A FLORISTIC SURVEY AND WETLAND VEGETATION ANALYSIS OF TATER HILL PRESERVE

A Thesis

by

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ABSTRACT

A FLORISTIC SURVEY AND WETLAND VEGETATION ANALYSIS OF TATER HILL PRESERVE (August 2007)

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A vascular plant inventory and vegetation analysis of Tater Hill Preserve, Watauga County, North Carolina was conducted during the growing seasons of 2002-2004. The preserve encompasses approximately 205 ha within the Amphibolite Macrosite of the Blue Ridge Physiographic Province. A detailed survey and analysis was conducted within the two ha open wetland found within the preserve. Nine 10 x 10 m plots were established in which species were identified and percent cover recorded. Within these plots and surrounding areas, soil seed banks were investigated to examine the effects of water level changes associated with beaver inundation on community composition. In June and July of 2003, soil samples (6.4 cm diameter x 15.2 cm depth) were taken from the nine 10 x 10 m plots and ten areas along the east perimeter of the wetland at 20 m intervals. At each soil collection site, two sets of 20 samples were extracted. At the Appalachian State University Greenhouse, half of the samples were placed in a constructed outdoor bog replicate with water-saturated conditions, the remaining placed outdoors on standard greenhouse benches with no water saturation. In late October 2003, samples were surveyed, with species presence and stem count recorded.

A total of 471 taxa representing 94 families were documented from the surveys. Eleven species identified are listed on the North Carolina Natural Heritage Program Watch List. Twenty-eight species (5.9%) found were non-native. A total of ten plant communities with 21 community subtypes were delineated following the description of Schafale and Weakley (2002). Voucher specimens were deposited in the herbarium at Appalachian State University (BOON).

A total of 131 plant taxa were documented within the open wetland. The number of species, Shannon-Weiner diversity indices and evenness values within the 10 x 10 m sample areas indicate that the northernmost portions of the bog are the most locally diverse. Calculated Czekanowski coefficients suggested high levels of habitat and species diversity across the two ha wetland.

Twenty-four vascular plant species and six bryophytes emerged from the seed bank study. In saturated conditions, 25 different species emerged with a total of 2426 stems; in natural conditions, 24 different species emerged with a total of 1106 stems. Grasses and sedges dominated both conditions. It is hoped that this work will assist Appalachian State University in the management of this area and inspire future botanical and ecological studies of high elevation southern Appalachian wetlands.

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INTRODUCTION

The current extinction crisis caused by human activity has increased the need for biological inventories and long-term studies of threatened and endangered ecosystems. During the past 600 million years, the average background rate of extinction, calculated from fossil remains has been no more than 1 species per year (Jablonski 1986; Raup 1986). Currently, a combination of habitat destruction, the introduction of invasive species, pollution and disease, has resulted in extinction rates to be 100 to 1000 times these levels (Myers 1989; Pimm et al. 1995). The initial step in preserving biodiversity is to conduct inventories of rare habitats that contain numerous rare or endangered species. Baseline inventories of locally diverse areas and the establishment of long-term study sites help us gain insight into the effects of human activity on fragmented ecosystems and further enhance research of other aspects of conservation science. It also provides a linked framework to provide information about the evolutionary history of groups of organisms, aids in learning and appreciation of biological diversity, and provides a small database and searching system about the characteristics of organisms.

Within the United States, the most apparent needs for inventories are in Hawaii, southern California, the southeastern coastal states, and southern Appalachia, where the greatest numbers of endangered species occur according

to Dobson (1997). He has also suggested that areas containing large numbers of endangered plant species will also contain the greatest numbers of other endangered groups such as arthropods and avian fauna, thus increasing the need for floristic studies and plant conservation (Dobson 1997).

Floristic studies are essential in southern Appalachian wetlands for they provide habitat for nearly 90 species of plants and animals considered rare, threatened, or endangered by the North Carolina Plant Conservation Program, the North Carolina Natural Heritage Program, or the U.S. Fish and Wildlife Service (Murdock 1994). Three examples include *Clemmys muhlenbergii* Schoepff (bog turtle), *Lilium grayi* S. Watson (Gray's lily), and *Ilex collina* Alexander (long-stalked holly), all three of which may be on the brink of extinction because of habitat loss (Murdock 1994). The topography of these wetlands – flat areas surrounded by mountainous terrain – makes them excellent sites for farming and development, creating inevitable competition between imperiled species and humans. Over ten years ago, Weakley and Schafale (1994) suggested that less than 15% of the original high elevation wetlands remain after years of extensive human development, with subsequent population growth likely causing this estimation to decrease even further.

The few remaining bogs in the headwaters of the New River in western North Carolina, including sites near Tater Hill, Long Hope Valley, and Bluff Mountain, have been recognized as premier examples of southern Appalachian bogs, swamp forest-bog complexes, and southern Appalachian fens (Schafale and Weakley 2002). These bogs and wetlands are generally found in areas of level terrain and are of high value in the mountains for development. This leads to the degradation and loss of many of these sites through drainage, impoundment and, clearing. Scientists and land managers have recognized the value of high elevation wetlands for decades, and several synopsis articles have called for further study of these areas (Murdock 1994; Weakley 2002); however, there are not many long-term studies of these wetlands to determine potential management needs for preservation.

Long-term studies are also needed to determine how to manage beaver (*Castor canadensis* Kuhl.) populations and how they influence southern Appalachian wetlands. Beavers profoundly affect aquatic ecosystems across North America (Naiman et al. 1986; Naiman et al. 1988; Johnston and Naiman 1990; Wright 2002; Bullock 2003; Alper 2005). Through tree removal and inundation, these ecosystem engineers modify local hydrology and channel morphology to create wetlands and ponds (Alper 2005). These activities retain sediment and organic matter, modify nutrient cycling and decomposition dynamics, and influence the rate of water and materials that are transported downstream (Naiman et al. 1986). This physical modification of habitat, or ecosystem engineering, increases habitat heterogeneity (Wright 2002). By increasing habitat heterogeneity, beavers can increase the number of

herbaceous plant species in the riparian zone by as much as 33% (Wright 2002). At a local level, beavers' creation of wetlands impact the greater species richness and total avian abundance, in particular the Neotropical migrants and woodland-breeding birds (Bullock 2003).

Tater Hill Preserve also includes premier examples of southern Appalachian high-elevation rock outcrop communities. This community type also provides habitat for numerous rare species, including forty plant species considered rare or endangered in North Carolina and Tennessee (Wiser 1994). These species include many Southern Appalachian endemics such as *Houstonia montana* Small (Roan Mountain bluet), *Saxifraga michauxii* Britt. (Michaux's saxifrage), and disjunct populations of northern species including *Carex crinita* Lamarck (fringed sedge) and *Sibbaldiopsis tridenta (*Aiton) Rydeberg (shrubby fivefingers). This suggests that many members of these rock outcrop communities are remnants of a Pleistocene alpine flora (White et al. 1984; Wiser 1996). The terrain of these rock outcrop communities consists of rounded, forested summits, with peaks (>1200m) of rugged relief and rock outcrops present. Limited in extent and spatially isolated from one another, these unique communities are threatened by anthropogenic influences such as air pollution and trampling.

Much of the ancient flora in western North Carolina moved ahead of the Wisconsin ice sheet, later migrating back into northern regions when the glaciers retreated (Ramseur 1960). These cool to cold temperature species persisted in refugia at higher altitudes and along river valleys with cold-air drainage basins (Graham 1999). During the current warming period, this ancient flora has presumably been eliminated in all but small isolated pockets, with the remaining outcrop and wetland flora likely migrating into these habitats with post-glacial warming (Wiser 1994).

The overall purpose of this study and collection is to assist those interested in collecting information about a particular group of organisms, by biologists seeking to update identification keys, figures, and other systematic information, and by educators teaching about organismal diversity. Although designed for scientists, the information garnered from this project includes information of interest to non-biologists, and other amateur scientists and nature lovers. For site-specific management decisions, the purpose of this study was to: 1.) Determine the presence and location of rare and endangered plant species in Tater Hill Preserve (THP), 2.) Determine the presence and location of non-native and invasive plant species in THP, 3.) Provide descriptive data that represents current habitat composition within the wetland, and 4.) Provide data to determine possible plant community changes associated with beaver inundation in Southern Appalachian wetlands.

Study Site

Tater Hill Preserve is located within the Blue Ridge physiographic province of the highlands region of the southern and central Appalachians, which extends from Pennsylvania south to northern Georgia (Hack 1989). Lying between the Valley and Ridge and Piedmont provinces, the boundaries of the Blue Ridge are located along the Blue-Ridge Piedmont fault zone to the west and the Brevard fault zone to the east. Divided into two sections, the Northern Blue Ridge extends 400 km, having an average width of 15 km, draining to the Atlantic Ocean. South of Roanoke, VA, the Southern Blue Ridge drains to the Gulf of Mexico, extending 560 km and averaging 120 km in width (Hack 1989).

Located in north-central Watauga County in northwest North Carolina, (Figure 1), the study area lies approximately between UTM coordinates 17 N 0435000 mE and 0436500 mE and 4018750 mN and 4015250 mN. The topographic coverage lies within the Zionville 7.5 minute USGS quadrangle with the closest towns in the vicinity being Boone NC, located approximately 11.3 km to the southeast, Zionville NC, 4.8 km to the northwest, and Mountain City TN, 17.7 km to the west. The preserve is located in the Amphibolite Macrosite of the Blue Ridge Physiographic Province within the South Fork of the New River watershed and contains portions of Rich Mountain (elevation 1637 m), Tater Hill (1583 m), and Harmon Knob (1463 m) (Figure 2). Elevation ranges from

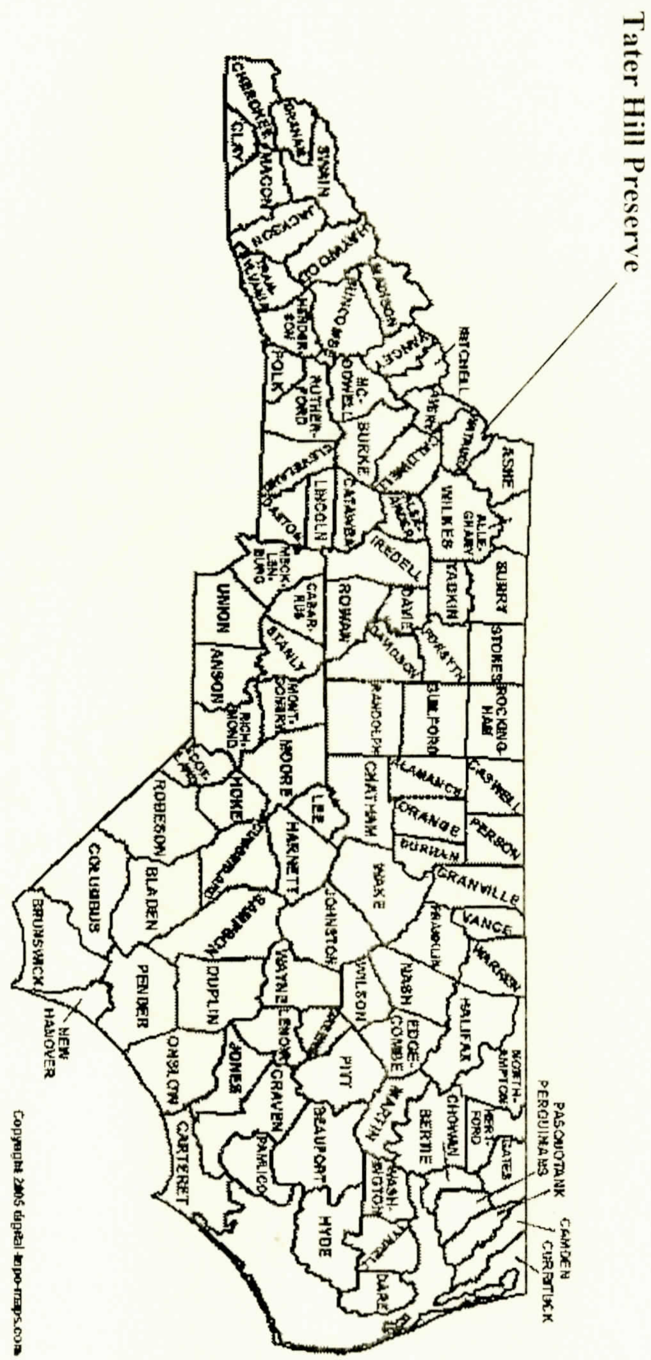

Figure 1. Location of Tater Hill Preserve, Watauga County, NC.

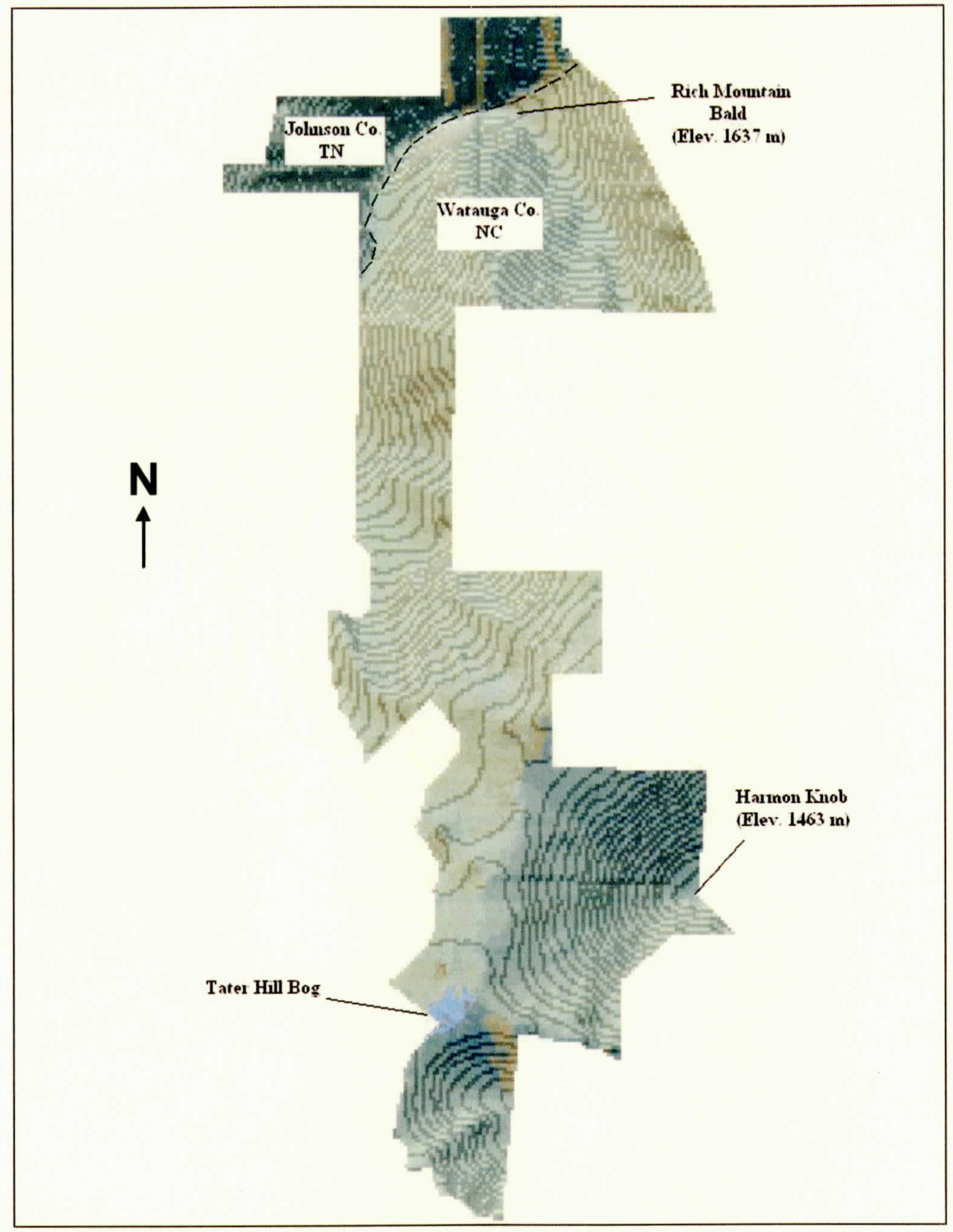

Figure 2. Property map of Tater Hill Preserve.

1195 –1637 m with the majority of the study area being the flat to gently sloping high elevation valley between Tater Hill and Harmon Knob. The bog area located in the south section of the preserve is permanently saturated by the numerous seeps that are present and runoff from the convergence of at least three tributary streams that form the headwaters of Howard's Creek.

Geomorphology

Based on two different bedrock suites, the Southern Blue Ridge is divided into western and eastern regions (Hack 1989). The boundary between these two regions is a major fault line that extends from Alabama to Newfoundland (Hack 1989). In North Carolina and northern Georgia, this fault is called the Hayesville Fault (Hack 1989). Mafic and ultramafic rock (high in iron and magnesium while low in silicon and potassium) is prevalent in the eastern region, while rare west of the fault line (Pitillo et al. 1998).

Many soils in the Southern Blue Ridge Province are acidic, having pH values less than 5.0 (Kintsch 1999). Research indicates that subsoil content of exchangeable calcium and magnesium are less than 0.5 cmil kg^{-1} soil, quickly decreasing to undetectable levels a meter or less below the surface (Pitillo et al. 1998). Exchangable potassium levels are also low, although mica minerals are abundant in these soils (Pitillo et al. 1998). The area within the Amphibolite Macrosite, including Tater Hill Preserve, is an exception to this. These

mountains are defined by a northeastern strike of rock stratum within the Ashe foundations; the substrate consisting of metamorphic rock that originated from ancient lava flows composed of mud, sand and volcanic ash (Pitillo et al. 1998).

Amphibolite is a mafic rock type that is characterized by its long, slender crystals that cleave at angles of 60° and 120° (Kintsch 1999). Primarily composed of horneblend gneiss, it is a mineral that is rich in magnesium, calcium, iron and aluminum and its color ranges from green to black depending on the amount of iron oxides present (Kintsch 1999). These important plant nutrients neutralize the acidic mountain soils and contribute to the region's diverse flora and fauna (Kintsch 1999).

Erosional processes and mass movement of colluvium are a predominant influence in soil distribution (Kintsch 1999). Amphibolite substrates are generally overlain by soils that are moderately permeable to well-drained and highly organic (Kintsch 1999). These soils are classified within the non-acid families of Entisols, Inceptisols, and Alfisols (Kintsch 1999). Soil particle sizes are variable, with some soils sandy throughout, while other soils are quite clayey (Pitillo et al. 1998). In areas of low-grade slopes, Toxaway series soils that do not drain well accumulate, allowing precipitation to run off quickly into the bogs, fens and the ephemeral streams of the area. Here water is maintained and then slowly released down the water basin. The combination of high soil organic content and water retention capacities contributes to microhabitat regulation and the high levels of diversity within the wetlands of this region (Kintsch 1999).

Site history

Although no direct evidence of permanent Native American settlements has been found at Tater Hill Preserve, historical records do indicate that this area was used for hunting (Flisser 1979). The first European to permanently settle within the Tater Hill Preserve area was Colonel Romulus Linney after returning home from the Civil War. In 1939 Colonel Linney's grandson transferred ownership to the Federal Land Bank, and the site was subsequently purchased by a local interest group known as Tater Hill Incorporated with the intention of developing a lake resort area. In 1940 construction of a concrete dam with an 18-inch drainpipe and concrete spillway was completed. Over the next 35 years, this area hosted camping facilities and a baseball field, and was heavily used by local residents. Between November 2 and 6, 1977, 33.3 centimeters of rain fell within the area destroying the dam, emptying Tater Hill Lake, and destroying homes and farms as water spilled into the narrow channel of Howard's Creek (Flisser 1979).

In 2000, a partnership between the Trust for Public Land and The North Carolina Plant Conservation Program (NCPCP) and Natural Heritage Trust Funds began a series of acquisitions aimed at preserving Tater Hill bog and its

surrounding areas. The process began in 2000 with a purchase of 158 acres that includes the former lakebed and surrounding areas, now considered a high quality southern Appalachian bog. Subsequent purchases of 239 acres in 2002 and 300 acres in 2003 have increased the area of protection to approximately 280 hectares. In 2002, the NCPCP and the Appalachian State Biology Department undertook a cooperative agreement for the management of this area. Tater Hill Preserve is now under management by just the NCPCP.

Prior to the time of this study, no evidence of beaver activity existed at Tater Hill Preserve, and they began inhabiting the area in the winter of 2003. The vegetation anaylsis of the wetland and adjacent areas and seed bank portions of this research were designed to simulate the possible effects of beaver on western North Carolina's high elevation wetlands.

MATERIALS AND METHODS

Vascular plant inventory

The vascular plant inventory was conducted on approximately 205 hectares during the 2002-2004 growing seasons. Priority areas of sampling were determined using topographic, digital, and property maps to locate boundaries and unique habitat. A total of 471 specimen collections were made. Instances in which single or few individuals of rare or endangered species were found, voucher specimens were documented with digital photographs. Other equipment used for field collection and processing included: pruning clippers, plant press, newspapers, and field notebooks. For each species, the following information was recorded: collection number, plant location and habitat, tentative family, genus, and species.

Plants were identified using Hitchcock (1935), Radford et al. (1968), Wofford (1989), Cronquist (1991), and Weakley (2006). Voucher specimens are deposited at the ASU herbarium; locally rare species were documented by digital photography. Uncommon species were categorized according to species status listed by the North Carolina Natural Heritage Program (Franklin and Finnegan 2004; Weakley 2006). Wetland indicator status was verified using the United States Department of Agriculture (USDA) website (2003). Wetland indicator categories are: obligate wetland species (OBL); plant species always occurring

in wetlands (>99%), facultative wetland species (FACW); plant species usually occurring in wetlands (67%-99%), facultative species (FAC); plant species equally likely to occur in wetlands and non-wetlands (34%-67%), facultative upland species (FACU); plant species rarely occurring in wetlands (1%-34%), obligate upland species (UPL); plant species always occurring in non-wetlands, and (N) when no information was available or no agreement has been reached on status. Non-native taxa were identified according to Radford et al. (1968), Cronquist (1991), and USDA, NRCS (2004). Plant communities and associations were determined according to Weakley (2002).

The regression formula used to calculate the predicted species richness for the preserve was $S = 272 A^{0.113}$, where S is the expected number of species and A is the area in hectares, (Wade and Thompson 1991). This species-area curve explains 80% of the variation in species numbers of floristic studies examined in Kentucky, West Virginia, Ohio, and Tennessee (Wade and Thompson 1991) and is now utilized in floristic studies of western North Carolina (Poindexter 2006).

Wetland vegetation analysis

Within the approximately two hectares of wetlands found at this site, nine 10 x 10 meter plots were established (Figure 3). Plot location was determined by topography, vegetation, and the presence or absence of standing water. Plots were established in sets of three, with one placed in area of standing water (A), one in a wet to dry transitional area (B), and one in a marginal upland dry area (C). Three sets of these wet/intermediate/dry plots were arrayed within the wetland to capture the variation across the apparent vertical gradient. Within these nine plots, species were identified and their relative percent cover recorded. Surveys of these plots were conducted from September 23 to October 9, 2002, June 19 to July 3, 2003, and September 24 to October 2, 2003. To examine species diversity within a plot, species richness and Shannon-Weiner diversity indices ($H' = -\sum_{i=1}^{s} p_i \ln p_i$, where s = the number of species, p_i = the proportion of individuals or the abundance of the ith species expressed as a proportion of the total cover, ln = natural log base) are given for each plot (Kent and Coker 1992). To compare actual diversity to the maximum possible diversity evenness values ($J = H'/\ln s$, where s = total number of species in each plot) were calculated for each plot (Kent and Coker 1992). To examine differences between wetland plots, Czekanowski's similarity coefficient values

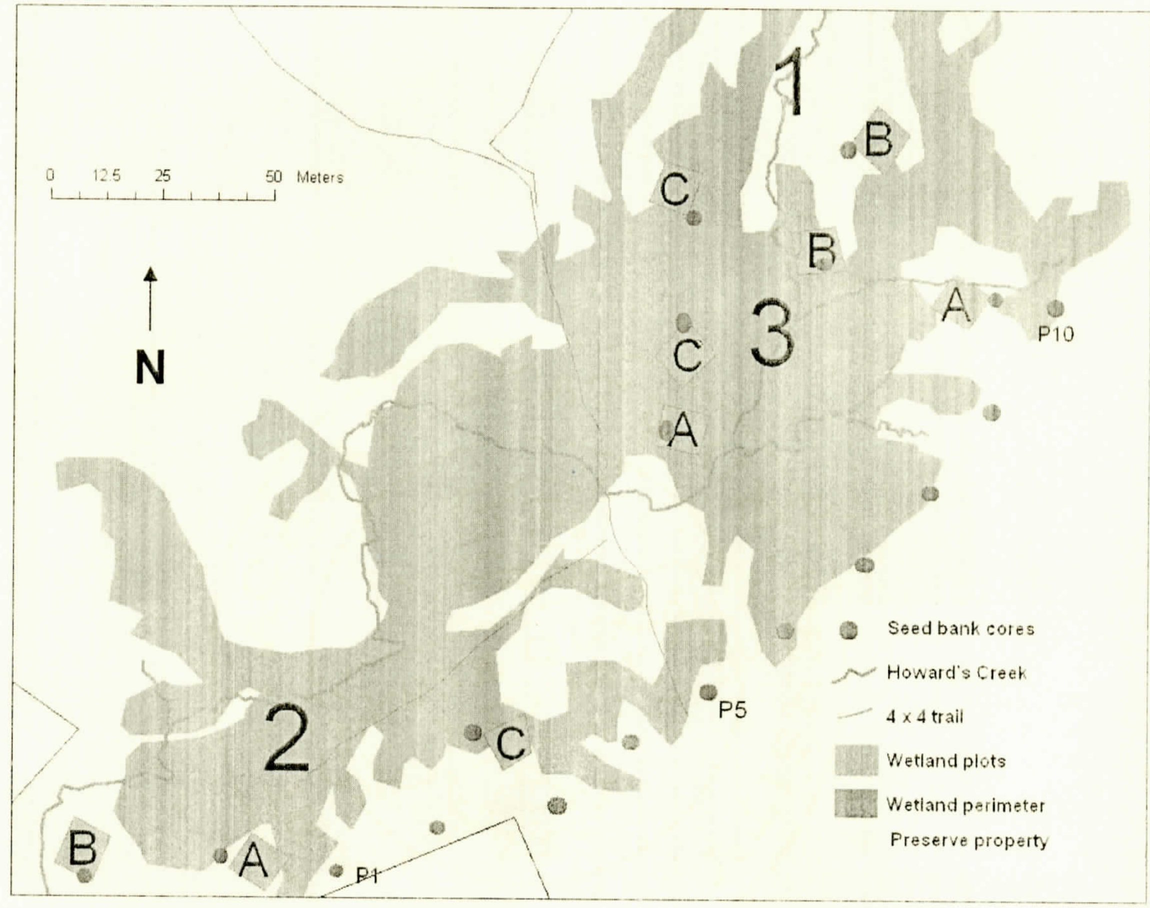

Figure 3. Tater Hill wetland zones, plot locations and seed bank cores.

($S_c = 2 \sum_{i=1}^{m} \min(X_i, Y_i) / \sum_{i=1}^{m} X_i + \sum_{i=1}^{m} Y_i$, where X_i and Y_i = the abundances of species i, $\sum_{i=1}^{m} \min(X_i, Y_i)$ = the sum of the lesser scores of species i where it occurs in both quadrats, m = number of species) were calculated for pairs of survey plots. These values range from 0 (completely dissimilar) to 1 (entirely similar) (Kent and Coker 1992).

Soil seed banks were investigated using the seedling emergence technique (Poiani and Johnson 1988) to examine the potential effects of water level change on future community composition. From June 13 to June 23, 2003 soil samples (6.35 cm diameter x 15.24 cm depth) were taken from the nine 10 x 10 m plots and ten areas along the east perimeter of the wetland at 20 m intervals. All soil core samples were placed into plastic bags and taken to the Appalachian State University Greenhouse for processing. Soil samples were standardized to 2.0 kilograms, spread evenly to a depth of approximately 2.5 cm, and placed in standard greenhouse flats (57 cm x 24 cm).

Half of the sample flats were placed outdoors in a constructed bog replicate. Recycled wood was used as a frame and cut to fit along the inside margin of a standard greenhouse bench. This wooden frame was then lined with plastic and stapled along the outside. Approximately 30 holes were punctured at even intervals in the plastic to simulate natural hydrologic conditions and prevent

stagnation. The remaining sample flats were placed next to the bog replicate on standard greenhouse benches that allowed for complete drainage. All samples were watered daily from June 13 to September 10, 2003 and as needed until October 23, 2003. From October 15 to October 23, 2003 all greenhouse flats were examined. All species that emerged were identified and their relative stem counts recorded.

RESULTS

Floristic survey

A total of 471 specific and infraspecific taxa representing 94 families were documented at Tater Hill Preserve from 2002-2004 (Table 1). The families most represented were Asteraceae (50 species), Poaceae (31 species), and Rosaceae (25 species). The richest genera were *Carex* (14 species), *Solidago* (8 species), and *Viola* (6 species). See Appendix A for a complete species list. Eleven species are listed on the North Carolina Natural Heritage Program Watch List, including the federally listed *Houstonia montana* Small, and *Lilium grayi* (Table 2). A total of 28 species (5.9%) found were non-native (Table 3). According to the United States Department of Agriculture Wetland Indicator Status, 38 (8.3%) species were obligate wetland species (OBL); 54 (12.1%) were facultative wetland species (FACW); 67 (15.0%) were facultative species (FAC); 93 (20.8%) were facultative upland species (FACU); 12 (2.6%) were obligate upland species (UPL); 180 (40.2%) did not have indicator status information available (N).

The recorded plant species richness of Tater Hill Preserve is 471, while the predicted species richness for 205 hectares is 496 species, (Wade and Thompson 1991). The relative species richness value is 94.9%, a -5.1% deviation value. The species richness of Tater Hill Preserve was compared

Table 1. Floristic summary of Tater Hill Preserve.

Division	Family	Genera	Total Species	Native	Non-native	Species Composition
	............................Number............................					..Percent
Lycopodiophyta	2	6	6	6	0	1.3%
Polypodiophyta	11	16	25	25	0	5.3%
Pinophyta	2	3	5	5	0	1.1%
Magnoliophyta						
Liliopsida	13	56	111	105	6	23.6 %
Magnoliopsida	66	189	324	300	24	68.7%
Total	**94**	**270**	**471**	**441**	**30**	

Table 2. Unique elements found at Tater Hill Preserve. Status identified by the North Carolina Natural Heritage Program. See Appendix B for status and rank definitions.

Species	Status		Rank	
	North Carolina	US	North Carolina	US
Aconitum reclinatum Gray	SR		S3	G3
Gentianopsis crinita (Froel.) Ma	E-SC		S1	G5
Goodyera repens (L.) R. Brown ex. Aiton	SR		S2S3	
Houstonia montana Terrell	E	E	S2	G2
Ilex collina Alexander	T		S1	G3
Lilium grayi S. Wats.	T-SC	SC	S3	G3
Lonicera canadensis Bartr. Ex Marsh.	SR-P		S2	G5
Platanthera grandiflora (Bigelow) Lindl.	SR-P		S2	G5
Platanthera peramoena (Gray) Gray	SR-P		S1	G5
Saxifraga pensylvanica L.	SR-P		S1	G5
Solidago uliginosa Nutt.	SR		S1S2	G4

Table 3. Non-native plants found at Tater Hill Preserve.

Achillea millefolium L.
Anthoxanthum odoratum L.
Arctium minus Bernh.
Barbarea vulgaris R. Brown
Berberis thunbergii DC
Cardamine hirsuta L
Cerastium glomeratum Thuill.
Chicorum intybus L.
Dactylis glomerata L.
Daucus carota L.
Dianthus armeria L.
Echinochloa crus-galli (L.) Beauv.
Lespedeza cuneata (Dumont) G. Don.
Leucanthemum vulgare Lam.
Lolium pratense (Huds.) S.J. Derbyshire
Medicago lupulina L.
Phleum pratense L.
Plantago lanceolata L.
Poa annua L.
Rosa multiflora Thunb. ex Murr.
Rumex acetosella L.
Rumex crispus L.
Taraxacum officianale Weber ex Wigg.
Trifolium pratense L.
Trifolium repens L.
Verbascum thapsus L.
Vicia caroliniana Walter
Vicia villosa Roth

to other floristic studies conducted from nearby areas and were divided into non-wetland and wetland habitat (Table 4). Non-wetland studies included are: Bluff Mountain (880 ha) in Ashe Co. NC containing 620 species (Tucker 1972), Phoenix Mountain (2330 ha) in Ashe Co., NC containing 440 species (Lacey 1979), Sims Pond (110 ha) in Watauga Co. NC containing 76 species (Livengood 1972), and Tablerock Mountain (1950 ha) in Burke Co. NC containing 401 species (Taylor 1974). Wetland studies included are: Celo bog-fen (0.4 ha) in Yancey Co. NC containing 175 species (McLeod 1996), Tulula bog (83 ha) in Graham Co. NC containing 107 species (Warren et al. 2004), and Boone Fork bog (3.2 ha) in Watauga Co. NC containing 116 species (Moore 1972).

Plant communities

A total of ten plant communities with 21 community subtypes were identified following the description of Weakley (2002). See Table 5 for all plant communities and associations identified.

High Elevation Red Oak Forest

This community type is found along the northern slope of Rich Mountain and in patchy areas along the south face of Tater Hill. To a lesser degree, this

Table 4. Species area comparisons to similar floristic studies. (W) indicates studies including wetland habitat.

	Location	Approximate area studied	Taxa	Taxa/ha
Bluff Mountain (Tucker 1972)	Ashe Co., NC	880 ha	620	0.705
Phoenix Mountain (Lacey 1979)	Ashe Co., NC	2330 ha	440	0.189
Simms Pond (Livengood 1972)	Watauga Co., NC	110 ha	76	0.691
Tablerock Mountain (Taylor 1974)	Burke Co., NC	1950 ha	401	0.206
Tater Hill Lake Basin (Flisser 1979)	Watauga Co., NC	2 ha	197	98.5 (W)
Tater Hill Preserve (Martin 2007)	Watauga Co., NC	205 ha	471	2.298 (W)
Tater Hill Bog (Martin 2007)	Watauga Co., NC	2 ha	131	65.5 (W)
Boone Fork Bog (Moore 1972)	Watauga Co., NC	3.2 ha	116	36.3 (W)
Celo Bog-Fen (McLeod 1996)	Yancey Co., NC	0.4 ha	175	437.5 (W)
Tulula Bog (Warren, Pittillo and Rossell 2004)	Graham Co., NC	83 ha	107	1.289 (W)

Table 5. Tater Hill Preserve plant communities (using categories of Schafale and Weakley, 2002).

Acidic Cove Forest (typic subtype)
Grassy Bald
High Elevation Birch Boulderfield Forest
High Elevation Red Oak Forest (heath subtype)
High Elevation Red Oak Forest (herb subtype)
High Elevation Red Oak Forest (orchard forest subtype)
High Elevation Red Oak Forest (sedge subtype)
Montane Oak Hickory Forest (acidic subtype)
Montane Oak Hickory Forest (typic substype)
Montane Oak Hickory Forest (white pine subtype)
Northern Hardwood Forest (forb beech gap subtype)
Northern Hardwood Forest (rich subtype)
Northern Hardwood Forest (typic subtype)
Rich Cove Forest (boulderfield subtype)
Rich Cove Forest (montane rich subtype)
Rich Montane Seep (high elevation type)
Southern Appalachian Bog (Long Hope Valley shrub subtype)
Southern Appalachian Bog (rhododendron subtype)
Southern Appalachian Bog (typic herb subtype)
Southern Appalachian Bog (typic shrub subtype)
Swamp Forest Bog Complex (typic subtype)

community type is also found near the summit of Harmon's Knob. Rich Mountain contains a good example of the herb subtype of this community, with *Quercus rubra* L., *Acer saccharum* Marsh., *Aesculus flava* Ait., *Fraxinus americana* L., *Fagus grandifolia* Ehrh., *Betula allegeniensis* Britt. dominating the canopy. The herb layer contains *Lillium superbum* L., *Arisaema triphyllum* L., and the occasional *Castanea dentata* Bockh. sprout. Also found within this area is the federally listed *Lilium grayi*. This area also includes an example of the orchard forest subtype, with *Quercus alba* L. and *Q. rubra* L. found in the canopy and *Carex spp.*, *Rudbeckia laciniata L.*, *Veratrum viride* Aiton, and *Impatiens pallida* Nutt. present in the herbaceous layer. These forests grade down slope into areas that could be delineated as a heath subtype or stunted heath subtype of this community, as the small-sized, high elevation *Rhododendron maximum* L., *R. catawbiense* Michx., and *Kalmia latifolia* L. gradually increase in size.

Northern Hardwood Forest

The north side of Rich Mountain contains an extensive northern hardwood forest (forb beech gap subtype). Gnarled, stunted *Fagus grandifolia* dominates the canopy, with a few individuals of similar sized *Quercus rubra* and *Q. alba*. The herbaceous layer contains a mixture of *Rubus sp.*, *Ageratina altissima* King and HE Robbins, and *Athyrium asplenoides* (Michx.) Eaton. A few individuals of *Lilium grayi* are also found. Along the perimeter of this area, near the summit's rock outcrops, this community grades into what may be considered the sedge beech gap subtype of this community as *Carex pensylvanica* Lam., *Carex scoparia* Schkuhr., and *Poa spp.* begin to dominate the herbaceous layer. Mixtures of both the typic and rich subtypes of this community are found in the steeply graded northern part of Rich Mountain, where *Betula allegheniensis, Fagus grandifolia, Acer saccharum, Cornus florida* L., *Acer spicatum* Lam., *Hamamelis virginiana* L., *Ribes glandulosum* Graver, and *Sambucus racemosa var. pubens* (L.) Koehne are found. A well-developed herbaceous layer of *Caulophyllum thalictroides* (L.) Michx., *Oxalis montana* Raf., *Oxypolis rigidior* Raf., *Allium tricoccum* Ait., *Dryopteris intermedia* (Muhl. ex Willd.), *D. marginalis* (L.) Gray, *Hydrophyllum virginianum* L., *Heuchera villosa* Michx., and *Geum geniculatum* Michx. can be found in these areas.

The middle and upper slope areas of Tater Hill Preserve contain good examples of the forb beech gap, Rich Subtype, and typic subtypes of northern hardwood forests. The forb beech gap subtype in these areas is dominated by stunted *Fagus grandiflora*, with minimal herbaceous cover besides *Epifagus virginiana* (L.) W. Bart. Mixtures of the rich and typic subtypes in this area include *Betula allegheniensis, Acer saccharum, Quercus rubra,* and *Aesculus flava*. Understory species include *Sambucus pubens var. racemosa, Ostyra virginiana* (Miller) K. Koch, *Acer spicatum, Ilex montana* Torr. & Gray ex Gray, *Vaccinium pallidum* Aiton, and *Cornus alternifolia* L. The herbaceous layer

includes *Erythronium americanum* Ker-Gawler, *Eurybia divercata* (L.) Nesom, *Rudbeckia laciniata, Monarda didyma* L., *Carex pensylvanica, Carex debilis* Michx., *Viola canadensis* L., *Laportea canadensis* (L.) Weddell, *Pycnanthemum muticum* (Michx.) Pers., *Scrophularia marilandica* L., *Clematis viorna* L., and *Cuscuta grovonii* Willd.

The southern and western slopes of Harmon's Knob also contain examples of the rich subtype and typic subtype northern hardwood forest communities. These areas are dominated by *Betula allegheniensis, Acer saccharum, Aesculus flava*, and to a lesser extent *Tsuga canadensis* (L.) Carr. Understory species include *Ilex montana, Cornus florida*, and *Ostyra virginiana*. Dominant forbs include *Cimicifuga racemosa* (L.) Nutt., *Dryopteris intermedia, Heuchera americana* L., *Angelica triquinata* Michx., *Geranium maculatum* L., *Cardamine concatenate* (Michx.) O. Schwartz, and *Hydrophyllum virginianum*. Stands of *Fagus grandifolia* are present throughout the area, which could be considered examples of the forb beech subtype.

Montane Oak-Hickory Forest

These forests co-occur with northern hardwood forests on the south and west portions of Harmon's Knob, including the crest. The typic subtype of this community is commonly found at Tater Hill Preserve with dominant canopy trees that include *Carya ovata* (P. Mill.) K. Koch, *C. glabra* P. Mill., *Quercus rubra, Q.*

alba, *Fraxinus americana*, *Aesculus flava*, and *Acer saccharum*. Understory species include *Cornus alternifolia*, *Corylus cornuta*, and *Ilex montana*. The herbaceous layer is well represented, including *Trillium grandiflorum* (Michx.) Salisb., *Cimicifuga racemosa*, *Caulophyllum thalictroides*, *Trillium erectum* L., *Uvularia grandiflora* Sm., *Prosartes lanuginosa* (Michx.) D. Don., *Actaea pachypoda* Ell., *Thelypteris noveborensis* L., *Arisaema triphyllum, Zizia trifoliata* (Michx.) Fern., and *Polystichum acrosticoides* L.

Areas of heavy *Rhododendron maximum* and *Kalmia latifolia* are present, especially on the far western and northern flanks of Harmon's Knob. Some of these areas include stands of *Quercus alba* and *Castanea dentata*. Considering this and the low numbers of herbaceous species found these stands, these areas could possibly be delineated as the acidic subtype of this community. Stands of *Pinus strobus* L. are present, which could be considered the white pine subtype.

Southern Appalachian Bog

Five plant communities are found within and surrounding the former lakebed. The northeastern portion of the bog, Zone 1 (Figure 3), consists of a water table that intersects the surface creating an area of approximately 1,280 m^2 that remains wet throughout the year as the result of groundwater discharge (Molina, in preparation). Sphagnum and peat accumulations reach 80 cm in many areas and overlay colluvial deposits likely established by large flooding

events and debris flow. Surface water within Zone 1 has incised a small ephemeral stream that drains towards the main channel. The western portion of this bog, Zone 2, is an area of approximately 420 m^2. This region contains colluvium overlain with depths of 40 cm of mineral soil and an O horizon that, in most places, is less than 10 cm deep. This area's water table intersects the surface throughout the year, with distinguishable O, A, and B soil horizons and a depth to refusal over 90 cm (Molina, in preparation).

This entire area is a Southern Appalachian Bog typic herb subtype community. Although herb dominated, encroaching woody species such as *Acer rubrum* and *Pinus strobus* of all sizes are common, with abundant colonial shrubs including *Salix sericea* Marsh., and *S. nigra* Marsh. Understory woody species include *Rhododendron calendulaceum* (Michx.) Torr., *Rosa palustris* Marsh., *R. carolina* L., *Viburnum cassanoides* L., and *Sorbus americana* Marsh. The raised perimeter contains a variety of smaller shrubs including *Hypericum densiflorum* Pursh., *Lyonia ligustrina* (L.) DC., *Vaccinium corymbosum* L., and to a lesser extent *Leucothoe recurva* (Buckl.) Gray. Sedges, rushes, and grasses dominate the herbaceous layer including: *Carex lurida* Wahl., *C. crinita*, *C. scoparia*, *C. atlantica* Bailey, *Juncus debilis* Gray, *J. effusus* L., *Scirpus expansus* Fern., *S. cyperinus* (L.) Kunth., *S. atrovirens* Willd., *Eleocharis tenuis* (Willd.) J.A. Schultes, *E. obtusa* J.A. Schultes, and *Rhynchospora capitellata* (Michx.) Val. Bryophytes and other non-vascular species are also abundant including

Sphagnum spp., *Aulacomnium palustre* (Hedw.) Schwaegr. and *Campyllium chrysophyllum* (Brid.) J. Lang (Wynns, pers. comm.). Dominant spring herbaceous species include *Drosera rotundifolia* L., *Houstonia serpyllifolia* Michx., *Rubus hispidus* L., and *Fragaria virginiana* Duchesne, while in the fall *Solidago caesia* L., *Lycopus virginicus* L., *Gentiana clausa* Raf., *Platanthera lacera* (Michx.) G. Don., and *Spiranthes cernua* (L.) L.C. Rich., are common. Pteridophytes found in these areas include *Osmunda cinnamomea* L., *O. regalis var. spectabilis* (Willd.) A. Gray, *O. claytoniana* L., and to a lesser extent *Botrypus virginianum* (L.) Holub. and *Lygodium palmatum* (Bernh.) Sw. Populations of the federally listed species *Lilium grayi* and *Gentianopsis crinita* (Froel.) Ma., are found in this vicinity. Additionally, the state listed *Saxifraga pensylvanica* L. is found in this community. Other species of interest found in these areas include *Isoetes engalmanii* A. Braun, *Sagittaria latifolia* Willd., and *Trillium undulatum* Willd.

Surrounding this Southern Appalachian Bog typic herb subtype are many elements and combinations of the following Southern Appalachian Bog subtype communities: Long Hope Valley shrub subtype, typic shrub subtype and rhododendron subtype. Also found in surrounding areas are examples of the Swamp Forest Bog typic subtype complex community. The slight rise in topography surrounding the former lakebed contains species described within the Long Hope Valley shrub subtype. These areas contain populations of *Lilium*

grayi and *Ilex collina*. Also found are the State listed *Lonicera canadensis* Bartr. ex Marsh., *Aconitum reclinatum* Gray, and *Platanthera grandiflora* (Bigelow) Lindl. Common woody species include *Salix sericea*, *Viburnum cassanoides*, *Clethra acuminata* Michx., *Ribes rotundifolium* Michx., *Ilex verticillata* (L.) A. Gray, and *Kalmia latifolia*. Present in high numbers are *Acer rubrum*, *Pinus strobes*, and *Tsuga canadensis*. The open herbaceous layer of the former lakebed is dominated by *Carex atlantica*, *C. gynandra* Scheinitz, *C. scoparia*, *Rhynchospora capitellata*, *Eriophorum virginianum* L., *Oxypolis rigidior*, *Glyceria canadensis* (Michx.) Hubbard, *G. melicaria* (Michx.) Hubbard, and *Huperzia lucidulum* (Michx.) Trevisan. Other less common herbaceous species include *Lonicera dioica* Batr. Ex Marsh., *Mimulus ringens* L., *Erythronium americanum*, *Veratrum parviflorum* (Michx.) S. Wats., and *Chelone glabra* L.

A series of open flat seeps and seasonal riparian areas north of the bog could be considered the typic subtype of a Swamp Forest Bog Complex. Woody species surrounding these open patches include *Acer rubrum*, *Viburnum cassanoides*, *Ilex collina*, and *I. verticillata*. Dominant herbaceous species include *Carex gynandra*, *C. crinita*, *C. lurida*, *Rhynchospora capitellata*, including patchy and at times large stands of *Sphagnum spp.* and *Osmunda cinnamomea*. Populations of the state listed *Aconitum reclinatum* are also found in these areas. Other steep gradient areas contain these same elements and could possibly be considered High Elevation Boggy Seep communities.

Large, wet stands of *Rhododendron maximum* and *Sphagnum spp.* with otherwise sparse herbaceous cover are also present within flat areas west and north of the bog. These areas could be considered the rhododendron subtype of a Southern Appalachian Bog.

The southern portion of the bog, Zone 3, encompasses 243 m^2 and is located near the discharge area for the entire basin (Molina, in preparation). This area generally does not contain standing water but does contain a small series of seeps near the main channel to the south. This region is considered to be a Southern Appalachian Bog typic shrub subtype. Medium sized shrubs are abundant in this area, including *Salix sericea*, *S. nigra*, *Lyonia ligustrina*, *Hypericum densiflorum*, *Rubus allegheniensis*, *Sambucus canadensis* L., and *Rosa palustris*. Grasses, sedges, rushes, and asters dominate the herbaceous layer, including *Scirpus expansus*, *S. cyperinus*, *Carex lurida*, *Juncus effuses* L., *Schoenoplectus purshianus* (Fern.) M.T. Strong, *Solidago caesia*, *Osmunda cinnamomea*, *Eupatorium perfoliatum* (L.) Boneset, and *Galium tinctorium* L.

Rich Cove Forests

The montane rich cove forest subtype surrounds much of Tater Hill Bog intermixing with many of the other community types found within this site. Predominant canopy species include *Tsuga canadensis, Acer rubrum, Magnolia fraseri* Walter, *Magnolia acuminata* L., *Betula allegheniensis, Aesculus flava, Tilia*

americana L., *Quercus rubra*, and *Q. alba*. Subcanopy trees and shrubs include *Fagus grandifolia, Ostyra virginiana, Hydrangea arborescens* L., *Hamamellis virginiana, Rhododendron calenduleceum, Viburnum lantanoides* Michx., *Rhododendron maximum, Robinia pseudoacacia* L., *Ilex montana*, including small individual *Lonicera canadensis*. The herbaceous layer is dense and supports populations of the State listed *Cardamine rotundifolia* Michx., as well as *Clintonia umbellulata* (Michx.) Morong, *Aralia racemosa*, *Arisaema triphyllum*, *Actaea pachypoda*, *Caulophyllum thalictroides, Lycopodium obscurum* L., *Cimicifuga racemosa, Trillium erectum, T. grandiflorum, Uvularia perfoliata* L., *U. grandiflora, Sanguinaria canadensis* L., *Aristolochia macrophylla* Lam., *Polystichum acrosticoides, Adiantum pedatum* L., *Dryopteris marginalis*, and occasionally *Panax quinquefolius* L.

These high elevation Rich Cove Forests contain scattered and at times numerous boulder fields that could be considered the boulderfield subtype. The canopy consists of *Betula allegheniensis*, *Fagus grandifolia*, *Aesculus flava*, and occasionally *Quercus rubra* and *Q. alba*; while vines such as *Ipomea pandurata* L., *Cuscuta grovonii*, *Clematis viorne*, pteridophytes such as *Asplenium platyneuron* L., and *Polypodium virginianum* L., and herbaceous species such as *Campanulastrum americana* L. Small and *Heuchera americana* occupy habitable areas of the rocky substrate.

Scattered throughout Tater Hill Preserve are high elevation rich montane seeps that contain *Viburnum lantanoides, Lilium grayi, Rudbeckia laciniata, R. triloba L., Saxifraga micranthidifolia* (Haw.) Steud., *Chelone glabra, Impatiens pallida, I. capensis* Meerb., *Monarda didyma, Diphylleia cymosa* Michx., and occasionally *Osmunda cinnamomea, Carex crinita* and *C. atlantica.*

Acidic Cove Forest

The typic subtype of this community is found scattered throughout the site and is common throughout the preserve. Acid tolerant, mesophytic trees such as *Liriodendron tulipifera* L., *Tsuga canadensis*, and *Acer rubrum* are present, with *Rhododendron maximum* dominating large regions. Other areas contain large stands of *Tsuga canadensis*. Herbaceous cover is sparse, with *Galax urceolata* (Poir.) Brummitt, *Goodyeara pubescens* (Willd.) R. Br. ex. Aiton, *Mitchella repens* L., and *Epigea repens* L. occasionally found.

Grassy Bald

Large meadows occur at the tops of both Tater Hill and Rich Mountain. Historically, these areas have been heavily grazed, but do have many elements of a grassy subtype of this community. This community contains populations of the federally listed *Geum geniculatum, Lilium grayi,* and *Houstonia montana.* Large woody species are scarce, although scattered. Stunted trees and mid-

sized shrubs such as *Rhododendron catawbiense, Abies fraseri* (Pursh.) Poiret, *Rubus allegheniensis,* and *Ribes glandulosum* are present. Herbaceous species such as *Sibbaldiopsis tridentata, Danthonia compressa* Austin ex. Peck, *Saxifraga michauxii, Heuchera villosa, Luzula acuminata* Raf., *Lilium superbum, Agrostis gigantea* Roth, *Schizachyrium scoparium* Michx. Nash, *Danthonia spicata* (L.) Beauv. ex Roemer & J.A. Schultes, *Juncus tenuis* Willd., *Athyrium asplenoides, Paronychia argyrocoma* (Michx.) Nutt., and *Oclemena acuminata* L. are present.

Collection time was limited and voucher specimens are underrepresented from certain areas of the preserve. The recently acquired northernmost parcels, including the high elevation grassy balds and meadows found on top of Rich Mountain and its southern and southeastern flanks have been recently purchased and are in need of further study. Also in need of further investigation are the most recently acquired areas west of the bog, where sightings of the federally listed *Vaccinium macrocarpon* Aiton have been reported.

Wetland vegetation analysis

A total of 130 taxa were identified from the nine 10x10 m sample areas (see Appendix C). The plot with the most species present in fall 2002 was plot B1, which had 42 species (Table 6). In both spring and fall 2003, plot C3 had the most species present, 52 and 63 species, respectively. The plot with the fewest

Table 6. Number of plant species found within each wetland plot. Shannon-Weiner diversity index values (H') are in parentheses. Evenness values (J) are given below.

	Fall 2002	Spring 2003	Fall 2003
A1	39 (3.046) 0.831	37 (2.915) 0.807	48 (2.895) 0.748
B1	42 (3.18) 0.851	45 (2.905) 0.763	54 (2.885) 0.723
C1	40 (2.725) 0.739	45 (3.248) 0.853	54 (3.571) 0.895
A2	28 (2.752) 0.826	45 (2.794) 0.734	45 (2.709) 0.712
B2	23 (2.471) 0.788	32 (2.663) 0.769	35 (2.899) 0.815
C2	31 (2.906) 0.846	51 (3.358) 0.854	50 (2.806) 0.717
A3	33 (3.194) 0.914	48 (3.159) 0.816	30 (2.784) 0.819
B3	40 (3.194) 0.866	42 (3.04) 0.813	41 (2.906) 0.783
C3	34 (2.919) 0.828	52 (3.353) 0.849	63 (3.364) 0.812

species in fall 2002 was plot B2 (23). In spring 2003, it was plot B2 (32), and in fall 2003, it was plot A3 (30). Plots with the lowest Shannon-Weiner diversity index values were: fall 2002 B2 (2.471), spring 2003 B2 (2.663), fall 2003 A2 (2.709). Plots with the highest diversity index values were: fall 2002, A3 and B3 (3.194), spring 2003, C2 (3.358), and fall 2003, C1 (3.571).

Czekanowski's coefficient of similarity values (Table 7) were calculated, and determined the least similar plots in fall 2002 to be: A2 and C3 (0.06), B2 and C3 (0.10), and A2 and C2 (0.16). In the spring 2003, B2 was the least similar with A1 and B1 (0.07), and B3 (0.09). In the fall of 2003, plots A2 and C1 (0.18), A1 and B2 (0.19), and B2 and C3 (0.19) were the least similar. The most similar plots in fall 2002 were A1 and B1 (0.51). In spring of 2003, B1 was the most similar plot to B3 (0.57), and A1 was similar to B1 (0.56) and B3 (0.53). In fall 2003, plot B1 was the most similar to B3 (0.58) and A1 (0.50). All plant species found in the 10x10m plots for the fall of 2002, spring 2003 and the following fall with their relative percent cover is provided in Appendix C.

<u>Seed bank study</u>

In the seed bank study, a total of 24 vascular plants and six different bryophytes emerged from the experimental flats (Table 8). Twenty-five different species emerged from the saturated flats, with a total of 2426 stems. Twenty-four

Table 7. Czekanowski's coefficient of similarity between plots for the three sample seasons.

Fall 2002

	B1	C1	A2	B2	C2	A3	B3	C3
A1	0.51	0.18	0.20	0.24	0.25	0.33	0.38	0.22
B1		0.25	0.17	0.25	0.35	0.43	0.32	0.28
C1			0.08	0.23	0.28	0.34	0.17	0.45
A2				0.40	0.16	0.24	0.22	0.06
B2					0.29	0.34	0.24	0.10
C2						0.43	0.17	0.30
A3							0.32	0.43
B3								0.22

Spring 2003

	B1	C1	A2	B2	C2	A3	B3	C3
A1	0.56	0.28	0.22	0.07	0.28	0.40	0.53	0.23
B1		0.25	0.27	0.07	0.27	0.35	0.57	0.22
C1			0.18	0.15	0.36	0.33	0.39	0.33
A2				0.46	0.39	0.36	0.24	0.20
B2					0.18	0.17	0.09	0.15
C2						0.44	0.37	0.31
A3							0.49	0.34
B3								0.31

Fall 2003

	B1	C1	A2	B2	C2	A3	B3	C3
A1	0.50	0.25	0.20	0.19	0.22	0.30	0.38	0.30
B1		0.26	0.20	0.13	0.36	0.42	0.58	0.40
C1			0.18	0.26	0.24	0.33	0.28	0.37
A2				0.28	0.31	0.25	0.22	0.21
B2					0.22	0.22	0.21	0.19
C2						0.46	0.34	0.32
A3							0.36	0.43
B3								0.38

Table 8. Emergent plant species and stem counts from seed bank study.

	Saturated	Natural	Total
Achillea millefolia	0	1	1
Aster sp.	0	1	1
Aulacomnium palustre	101	60	161
Dicanthelium depauperatum	601	505	1106
Dicanthelium laxiflorum	70	80	150
Drosera rotundifolia	1	0	1
Eleocharis tenuis	889	162	1051
Epilobium leptophyllum	5	0	5
Eupatorium perfoliatum	18	3	21
Galium tinctorium	26	3	29
Houstonia serpyllifolia	77	107	184
Hypericum sp.	298	62	360
Juncus acuminatus	5	1	6
Lycopus virginiana	21	0	21
Mnium sp.	2	0	2
Moss sp. 1	27	20	47
Moss sp. 2	19	25	44
Poa sp.	17	0	17
Polytrichum sp.	144	29	173
Potentilla canadensis	6	2	8
Rubus canadensis	12	13	25
Schizachyrium scoparia	0	3	3
Scirpus sp.	4	0	4
Selaginella apoda	24	5	29
Senecio sp.	12	4	16
Solidago sp. 1	15	7	22
Solidago sp. 2	0	1	1
Sphagnum sp.	15	7	22
Thuidium sp.	17	5	22
Viola sp.	26	18	44
Total species	**25**	**24**	**29**
Total stem count	**2426**	**1106**	**3532**

different species emerged from the well-drained experimental flats, with a total of 1106 stems. The most dominant species in both the saturated (S) and natural conditions (N) that emerged in this study was *Dicanthelium depauperatum* (601 S, 505 N). Species that had the largest differences in total stem counts between saturated and natural conditions were *Eleocharis tenuis* (889 S, 162 N), *Hypericum sp.* (298 S, 62 N), and *Polytrichum sp.* (144 S, 29 N). Species that emerged in saturated conditions but not in natural conditions were *Drosera rotundifolia* L. (1 S), *Lycopus virginiana* Michx. (21 S), *Epilobium leptophyllum* Raf. (5 S), *Mnium sp.* (2 S), *Poa sp.* (17 S), and *Scirpus sp.* (4 S). Species that had more than twice the number of stems emerge in saturated conditions than in natural conditions were *Polytrichum sp.* (144 S, 29 N), *Selaginella apoda* (L.) Spring, (24 S, 5 N) *Senecio sp.* (12 S, 4 N), *Solidago* sp. 1 (15 S, 7 N), and *Thuidium sp.* (17 S, 5N). Species that emerged in natural conditions but not saturated conditions were *Achillea millefolia* (1 N), *Aster sp.* (1 N), *Schizachyrium scoparia* (3 N), and *Solidago sp. 2* (1 N). *Houstonia serpyllifolia* (77 S, 107 N) was the only other species that had more emergent stems in natural conditions than in saturated conditions.

DISCUSSION

The 471 vascular plants documented in this study, including 11 rare and endangered species, ten different plant communities, and 21 community subtypes confirms that Tater Hill Preserve is of high quality in terms of biodiversity in the Southern Appalachians. In comparision with other floristic studies done in this area, the total species richness of Tater Hill Preserve is intermediate to other study areas sampled. However, when taxa/hectare is calculated, Tater Hill Preserve's richness is greater than many of the larger areas studied. In fact, from the floristic studies examined that include wetland habitat, there is a dramatic increase in species per hectare when compared with those studies that don't include wetland habitat. This further underscores the importance and significance of wetland habitat preservation in the southern Appalachians.

A majority of the rare and endangered plants found at Tater Hill Preserve, including *Aconitum reclinatum, Houstonia montana, Ilex collina,* and *Lilium grayi* are southern Appalachian endemics, generally occurring in small isolated populations (Weakley 2006; Boetsch and Nielsen 2003). Many other plant species in this area have a northern affinity and were likely left in the Southern Appalachians after the retreat of the latest continental glacial maximum 18,000 years ago (Shafer 1986). The high degree of landscape connectivity to other significant Amphibolite Mountains Macrosite areas such as Long Hope Valley, Bluff Mountain, and Three Top Mountain (Oakley 2000) makes Tater Hill Preserve a critical component for maintaining these populations of northern disjunct and endemic species.

The single greatest threat to biodiversity is habitat loss followed by the spread of alien species, with nearly half of the imperiled species in the United States at risk because of these two factors (Wilcove et al. 1998). At this time, the impact of many of the 30 non-native taxa found in this study appears to be minimal and manageable at least in high quality areas. However, a primary concern is the effect of *Rosa multiflora* Thunb. ex Murr. on the endangered plants found in nearby wetland communities. Introduced from Asia, it has the potential to become prolific and destroy perimeter areas once it becomes established (Robertson et al. 1994). Concern should be focused on areas west of the wetland in what was formerly the old baseball diamond. A number of large colonies of *R. multiflora* occupy this disturbed area, and priority should be given to further assess their ability to colonize and displace closely related native species such as *Rosa palustris* within high-elevation wetlands.

Detailed surveys within the wetland were conducted to provide descriptive and numerical data to represent the local diversity. The 131 plant taxa documented supports the idea that, although disturbed, this is a good example of the species diversity found in southern Appalachian wetlands. The number of

species found in the 10x10 m sample areas indicates that zone one, the northernmost portion of the bog, is the most locally diverse. Shannon-Weiner diversity index and evenness values also indicate that the northern portions of the bog are some of the most locally diverse areas. These data, along with the existing populations of rare and endangered plant species, confirms that this area and the surrounding perimeter areas should remain a priority for preservation and management.

The Czekanowski coefficient values generated in this study suggested high levels of habitat diversity within this study area and indicate that there were at least two separate wetland communities within the former lakebed prior to beaver inundatation. The apparent reason for this high degree of diversity is a combination of minerotrophic conditions created by the local hydrology and the numerous microhabitats created by *Sphagnum sp.* hummocks.

A vascular flora inventory was conducted following the dam failure of 1977 within the former lakebed (Flisser 1979). A 10-meter strip surrounding the former lake basin was surveyed, and 197 species were identified. *Gratiola virginiana* L. was identified as being the first flowering vascular plant to colonize the drained lakebed and *Typha latifolia* L. was described as prevalent in and around the perimeter. Neither of these two species was found in this study. These species are frequent colonizers of pioneer habitat (Smith 1967), and were likely outcompeted by other plant species from the time of this study. Additionally, an abundance of aquatic species such as *Callitriche heterophylla* Pursh. and *Sagittaria latifolia* Willd. was reported. In this study, the number of individuals of *C. heterophylla* was low (less than 5) and restricted to one or two areas, while *S. latifolia* was not located. Of note was a population of *Tsuga caroliniana* Engel. listed in Flisser's year, but this species was not identified in this survey. Also mentioned was the rapid colonization of maples and pines in the northern half of the bog. These colonization patterns are not surprising, yet they do provide insight into how quickly successional patterns can occur in disturbed southeastern high elevation wetlands.

In the winter of 2003-2004, beavers moved into the southern portions of Tater Hill bog and have remained until present. This study indicates that no primary plant species of concern were documented in this area prior to this. In the summer of 2005, the northern portions of the bog began to become flooded. The open sphagnum patches and microtopography that provides the current suitable habitat for rare and endangered plants such as *Saxifraga pensylvanica*, *Lilium grayi*, and *Gentianopsis crinita* could be jeopardized. It is also possible that expansion into the shrubby marginal areas of the old lakebed that provides habitat for *Ilex collina* and *Lonicera canandensis* could be affected as well. Studies to examine long-term inundation on seed recruitment of these species would provide a better understanding of how beaver will effect these populations. Encroachment of woody species such as *Pinus strobus* and *Acer rubrum* should

also be monitored; although the recent beaver activity could naturally maintain and control this problem.

Soil seed banks represent the viable reserves of seeds in soil and help predict future vegetation communities (Rossell and Wells 1999). As environmental conditions change, species that are adapted to these conditions change so that those present in the seed bank are recruited and become established (van der Valk and Davis 1976; van der Valk et al. 1992). Data collected from the seed bank study during the summer of 2003 were designed to simulate the effects of beaver inundation on plant community dynamics.

The 24 vascular plant species and six bryophytes that emerged from these seed bank studies indicate that beaver activity Tater Hill Preserve's wetland will promote the growth of graminoids such as *Eleocharis tenuis, Dicanthelium depauperatum,* and *D. laxiflorum* as they constitute much of the current seed reserve. The seed dispersal capabilities of these common colonizing grasses could have entered the outdoor growing conditions of this study and contributed to these results. Other wetland indicator species such as the herbaceous *Hypericum sp.*, *Houstonia serpyllifolia*, and the mosses *Aulacomnium palustre* and *Polytrichum sp.*, and to a lesser extent *H. serpyllifolia* and *Aulacomnium palustre*, could also increase in abundance in the presence of beavers in Tater Hill Preserve.

Seed bank studies in a southern Appalachian forest gap bog complex in Graham County, North Carolina resulted in 32 taxa emerging, with graminoids such as *Juncus spp.* dominating (Rossell and Wells 1999). Similar studies conducted in a high elevation sphagnum bog in West Virginia identified 12 different species consisting predominantly of *Juncus effusus* and *Carex cannescens* L. (McGraw 1987). Seed banks from seven different Carolina bays in South Carolina found a total of 69 species that emerged, with a maximum of 35 species within one site that were dominated by wetland-dependent grasses, sedges and forbs such as *Panicum verrucosum* Muhl., *Scleria reticularis* Michx., and *Ludwigia linearis* Walter (Poiani and Dixon 1995). These seed bank studies, along with my data, suggest that most of the seed bank reserves in southern Appalachian wetland systems are dominated by grasses, sedges, and rushes. These species will initially germinate in beaver-saturated conditions.

Donor seed banks have been used to restore former wetlands by covering the disturbed area with a layer of topsoil from existing wetlands. Wetlands can become established quickly given similar environmental and hydrological conditions (van der Valk et al. 1992). There is a great deal of potential using seed banks for restoration purposes in the high elevation wetlands of the Southern Appalachians.

The overall preservation of Tater Hill Preserve and its surrounding areas is essential. There is an immense value to these high elevation areas due to high

levels of species diversity. The populations of threatened and endangered taxa depend on the preservation of this suitable habitat. In an area in which the landscape is constantly changing due to a variety of reasons, additional inventory and long-term studies should be conducted. Land acquisitions and conservation easements with neighboring landowners should be pursued in order to create buffer zones around the preserve that lessen the impact of regional development.

In closing, it is hoped that this work will assist in the management of this area and inspire future botanical and ecological studies of high elevation southern Appalachian wetlands.

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APPENDIX A

Annotated Checklist of the Vascular Flora of Tater Hill Preserve

Nomenclature follows Weakley (2006) and Kartesz (1994). The flora is divided into the following major groups: Lycopodiophyta, Polypodiophyta, Pinophyta, and Magnoliophyta. The Magnoliophyta are further divided into Magnoliopsida and Lilliopsida. All families and genera within these groups are arranged in alphabetical order. Species that are classified under the North Carolina Natural Heritage Program Watch List (Franklin and Finnegan 2004) are in bold print. Non-native species are preceded with an asterisk. The United States Department of Agriculture wetland indicator status (OBL-obligate, FACW-facultative wetland, FAC-facultative, FACU facultative upland, UPL-upland, N-information not available) follows each species name.

LYCOPODIOPHYTA

LYCOPODIACEAE

Dendrolycopodium obscurum (L.) A. Haynes, FACU (Martin 025)
Diphasiastrum digitatum Dill.ex A. Braun, N (Martin 189)
Huperzia lucidula Michx. Trevisan, FACW
Lycopodiella inundata L., OBL
Lycopodium clavatum L., FAC

SELAGINACEAE

Selaginella apoda (L.) Spring, FACW

POLYPODIOPHYTA

ASPLENIACEAE

Asplenium montanum Wild., N
Asplenium platyneuron L. FACU (Martin 159)
Asplenium trichomanes, L., N

DENNSTADIACEAE

Dennstaedtia punctilobula (Michx.) Moore, N (Martin 225)
Pteridium aquilinum (L.) Kuhn *var. latiusculum* (Devaux) Underwood ex. Heller, FACU (Martin 163)

DRYOPTERIDACEAE

Athyrium asplenoides (Michx.) Eaton, N (Martin 212)
Dryopteris cristata (L.) A. Gray, OBL
Dryopteris intermedia (Muhl. ex Willd.) Gray, FACU (Martin 223)
Dryopteris marginalis (L.) Gray, FACU (Martin 128)
Onoclea sensibilis L., N
Polystichum acrostichoides L., N (Martin 134)

EQUISETACEAE

Equisetum arvense L., FAC (Martin 137)

ISOETACEAE

Isoetes engelmannii A. Braun, OBL (Martin 117)

LYGODIACEAE

Lygodium palmatum (Bernh.) Sw., N (Martin 030)

OPHIOGLOSSACEAE

Botrypus virginianum (L.) Holub., N
Sceptrydium dissectum Spreng. Lyon, FAC

OSMUNDACEAE

Osmunda cinnamomea L., FACW (Martin 153)
Osmunda claytoniana L., N
Osmunda regalis var. spectabilis (Willd.) A. Gray, N (Martin 096)

PTERIDACEAE

Adiantum pedatum L. FACU (Martin 068)

THELYPTERIDACEAE

Phegopteris hexagonoptera (Michx.) Fée, FACU (Martin 127)
Thelypteris noveboracensis L., N
Thelypteris palustris Schott *var. pubescens* (Lawson), N (Martin 220)

POLYPODIACEAE

Pleopeltis polypodidoides (L.) E.G. Andrews & Windham, N
Polypodium virginianum L., N (Martin 173)

PINOPHYTA

CUPRESSACEAE

Juniperus virginiana L., FACU

PINACEAE

Pinus pungens Lambert, FACU
Pinus strobus L. FACU
Pinus virginiana P. Mill., N
Tsuga canadensis (L.) Carr., N

MAGNOLIOPHYTA

MAGNOLIOPSIDA

ACERACEAE

Acer pensylvanicum L., FAC
Acer rubrum var, rubrum L., FAC
Acer saccharum Marsh., FAC
Acer spicatum Lam., N (Martin 194)

ADOXACEACE

Sambucus canadensis L., FAC (Martin 123)
Sambucus racemosa var. *pubens* (Michx) Koehne, FACW (Martin 063)
Viburnum lantanoides Michx., FAC (Martin 181)
Viburnum cassinoides L., FACW (Martin 119)
Viburnum prunifolium L., FACU

ANACARDIACEAE

Rhus glabra L., N
Rhus typhina L., N

APIACEAE

Angelica triquinata Michx.,FAC
**Daucus carota* L. FAC
Heracleum maximum Bartr., FAC
Osmorhiza claytonii (Michx.) C.B. Clarke, FAC (Martin 051)
Oxypolis rigidior (L.) Raf., OBL (Martin 046)
Sanicula marilandica L. FACU
Thaspium barbinode (Michx.) Nutt., UPL (Martin 207)
Thaspium trifoliatum var. aureum (L.) Gray Britt., N
Thaspium trifoliatum (L.) Gray var. *trifoliatum,* N (Martin 019)
Trautvatteria carolinensis (Walter) Vail, N (Martin 071)
Zizia trifoliata (Michx.) Fern., FAC (Martin 091)

APOCYNACEAE

Asclepias exaltata L., N
Asclepias syriaca L., N
Asclepias tuberosa L., N

AQUIFOLIACEAE

Ilex ambigua (Michx.) Torrey, N
Ilex collina Alexander, N (Martin 054)

Ilex montana Torr. & Gray ex Gray, N (Martin 121)
Ilex opaca Ait., FAC
Ilex verticillata (L.) A. Gray, FACW (Martin 184)

ARACEAE

Arisaema triphyllum L. (Schott), FACW (Martin 047)
Peltandra virginica (L.) Schott & Endl., OBL (Martin 087)

ARALIACEAE

Aralia racemosa ssp. racemosa L., N (Martin 047)
Panax quinquefolius L., N

ARISTOLOCHIACEAE

Aristolochia macrophylla Lam., N
Asarum canadense L., N

ASTERACEAE

**Achillea millefolium* L., FACU
Ageratina altissima (L.) King & H.E. Robins, N
Ageratina rugosum Houttyn, FACU (Martin 200)
Ambrosia artemisiifolia L., FACU (Martin 183)
Antennaria solitaria Rydb., N
**Arctium minus* Bernh., N
Arnoglossum atriplicifolium L., N
Arnoglossum muehlenbergii (Schultz-Bip.) H.E. Robins., N
Bidens tripartita L., OBL (Martin 226)
Cacalia atriplicifolia L., FACU (Martin 064)
Centaurea maculosa DC., N (Martin 113)
**Chicorum intybus* L., FACU
Cirsium discolor (Muhlenberg ex. Willdenow), FACU (Martin 089)
Cirsium vulgare (Savi) Ten., FAC
Doelingeria umbellata (P. Miller) Nees, FAC
Erigeron pulchellis Michx., FACU
Erigeron strigosus var. strigosus (Muhl.) ex. Willd., FAC (Martin 007)
Eupatoriadelphus fistulosus Barratt, FAC (Martin 214)
Eupatoriadelphus purpureus L., N (Martin 122)
Eupatorium perfoliatum (L.) *var. perfoliatum* OBL
Eupatorium rugosum Houttyn FAC (Martin 203)
Eurybia chlorolepis (Burgess) Nesom, N
Eurybia divercata (L.) Nesom, N
Eurybia macrophylla (L.) Cassini, N
Helenium autumnale L., FACW (Martin 185)
Helianthus decapetalus L., N (Martin 220)
Helianthus tuberosus L., N (Martin 196)
Hieracium caespitosum Dumort., N
Hieracium paniculatum L., N (Martin 232)
Hieracium pratense Tausch, N (Martin 225)
**Leucanthemum vulgare* Lam, N (Martin 219)
Oclemena acuminata L., N
Packera aurea (L.) A. & D. Löve, FACW (Martin 216)
Packera schweinitziana (Nuttall) Weber & Love
Prenanthes altissima L., UPL (Martin 052)
Rudbeckia hirta var. hirta L., FACU (Martin 199)
Rudbeckia laciniata L., FACW (Martin 224)
Rudbeckia triloba L., FACU (Martin 115)

Senecio vulgaris L. FAC
Solidago altissima L. FACU (Martin 210)
Solidago bicolor L. N (Martin 221)
Solidago caesia L., FACU
Solidago caesia L. var. *curtisii* (Torr. & Gray) Wood, N (Martin 218)
Solidago canadensis L. var. *scabra* Torr. & Gray, FACU
Solidago curtisii Torr. & Gray, N (Martin 092)
Solidago nemoralis Aiton *var. nemoralis,* N (Martin 214)
Solidago petiolaris Ait., N (Martin 221)
Solidago roanensis Porter, N (Martin 081)
Solidago rugosa P. Mill, N
Solidago uliginosa Nutt., OBL
Symphyotrichum divercatum (Nuttal) Nesom, N (Martin 211)
Symphyotrichum drummondii (Lindl.) Nesom, N
Symphyotrichum grandiflorum (Nuttall) Nesom., N
Symphyotrichum lowrieanum (Porter) Nesom, N
Symphyotrichum oblongifolium (Nuttall) Nesom, N
Symphyotricum pilosum (Willdenow) Nesom *var. pilosum,* N
Symphyrotricum puniceum (L.) Love and Love, OBL (Martin 215)
**Taraxacum officianale* G.H. Weber ex Wiggers, UPL
Tussilago farfara L., N
Verbesina alternifolia (L.) Britt. ex Kearney, FACW
Vernonia noveboracensis (L.) Michx., FAC (Martin 215)

BALSAMINACEAE

Impatiens capensis Meerb., FACW
Impatiens pallida Nutt., FACW (Martin 130)

BERBERIDACEAE

**Berberis thunbergii* DC, N
Caulophyllum thalictroides (L.) Michx., N (Martin 070)
Diphylleia cymosa Michx., FAC
Podophyllum peltatum L., FACU (Martin 108)

BETULACEAE

Alnus serrulata (Aiton) Willd., OBL
Betula alleghaniensis Britt., N
Betula lenta L., FACU
Corylus cornuta Marsh., FACU (Martin 049)
Ostyra virginiana (Miller) K. Koch. UPL

BORAGINACEAE

Cynoglossum virginianum L., N
Myosotis scorpioides L., OBL

BRASSICACEAE

Arabis leavigata (Muhl. Ex Willd) Poir, N (Martin 129)
**Barbarea vulgaris* R. Brown, FAC (Martin 003)
Cardamine bulbosa (Schreber ex Muhl.) Brit. & Pog, N
Cardamine concatenata (Michx.) O. Schwartz, N (Martin 173)
**Cardamine hirsuta* L. FAC
Cardamine rotundifolia Michx. (Martin 174)
Lepidium virginicum L., FACU

CAESALPINACEAE

Cercis canadensis L., FACU

CALLITRICHACEAE

Callitriche heterophylla Pursh., OBL

CAMPANULACEAE
Campanula divericata Michx., OBL (Martin 191)
Campanulastrum americana L. Small, FAC (Martin 193)
Lobelia cardinalis L., FAC
Lobelia inflata L., FAC (Martin 072)
Lobelia siphilitica L., OBL (Martin 069)

CAPRIFOLIACEAE
Lonicera canadensis Bartr. ex Marsh., FACU (Martin 012)
Lonicera dioica L., FACU (Martin 124)
Triosteum aurantiacum Bicknell, N

CARYOPHYLLACEAE
**Dianthus armeria* L., N (Martin 057)
**Cerastium glomeratum* Thuill., FACU
Paronychia argyrocoma (Michx.) Nutt., N (Martin 164)
Silene stellata (L.) Ait. f., N (Martin 179)
Silene virginica L., N (Martin 148)
Stellaria graminea L., N
Stellaria media L. Vill., FACU
Stellaria pubera Michx., N (Martin 171)

CLETHRACEAE
Clethra acuminata Michx., N (Martin 059)

CONVULVULACEAE
Cuscuta grovonii Willd, N (Martin 088)
Calystegia sepium (L.) R. Br., FACU (Martin 206)

CORNACEAE
Cornus alternifolia L., N (Martin 162)
Cornus florida L., N

CRASSULACEAE
Sedum ternatum Michx., N (Martin 177)

DIAPENSIACEAE
Galax urceolata (Poir.) Brummitt, N (Martin 076)

DROSERACEAE
Drosera rotundifolia L., OBL

ERICACEAE
Chimaphila maculata (L.) Pursh, N
Epigaea repens L., N
Gaultheria procumbens L., FACU
Kalmia latifolia L., FACU (Martin 097)
Leucothoe recurva (Buckl.) Gray, FACU (Martin 016)
Lyonia ligustrina (L.) DC., FACW (Martin 075)
Monotropa uniflora L., FACU (Martin 038)
Rhododendron calendulaceum (Michx.) Torr., N (Martin 077)
Rhododendron catawbiense Michx., N
Rhododendron maximum L., N (Martin 219)
Rhododendron vaseyi Gray, FACU
Vaccinium corymbosum L., FACW (Martin 048)
Vaccinium pallidum Aiton, UPL (Martin 192)
Vaccinium simulatum L., FACW
Vaccinium stamineum L., FACU (Martin 111)

EUPHORBIACEAE
Euphorbia corollata L., N

FABACEAE
Amphicarpaea bracteata L. Fern., FAC (Martin 170)
Apios americana Medikus, N

Desmodium nudiflorum (L.) Condolle, N
Desmodium paniculatum (L.) Condolle, N
Desmodium perplexum Schubert, N
Lespedeza bicolor Turcz., N (Martin142)
**Lespedeza cuneata* (Dumont) G. Don., N
Lespedeza repens (L.) W. Barton, N
**Medicago lupulina* L., FACU (Martin 009)
Robinia pseudoacacia L., UPL
**Trifolium pratense* L., FACU (Martin 139)
**Trifolium repens* L., FACU
**Vicia caroliniana* Walter, UPL
**Vicia villosa* Roth, N (Martin 008)

FAGACEAE
Castanea dentata (Marsh) Bockh, N (Martin 004)
Fagus grandifolia Ehrh., FACU (Martin 190)
Quercus alba L., FACU
Quercus montana, FACU
Quercus prinus, FACU
Quercus rubra L., FACU
Quercus velutina Lam., N

FUMARIACEAE
Dicentra cucullaria (L.) Bernh., N

GENTIANACEAE
Gentiana saponaria L., N (Martin 203)
Gentianella quinquefolia (L.) Small, N (Martin 222)
Gentianopsis crinita (Froel.) Ma, FAC

GERANIACEAE
Geranium maculatum L., FACU (Martin 093)

GROSSULARIACEAE
Ribes glandulosum Graver, N (Martin 078)
Ribes rotundifolium Michx, N (Martin 029)

HAMAMELIDACEAE
Hamamelis virginiana L., FACU (Martin 169)

HIPPOCASTANACEAE
Aesculus flava Ait., N

HYDRANGEACEAE
Hydrangea arborescens L., FACU (Martin 118)

HYDROPHYLLACEAE
Hydrophyllum canadense L. FACW
Hydrophllum virginianum L., N
Phacelia fimbriata Michx., N

HYPERICACEAE
Hypericum densiflorum Pursh., FACW (Martin 112)
Hypericum hypericoides (L.) Crantz, N
Hypericum mutilum L., FACW (Martin 154)
Hypericum perforatum L., N
Hypericum punctatum Lam., FAC (Martin 079)

JUGLANDACEAE
Carya alba (L.) Nuttall ex. Elliot, N
Carya glabra (P. Mill.), FACU
Carya ovata (P. Mill.) K. Koch, FACU
Carya pallida (Ashe) Engl. & Graebner, N

LAMIACEAE
Castilleja coccinea L., FAC
Clinopodium vulgaris L. UPL (Martin 227)
Collinsonia canadensis L., FAC
Lamium purpureum L. N

Lycopus uniflorus Michx., OBL (Martin 204)
Monarda clinopodia L., N (Martin 065)
Monarda didyma L., FAC (Martin 062)
Monarda fistulosa L., FACU
Prunella vulgaris L., FAC (Martin 032)
Pycnanthemum montanum Michx., N
Pycnanthemum muticum (Michx.) Pers., FAC (Martin 213)
Pycnanthemum tenuifolium Schrad., FAC
Stachys latidens Small ex. Britton, FACU (Martin 084)

LINACEAE
Linum striatum Walt., FACW (Martin 202)

MALVACEAE
Tilia americana L., N

MAGNOLIACEAE
Liriodendron tulipifera L., FAC
Magnolia acuminata (L.), N (Martin 116)
Magnolia fraseri Walter, FAC (Martin 094)

OLEACEAE
Fraxinus americana L., FACU (Martin 166)

ONAGRACEAE
Circaea lutetiana L., FACU
Epilobium leptophyllum Raf., OBL (Martin 126)
Oenothra biennis L., FACU (Martin 217)

OROBANCHACEAE
Agalinis purpurea L. (Pennell), FACW (Martin
Aureolaria laevigata Raf. (Raf.), N (Martin 187)
Conopholis americana L., N
Epifagus virginiana (L.) W. Bart., N (Martin 182)
Pedicularis canadensis L., FACU (Martin 034)
Scutellaria elliptica Muhl.ex. Sprengel, N

OXALIDACEAE
Oxalis montana Raf., UPL
Oxalis stricta L., UPL (Martin 060)

PHYRMACEAE
Mimulus ringens L., OBL (Martin 050)

PHYTOLACCACEAE
Phytolacca americana L., FACU (Martin 231)

PLANTAGINACEAE
Chelone glabra L., OBL
Chelone lyonii Pursh., FACW (Martin 163)
**Plantago lanceolata* L., FAC
Plantago major L., FAC
Plantago rugelii Dcne., FAC (Martin 160)
Plantago virginica L., FACU (Martin 027)

POLEMONEACEAE
Phlox glaberrima L., N
Phlox paniculata L., FACU

POLYGONACEAE
Polygonum pensylvanicum L. FACW
Polygonum sagittatum L., OBL
Polygonum virginianum L., FACU (Martin 152)
**Rumex acetosella* L., FACW (Martin 061)
**Rumex crispus* L., N

PRIMULACEAE
Lysimachia ciliata L., FACW (Martin 168)
Lysimachia quadrifolia L., FACU (Martin 058)

RANUNCULACEAE
Aconitum reclinatum Gray, N (Martin 125)
Aconitum uncinatum L., N (Martin 129)
Actaea pachypoda Ell., N (Martin 100)
Anemone quinquefolia L., N (Martin 039)
Anemone virginiana L., N (Martin 114)
Aquilegia canadensis L. FAC
Cimicifuga racemosa (L.) Nutt., N (Martin 156)
Clematis viorna L., N (Martin 167)
Clematis virginiana L., FAC (Martin 141)
Delphinium tricorne Michx., N (Martin 021)
Ranunculus bulbosus L., FAC
Ranunculus recurvatus Poir., FAC (Martin 106)
Sanguinaria canadensis L., N (Martin 031)
Thalictrum dioicum L., FAC (Martin 023)

ROSACEAE
Agrimonia gryposepala Walroth., FACU (Martin 010)
Amelanchier arborea var. laevis Wieg., N (Martin 074)
Aronia melanocarpa (Michx.) Schneider, N (Martin 103)
Crataegus crusgalli L., N (Martin 146)
Crataegus macrosperma Ashe, N
Crataegus punctata Jacq., N
Fragaria virginiana Duchesne, FAC (Martin 040)
Geum canadense Jacq., FAC (Martin 217)
Geum virginianum L., FACW
Porteranthus trifoliatus (L.) Meonch. (Martin 073)
Potentilla canadensis L., N (Martin 180)
Prunus serotina Ehrh., FACU
Prunus virginiana L., N (Martin 176)
Rosa carolina L., FACU (Martin 109)
**Rosa multiflora* Thunb. ex Murr., UPL (Martin 150)
Rosa palustris Marsh., OBL (Martin 137)
Rubus allegheniensis Porter, UPL (Martin 140)
Rubus argutus Link, FACU (Martin 067)
Rubus canadensis L., N (Martin 132)
Rubus flagellaris Lam., FACW (Martin 085)
Rubus hispidus L., FACW
Rubus odoratus L., N (Martin 095)
Sibbaldiopsis tridentata (L.) Meonch., N
Sorbus americana Marsh., FACU (Martin 022)
Spirea alba DuRoi, N
Spirea tomentosa L., N

RUBIACEAE
Galium aparine L., N (Martin 178)
Galium lanceolatum Torr. (Martin 120)
Galium mullago L., N
Galium tinctorium L., FACW
Galium triflorum Michx., FACW (Martin 155)
Houstonia caerulea L., FAC
Houstonia montana Terrell, N
Houstonia purpurea L., N (Martin 143)
Houstonia serpyllifolia Michx., FACW
Mitchella repens L., FACW (Martin 056)

SALICACEAE

Salix caprea Marsh., OBL (Martin 212)
Salix nigra Marsh., OBL
Salix sericea Marsh., OBL (Martin 101)

SAXIFRAGACEAE

Heuchera americana L., FACU
Heuchera villosa Michx., N (Martin 078)
Mitella diphylla L., FACU (Martin 211)
Saxifraga michauxii Britt., FACW
Saxifraga micranthidifolia (Haw.) Steud., FACW
Saxifraga pensylvanica L., OBL
Tiarella cordifolia L, FAC (Martin 037)

SCROPHULARIACEAE

Scrophularia marilandica L., N (Martin 188)
**Verbascum thapsus* L., N
**Veronica arvensis* L., N
**Veronica peregrina* L., N

SMILACACEAE

Smilax glauca Walt., FAC
Smilax herbacea L., FAC
Smilax rotundifolia L., FAC
Smilax tamnoides L., FAC

SOLANACEAE

Solanum carolinense L. FACU

ULMACEAE

Ulmus rubra Muhl., N

URTICACEAE

Boehemeria cylindrica (L.) Swartz, FACW
Laportea canadensis (L.) Weddell, FACW (Martin 053)
Pilea pumila L. Gray, N

VIOLACEAE

Viola blanda Willdenow, FACW (Martin 149)
Viola canadensis L., N
Viola hirsutula Brainerd, N (Martin 105)
Viola pubescens Ait., FACU (Martin 186)
Viola rotundifolia Michx., FAC (Martin 035)
Viola sororia Willdenow, FACW (Martin 161)

VITACEAE

Parthenocissus quinquefolia (L.) Planch., N

LILIOPSIDA

ALLIACEAE

Allium cernuum Roth ex. Roemer, N
Allium tricoccum Ait., N

COLCIHICACEAE

Uvularia grandiflora Sm., N
Uvularia perfoliata L., FACU
Uvularia puberula Michx., FAC (Martin 036)

COMMELINACEAE

Tradescantia subaspera Ker-Gawl., N (Martin 099)

CYPERACEAE

Bulbostylis capillaris (L.) Kunth ex C.B. Clarke, FAC
Carex atlantica Bailey, FACW (Martin 224)
Carex austrocaroliniana Bailey, N (Martin 028)
Carex brunnescens (Pers.) Por., FAC
Carex crinita Lamark, FACW (Martin 145)
Carex debilis Michx., FAC (Martin 226)

Carex digitalis Willd., FACW
Carex frankii Kunth., FACU (Martin 201)
Carex gynandra Scheinitz, N
Carex intumescens Rudge, FACW
Carex lurida Wahl., OBL (Martin 098)
Carex pensylvanica Lam., N
Carex plantaginea Lam., N
Carex roanensis F.J. Hermann, N (Martin 209)
Carex scoparia Schkuhr ex. Willd., FACW (Martin 135)
Carex stricta Lam., N (Martin 020)
Carex torta Boot, ex. Tuckerman, OBL
Carex vulpinoidea Michx., OBL (Martin 195)
Eleocharis obtusa (Willd.) J.A. Schultes, OBL
Eleocharis tenuis (Willd.) J.A. Schultes, FACW (Martin 024)
Eriophorum virginicum L., OBL (Martin 014)
Rhynchospora capitellata (Michx.) Vahl, OBL (Martin 104)
Schoenoplectus purshianus (Fern.) M.T. Strong, OBL (Martin 042)
Scirpus atrovirens Willd., OBL (Martin 230)
Scirpus cyperinus L. Kunth., OBL (Martin 055)
Scirpus expansus Fern., OBL (Martin 138)
Scirpus pendulus Muhl., OBL (Martin 020)
Scirpus polyphyllus Vahl., OBL

DIOSCOREACEAE

Dioscorea batatas Dcne., N
Dioscorea quaternata J.F. Gmelin, FACU (Martin 082)
Dioscorea villosa L., FAC

HEMEROCALLIDACEAE

Hemerocallis fulva L., N

IRIDACEAE

Iris cristata Aiton, N
Sisyrinchium angustifolium Miller, N

JUNCACEAE

Juncus acuminatus Michx., OBL (Martin 110)
Juncus canadensis?
Juncus debilis Gray, OBL (Martin 013)
Juncus effusus L., FACW (Martin 133)
Juncus marginatus Rostk. , FACW
Juncus tenuis Willd., FACW
Luzula acuminata Raf., FAC (Martin 045)
Luzula multiflora (Ehrh.) Lej., FACU (Martin 107)

LILIACEAE

Clintonia umbellulata (Michx.) Morong, N (Martin 131)
Erythronium americanum KerGal, N (Martin 044)
Lilium canadense L., FAC
Lilium grayi S. Wats., FACU (Martin 041)
Lilium superbum L., FACW (Martin 229)
Medeola virginiana L., N
Prosartes lanuginosua (Michx.) D. Don., N (Martin 144)
Smilacina racemosa (L.) Desf., N

MELANTHIACEAE

Veratrum parviflorum (Michx.) S. Wats., N (Martin 158)
Veratrum viride Aiton, N
Trillium erectum L., N (Martin 077)
Trillium grandiflorum (Michx.) Salisb., N (Martin 026)
Trillium undulatum Willd., FACU

ORCHIDACEAE

Aplectrum hyemale (Muhl. Ex Wild) Torrey, FAC

Cyprididedium acaule Ait., FAC
Cypripedium parviflorum Salisb., FACU
Galearis spectabilis (L.) Rafinesque, N (Martin 001)
Goodyera pubescens (Willd.) R. Br. ex Ait f., UPL
Goodyera repens (L.) R. Brown ex. Aiton, FACU (Martin 083)
Platanthera grandiflora (Bigelow) Lindl., FACW
Platanthera clavellata (Michx.) Luer, OBL (Martin 228)
Platnethera lacera (Michx.) G. Don., N
Platanthera orbiculata (Pursh) Lindl., FACU
Platanthera peramoena (Gray) Gray, FACW
Spiranthes cernua (L.) L.C. Rich., FACW (Martin 102)
Spiranthes lacera (Rafinesque) *var. gracillis* (Bigelow) Luer., N
Tipularia discolor (Pursh.) Nuttall, FACU

POACEAE

Agrostis hyemalis (Walt.) B.S.P., FAC
Agrostis gigantea Roth., FACU (Martin 080)
Agrostis perennans (Michx.) Nash var. *scoparium*, N
**Anthoxanthum odoratum* L., FACU (Martin 015)
Aristida dichotoma Michx., FACU
**Dactylis glomerata* L., FACU (Martin 136)
Danthonia compressa Austin ex. Peck, FACU
Danthonia sericea var epilis Nuttall., FACU (Martin 222)
Danthonia spicata (L.) Beauv. Ex Roemer & J.A. Schultes, N
Deschampsia flexuosa (L.) Trin., N
Dicanthelium depauperatum (Muhl.) Gould, UPL (Martin 090)
Dicanthelium dichotomum (L.) Gould, N
Dicanthelium laxiflorum (Lam.) Gould, FAC (Martin 033)
Dicnathelium linearifolium (Scribn. ex Nash), N
**Echinochloa crus-galli* (L.) Beauv., FACW
Festuca rubra L., FACU (Martin 209)
Glyceria canadensis (Michx.) Trin., OBL (Martin 233)
Glyceria melicaria (Michx.) Hubbard, N (Martin 210)
Glyceria striata (Lam.) Hitchc., OBL (Martin 086)
Holcus lanatus L., FACU (Martin 011)
Hystirx patula Moench., N
**Lolium pratense* (Huds.) S.J. Derbyshire, FACU
Panicum boscii (Poir.) Gould & C.A. Clark, N
**Phleum pratense* L., FACU (Martin 066)
Piptochaetium avenaceum (L.) Parodi, UPL (Martin 216)
**Poa annua* L., FAC
Poa autumnalis Muhl. ex Ell., FACW
Poa pratensis L., FACU
Schizachyrium scoparium (Michx.) Nash, FACU (Martin 045)
Setaria glauca (L.) R. Br., FAC
Sorghastrum nutans (L.) Nash, FACU (Martin 026)
Tridens flavus (L.) A.S. Hitchc., FACU

RUSACEAE

Convallaria majuscula Greene, N (Martin 172)
Maianthemum canadense Desf., FAC (Martin 002)

Polygonatum biflorum (Walter) Elliot
Polygonatum pubescens (Willd.) Pursh, N (Martin 147)

APPENDIX B
The North Carolina Natural Heritage Program Endangered, Threatened and Special Concern Species Status Definitions

North Carolina Status. Endangered, Threatened, and Special Concern species have legally protected status in North Carolina through the North Carolina Plant Conservation Program (NC PCP). The North Carolina Natural Heritage Program includes additional status categories other than those listed.

STATUS CODE	STATUS	DEFINITION
E	Endangered	Any species or higher taxon of plant whose continued existence as a viable component of the State's flora is determined to be in jeopardy.
T	Threatened	Any resident species of plant which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.
SC	Special Concern	Any species of plant in NC which requires monitoring but which may be collected and sold under regulations adopted under the provisions of the Plant Protection and Conservation Act.
SR	Significantly Rare	Species which are rare in NC, generally with 1-100 populations in the state, generally substantially reduced in numbers by habitat destruction (and sometimes also by direct exploitation or disease).
-T	Throughout	These species are rare throughout their ranges (fewer than 100 populations total).
-P	Peripheral	The species is at the periphery of its range in NC. These species are generally more common somewhere else in their ranges, occurring in NC peripherally to their main ranges, mostly in habitats which are unusual in NC.
-O	Other	The range of the species is sporadic or cannot be described by the other Significantly Rare categories.

W	Watch List	Any other species believed to be rare and of conservation concern in the state but not warranting active monitoring at this time.
P_	Proposed	A species which has been formally proposed for listing as Endangered, Threatened, or Special Concern, but has not yet completed the legally mandated listing process.

United States Status is designated by the U.S. Fish and Wildlife Service (U.S. FWS) and the U.S. National Marine Fisheries Service in accordance with the U.S. Endangered Species Act of 1973.). The U.S. FWS includes additional status categories other than those listed.

STATUS CODE	STATUS	DEFINITION
E	Endangered	A taxon in danger of extinction throughout all or a significant portion of its range.
FSC	(Federal) Species of Concern	. . . the Service is discontinuing the designation of Category 2 species as candidates in this notice. The Service remains concerned about these species but further biological research and field study are needed to resolve the conservation status of these taxa. Many species of concern will be found not to warrant listing, either because they are not threatened or endangered or because they do not qualify as species under the definition of the Endangered Species Act.

North Carolina Rank. North Carolina ranks are based on NatureServe and The Nature Conservancy's (TNC) system of measuring rarity and threat status. This system is now widely used by other agencies and organizations, as the best available scientific and objective assessment of a species' rarity at the state level. This agency includes additional rank categories other than those listed.

RANK	NUMBER OF EXTANT POPULATIONS	DESCRIPTION
S1	1-5	Critically imperiled in NC because of extreme rarity or because of some factor (s) making it especially vulnerable to extirpation from the state.
S2	6-20	Imperiled in NC because of rarity or because of some factor(s) making it very vulnerable to extirpation from the state.
S3	21-100	Rare or uncommon in NC.

A rank involving two numbers indicates uncertainty of rank. For instance, a S2S3 rank indicates that the species may be a S2 or a S3, but that existing data do not allow that determination to be made.

Global rank. Similar to North Carolina ranks, global ranks are assigned by a consensus of scientific experts, the various natural heritage programs, NatureServe, and TNC. They apply to the status of a species throughout its range, and are based on data on the species' status rangewide. This system is now widely used by other agencies and organization, as the best available scientific and objective assessment of a species' rarity throughout its range. This agency includes additional rank categories other than those listed.

RANK	NUMBER OF EXTANT POPULATIONS	DESCRIPTION
G2	6-20	Imperiled globally because of rarity or because of some factor(s) making it very vulnerable to extinction throughout its range.

G3	21-100	Either very rare and local throughout its range or found locally (even abundantly at some of its locations) in a restricted range (e.g., a single physiographic region) or because of other factors making it vulnerable to extinction throughout its range.
G4	100-1000	Apparently secure globally, though it may be quite rare in parts of its range, especially at the periphery.
G5	1000+	Demonstrable secure globally, through it may be quite rare in parts of its range, especially at the periphery.
GH	0?	Of historical occurrence throughout its range, I.e., formerly part of the established biota, with the expectation that it might be rediscovered.

A rank involving two numbers indicates uncertainty of rank. For instance, a G2G3 rank indicates that the species may be a G2 or a G#, but that existing data do not allow that determination to be made.

APPENDIX C

Tater Hill Preserve Wetland Species List and Percent Cover of 10 x 10 Meter Plot Surveys

	Fall 2002									Spring 2003									Fall 2003								
	A1	B1	C1	A2	B2	C2	A3	B3	C3	A1	B1	C1	A2	B2	C2	A3	B3	C3	A1	B1	C1	A2	B2	C2	A3	B3	C3
Acer rubrum	5	8	1			5	1	3	2	3	7	2	1		5	8	4	8	2	7	5	1			5	7	5
Achillea millefolium			1			1		1	1			5			1			3			15			1			2
Agalinis purpurea	1	1																									
Agrostis perrenans																						1		1	1		
Alnus serrulata	3	8					1																				
Amelanchier arborea			1				3	3	2	1	1						1	30	3	2				2		1	20
Antennaria solitaria									1			1								1	1	1		1	1	1	1
Anthoxanthum odoratum											1	20	3					1		1	6	1			1	1	1
Aulocomnium palustre	30	5								50	10								4	50	5	3		2		50	15
Betula lenta	2	2								1	1				5	10		3	1	2				5			2
Botrychium virginianum							1		1			1												2			
Carex atlantica			2							4	40	5	5	2	1	3	10	3		2		1		1	5		
Carex crinita	10	10			40	5		3	1	40	8		1		1	5	10	4	7	2		3			2	8	1
Carex lurida		12		5	1		5	10	3	3			2	5	2		1	2	1			70	5	15	5	1	1
Carex scoparia				1				1		2		1	3	1	5	5	5		1		10		2	1		5	
Chelone glabra																								1			1
Cirsium vulgare																											2
Clematis virginiana		2	1	1		1	1	1		1	5	3	2	10	2	2			2	2	8	2	12	1	5		
Clethra acuminata									2		1							2		1	1			1			
Crataegus macrosperma																3											
Crataegus punctata									12		1	3			1			2		1	5						2
Dactyllis glomeratus						1				1	1	2	1		1		1				2						
Danthonia sericea																1			1	1	2	1					1
Dennstaedtia punctulobula	1																										
Dicanthelium depauperatum							1	1								1		2	1		2		2	1	1		5
Dicanthelium dichotomum			2	1	1		1		5																		
Dicanthelium laxiflorum										30		3	2			10		2	20		10	3		1			3
Diphasiastrum digitatum						1	1	2					2				5	15									
Doelingeria umbellata													1	30							2						

Drosera rotundifolia	1	1								5	3		2			2	10	2	2	1		1		1	2	5	1
Dryopteris intermedia						3																					
Eleocharis obtusa													1														
Eleocharis tenuis														1	2	1				1							
Epilobium leptophyllum													1	1	1	1					1		1	1			
Erectities hieracifolia																											1
Erigeron pulchellus												2						2									
Erigeron stigosus															1												
Eriophorum virginicum	1									2				8		1			4				1				
Eupatorium fistulosum							1	1				3									10						
Eupatorium rugosa		1	30											1									1	1			
Eupatrorium perfoliatum		1		1	1	1	1	5			2		3	2	2	1	10	1		1		2	5			12	2
Fern sp.											1					5											
Fragaria virginiana												10						2			4						5
Galium tinctorium		1		1	5		1	1		1	1		3	15	3	1	1	2	2	1		1	20	1	2	1	1
Gentiana clausa	3	1	1					1											1	3				1		1	
Glyceria canadensis																					1						
Glyceria striata	1	1	1		1									1										1			
Grass sp. 1											1	2												1	1	1	
Helenium autumnale	2	5	2	5	3	1	5	2	1		2	1	1	10	2			2									
Helianthus decapetalus												3									5						
Hieracium caespitosum															2												
Hieracium pratense			1		3			12	1																		
Holcus lanatus						1										1	3	5		1	3	1					
Houstonia caerulea		1	12						20																		
Houstonia pupurea																							1				
Houstonia serpyllifolia	5	10					1	1		30	70	25	2	1	10		60	3	60	50		1		1	5	5	
Hypericum densiflorum	10	15	1			10	5	2	1	15	20			1		2	3	1	7	10			8	4	2	5	5
Hypericum hypericoides										3			1	4	1		2	1	3			2	5				2
Hypericum mutilum	2	2	1	5	1	1	1	1			2	1			2	1		2		2	1			1		1	1
Hypericum perforatum															2												

Hypericum punctatum													1		1	1	1			1							1
Ilex ambigua								1			1													1			
Ilex collina		1																	1					1			
Impatiens capensis													1	5							2						
Juncus canadensis	1						1				10		2				2		1			1		1		2	
Juncus debilis	1	1		1		2						1	1	4	1		5	5		1		2	5		1		5
Juncus effusus	5	2		10	3	5	5	3		5	20		12		15	5			4	15		20		10	5	5	5
Kalmia latifolia	10		15					3	5	3		1					1	25	8		10						5
Leucanthemum vulgare			1						1			4						2			2						
Lilium grayii											1																
Linum striatum				1	3																	2	1	1		1	1
Luzula multiflora				2												1											
Lycopodium clavatum															2									1			
Lycopus virginianum	1	1	1	1	1			1	1	1	1	1	2	1	1	1	1	1	4	1	2	2	1	1	1	1	1
Lyonia ligustrina	5	25	5		5	20	20	5	20	35	40	15			2	20	20	18	10	20	15		2	4	20	2	30
Oenethra biennis										3	1	8	1	1	5	2	6	2	1	1	8	2		2			
Onoclea sensibilis				1						1	1		4			2	2		1			3					
Osmunda cinnamomea	5	20		5			1			30	20		2		5	5	25		10	20	2	2	5	1		5	
Osmunda claytoniana																1	5		5	1						1	
Osmunda regalis	1	1						2		7	1						2										
Oxypolis rigidior	1	1								5	1	1						1	1	1	2					1	1
Packera aurea										5	5	7	2		8	5	15	1	1	1	5	2		7		2	2
Packera aurea			1			15		2	1																		
Pedicularis canadensis			1	1								5				1	3	2			8						2
Polygonum sagittatum					1							3	2	10	1							1	8				1
Polystichum acrosticoides															1			1									
Polytrichum sp.		15	1			5			3				2	10	3	20	1	7			2	5	15	12	10	5	10
Potentilla canadensis	1		1			2			1			10		2	2			4		1	10		5	2			2
Prunella vulgaris			1						1												2						1
Quercus rubra						1												3			2						1
Rhododendron calendulaceum	5															3			3	1						10	5

Rhododendron maximum	12	10						1	2	10	5						3	3	12	5						5	5
Rosa palustris									5	1								1	1	1		1				1	1
Rubus allegheniensis			2	1	8		8				1	12	3	30		7		4		2	20	7	40		5		1
Rubus hispidus	1	8	40				12	1	20	15	20	10		4	4	7	20	8	10	2	20		10	3	2	12	8
Rudbeckia hirta			2												1						5						1
Rumex acetosella																						2					
Ryhchospora captitellata	1	1						1								1	3		1	1				1		1	1
Sagittaria latifolia																					1						
Salix nigra													2		8			7				4					3
Salix sericea	5	15	20	3	20	20	30	3	5	4		15	7	1	15	40	35	4	10	25	20	3	2	30	25	20	15
Sambucus canadensis			2		2						1	1	2	4						1	2	5	5				
Saxifraga pensylvanica																2	1										
Schizachyrium scoparia			1						8												7						2
Schoenoplectus purshianus				5																1							
Scirups cyperinus				20	15								45	50	1	3		2				8	40	5			1
Scirups expansus	1	1		10	15	15		2		2			35	30	7	5	4	3	5	1		12	30	1		1	1
Selaginella apoda							1	1		2	1					5			2	1					2		
Senecio vulgaris												1															
Solidago altissima			20			40	5	2	15		10					1						3				5	
Solidago caesia	5			5	5			2		30	40	2	40	2	12	30	20	6	5	18	2	2	5	45	5	12	1
Solidago erecta		10	5		2	30				10	1	7	3		20	5	10	5	5	15	4	5			2	5	20
Solidago roanensis						30			1																		
Solidago rugosa						20	12		8														8				
Solidago sp.				15																							
Sphagnum sp. 1	25	10			2		5	20		15	15					5	20		10	20						25	2
Sphagnum sp. 2	25	12						2		15	25						5		10	1							
Spiranthes cernua	1	1		1		1	2	1	1										2	2		1	1	2	1	1	1
Symphyotrichum grandiflorum							1								1				2								1
Symphyotrichum puniceum	12	2	1	5	5	15	12					3	1						1	1						1	
Thelypteris palustris				1			1	2															2				
Thuidium sp.															2	2				1		1		1	2	1	2

Tradescantia subaspera			1						1
Tsuga canadensis									5
Vaccinium corymbosum									
Vaccinium stamineum	20	8	5			3	10		15
Vernonia noveboracensis			1					1	
Viburnum cassanoides		5	3						
Viburnum lantanoides			1						
Viola canadensis	1		1	1		1	1		
Viola rotundifolia									
Number of species	**38**	**40**	**38**	**27**	**23**	**29**	**33**	**38**	**34**

Tradescantia subaspera						1			20
Tsuga canadensis								5	
Vaccinium corymbosum									
Vaccinium stamineum	1	2	8			1	5	8	20
Vernonia noveboracensis			2						
Viburnum cassanoides		5	1					1	
Viburnum lantanoides									
Viola canadensis					1	1		1	1
Viola rotundifolia		2	1	1	1	2	1	1	
Number of species	**38**	**45**	**42**	**41**	**32**	**48**	**48**	**44**	**50**

Tradescantia subaspera									
Tsuga canadensis									5
Vaccinium corymbosum	1					1	1	1	
Vaccinium stamineum	1	5	5			3	5		5
Vernonia noveboracensis			5						
Viburnum cassanoides		5	3						
Viburnum lantanoides									
Viola canadensis				1					
Viola rotundifolia									
Number of species	**47**	**52**	**48**	**42**	**30**	**48**	**29**	**41**	**58**

VITA

Alex W. Martin was born in Cedar Rapids, Iowa on December 21, 1973 to Maynard and Dianne Martin. He graduated from Nevada High School in 1992. After completing his B.S. in Biology at Buena Vista University in 1996, he spent time teaching outdoor environmental education, living in Japan teaching English, and traveling in Southeast Asia. Upon returning stateside, with his soon-to-be North Carolinian bride, he began attending Appalachian State University in Boone, North Carolina in 2000. Finally completing his M.S. in Biology in 2007, he now teaches high school science.