High-elevation Seepage Wetland (Appendix 13).

This vegetation type applies to seepage-slope wetlands typically dominated by forbs (NatureServe2007). These wetlands occur at elevations above 1200m in the Southern Blue Ridge Province. Dominant species include *Rudbeckia laciniata*, *Thalictrum* species, *Impatiens* spp., and *Monarda didyma*. Other characteristic species include *Veratrum viride*, *Chelone* species, *Solidago curtisii*, *Trautvetteria caroliniensis*, *Ageritina altissima*, *Eurybia chlorolepis*, *Carex pennsylvanica*, *Laportia canadensis* and *Packera aurea*. *Sphagnum* species may or may not be present and are never extensive. This vegetation type is often associated with northern hardwood forests (NatureServe 2007).

The vegetation type recognized here fits well within the NVC type *Impatiens (capensis, pallida)* - *Monarda didyma* - *Rudbeckia laciniata* var. *humilis* Herbaceous Vegetation (CEGL004293). It also fits within the Schafale (2002) concept of Rich Montane Seep (High Elevation Subtype).

Sedge Seep (G10): *Rhododendron maximum* – (*Viburnum cassinoides* – *Lyonia ligustrina*) / *Carex ruthii* - *Carex gynandra* - *Carex debilis* var. *rudgei* - *Oclemena acuminata* - *Platanthera clavallata* Seepage Bog (Appendix 14).

The vegetation type defined here recognizes only a small number of sample sites (5) and is difficult to distinguish from the seepage vegetation described in the next group (G11). Further work is needed to determine the significance of this group.

The concept described here can be fit into the NVC concept *Carex gynandra*-*Platanthera clavallata*-*Drosera rotundifolia*-*Carex ruthii*-*Carex atlantica*/*Sphagnum* spp. Herbaceous Vegetation (CEGL007697). This concept fits within Schafale's High Elevation Boggy Seep community.

Boggy Seep (G11): *Betula alleghaniensis* - (*Picea rubens*, *Abies fraserii*) / *Sorbus americana* - *Rhododendron maximum* / *Oclemena acuminata* - *Oxalis montana*, *Dryopteris campyloptera* - *Dennstaedtia punctilobula*, *Sphagnum* spp. (Appendix 15).

This community type defines herb-dominated seepage slopes found within North Carolina. These seeps are open but trees and shrub are often present on the margins and contribute to cover (NatureServe 2007). Typical trees found on the edges include *Betula alleghaniensis* and *Picea rubens*. Typical shrubs include *Sorbus americana* and *Rhododendron maximum*. The dominant herbaceous stratum includes *Oclemna acuminata*, *Arisaema triphyllum*, *Oxalis montana*, *Glyceria melicaria*, *Dryopteris campyloptera*, *Carex aestivalis*, and *Dennstaedtia punctilobula*. *Sphagnum* species are typically present.

The type described here can be fit within the NVC type *Carex gynandra*-*Platanthera clavallata*-*Drosera rotundifolia*-*Carex ruthii*-*Carex atlantica*/*Sphagnum* spp. Herbaceous Vegetation (CEGL007697) and Schafale's High Elevation Boggy Seep concept.

Rich Montane Seep (G12): *Diphyleia cymosa* - *Saxifraga micranthidifolia* - *Laportia canadensis* Herbaceous Vegetation (Appendix 16).

This vegetation type represents herb-dominated seepages embedded in a forest matrix and lacking *Spagnum* ssp. The herbaceous layer is thick and typically dominated by *Diphyleia cymosa*, *Saxifraga micranthidifolia*, *Laportia canadensis*. Other characteristic species include *Mondarda didyma*, *Cryptotaenia canadensis*, *Impatiense* species, *Carex brunnescens* var. *sphaerotachya*, and *Carex plataginea*. This vegetation type occurs at moderate to high elevations (Shafale 2002).

This concept fits well within the already established *Diphylleia cymosa*-*Saxifraga micranthidifolia*-*Laportea canadensis* Herbaceous Vegetation (CEGL004296) of the NVC and Schafale's (2002) Rich Montane Seep (Cove Subtype).

V. Conclusions and future work

The community characterization presented above is based upon data collected within the Blue Ridge Physiognomic Province. Twelve community types are clearly justifiable, and several more are likely to be recognized after more plot data are obtained. Further data is needed to determine to what extent environmental variables such as elevation and latitude affect floristic compositions. In the summer of 2007, plot data will be collected from sites within the Blue Ridge Province not sampled during 2006. These data will help to determine the appropriate revisions to both U.S. National Vegetation Classification and the N.C. Natural Heritage Program's classification (Schafale 2002).

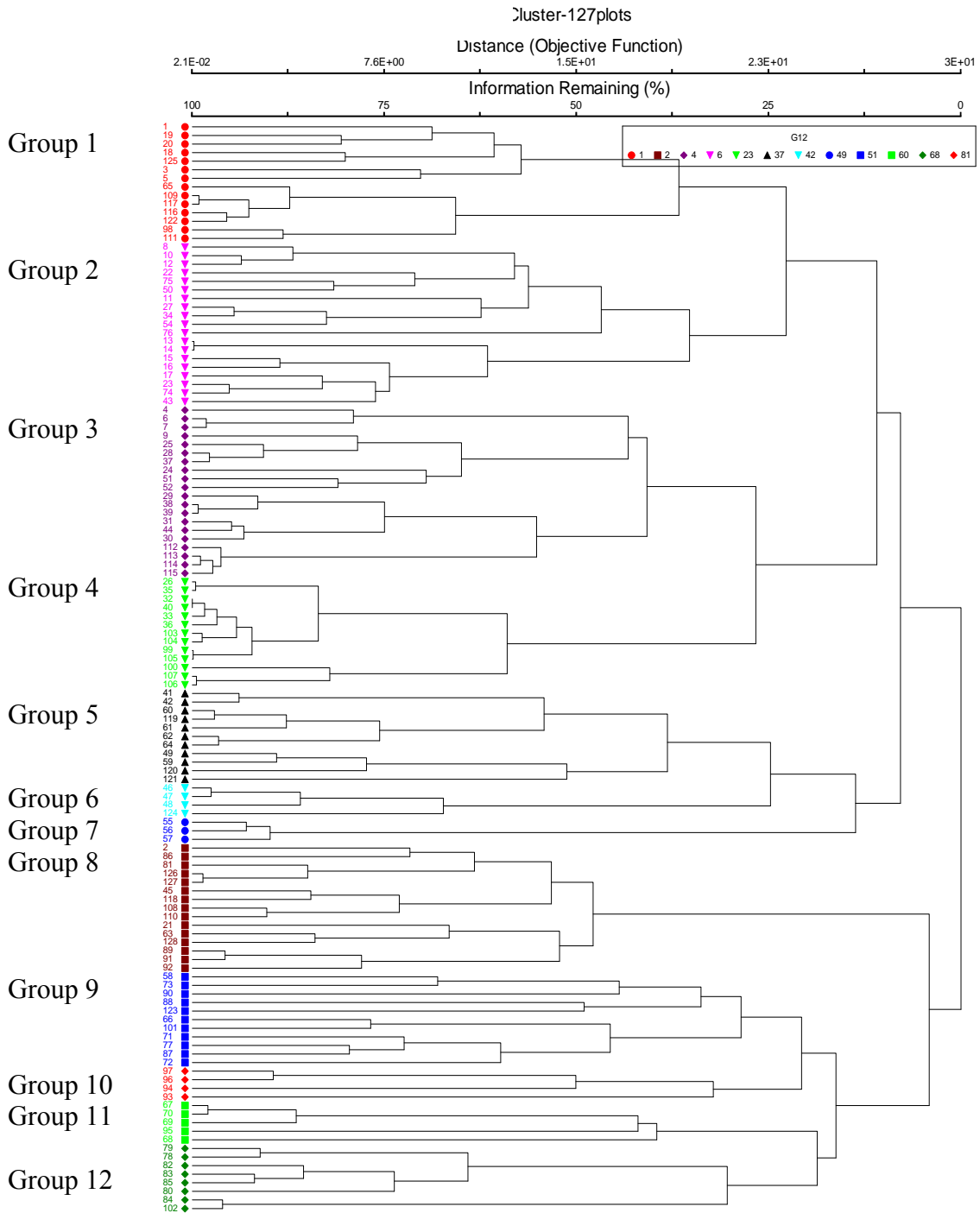
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Appendix 1: Montane non-alluvial Vegetation types currently recognized U.S. National Vegetation Classification and the North Carolina Natural Heritage Program (Schafale 2002). NVC-recognized communities are presented with their NVC unique identification numbers (CEGL codes).

NVC name (NatureServe 2007)	CEGL	Schafale Name (2002)
<i>Pinus rigida</i> / <i>Toxicodendron vernix</i> / <i>Gaylussacia baccata</i> / <i>Symplocarpus foetidus</i> Woodland	3667	Southern Appalachian Bog (Skunk Cabbage Subtype)
<i>Rhododendron maximum</i> / <i>Sphagnum</i> spp. Shrubland	3849	Southern Apalachian Bog (Rhododendron Subtype)
<i>Alnus serrulata</i> - <i>Lindera benzoin</i> / <i>Sphagnum</i> spp. Shrubland	3909	
<i>Rhododendron</i> (maximum, catawbiense) - <i>Ilex collina</i> - <i>Salix sericea</i> / <i>Carex trisperma</i> - <i>Eriophorum virginicum</i> Shrubland	3913	Southern Appalachian Bog (Long Hope Valley Shrub Subtype)
<i>Alnus serrulata</i> - <i>Rhododendron arborescens</i> / <i>Sarracenia oreophila</i> - <i>Rhynchospora rariflora</i> Shrubland	3914	Low Mountain Seepage Bog
<i>Alnus serrulata</i> - <i>Kalmia carolina</i> - <i>Rhododendron catawbiense</i> - <i>Spiraea alba</i> / <i>Carex folliculata</i> - <i>Lilium grayi</i> Shrubland	3915	Southern Appalachian Bog (Typic Shrub Subtype)
<i>Alnus serrulata</i> - <i>Rhododendron viscosum</i> - <i>Rhododendron maximum</i> / <i>Juncus gymnocarpus</i> - <i>Chelone cuthbertii</i> Shrubland	3916	Southern Appalachian Bog (Low Elevation Subtype)
<i>Alnus serrulata</i> / <i>Sanguisorba canadensis</i> / <i>Parnassia grandifolia</i> - <i>Helenium brevifolium</i> Shrubland	3917	Southern Appalachian Fen (Glades Subtype)
<i>Alnus serrulata</i> - <i>Viburnum nudum</i> var. <i>nudum</i> - <i>Chamaedaphne calyculata</i> / <i>Woodwardia areolata</i> - <i>Sarracenia rubra</i> ssp. <i>jonesii</i> Shrubland	3918	
<i>Carex</i> (<i>atlantica</i> , <i>echinata</i> , <i>leptalea</i> , <i>lurida</i>) - <i>Solidago patula</i> Herbaceous Vegetation	4156	
<i>Carex atlantica</i> - <i>Rhynchospora alba</i> - <i>Parnassia asarifolia</i> / <i>Sphagnum warnstorffii</i> Herbaceous Vegetation	4157	Southern Appalachian Bog (Long Hope Valley Herb Subtype)
<i>Carex atlantica</i> - <i>Solidago patula</i> var. <i>patula</i> - <i>Lilium grayi</i> / <i>Sphagnum bartlettianum</i> Herbaceous Vegetation	4158	
<i>Cladium mariscoides</i> - <i>Sanguisorba canadensis</i> / <i>Sphagnum subsecundum</i> Herbaceous Vegetation	4167	Southern Appalachian Fen (Bluff Mountain Subtype)
<i>Impatiens</i> (<i>capensis</i> , <i>pallida</i>) - <i>Monarda didyma</i> - <i>Rudbeckia laciniata</i> var. <i>humilis</i> Herbaceous Vegetation	4293	Southern Appalachian Bog (Typic Herb Subtype)
<i>Diphylleia cymosa</i> - <i>Saxifraga micranthidifolia</i> - <i>Laportea canadensis</i> Herbaceous Vegetation	4296	French Broad Valley Bog
<i>Acer rubrum</i> var. <i>trilobum</i> - <i>Fraxinus pennsylvanica</i> / <i>Carex crinita</i> - <i>Peltandra virginica</i> Forest	4420	
<i>Sparganium americanum</i> - <i>Epilobium leptophyllum</i> Herbaceous Vegetation	4510	
<i>Pinus strobus</i> - <i>Acer rubrum</i> / <i>Spiraea alba</i> var. <i>latifolia</i> / <i>Sanguisorba canadensis</i> Woodland	4994	
<i>Carex leptalea</i> - <i>Parnassia grandifolia</i> - <i>Rhynchospora alba</i> Herbaceous Vegetation	4997	
<i>Picea rubens</i> - (<i>Tsuga canadensis</i>) / <i>Rhododendron maximum</i> Saturated Forest	6277	
<i>Liquidambar styraciflua</i> - <i>Acer rubrum</i> / <i>Carex</i> spp. - <i>Sphagnum</i> spp. Forest	7338	
<i>Tsuga canadensis</i> - <i>Acer rubrum</i> - (<i>Liriodendron tulipifera</i> , <i>Nyssa sylvatica</i>) / <i>Rhododendron maximum</i> / <i>Sphagnum</i> spp. Forest	7565	Swamp Forest-Bog Complex (Typic Subtype)
<i>Carex gynandra</i> - <i>Platanthera clavellata</i> - <i>Drosera rotundifolia</i> - <i>Carex ruthii</i> - <i>Carex atlantica</i> / <i>Sphagnum</i> spp. Herbaceous Vegetation	7697	
<i>Carex gynandra</i> - <i>Scirpus cyperinus</i> - <i>Eriophorum virgincum</i> - <i>Osmunda cinnamomea</i> Herbaceous Vegetation	7771	
<i>Juncus effusus</i> - <i>Chelone glabra</i> - <i>Scirpus</i> spp. Southern Blue Ridge Beaver Pond Herbaceous Vegetation	8433	Swamp Forest-Bog Complex (Spruce Subtype)
<i>Glyceria striata</i> - <i>Carex gynandra</i> - <i>Chelone glabra</i> - <i>Symphyotrichum puniceum</i> / <i>Sphagnum</i> spp. Herbaceous Vegetation	8438	

Appendix 2: Classification of montane non-alluvial vegetation types. Dendrogram produced in cluster analysis using flexible beta ($\beta = -0.25$) for group linkage.



Appendix 3. Vegetation types presented in this report are compared with currently recognized types in the National Vegetation Classification and Natural Heritage Program Third Approximation (Schafale 2002). Types are matched at three levels: “<” indicates a concept is narrower than a currently defined concept, “=” indicates two concepts are approximately equal, and “>” indicates a concept is broader than a currently defined type. Certainty is ranked on a scale of three with 1 being least certain and 3 being most certain. Group numbers follow those presented in the text of the document.

Appendix 4: Average soil nutrient and textural components by vegetation group. Group numbering follows those presented in the text of this document. Soil variables presented include: pH, percent base saturation (BS), total cation exchange capacity (TEC), organic matter (OM), ppm of various macro- and micronutrients, and percent clay, silt and sand.

Group	pH	BS	TEC	OM	N	P	Ca	Mg	K	Na	Fe	Mn	Cu	Zn	Al	Clay	Silt	Sand
1	4.58	39.80	5.50	26.45	64.56	20.06	263.33	88.18	51.58	19.03	239.84	5.28	0.88	2.38	942.56	4.85	21.15	74.01
2	4.49	37.85	5.24	28.32	65.35	21.67	230.41	82.67	54.22	18.64	258.57	5.68	0.88	2.34	876.89	5.40	20.41	74.18
3	4.52	38.35	5.80	28.87	65.66	22.62	268.12	92.83	53.87	18.86	259.40	6.50	0.96	2.39	855.50	5.40	20.41	74.18
4	4.43	36.51	5.94	25.13	64.29	17.66	290.21	84.36	53.44	17.31	257.04	5.88	0.90	2.30	978.55	5.56	22.65	71.80
5	4.26	32.85	4.82	28.59	65.75	20.47	195.26	63.43	54.30	16.98	237.23	4.08	0.60	2.20	1073.89	5.77	19.37	74.86
6	4.43	36.39	5.45	27.73	65.26	20.60	246.00	80.82	53.96	17.95	253.06	5.53	0.84	2.31	946.21	5.53	20.71	73.75
7	4.37	35.25	5.40	27.15	65.10	19.58	243.82	76.21	53.90	17.41	249.11	5.17	0.78	2.27	999.55	5.62	20.91	73.47
8	4.36	34.79	4.73	26.23	64.12	20.11	201.90	64.08	50.57	16.83	241.67	4.58	0.63	2.17	1010.08	5.38	17.99	76.62
9	4.43	36.48	5.36	27.31	65.01	20.35	242.38	79.07	53.23	17.87	249.49	5.34	0.81	2.29	960.40	5.44	20.45	74.11
10	4.40	35.73	5.24	27.11	64.87	20.16	233.52	75.05	52.91	17.52	248.33	5.15	0.76	2.26	979.06	5.49	20.02	74.49
11	4.40	35.73	5.24	27.11	64.87	20.16	233.52	75.05	52.91	17.52	248.33	5.15	0.76	2.26	979.06	5.49	20.02	74.49
12	4.40	35.79	5.33	27.25	64.99	20.19	239.41	76.77	53.23	17.58	249.30	5.27	0.78	2.27	975.81	5.52	20.28	74.20

Appendix 5: Floristic table for group 1, *Acer rubrum* / *Kalmia latifolia* / *Carex folliculata*, *Sphagnum* ssp. Bog Forest.

number of plots:	14		
average richness:	41		
homotoneity:	54		
Number	Species Name	Constancy	Average Cover Class
1	<i>Sphagnum</i> spp.	100	8
2	<i>Acer rubrum</i>	100	7
3	<i>Galium</i> spp.	100	2
4	<i>Carex folliculata</i>	86	5
5	<i>Pinus strobus</i>	86	5
6	<i>Impatiens</i> spp.	86	3
7	<i>Alnus serrulata</i>	71	6
8	<i>Rhubus hispidus</i>	71	5
9	<i>Nyssa sylvatica</i>	71	4
10	<i>Viola macloskei</i> var. <i>pallens</i>	64	3
11	<i>Lyonia ligustrina</i>	57	6
12	<i>Viburnum cassinoides</i>	57	4
13	<i>Persicaria sagitifolia</i>	57	2
14	<i>Viola cucullata</i>	57	2
15	<i>Symplocarpus foetidus</i>	50	7
16	<i>Ilex verticillata</i>	50	6
17	<i>Kalmia latifolia</i>	50	5
18	<i>Rosa palustris</i>	50	4
19	<i>Vaccinium corymbosum</i>	50	4
20	<i>Osmunda cinnamomea</i>	50	4
21	<i>Smilax glauca</i>	50	2
22	<i>Carex leptalea</i>	50	2
23	<i>Dalibardia repens</i>	50	2
24	<i>Amelanchier</i> spp.	50	2
25	<i>Lycopus virginicus</i>	50	2
26	<i>Pinus rigida</i>	43	7
27	<i>Quercus rubra</i> var. <i>rubra</i>	43	2
28	<i>Symphyotrichum</i> spp.	43	2
29	<i>Sambucus canadensis</i>	43	2
30	<i>Viburnus nudum</i>	36	5
31	<i>Kalmia caroliniana</i>	36	5
32	<i>Thelypteris noveboracensis</i>	36	5
33	<i>Photinia arbutifolia</i>	36	4
34	<i>Carex atlantica</i>	36	4
35	<i>Toxicodendron vernix</i>	36	4
36	<i>Carex lurida</i>	36	4
37	<i>Rhododendron maximum</i>	36	4
38	<i>Juncus effusus</i>	36	3
39	<i>Hypericum densiflorum</i>	36	3
40	<i>Arisaema triphyllum</i>	36	2

Appendix 6: Floristic table for group 2, *Acer rubrum* – *Pinus strobus* / *Kalmia latifolia* – *Viburnum cassinoides* – *Rhododendron maximum*.) / *Thelypteris noveboracensis* – *Sphagnum* spp. Swamp Forest Bog.

number of plots:	15		
average richness:	42		
homotoneity:	4		
number	Species Name	Constancy	Average Cover Class
1	<i>Acer rubrum</i>	100	7
2	<i>Kalmia latifolia</i>	100	6
3	<i>Rhododendron maximum</i>	87	6
4	<i>Smilax rotundifolia</i>	87	2
5	<i>Pinus strobus</i>	80	6
6	<i>Vaccinium cassinoides</i>	80	4
7	<i>Amelanchier</i> spp.	80	3
8	<i>Sphagnum</i> spp.	73	6
9	<i>Quercus alba</i>	73	4
10	<i>Osmunda cinnamomea</i>	73	4
11	<i>Thelypteris noveboracensis</i>	73	4
12	<i>Medeola virginiana</i>	73	2
13	<i>Syssa sylvatica</i>	67	7
14	<i>Smilax glauca</i>	67	2
15	<i>Galussacia ursina</i>	60	4
16	<i>Vaccinium corybosum</i>	60	3
17	<i>Hexasyllis</i> spp.	60	2
18	<i>Rhubus hispidum</i>	60	2
19	<i>Mitchella repens</i>	60	2
20	<i>Tsuga canadensis</i>	53	5
21	<i>Magnolia fraseri</i>	47	6
22	<i>Prunus serontina</i> var. <i>serontina</i>	47	4
23	<i>Quercus rubra</i> var. <i>rubra</i>	47	4
24	<i>Ilex verticillata</i>	47	4
25	<i>Trillium undulatum</i>	47	2
26	<i>Leucothoe fontanesiana</i>	40	6
27	<i>Carex folliculata</i>	40	4
28	<i>Xanthorhiza simplicissima</i>	40	3
29	<i>Liriodendron tulipifera</i>	40	3
30	<i>Dendrolycopodium obscurum</i>	40	3
31	<i>Oxypolis rigidior</i>	40	2
32	<i>Houstonia serpitifolia</i>	40	2
33	<i>Photinia arbutifolia</i>	40	2
34	<i>Symplocarpus foetidus</i>	33	5
35	<i>Ilex opaca</i> var. <i>opaca</i>	33	4
36	<i>Carex intumescens</i>	33	4
37	<i>Ilex montana</i>	33	3
38	<i>Alnus serrulata</i>	33	3

39	<i>Dennstaedtia punctilobula</i>	33	3
40	<i>Viola primulifolia</i>	33	2
41	<i>Impatiens spp.</i>	33	2
42	<i>Goodyera pubescens</i>	33	2

Appendix 7: Floristic table for group 3, *Rosa palustris* / *Carex echinata* – *Carex leptalea* – *Vaccinium macrocarpon* – *Eriophorum virginicum* – *Solidago patula* / *Sphagnum* species High Elevation Herb Bog.

number of plots:	12		
average richness:	29		
homotoneity:	4		
Number	Species Name	CON	RCC
1	<i>Sphagnum species</i>	100	7
2	<i>Carex echinata</i>	100	7
3	<i>Houstonia serpitifolia</i>	100	5
4	<i>Carex leptalea</i>	100	5
5	<i>Rosa palustris</i>	100	5
6	<i>Vaccinium macrocarpon</i>	91.7	7
7	<i>Juncus effusus</i>	91.7	2
8	<i>Drosera rotundifolia</i>	91.7	2
9	<i>Solidago patula</i> var. <i>patula</i>	83.3	6
10	<i>Rhynchospora alba</i>	83.3	4
11	<i>Parnassia asarifolia</i>	83.3	3
12	<i>Eriophorum virginicum</i>	83.3	3
13	<i>Packera aurea</i>	83.3	3
14	<i>Oxypolis ridigior</i>	83.3	2
15	<i>Acer rubrum</i>	83.3	2
16	<i>Rhynchospora capitellata</i>	75	5
17	<i>Schizachyrium scoparium</i>	75	5
18	<i>Juncus species</i>	75	4
19	<i>Pogonia ophioglossoides</i>	75	3
20	<i>Lyonia ligustrina</i>	50	4
21	<i>Thelypteris palustris</i> var. <i>pubescens</i>	50	4
22	<i>Viola cucullata</i>	50	2
23	<i>Linum striatum</i>	41.7	2
24	<i>Viola macloskeyi</i> var. <i>pallens</i>	41.7	2
25	<i>Epilobium leptophyllum</i>	41.7	2
26	<i>Salix sericea</i>	33.3	6
27	<i>Carex buxbaumii</i>	33.3	6
28	<i>Scipus cyperinus</i>	33.3	4
29	<i>Osmunda cinnamomea</i>	33.3	3

**Appendix 8, Floristic table for group 4, *Spiraea tomentosa* - *Vernonia noveboracensis*
– *Scirpus expansus* – *Juncus* spp. Low Elevaton Herbaceous Bog**

number of plots:	11		
average richness:	47		
homotoneity:	3		
number	Species Name	CON	RCC
1	<i>Lycopus uniflorus</i>	82	2
2	<i>Juncus species (Septate)</i>	82	2
3	<i>Syphyotrichum species</i>	82	3
4	<i>Osmunda cinnamomea</i>	82	3
5	<i>Juncus effusus</i>	82	4
6	<i>Acer rubrum</i>	82	5
7	<i>Rhubus hispidus</i>	82	6
8	<i>Scirpus expansus</i>	73	3
9	<i>Vernonia noveboracensis</i>	73	3
10	<i>Spiraea tomentosa</i>	73	3
11	<i>Carex atlantica</i>	73	5
12	<i>Sphagnum species</i>	73	7
13	<i>Hypericum canadense</i>	64	2
14	<i>Oxypolis rigidior</i>	64	2
15	<i>Solidago patula</i> var. <i>patula</i>	64	2
16	<i>Rhynchospora capitellata</i>	64	5
17	<i>Viola cucullata</i>	55	2
18	<i>Lycopus uniflorus</i>	55	2
19	<i>Viola primulifolia</i>	55	2
20	<i>Viola macloskeyi</i> var. <i>palens</i>	55	2
21	<i>Schizachryum scoparium</i>	55	2
22	<i>Agrostis stolonifera</i>	55	2
23	<i>Dichanthelium dichotomum</i>	55	2
24	<i>Dichanthelium lucidum</i>	55	2
25	<i>Carex echinata</i>	55	2
26	<i>Eriophorum virgnianum</i>	55	3
27	<i>Osmunda regalis</i>	55	3
28	<i>Symplocarus foetidus</i>	55	4
29	<i>Alnus serrulata</i>	55	5
30	<i>Solidago</i> spp.	45	2
31	<i>Hypericum mutilum</i> var. <i>mutilum</i>	45	2
32	<i>Juncus biflorus</i>	45	2
33	<i>Rosa palustris</i>	45	2
34	<i>Eupatorium perfoliatum</i>	45	2
35	<i>Aronia arbutifolia</i>	45	2
36	<i>Lyonia ligustrina</i>	45	2
37	<i>Pycnanthemum muticum</i>	45	2
38	<i>Carex lurida</i>	45	2

39	<i>Carex foliculata</i>	45	3
40	<i>Smilax glabra</i>	36	1
41	<i>Ipatiense spp.</i>	36	2
42	<i>Drosera rotundifolia</i>	36	2
43	<i>Linum striatum</i>	36	2
44	<i>Carex intumescens</i>	36	2
45	<i>Rhyncospora gracilenta</i>	36	2
46	<i>Hypericum densiflorum</i>	36	4
47	<i>Thelypteris palustris var. pubescens</i>	36	4

Appendix 9: Floristic table for group 5, *Cladium mariscoides* – *Solidago uliginosa* – *Triantha glutinosa* - *Sanquisorba canadensis* Mafic Fen.

number of plots:	4		
average richness:	41		
homotoneity:	4		
Number	Species Name	Constancy	Average Cover Class
3	<i>Cladium mariscoides</i>	100	6
1	<i>Sphagnum species</i>	100	5
2	<i>Acer rubrum</i>	100	4
4	<i>Kalmia latifolia</i>	100	4
5	<i>Lycopus uniflorus</i>	100	4
6	<i>Agrostis stolonifera</i>	75	4
7	<i>Betula alleghaniensis</i>	75	4
8	<i>Carex leptalea</i>	75	4
9	<i>Carex atantica</i>	75	4
10	<i>Amelanchier spp.</i>	50	4
11	<i>Symphytrichum spp.</i>	50	4
12	<i>Galium spp.</i>	50	4
13	<i>Eriophorum virginicum</i>	50	4
14	<i>Drosera rotundifolia var. rotundifolia</i>	50	4
15	<i>Carex echinata</i>	50	4
16	<i>Galax urceolata</i>	50	4
17	<i>Salix humilis</i>	50	4
18	<i>Viola macloskeyi var. pallens</i>	50	4
19	<i>Rhubus spp. (Blackberry)</i>	50	4
20	<i>Asteraceae spp.</i>	50	4
21	<i>Rhynchospora capitellata</i>	50	4
22	<i>Linum stiatum</i>	50	4
23	<i>Oxypolis rigidior</i>	50	4
24	<i>Vaccinium simulatum</i>	50	4
25	<i>Parnassia grandifolia</i>	50	4
26	<i>Viburnum cassinoides</i>	50	4
27	<i>Triantha glutinosa</i>	50	4
28	<i>Quercus rubra var. rubra</i>	50	4
29	<i>Alnus serrulata</i>	50	4
30	<i>Solidago patula var. patula</i>	50	4
31	<i>Rhododendron maximum</i>	50	4
32	<i>Osmunda cinnamomea</i>	50	4
33	<i>Solidago uliginosa var. uliginosa</i>	50	4
34	<i>Platanthera clavalata</i>	50	3
35	<i>Houstonia serpitifolia</i>	50	3
36	<i>Hypericum canadensis</i>	50	3
37	<i>Xyris torta</i>	50	3
38	<i>Platanthera lacera</i>	50	3
39	<i>Acer saccharum</i>	50	3
40	<i>Rhynchospora alba</i>	25	5
41	<i>Scirpus expansus</i>	25	5

Appendix 10: Floristic table for group 6, *Acer rubrum* - *Pinus virginiana* / *Danthonia epilis* - *Rhynchospora grandiflora* Granitic Blanket Bog.

number of plots:	3		
average richness:	75		
homotoneity:	75		
Number	Species Name	Constancy	Average Cover Class
1	<i>Sphagnum</i> spp.	100	7
2	<i>Danthonia epilis</i>	100	7
3	<i>Acer rubrum</i>	100	6
4	<i>Rhynchospora gracilentia</i>	100	6
5	<i>Pinus virginiana</i>	100	5
6	<i>Sarrecenia jonesii</i>	100	5
7	<i>Vaccinium formuosum</i>	100	5
8	<i>Eupatorium pilosum</i>	100	4
9	<i>Vitis rotuntifolia</i> var. <i>rotundifolia</i>	100	3
10	<i>Scleria triglomerata</i>	100	3
11	<i>Xyris platylepis</i>	100	3
12	<i>Dichantherium lucidum</i>	100	3
13	<i>Calamagrostis cinnoides</i>	100	3
14	<i>Viola primulifolia</i>	100	2
15	<i>Rhubus</i> spp. (Blackberry)	100	2
16	<i>Bignonia capreolata</i>	100	2
17	<i>Croton willdenowii</i>	100	2
18	<i>Dichantherium ensifolium</i>	100	2
19	<i>Dichantherium sphaerocarpon</i>	100	2
20	<i>Linum floridanum</i>	100	2
21	<i>Lobelia nutallii</i>	100	2
22	<i>Selagenela apoda</i>	100	2
23	<i>Ludwegia alternifolia</i>	100	2
24	<i>Hypericum hypericoides</i>	100	2
25	<i>Eupatorium rotundifolium</i>	100	2
26	<i>Fuirena brevissea</i>	100	2
27	<i>Oxypolis rigidior</i>	100	2
28	<i>Smilax laurifolia</i>	100	2
29	<i>Aronia arbutifolia</i>	100	2
30	<i>Liriodendron tulipifera</i> var. <i>tulipifera</i>	100	2
31	<i>Pinus echinata</i>	67	5
32	<i>Liatris spicata</i>	67	5
33	<i>Nyssa sylvatica</i>	67	4
34	<i>Pinus taeda</i>	67	4
35	<i>Solidago patula</i> var. <i>strictula</i>	67	4
36	<i>Oxydendron arboreum</i>	67	4
37	<i>Kalmia latifolia</i>	67	3
38	<i>Eriocaulon decangulare</i> var. <i>decangulare</i>	67	3
39	<i>Rhexia mariana</i> var. <i>mariana</i>	67	3
40	<i>Rhus copallinum</i>	67	2

41	Schizachrium scoparium	67	2
42	Prunus serotina var. serotina	67	2
43	Apios american	67	2
44	Utricularia subulata	67	2
45	Polygala cruciata	67	2
46	Andropogon perangustatus	67	2
47	Dichantherium aciculare	67	2
48	Eleocharis tuberculosa	67	2
49	Gymnopogon brevifolius	67	2
50	Rhynchospora recognita	67	2
51	Scleria oligantha	67	2
52	Xyris jupicai	67	2
53	Lespedeza capitata	67	2
54	Sericocarpus linifolius	67	2
55	Sophronanthe pilosa	67	2
56	Smilax glauca	67	2
57	Symphotrichum spp.	67	2
58	Xanthorhiza simplicissima	67	2
59	Helianthis angustifolius	67	2
60	Rhynchospora capitellata	67	2
61	Coreopsis major	67	2
62	Dennstaedtia punctilobula	67	2
63	Liquidambar styraciflua	67	2
64	Amelanchier spp.	67	2
65	Eutrochium spp.	67	2
66	Osmunda cinnamomea	33	6
67	Rhododendron viscosum	33	4
68	Viburnus cassinoides	33	3
69	Osumunda regalis var. spectabilis	33	3
70	Lyonia ligustrina	33	3
71	Vaccinium fuscatum	33	3
72	Eriocaulon texense	33	3
73	Dichantherium strigosum var. leucoblepharis	33	3
74	Potentilla canadensis var. canadensis	33	2
75	Woodwardia areolata	33	2

Appendix 11: Floristic table for group 7, *Viburnum cassinoides* – *Kalmia latifolia* – *Lyonia ligustrina* / *Osmunda cinnamomea* - *Carex echinata* – *Solidago patula* Mosaic Bog.

number of plots:	20		
average richness:	37		
homotoneity:	4		
Number	Name	Constancy	Average Cover Class
1	<i>Sphagnum spp.</i>	100	8
2	<i>Acer rubrum</i>	100	5
3	<i>Carex echinata</i>	95	7
4	<i>Osmunda cinnamomea</i>	85	5
5	<i>Viburnum cassinoides</i>	80	5
6	<i>Viola macloskeyi</i> var. <i>pallens</i>	80	2
7	<i>Kalmia latifolia</i>	75	4
8	<i>Lyonia ligustrina</i>	70	6
9	<i>Rhododendron maximum</i>	70	5
10	<i>Solidago patula</i> var. <i>patula</i>	70	5
11	<i>Carex leptalea</i>	70	4
12	<i>Juncus spp.</i>	70	2
13	<i>Galium spp.</i>	70	2
14	<i>Rhubus hispidus</i>	65	6
15	<i>Salix sericea</i>	65	5
16	<i>Asteraceae species</i>	65	2
17	<i>Houstonia serptifolia</i>	60	2
18	<i>Drosera rotundifolia</i> var. <i>rotundifolia</i>	60	2
19	<i>Scirpus expansus</i>	55	6
20	<i>Juncus effusus</i>	55	3
21	<i>Rhubus spp.</i> (Blackberry)	55	3
22	<i>Epilobium leptophyllum</i>	55	2
23	<i>Picea rubens</i>	50	5
24	<i>Betula alleghaniensis</i>	45	5
25	<i>Symphyotricum spp.</i>	45	4
26	<i>Vaccinium corybosum</i>	45	2
27	<i>Viola cucullata</i>	45	2
28	<i>Chelone spp.</i>	40	5
29	<i>Lycopus uniflorus</i>	40	4
30	<i>Amelanchier spp.</i>	40	3
31	<i>Oxypolis rigidior</i>	40	2
32	<i>Rosa palustris</i>	35	4
33	<i>Scirpus expansus</i>	35	2
34	<i>Carex lurida</i>	35	2
35	<i>Hypericum punctatum</i>	35	2
36	<i>Eupatorium perfoliatum</i>	35	2
37	<i>Platanthera clavellata</i>	35	2

Appendix 12: Floristic table for group 8, *Lyonia ligustrina* / *Salix sericea* – *Galium* species. – *Persicaria sagitifolia* / *Sphagnum* spp. Beaver Influenced Bog.

number of plots:	18		
average richness:	32		
homotoneity:	4		
Number	Species Name	Constancy	Average Cover Class
1	<i>Sphagnum species</i>	100	8
2	<i>Acer rubrum</i>	94	5
3	<i>Galium species</i>	94	3
4	<i>Persicaria sagitifolia</i>	83	3
5	<i>Impatiens species</i>	78	3
6	<i>Viola macloskeyi</i> var. <i>pallens</i>	72	3
7	<i>Juncus effusus</i>	67	5
8	<i>Carex echinata</i>	56	6
9	<i>Salix sericea</i>	56	5
10	<i>Lyonia ligustrina</i>	56	5
11	<i>Osmunda cinnamomea</i>	56	4
12	<i>Epilobium leptophyllum</i>	56	3
13	<i>Rosa palustris</i>	50	6
14	<i>Vaccinium cassinoides</i>	50	5
15	<i>Solidago patula</i> var. <i>patula</i>	50	5
16	<i>Scirpus cyperinus</i>	50	4
17	<i>Carex leptalea</i>	50	4
18	<i>Rubus hispidus</i>	44	6
19	<i>Juncus gymnocarpus</i>	44	4
20	<i>Hypericum muticum</i> var. <i>muticum</i>	44	3
21	<i>Epilobium coloratum</i>	44	3
22	<i>Sambucus canadensis</i>	44	3
23	<i>Juncus</i> spp.	39	4
24	<i>Rubus</i> spp. (<i>Blackberry</i>)	39	3
25	<i>Carex lurida</i>	39	3
26	<i>Scirpus expansus</i>	33	7
27	<i>Ludwegia palustris</i>	33	4
28	<i>Arisaema triphyllum</i>	33	3
29	<i>Mimulus ringens</i>	33	3
30	<i>Carex</i> spp. (<i>Section Ouales</i>)	33	3
31	<i>Sympyotrichum</i> spp.	33	3
32	<i>Houstonia serpitifolia</i>	33	3

Appendix 13: Floristic table for group 9, *Acer rubrum* - *Betula alleghaniensis* / *Aesculus flava* / *Thalictrum* sp.- (*Rudbeckia laciniata* - *Trautvetteria caroliniensis*) High Elevation Seepage Wetland.

Number of Plots:	11		
Average Richness:	54		
Homoteneity:	46		
Number	Species Name	Constancy	Average Cover Class
1	<i>Acer rubrum</i>	82	6
2	<i>Thalictru species</i>	82	2
3	<i>Betula alleghaniensis</i>	73	6
4	<i>Spagnum species</i>	64	6
5	<i>Solidago curtisii</i>	64	2
6	<i>Aesculus flava</i>	55	6
7	<i>Chelone glabra/ovbliqua</i>	55	5
8	<i>Faxinus americana</i>	55	4
9	<i>Arisamea triphyllum</i>	55	2
10	<i>Athyrium asplenioides</i>	55	2
11	<i>Veratrum viride</i>	55	2
12	<i>Ageritina altissima</i>	55	2
13	<i>Quercus rubra var. rubra</i>	45	6
14	<i>Eurybia chlorolepis</i>	45	4
15	<i>Thelypteris noveboracensis</i>	45	4
16	<i>Hamamelis virginiana</i>	45	4
17	<i>Impatiense species</i>	45	3
18	<i>Galium species</i>	45	2
19	<i>Acer pensylvanicum</i>	45	2
20	<i>Trautvetteria caroliniensis</i>	45	2
21	<i>Prunus serotina</i>	45	2
22	<i>Tiarella cordifolia</i>	45	2
23	<i>Rudbeckia laciniata</i>	36	6
24	<i>Rhododendron maximum</i>	36	6
25	<i>Fagus grandiflora</i>	36	6
26	<i>Liriodendron tulipifera</i>	36	6
27	<i>Acer saccharum</i>	36	6
28	<i>Laportia canadensis</i>	36	5
29	<i>Eurybia divaricata</i>	36	5
30	<i>Mondarda didyma</i>	36	4
31	<i>Rubus species</i> (Blackberry)	36	3
32	<i>Oxypolis rigidior</i>	36	3
33	<i>Mianthemum canadense</i>	36	3
34	<i>Diphylleia cymosa</i>	36	3
35	<i>Sambucus canadensis</i>	36	2
36	<i>Amelanchier spp.</i>	36	2
37	<i>Syphyotrichum spp.</i>	36	2
38	<i>Viola cucullata</i>	36	2
39	<i>Prenathese spp.</i>	36	2
40	<i>Packera aurea</i>	27	6
41	<i>Danthonia compressa</i>	27	5

Appendix 14: Floristic table for group 10: *Rhododendron maximum* – (*Viburnum cassinoides* – *Lyonia ligustrina*) / *Carex ruthii*, *Carex gynandra*, *Carex debilis* var. *rudgei*, *Oclemena acuminata*, *Platanthera clavalata* Sedge Seep.

number of plots:	5		
average richness:	31		
homotoneity:	61		
Key	Species Name	Constancy	Average Cover Class
1	<i>Carex ruthii</i>	100	7
2	<i>Carex gynandra/mitchelliana</i>	100	5
3	<i>Oclemena acuminata</i>	80	3
4	<i>Carex debilis rudgei</i>	80	2
5	<i>Juncus acuminatus</i>	80	2
6	<i>Rubus</i> spp.(Blackberry)	80	2
7	<i>Deschampsia flexuosa</i>	80	2
8	<i>Platanthera clavalata</i>	80	1
9	<i>Hypericum densiflorum</i>	60	5
10	<i>Osmunda cinnamomea</i>	60	4
11	<i>Solidago species</i>	60	4
12	<i>Scirpus</i>	60	3
13	<i>Amelanchier species</i>	60	2
14	<i>Agrostis perennans</i>	60	2
15	<i>Juncus gymnocarpus</i>	60	2
16	<i>Viburnum cassinoides</i>	60	2
17	<i>Solidago patula</i> var. <i>patula</i>	60	2
18	<i>Rhododendron catawbiense</i>	60	2
19	<i>Calamagrostis coarctata</i>	60	2
20	<i>Photina melicaria</i>	60	2
21	<i>Lyonia ligustrina</i>	60	2
22	<i>Dennstaedtia punctilobula</i>	60	1
23	<i>Ageritina altissima</i>	40	6
24	<i>Hypericum graveolens</i>	40	5
25	<i>Hypericum mitchellianum</i>	40	4
26	<i>Viola macloskeyi</i> var. <i>pallens</i>	40	3
27	<i>Vaccinium stamineum</i>	40	3
28	<i>Juncus effusus</i>	40	2
29	<i>Danthonia compressa</i>	40	2
30	<i>Angelica triquinata</i>	40	2
31	<i>Lycopodium clavatum</i>	40	2

Appendix 15: Floristic table for group 11, *Betula alleghaniensis*, (*Picea rubens*, *Abies fraserii*) / *Sorbus americana* - *Rhododendron maximum* / *Oclemena acuminata*, *Oxalis montana*, *Dryopteris campyloptera*, *Dennstaedtia punctilobula*, *Sphagnum* spp. Boggy Seep.

number of plots:	8		
average richness:	28		
homotoneity:	58		
Number	Species Name	Constancy	Average Cover Class
1	<i>Oclemena acuminata</i>	100	5
2	<i>Betula alleghaniensis</i>	88	7
3	<i>Sorbus americana</i>	88	2
4	<i>Sphagnum</i> species	75	6
5	<i>Picea rubens</i>	75	6
6	<i>Abies fraserii</i>	75	5
7	<i>Dennstaedtia punctilobula</i>	75	5
8	<i>Arisaema triphyllum</i>	75	2
9	<i>Oxalis montana</i>	75	2
10	<i>Rhododendron maximum</i>	63	6
11	<i>Glyceria melicaria</i>	63	3
12	<i>Eurybia chlorolepis</i>	50	4
13	<i>Carex ruthii</i>	50	4
14	<i>Vaccinium erythrocarpum</i>	50	3
15	<i>Amelanchier</i> spp.	50	3
16	<i>Vaccinium simulatum</i>	50	3
17	<i>Athyrium asplenoides</i>	50	2
18	<i>Dryopteris campyloptera</i>	50	2
19	<i>Rubus</i> spp. (Blackberry)	50	2
20	<i>Carex debilis</i> var. <i>rudgei</i>	50	2
21	<i>Acer rubrum</i>	50	2
22	<i>Ageritina altissima</i>	38	4
23	<i>Acer spicata</i>	38	4
24	<i>Rhododendron catawbiense</i>	38	3
25	<i>Impatiens</i> spp.	38	2
26	<i>Carex aestivalis</i>	38	2
27	<i>Ilex montana</i>	38	2
28	<i>Carex intumescens</i>	38	2

Appendix 16: Floristic table for group 12, *Diphyleia cymose*, *Saxifraga micranthidifolia*, *Laportia canadensis* Rich Montane Seep.

number of plots:	4		
average richness:	14		
homotoneity:	25		
Number	Species Name	Constancy	Average Cover Class
1	<i>Galium species</i>	25	2
2	<i>Actaea racemosa var. racemosa</i>	25	2
3	<i>Ageritina altissima</i>	25	2
4	<i>Mitella diphylla</i>	25	2
5	<i>Eupatorium purpureum</i>	25	2
6	<i>Sceptridium species</i>	25	1
7	<i>Arisaema triphyllum</i>	25	1
8	<i>Acer spicatum</i>	25	1
9	<i>Hydrophyllum canadense</i>	25	1
10	<i>Hydrophyllum virginianum</i>	25	1
11	<i>Oxalis</i> spp. (Section <i>Corniculatae</i>)	25	1
12	<i>Thalictrum species</i>	25	1
13	<i>Tsuga canadensis</i>	25	1
14	<i>Platanthera grandiflora</i>	25	1