COMMONWEALTH of VIRGINIA

Management Plan for Hickory Hollow Natural Area Preserve

Prepared by:
Virginia Department of Conservation and Recreation
Division of Natural Heritage

Natural Heritage Technical Report 08-09
March 2008

Virginia Department of Conservation & Recreation

State Parks • Soil & Water Conservation • Natural Heritage
Chesapeake Bay Local Assistance • Land Conservation
Outdoor Recreation Planning • Dam Safety & Floodplains

Management Plan for Hickory Hollow Natural Area Preserve

2008

NATURAL HERITAGE TECHNICAL REPORT 08-09

VIRGINIA DEPARTMENT OF CONSERVATION AND RECREATION

DIVISION OF NATURAL HERITAGE

217 GOVERNOR STREET

RICHMOND, VIRGINIA 23219

(804) 786-7951

This document may be cited as follows:
Clarke, P.A. & R.O. Wilson. 2008. Management Plan for Hickory Hollow Natural Area Preserve. Natural Heritage Technical Report #08-09. Virginia Department of Conservation and Recreation, Division of Natural Heritage. Richmond, Virginia. 25 pp.

Table of Contents

Table of Figures and Tables

Abstract Approvals

Recommended by:

_____ _____

Thomas L. Smith, Director — Date
Division of Natural Heritage

Approved by:

_____ _____

Joseph H. Maroon, Director — Date
Department of Conservation and Recreation

_____ _____

Peter Saam, President — Date
Northern Neck Audubon

Management Plan for Hickory Hollow Natural Area Preserve

PLAN SUMMARY

Hickory Hollow Natural Area Preserve (HHNAP), located in Lancaster County, Virginia, is owned by Northern Neck Audubon (NNA) and managed cooperatively with the Virginia Department of Conservation and Recreation, Division of Natural Heritage (DNH). The preserve was dedicated as a Natural Area Preserve on July 12, 2000[1]. HHNAP consists of mixed pine-hardwood forest, ravines and swamp, which form an important habitat for migratory songbirds, wild turkey and the rare Kentucky lady's slipper. The long-term management objective is to preserve rare species and ecological communities on HHNAP for the perpetual benefit, education, and enjoyment of Virginia's citizens.

This management plan strives to capture the key and priority stewardship management issues that are currently known to the preserve and gives an overview of the preserve's natural resources and public recreational and educational offerings. When feasible, additional information resources are identified to supplement the intended scope of this plan.

[1] For more information on the legal status of Natural Area Preserves and the Department of Conservation and Recreation's authorization for dedication, see the Virginia Natural Area Preserves Act, Code of Virginia, section 10.1-209-217, in Appendix A.

INTRODUCTION

The primary purpose of HHNAP is the preservation of outstanding natural heritage resources found at this site as well as the preservation of natural, historic, scientific, and recreational open-space resources. Management for enhancement and preservation of natural heritage resources shall take precedence over other purposes and management at this site. Secondary purposes of the preserve include scientific research, environmental education, and compatible outdoor recreational uses.

Hickory Hollow Natural Area Preserve encompasses 254 acres of moist hardwood forest, successional pine forest, and seepage swampland along the Western Branch of the Corrotoman River and Cabin Swamp. Cabin Swamp is an exceptional quality wetland community that supports a very high diversity, perhaps 500 plant species including several mountain disjuncts and a rare Lady's slipper orchid, and as many as 115 bird species.

Agricultural fields and forests dominate the landscape surrounding the preserve. Much of the forestland is in various stages of timber production, and most of the fields are still actively farmed. There has been some limited development in the area, mostly in the town of Lancaster to the southwest of the preserve, but also along Route 604 adjacent to the preserve.

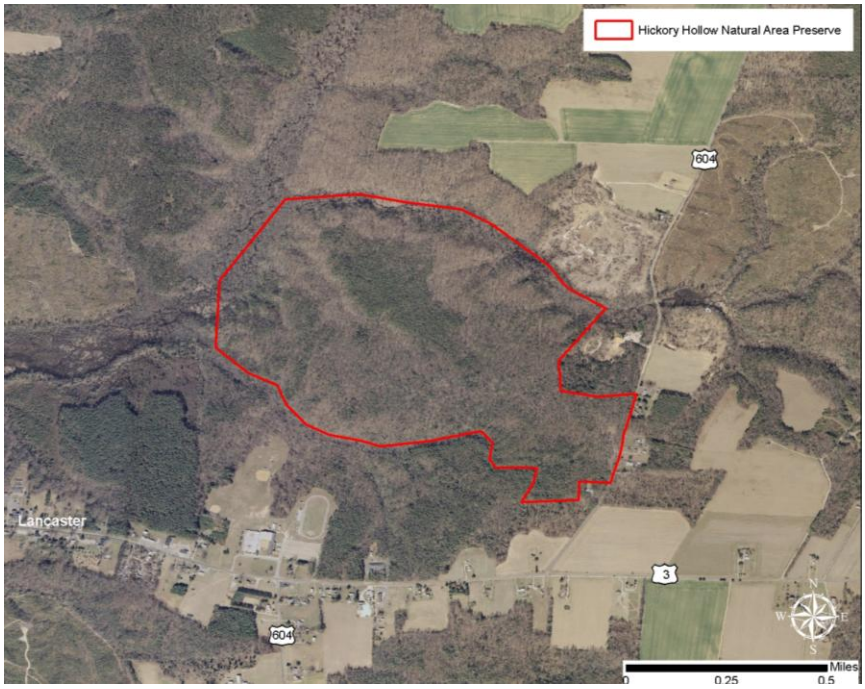

Figure 1 Hickory Hollow NAP

The preserve is open to the public and includes a small parking lot, a sheltered picnic table, several miles of trails and an information kiosk. Trail maps can be found at the kiosk, online at http://www.northernneckaudubon.org/ and in Appendix C.

NATURAL RESOURCES

Overview

Natural heritage resources are defined in the Virginia Natural Areas Preserves Act (Appendix A), as "the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest benefiting the welfare of the citizens of the Commonwealth". Natural heritage resources are the most likely natural resources to be lost without conservation action. At HHNAP, the Kentucky lady's slipper and the Coastal Plain / Piedmont Basic Seepage Swamp are formally identified natural heritage resources. Additionally, HHNAP supports important migratory bird habitat, Mesic Mixed Hardwood Forest, Acidic Oak-Hickory Forest and Successional Tulip Tree-Loblolly Pine Upland Forest. Following is a brief description of these resources, their conservation significance, and their ecological requirements, as currently understood.

Kentucky lady's slipper

The Kentucky lady's slipper (*Cypripedium kentuckiense*) is a tall orchid with the largest flowers of any lady's slipper (Berkshire 2006). *C. kentuckiense* is known from 10 states from Texas to Georgia and north to Kentucky and Virginia. Figure 1 shows Kentucky lady's slipper distribution (Berkshire 2006).

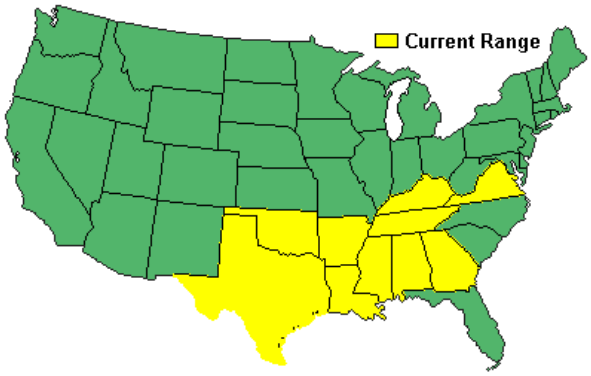

Figure 2 Distribution of *Cypripedium kentuckiense*

The Kentucky lady's slipper is currently globally ranked as G3 and is a federal Species of Concern. Currently, there is no recovery plan for *C. kentuckiense*. From the ten states where it is known to occur, it is listed as either extremely rare (S1) or very rare (S2). (In Mississippi, it is listed as "status uncertain" due to low search effort or cryptic nature of the lady's slipper)[2]. Table 1 list the states were the Kentucky lady's slipper is found along with its current state rank and status.

[2] For a more detailed explanation of global ranks (G-ranks) and state ranks (S-ranks), see Appendix B.

Table 1 *Cypripedium kentuckiense* state ranks and status

State	State Rank	State Status
Alabama	S1	
Arkansas	S3	
Georgia	S1	
Kentucky	S2S3	Special Concern
Louisiana	S1	
Mississippi	SU	
Oklahoma	S2	
Tennessee	S1S2	State Endangered
Texas	S1	
Virginia	S1	

Bees attracted by the scent result in the cross-pollination of *Cypripedium* orchids. Viability of *Cypripedium* seeds is variable and dispersal is by water or air (Berkshire 2006). Seed germination in orchids requires the early association of the germinating seed with specific soil fungi known as mycorrhizae (Muir 1989, Otero 2002), and successful growth of orchids requires continual mycorrhizal assocation.

C. kentuckiense is adversely affected by direct or indirect habitat destruction, erosion and alteration of hydrology of sites, such as from certain timber cutting practices, agriculture and development or from beaver activity. Overcollection by plant enthusiasts or collectors of traditional medicines is also responsible for the loss of populations (Berkshire 2006).

Coastal Plain / Piedmont Basic Seepage Swamp

Coastal Plain / Piedmont Basic Seepage Swamp[3] covers approximately 26 acres at Hickory Hollow and provides habitat for the Kentucky lady's slipper and an unusual array of species that are more typically found in the mountains far to the west of this site. The basic seepage swamp at Hickory Hollow is a saturated deciduous forest which occurs adjacent to ravines that have down cut into Tertiary shell deposits or limesands. Regionally, Coastal Plain / Piedmont Basic Seepage Swamps are naturally rare, small-patch communities known from the dissected inner Coastal Plain of Surry, Isle of Wight, York, and James City Counties. The Hickory Hollow basic seepage swamp consists of mucky, braided ravines saturated by constant groundwater seepage and contains soils with high base status. Hummock-and-hollow microtopography is prevalent, and exposed shells are common in springs and rills.

[3] U.S. National Vegetation Classification (USNVC): Coastal Plain Basic Seepage Swamp (CEGL006413)

Green ash (*Fraxinus pennsylvanica*), red maple (*Acer rubrum*) are common canopy trees. Small trees and shrubs include ironwood (*Carpinus caroliniana*), stiff dogwood (*Cornus foemina*), flowering dogwood (*Cornus florida*), pawpaw (*Asimina triloba)* and fringe tree *(Chionanthus virginicus*). A number of remarkable mountain disjuncts have been documented in the herbaceous flora of these communities, including marsh-marigold (*Caltha palustris)* and American false-hellebore (*Veratrum viride*). The damp, fertile habitats are particularly susceptible to invasion by the exotic grass *Microstegium vimineum*. Communities like Hickory Hollow's basic seepage swamp are not well documented or protected and should be high priorities for future inventory and conservation. This is the only documented occurrence of this community on the Northern Neck peninsula.

Acidic Oak - Hickory Forests

Acidic Oak- Hickory Forest[4] covers approximately 150 acres across Hickory Hollow NAP. These forests are widely but locally distributed throughout the Piedmont, inner Coastal Plain, mountain valleys, and lower mountain slopes of both the Blue Ridge and Ridge and Valley, up to about 600 m (2,000 ft) elevation. Hickories (*Carya* spp.) are less abundant than in the Basic Oak-Hickory Forests group but are nevertheless prominent, often primarily as understory trees. At Hickory Hollow Natural Area Preserve dominant tree species include sand hickory (*Carya pallida*), red maple, (*Acer rubrum*) and downey service berry with a small percentage of oaks species. Small trees and shrubs include ironwood (*Carpinus caroliniana*), flowering dogwood (*Cornus florida),* fringe tree *(Chionanthus virginicus*) and Allegheny chinkapin (*Castanea pumila).* Deciduous ericads, especially black huckleberry (Gaylussacia baaccata) and dangleberry (Gaylussacia frondosa) are present in the shrub layer. Acidic Oak-Hickory Forests are ecologically intermediate between species-rich Basic Oak-Hickory Forests and floristically depauperate Oak/Heath Forests. Many contemporary stands of Acidic Oak-Hickory Forests are suffering from the effects of fire exclusion, including poor oak recruitment and the invasion of understories by fire-intolerant mesophytic species such as red maple (*Acer rubrum*) and American beech (*Fagus grandifolia)*(Fleming, et. al.2006).
For details on fire management at HHNAP, see "Fire Management Issues" on page 16.

Mesic Mixed Hardwood Forest

Mesic Mixed Hardwood Forest[5] covers approximately 30 acres across Hickory Hollow NAP. Regionally, mesic mixed hardwood forests occur in infertile habitats throughout the Coastal Plain and Piedmont, and more locally at lower elevations in the mountains. At Hickory Hollow NAP, mesic mixed hardwood forests occupy ravines, lower slopes, and well-drained "flatwoods" on relatively nutrient-poor but relatively moist soils. The most typical tree canopies contain mixtures of American beech (*Fagus grandifolia*), white oak (*Quercus alba*), southern red oak (*Quercus falcata*), northern red oak (*Quercus rubra*), tulip-poplar (*Liriodendron tulipifera*), and red maple (*Acer rubrum.* American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*) and American holly (*Ilex opaca* var. *opaca*) are prominent understory plants. These communities

[4] USNVC: Piedmont Acidic Oak-Hickory Forest (CEGL008475)
[5] USNVC: Mid-Atlantic Mesic Mixed Hardwood Forest (CEGL006075)

generally lack the lush herbaceous layers of rich mixed hardwood forests, although herbaceous species such as Christmas fern (*Polystichum acrostichoides*) may form moderately dense clumps. The name "Southern Mixed Hardwood Forest" has often been applied to Coastal Plain representatives of this group. Although mesic mixed hardwood forests still cover sizeable areas east of the mountains in Virginia, repeated logging has reduced their quality and extent (Fleming, et. al. 2001).

Successional Tuliptree - Loblolly Pine Upland Forest
Successional Tuliptree – Loblolly Pine Upland Forest[6] covers approximately 30 acres near the center of the preserve. This community is likely a remnant of timber production efforts at Hickory Hollow, as is a small stand of White Pine that occurs near the southern boundary of the preserve. This semi-natural forest community is strongly dominated by *Liriodendron tulipifera* and *Pinus taeda*, which together contribute more than 75% canopy cover. Other canopy species include *Liquidambar styraciflua* and *Acer rubrum*. This community develops on slopes following cropping, and soils usually have 60-70% sand. The understory and ground layers are very sparse with much open ground present.

Migratory Bird Habitat
HHNAP provide important habitat for migrating songbirds and raptors. The preserve provides a diversity of habitat types and contributes to a system of conservation lands within Virginia's Northern Neck. As Management of the preserve progresses and additional lands are restored, the value of HHNAP to migrating birds will only increase.

Potential Natural Heritage Resources
It is possible that management activities, coupled with long-term monitoring could uncover new or regenerated occurrences of some rare or uncommon plant or animal species. Least trillium (*Trillium pusillum*, G3/S2), old-field milkvine (*Matelea decipiens*, G5/S1) and bald eagle (*Haliaeetus leucocephalus*, G5/S3S2B/S3N) are all potential elements at Hickory Hollow.

[6] USNVC: Successional Tuliptree – Loblolly Pine Upland Forest (CEGL007521)

RESOURCE STEWARDSHIP

Stewardship Objectives

The primary objective of natural areas stewardship is to provide for the continued presence of natural heritage resources. The overriding goal at HHNAP is a maintained and functioning ecosystem with a matrix of communities native to the site. The philosophy and policy direction for the management of natural area preserves is outlined in the Natural Area Preserve Management Guidelines (DCR 2000). Preserve-level management and monitoring actions, as well as cooperative management initiatives and protection strategies should be planned based on the best current information and available resources.

Primary conservation objectives for HHNAP include:

- Maintain and restore natural communities.
- Maintain or enhance existing hydrologic regime.
- Manage *C. kentuckiense* habitat to maintain or enhance *C. kentuckiense* populations.
- Manage habitat to benefit other natural resources, scenic resources and historic resources.
- Evaluate effects of management on plants, animals, and natural communities.
- Provide for natural resources protection.
- Ensure visitor safety and site-security.

Secondary objectives for HHNAP include:

- Foster research to accomplish conservation objectives and contribute to the body of knowledge on the flora, fauna, natural communities, and natural processes of Virginia.
- Foster research to further understand groundwater and other hydrologic processes at Hickory Hollow.
- Increase public awareness of the preserve through appropriate public access and education.
- Manage land in such a way that it serves as a good example of natural area stewardship in the Northern Neck region of Virginia.

Biological Management Issues

Biological resource management actions are taken to return human-altered land or vegetation to a condition that supports continued existence of rare species and/or natural communities by reinstating natural processes or abating threats. Major threats to biodiversity include: habitat degradation/loss, exotic invasive species, pollution, overexploitation, and disease (Wilcove et al. 1998). The more destructive forms of habitat degradation are: land conversion, water development (e.g., dams, drainage projects), agricultural practices, livestock grazing, outdoor recreation (includes off-road vehicles), pollutants, infrastructure development (includes roads), disruption of fire regimes, logging, and mining activities. After habitat loss, exotic invasive species are the greatest threat to terrestrial species. For aquatic species, water pollution is the most significant threat after habitat loss (Richter et al. 1997). Because of these threats to

biodiversity, active management is often needed to restore and maintain natural heritage resources (Wilcove and Chen 1998).

Several biological issues currently threaten the natural heritage resources of HHNAP. Biological issues of greatest concern and most likely to cause negative impacts to natural heritage resources at HHNAP are invasive non-native plants and threats to existing hydrology through surrounding land use practices or beaver activity.

Invasive, non-native species. Nationwide, invasive species have been identified as the second highest threat to biological diversity, second only to loss of species and habitat from development and urban sprawl. Control of invasive non-native plants is expensive, resources are limited, and management efforts must be prioritized (Hiebert and Stubbendieck, 1993). The goal of management is to prevent the worst invasive species from becoming established in high-quality natural communities. Eradication may not be a practical option for some invasive species already well established at HHNAP; however, preventing new invasive species from becoming established on the preserve is a viable objective. Control efforts will focus on reducing abundance of the most problematic invasive plants in or near the highest quality natural communities. Control efforts will focus on reducing the abundance of the most problematic invasive plants in or near the highest quality natural communities.

At HHNAP, the following invasive species are known to occur: Japanese stilt grass (*Microstegium vimineum*), Japanese honeysuckle (*Lonicera japonica*), Russian olive (*Elaeagnus angustifolia*), and privet (*Ligustrum vulgare).*

Japanese stilt grass (*microstegium vimineum*). A native of Asia, Japanese stilt grass is now widespread east of the Mississippi (Hunt and Zaremba 1992; Redman 1995; Ehrenfeld 1999). Japanese stilt grass is typically an annual grass, although a perennial form has apparently been discovered (Ehrenfeld 1999), that spreads into mesic forest habitats. It spreads rapidly into disturbed areas but can invade undisturbed upland areas by forming satellite populations brought in by animals or flooding. It is generally slow to invade undisturbed areas, but rapidly fills disturbed areas such as flood-scoured streamsides, tip-up mounds, and along roads and trails (Tu 2000).

An individual plant of Japanese stilt grass can produce up to 1,000 seeds, which can remain viable in the soil for three to five years. Once established, Japanese stilt grass is able to crowd out native herbaceous vegetation in wetlands and forests within three to five years (Barden 1987; Hunt and Zaremba 1992). Manual/mechanical, environmental/cultural, and chemical methods have all been used with some success for control of Japanese stilt grass. Prescribed burns have not been successful in controlling this species so far, but fall burns may have the potential for partial control. If controlled during the early stages of invasion, the potential for successful management is high. The potential for large-scale restoration of wildlands where Japanese stilt grass has become established is probably moderate (Tu 2000). Grass-specific herbicides may need to be used to control Japanese stilt grass at the cost of sacrificing some native grass species populations. The best combination of control for Japanese stilt grass will likely involve

mowing/cutting in late summer prior to seed set and spot treatments of herbicide in early summer, along with the use of pre-emergent herbicides in late winter.

Japanese honeysuckle (*Longicera japonica*). This semi-evergreen perennial vine rapidly invades open areas but can also persist in shade. Birds readily disperse seeds of Japanese honeysuckle (Nyboer 1992). In fire-adapted communities, periodic spring burning will control this species. Glyphosate herbicides applied in the fall when the surrounding vegetation has become dormant, but applied before a hard freeze (25° Fahrenheit), will allow for control of this species without negatively impacting non-target plants.

Russian olive (*Elaeagnus angustifolia*). Russian Olive is a deciduous shrub or small tree in the Oleaceae family (the Oleaceae family includes ash, olive, jasmine, forsythia and privet). Leaves of Russian olive are alternate, elliptic to lanceolate, untoothed and its branches are usually thorny. Russian olive can be found in dry to moist soils, but does particularly well in sandy floodplains. Native to Eurasia, it was commonly planted as an ornamental and escaped cultivation. At Hickory Hollow, Russian olive was planted as a wildlife enhancement and nitrogen fixation project prior to the realization of the shrub's invasive and deleterious habits.
In addition to its prolific fruiting, seed dispersal by birds, rapid growth and ability to thrive in poor soil, it resprouts vigorously after cutting or burning. Seedlings and sprouts can be hand-pulled when the soil is moist to insure removal of the root system. On larger plants, cutting alone results in thicker, denser growth. Burning during the dormant season also results in vigorous resprouting. Glyphosate or triclopyr based herbicides can be used to control larger plants. The recommended herbicide method includes application of the herbicide to the freshly cut stumps of the invasive shrub to minimize damage to other plants.

Chinese privet (*Ligustrum sinense*). A member of the olive family, Chinese privet is a shrub that can grow to twelve feet in height. Leaves are oval or elliptical, two inches long, and opposite. Chinese privet is distinguished from other privets by the presence of fine hairs on the twigs and underside of leaves. Small, white, four-petaled flowers grow in clusters at the ends of branches. The fleshy blue fruits, less than a quarter-inch in diameter, contain a hard seed. Chinese privet prefers wet damp habitat. It is usually found in low woods, bottomlands, streamsides, and disturbed areas. Native to China, it is now found in Virginia, North Carolina, Georgia, Tennessee, and Kentucky.

Chinese privet can dominate the shrub layer of an invaded habitat, thus altering species composition and natural community structure by choking out native plant species. Controlling plants by hand is effective for plants with stems an inch or less in diameter. The entire root must by removed. Mechanical methods such as cutting or plowing will result in an increase of growth. Using herbicide, a combination of cutting followed immediately by application of glyphosate or triclopyr to the stump is the most effective control.

Native Problem Species. When natural processes have been altered sufficiently, native species can be allowed a disproportionate advantage that can result in negative impacts to the greater ecological community. The negative impacts to Cabin swamp due to beaver

damage and the increase of alder are two examples of native species that require monitoring and appropriate management to meet conservation objectives.

Beaver (*Castor canadensis*). Although beaver is a native species and a component of Virginia's natural landscape, in certain situations large local populations of these animals can degrade and/or destroy natural heritage resources. Like white-tailed deer, beavers were over-harvested in the 19th century but have since rebounded in population size. They have continued to increase in population size due to declines in trapping pressure and a near absence of natural predators in Virginia (Linzey 1998). Beavers can destroy rare plant habitat and natural communities at HHNAP by creating dams on streams that back up and inundate and/or silt in the natural heritage sites (Hammerson 1994; Wilson 2001), such as habitat for the Kentucky lady's slipper. In the northeast beavers have been implicated in the destruction of some sites for the federally endangered northeastern bulrush (*Scirpus ancistrochaetus*) (USFWS 1993). In Virginia, beavers have negatively impacted populations of the rare swamp-pink (*Helonias bullata*) and Kentucky lady's slipper.

Of course, beavers modified streams in the pre-settlement landscape. However, protected sites supporting high-quality, rare wetland communities such as the Basic Seepage Swamp of Cabin Swamp must be protected in today's landscape context from destruction by the activities of an, arguably, artificially-high beaver population. Numerous streams and seeps abound in the landscape around HHNAP that do not harbor natural heritage resources and provide habitats where beavers can (and do) create impoundments. In the pre-settlement era, there were more Seepage Swamps; timber wolves (*Canis lupis*) were a frequent predator of beavers (Wilson 2001), and invasive plant species were a minor issue. Hence, beavers and Seepage Swamps were once in better balance and the loss of a few Seepage Swamps would not have had a significant impact on the status of this natural community type. Today, the story is much different. We must conserve the few remaining Seepage Swamps that remain as part of DCR-DNH's mission to preserve biological diversity.

At HHNAP, the strategy will be to monitor beaver activity, utilize pond levelers and remove dams and populations that become established within the habitat of *C. kentuckiense* and the Seepage Swamp community occurrences. Water level control devices installed at HHNAP in 2004 should continue to partially mitigate the effects of beaver dams by preventing further flooding. In conjunction with water leveling devices and dam removal, trapping should be conducted in cooperation with Virginia Department of Game and Inland Fisheries (DGIF) wildlife biologists to develop a strategy to effectively trap beavers.

Beaver activity and off site timber management efforts have directly and indirectly caused a change in plant composition and structure in Cabin Swamp. Areas that were once densely shaded by overstory trees are now open and there is an increase in relative cover of grass and shrubs. In areas where beaver have been most active the tree mortality is estimated to be 80-90%. There is potential for these species to negatively impact the establishment of overstory trees. Alder (*Alnus serrulata)* species in particular should be

monitored to determine if it is becoming opportunistically dominant and shading out tree seedlings.

Urban interface factors

The Coastal Plain / Piedmont Basic Seepage Swamp at HHNAP is directly linked to the flow regime and water quality of the surrounding watershed and groundwater supplies. Protecting or restoring natural hydrologic regimes and water chemistry is basic to conserving aquatic, riparian, and wetland natural communities (Mitsch and Gosselink 1993). Groundwater seepage wetlands receive their primary water inputs through groundwater inflows. This occurs when the groundwater surface intersects with the land surface (Mitsch and Gosselink 1993). It is not known whether the groundwater that feeds the seepage swamps is derived from local water table or a more regional aquifer. An important question is whether the ground water of the seepage swamps is affected by groundwater contamination or well pumping outside of the preserve. More baseline data on water resources of HHNAP would be helpful in determining long-term viability of the seepage swamp.

Development pressures, such as new housing and associated roads, well and septic systems, or land use, such as agricultural and forestry practices can have direct and indirect impacts on the landscape in general and on HHNAP specifically. Pressures from development and/or land use can impact HHNAP's groundwater through altering the water recharge timing and magnitude, water chemistry, and sedimentation. To mitigate these potential impacts, efforts should be taken to pursue conservation easements and land acquisition of key tracts surrounding the preserve.

Fire Management Issues

Forestry personnel have conducted prescribed fires at Hickory Hollow in the past for forest product management. However, it is unlikely that fire has played a significant role in the ecological processes of either the Coastal Plain / Piedmont Basic Seepage Swamp or the Mesic Mixed Hardwood Forest, and fire exclusion is not such a serious threat to the Acidic Oak-Hickory Forest at HHNAP as to warrant prescribed fire. Accordingly, there are currently no plans for utilizing prescribed fire at HHNAP.

Operations Management

Operations management is a crucial aspect of natural areas stewardship, especially on lands where recreational uses by members of the public may conflict with the primary management objective of protecting natural heritage resources. Natural area managers must design and maintain infrastructure such as trails, signs and observation areas to provide high quality visitor experiences, while protecting natural heritage resources from adverse human effects. Routine operations management activities include boundary line and access road maintenance, site security, visitor safety, and law enforcement. Since HHNAP is owned and managed by NNA, site operations will be different than on a preserve owned by the Commonwealth. DCR-DNH operations stewards may assist NNA as needed to accomplish operational objectives, but the presence of DCR-DNH operations stewards at HHNAP will be less frequent than at state-owned NAPs.

Appropriate uses and hiking trails. Normally appropriate uses of the preserve include birding, wildlife-watching, wildflower and native plant observation, photography, hiking, research, teaching, and interpretation. See the DCR Natural Area Preserve Management Guidelines (DCR 2000) for more information on public use of NAPs. Public use of HHNAP for general hiking and nature study will be restricted to developed and existing trails on the preserve. Hiking trails allow visitors to appreciate and enjoy the biota, natural history, and natural beauty of HHNAP as well as affording good exercise. However, all trails – even well-designed and constructed foot trails – have some negative impacts on natural resources (Hammitt and Cole 1987). Trails invariably create some degree of soil alteration (compaction and erosion), create vectors for edge species that are sometimes invasive (Hickman 1990; Adkison and Jackson 1996) and can disrupt breeding bird populations (Miller et al. 1998). Hiking off the designated trail bed can negatively influence natural communities, as well. Off-trail hiking at HHNAP should be limited to resource management activities, research and monitoring, and periodic interpretive walks.

Inappropriate uses. Deterring the following inappropriate uses will require some level of operational work, e.g., on-site staff and/or volunteer presence, public contact and outreach efforts, or law enforcement.

- *Horseback riding* on trails creates more erosion, soil compaction, and introduction of non-native plant species does use by hiking alone (Whittaker 1978; Summer 1980; Hammitt and Cole 1987; Adkison and Jackson 1996). While hiking trails can also impact natural resources negatively, damage from horse trails is often greater and more pervasive. Horseback riding is considered an inappropriate activity on Virginia's NAPs (DCR 2000).

- *Off-road vehicles (ORVs),* with their growing popularity and technological advances, are splintering the landscape into a web of trails and roads. These vehicles are built to travel across rugged landscapes and can cause severe disruption to the soil, facilitate the spread of invasive plants, and disturb sensitive and endangered wildlife. Soil impacts from ORVs include erosion, compaction and rutting (Webb et al. 1978; Webb and Wilshire 1983; Kuss et al. 1990). ORVs are particularly hard on hydrologic regimes and wetlands (Defenders of Wildlife 2002). ORVs can easily degrade natural communities by crushing vegetation and rutting the soil. For these reasons, ORVs are an inappropriate use on NAPs. Resource management use of ORVs will be limited to driving on established trails.

- *Mountain biking*, like all recreational activities, affects land and resources. The number of mountain bike users has increased steadily, as have impacts. These impacts can be classified broadly into the following categories: trampling, erosion, and wildlife disturbance. Research is not conclusive as to whether mountain bikes create greater soil and vegetation impact than hiking trails (Cessford 1995). However, the speed at which mountain bikes travel creates user conflicts with hikers and those studying nature from trails (Grost 1989; Watson et al. 1991; Chavez et al. 1993).

Mountain biking is an inappropriate use of NAPs and disrupts/conflicts with appropriate uses such as birding/wildlife watching.

- *Unleashed dogs and feral cats* disrupt or prey on ground-nesting birds (Yalden and Yalden 1990; Mitchell and Beck 1992) and terrestrial fauna. Pets must be restrained by a leash on NAPs at all times. Feral cats, dogs, or livestock that become established at HHNAP should be trapped and removed from the preserve.

- *Camping* causes long-term concentrated impacts on soils and vegetation from trampling and fire rings (Marion and Cole 1996), and is an inappropriate use of NAPs. Virginia State Parks and nearby National Parks offer a wide array of camping opportunities.

- *Collection of plants, animals, minerals or artifacts* has direct impacts on the natural resources of a NAP and can quickly decimate populations of rare plants or animals. For this reason, collection of these materials is prohibited except for the non-commercial, incidental gathering of common species (e.g. blackberries) for personal consumption. Collection of plants, animals, minerals or artifacts for research or educational purposes requires a permit approved by DCR-DNH.

Data Gaps and Research Needs

Managing HHNAP's natural resources would be facilitated through better understanding the key ecological factors that support the preserve's resources. Primarily, research or studies that would expand the level of knowledge regarding Kentucky lady's slippers' long-term viability needs, including its relationship with soil fungi and the soil requirements to maintain the fungi would be beneficial.

MANAGEMENT UNITS

In order to more efficiently conserve natural heritage resources and to expedite site operations management, HHNAP has been subdivided into two management areas. These management units were subjectively delineated based on the major ecological communities at HHNAP and should provide managers a method to conveniently map and organize information about HHNAP and facilitate application of management treatments.

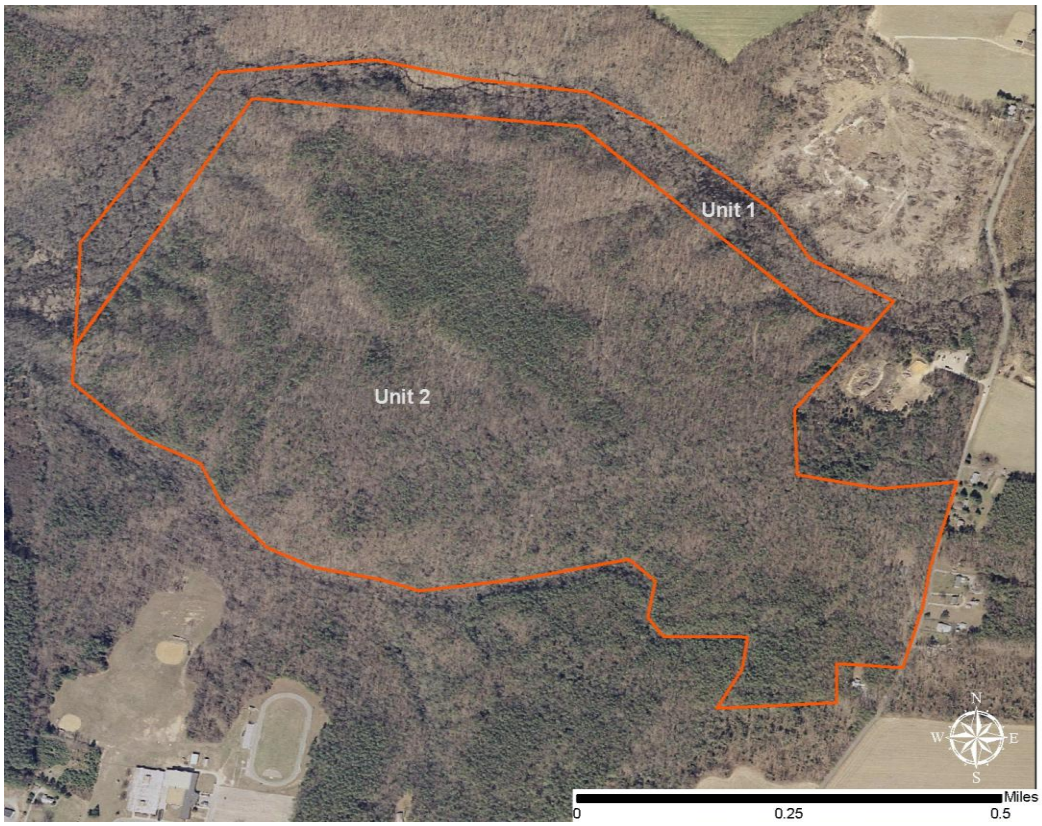

Figure 3 Management Units

Unit 1.
26 acres. This unit is primarily composed of Coastal Plain / Piedmont Basic Seepage Swamp, with several ravines and Mesic Mixed Hardwood Forest along the southern and southeastern edges of the management unit. The Kentucky lady's slipper occurs within this management unit.

Management issues

- Invasive, exotic plant species; primarily *Lonicera japonica;*
- Native species that are over abundant and highly competitive due to human and/or natural disturbances; primarily beaver and alder shrub;
- Hydrology of seepage swamp;
- Beaver impact on seepage swamp and Kentucky lady's slipper habitat;
- Trail use impacts to seepage swamp and Kentucky lady's slipper habitat.

Management actions

- Target specific, treatable populations of invasive, exotic plant species that have invaded the seepage swamp;
- Control invasives (and possibly native species threatening the viability of Kentucky lady's slipper due to disturbances or unnatural balances) using herbicides, mowing/cutting, hand pulling, or girdling depending on the species and infestation;
- Monitor beaver activity;
- Maintain water levelers;
- If beavers begin constructing dams that impact the seepage swamp, initiate trapping to eliminate the beavers following DGIF recommendations and regulations for beaver trapping;
- Promote water quality within the seepage wetland's watershed and recharge area;
- Maintain trails and boardwalk to prevent degradation to natural communities.

Unit 2

228 acres. This unit is primarily composed of Mesic Mixed Hardwood Forest and Successional Tuliptree - Loblolly Pine Upland Forest. There is also a small stand of Eastern white pine (*Pinus strobus*) located near the center of the unit. The stand dates back about forty years to a planting effort by the Department of Forestry.

Management issues

- Invasive, exotic plant species (primarily *Microstegium vimineum, Lonicera japonica* and *Elaeagnus angustifolia)*
- Trail use impacts
- ORV trespass
- Vandalism

Management activities

- Target specific, treatable populations of invasive, exotic plant species that have invaded the unit
- Control invasives using herbicides, mowing/cutting, hand pulling, or girdling depending on the species and infestation
- Maintain running/hiking trails to prevent degradation to natural communities
- Control ORV trespass through signs, barricades, and enforcement (e.g. patrols, citations) as necessary

CONCLUSION

Management to protect and maintain biological diversity at HHNAP will require ongoing learning and assessment to ensure that natural heritage resources are conserved. The complexity of ecosystems and a shortfall of stewardship resources (staff time and funding) will usually preclude a full understanding of the effects of ongoing biological change and management actions used to direct that change. Since the human-dominated landscape of Virginia today is far different than that of the "natural" landscape of pre-industrial/pre-urban expansion America 500 years ago, "doing nothing" as a management strategy will often not conserve natural heritage resources. By taking an active and adaptive ecosystem management approach at HHNAP (Walters and Holling 1990), by using the existing strong baseline of inventory data, and by monitoring trends in natural communities following management actions (e.g. assess the effectiveness of controlling an invasive species on plant species composition in a high quality stand of a natural community) it is likely that successful stewardship of natural heritage resources will be attained.

REFERENCES CITED

Adkison, G.P. and M.T. Jackson. 1996. Changes in ground-layer vegetation near trails in Midwestern U.S. forests. Natural Areas Journal 16:14-23.

Barden, L.S. 1987. Invasion of *Microstegium vimineum* (Poaceae), an exotic, annual, shade-tolerant, C4 grass, into a North Carolina floodplain. American Midland Naturalist 118: 40-45.

Berkshire, David C. 2006. Center for Plant Conservation (http://www.centerforplantconservation.org/ASP/CPC_ViewProfile.asp?CPCNum=1235, October 2006) *Cypripedium kentuckiense*, Plant Profile.

Cessford, G.R. 1995. Off-road mountain biking: a profile of riders and their recreation settings and experience preferences. Science & Research Series No. 93. New Zealand Department of Conservation. Wellington, New Zealand.

Chavez, D.J., P.L. Winter, and J.M. Baas. 1993. Recreational mountain biking: A management perspective. Journal of Parks and Recreation Administration 11(3):29-36.

DCR. 2000. Natural Area Preserve Guidelines. Department of Conservation and Recreation, Division of Natural Heritage. Commonwealth of Virginia. 2002.

Defenders of Wildlife. 2002. Out of control: The impacts of off-road vehicles and roads on wildlife and habitat in Florida's national forests. Washington, D.C.

Ehrenfeld, J.G. 1999. A rhizomatous, perennial form of *Microstegium vimineum* (Trin.) A. Camus in New Jersey. Journal of the Torrey Botanical Society 126(4): 352-358.

Fleming, G.P., P.P. Coulling, D.P. Walton, K.M. McCoy, and M.R. Parrish. 2001. *The natural communities of Virginia: classification of ecological community groups. First approximation*. Natural Heritage Technical Report 01-1. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. Unpublished report. January 2001. 76 pp.

Fleming, G.P., P.P. Coulling, K.D. Patterson, and K. Taverna. 2006. The natural communities of Virginia: classification of ecological community groups. Second approximation. Version 2.2. Virginia Department of Conservation and Recreation, Division of Natural Heritage, Richmond, VA. http://www.dcr.virginia.gov/natural_heritage/ncintro.shtml.

Grost, R. 1989. Managing the mountain bike. American Forests 95: 50-53, 75-77.

Hammitt, W.E. and D.N. Cole. 1987. Wildland recreation: Ecology and management. John Wiley and Sons, New York.

Hickman, S. 1990. Evidence of edge species' attraction to nature trails within deciduous forests. Natural Areas Journal 10:3-5.

Hiebert, R. and J. Stubbendieck. 1993. Handbook for ranking exotic plants for management control. USDI National Park Service, Midwest Regional Office, Omaha.

Hunt, D.M. and R.E. Zaremba. 1992. The northeastward spread of *Microstegium vimineum* (Poaceae) into New York and adjacent states. Rhodora 94(878):167-170.

Kuss, F.R., A.R. Graefe, and J.J. Vaske. 1990. Visitor impact management: A review of research. Vol. I. National Parks and Conservation Association, Washington, D.C.

Marion, J.L. and D.N. Cole. 1996. Spatial and temporal variation in soil and vegetation impacts on campsites. Ecological Applications 6(2):520-530.

Miller, S.G., R.L. Knight, and C.K. Miller. 1998. Influence of recreational trails on breeding bird communities. Ecological Applications 8:162-169.

Mitchell, J.C. and R.A. Beck. 1992. Free-ranging domestic cat predation on native vertebrates in rural and urban Virginia. Virginia Journal of Science 43:197-207.

Mitsch, W.J. and J.G. Gosselink. 1993. wetlands. 2nd edition. John Wiley and Sons, Inc., New York.

Muir H. J. 1989. *Germination and mycorrhizal fungus compatibility in European orchids*. *In* H. W. Prichard [ed.], Modern methods in orchid conservation: the role of physiology, ecology and management, 39–56. Cambridge University Press, Cambridge, UK.

Nyboer, R. 1992. Vegetation management guideline: Japanese honeysuckle (*Lonicera japonica* Thumb.). Natural Areas Journal 12:217-218.

Otero, J. Tupac, James D. Ackerman and Paul Bayman. 2002.*Diversity and host specificity of endophytic Rhizoctonia-like fungi from tropical orchids*. American Journal of Botany. 2002;89:1852-1858.

Redman, D.E. 1995. Distribution and habitat types for Nepal Microstegium [*Microstegium vimineum* (Trin.) Camus] in Maryland and the District of Columbia. Castanea 60(3):270-275.

Richter, B.D., D.P. Braun, M.A. Mendelson, and L.L. Master. 1997. Threats to imperiled freshwater fauna. Conservation Biology 11:1081-1093.

Summer, R.M. 1980. Impact of horse traffic in Rocky Mountain National Park. Journal of Soil and Water Conservation 35:85-87.

Tu, M. 2000. Element Stewardship Abstract for *Microstegium vimineum*, stilt grass. The Nature Conservancy's Wildland Invasive Species Program.

USDA, NRCS. 2006. The PLANTS Database (http://plants.usda.gov, 24 October 2006). National Plant Data Center, Baton Rouge, LA 70874-4490 USA.

Walters, C.J. and C.S. Holling. 1990. Large scale management experiments and learning by doing. Ecology 71:2060-2068.

Watson, A.E., D.R. Williams, and J.J. Daigle. 1991. Sources of conflict between hikers and mountain bike riders in the Rattlesnake National Recreation Area. Journal of Parks and Recreation Administration 9(3): 59-71.

Webb, R.H., and H.G. Wilshire (eds.). 1983. Environmental effects of off-road vehicles: Impact and management in arid regions. Springer-Verlag, New York.

Webb, R.H., H.C. Ragland, W.H. Godwin, and D. Jenkins. 1978. Environmental effects of soil property changes with off-road vehicle use. Environmental Management 2:219-233.

Whittaker, P.L. 1978. Comparisons of surface impact by hiking and horseback riding in the Great Smoky Mountains National Park. USDI National Park Service, Southeast Region, Research/Resource Management Report No. 24.

Wilcove, D.S. and L.Y. Chen. 1998. Management costs for endangered species. Conservation Biology 12:1405-1407.

Wilcove, D.S., D Rothstein, J. Dubow, A. Phillips, and E. Losos. 1998. Quantifying threats to imperiled species in the United States. BioScience 48:607-615.

Yalden, P.E. and D. Yalden. 1990. Recreational disturbance of breeding golden plovers, *Pluvialis apricarius*. Biological Conservation 51:243-262.

APPENDICES

A. Virginia Natural Area Preserves Act

B. Natural Heritage Rarity Ranks and Status Explanation

C. Hickory Hollow NAP Trail Map

Appendix A – Virginia Natural Area Preserve Act

CODE OF VIRGINIA

Article 3.

Virginia Natural Area Preserves Act

10.1-209. Definitions.
Whenever used or referred to in this article, unless a different meaning clearly appears from the text:

"Fund" means the Natural Area Preservation Fund.
"Dedication" means the transfer to the Commonwealth of an estate, interest, or right in a natural area by any manner authorized in ' 10.1-213.
"Instrument of dedication" means any written document by which an estate, interest, or right in a natural area conveys formal dedication as a natural area preserve pursuant to the provisions of ' 10.1-213.
"Natural area" means any area of land, water, or both land and water, whether publicly or privately owned, that retains or has reestablished its natural character, though it need not be completely natural and undisturbed; or which is important in preserving rare or vanishing flora, fauna, native ecological systems, geological, natural historical, scenic or similar features of scientific or educational value benefiting the citizens of the Commonwealth.
"Natural area preserve" means a natural area that has been dedicated pursuant to ' 10.1-213.
"Natural heritage resources" means the habitat of rare, threatened, or endangered plant and animal species, rare or state significant natural communities or geologic sites, and similar features of scientific interest benefiting the welfare of the citizens of the Commonwealth.
"Program" means the Virginia Natural Heritage Program.
"Owner" means any individual, corporation, partnership, trust or association, and all governmental units except the state, its department, agencies or institutions.
"Registry" means an agreement between the Director and the owner of a natural area to protect and manage the natural area for its specified natural heritage resource values.
"System" means the state system of natural area preserves established under ' 10.1-214.
(1989, c. 553.)

10.1-210. Additional powers of the Department.
In addition to other powers conferred by law and subject to the provisions of this article, the Department shall have the power, which may be delegated by the Director:
1. To establish criteria for the selection, registration and dedication of natural areas and natural area preserves.
2. To purchase, lease or otherwise acquire in the name of the Commonwealth, using moneys from the Natural Area Preservation Fund, lands suitable for natural area preserves.
3. To acquire by gift, devise, purchase, or otherwise, absolutely or in trust, and to hold and, unless otherwise restricted by the terms of a gift or devise, to encumber, convey or otherwise dispose of, any real property, any estate or interests therein, or products on or derived from such real property, as may be necessary and proper in carrying into effect the provisions of this article.
4. To accept, hold and administer gifts and bequests of money, securities, or other property, absolutely or in trust, made for purposes of this article. Unless otherwise restricted by the terms of the gift or bequest, the Department may sell, exchange or otherwise dispose of such money, securities or other property given or bequeathed to the Department. The principal of such funds,

together with the income and all revenues derived therefrom, shall be placed in the Natural Area Preservation Fund.
(1989, c. 553.)

10.1-211. Additional duties of the Department
In addition to other duties conferred by law, the Department shall, subject to the provisions of this article:
1. Preserve the natural diversity of biological resources of the Commonwealth.
2. Maintain a Natural Heritage Program to select and nominate areas containing natural heritage resources for registration, acquisition, and dedication of natural areas and natural area preserves.
3. Develop and implement a Natural Heritage Plan that shall govern the Natural Heritage Program in the creation of a system of registered and dedicated natural area preserves.
4. Publish and disseminate information pertaining to natural areas and natural area preserves.
5. Grant permits to qualified persons for the conduct of scientific research and investigations within natural area preserves.
6. Provide recommendations to the Commissioner of the Department of Agriculture and Consumer Services and to the Board of Agriculture and Consumer Services on species for listing under the Virginia Endangered Plant and Insect Act, prior to the adoption of regulations therefor.
7. Provide recommendations to the Executive Director of the Department of Game and Inland Fisheries and to the Board of Game and Inland Fisheries on species for listing under the Virginia Endangered Species Act, prior to the adoption of regulations therefor.
8. Cooperate with other local, state and federal agencies in developing management plans for real property under their stewardship that will identify, maintain and preserve the natural diversity of biological resources of the Commonwealth.
9. Provide for management, development and utilization of any lands purchased, leased or otherwise acquired and enforce the provisions of this article governing natural area preserves, the stewardship thereof, the prevention of trespassing thereon, or other actions deemed necessary to carry out the provisions of this article.
(1989, c. 553.)

10.1-212. Virginia Natural Heritage Program.
A. The Virginia Natural Heritage Program is hereby established and shall be administered by the Department.
B. For purposes of this Program the Department shall:
1. Produce an inventory of the Commonwealth's natural heritage resources, including their location and ecological status.
2. Maintain a natural heritage data bank of inventory data and other relevant information for ecologically significant sites supporting natural heritage resources. Information from this data bank will be made available to public agencies and may be made available to private institutions or individuals for environmental assessment and land management purposes.
3. Develop a Natural Heritage Plan which establishes priorities for the protection, acquisition and management of registered and dedicated natural areas and natural area preserves.
C. The Program shall include other functions as may be assigned by the Director for the registration, dedication, protection and stewardship of natural areas and natural area preserves.
(1989, c. 553.)

10.1-213. Dedication of natural area preserves.
A. The Director may, in the name of the Department, accept the dedication of natural areas on lands deemed by the Director to qualify as natural area preserves under the provisions of this

article. Natural area preserves may be dedicated by voluntary act of the owner. The owner of a qualified natural area may transfer fee simple title or other interest in land to the Commonwealth. Natural area preserves may be acquired by gift, grant, or purchase.
B. Dedication of a natural preserve shall become effective only upon acceptance of the instrument of dedication by the Director.
C. The instrument of dedication may:
1. Contain restrictions and other provisions relating to management, use, development, transfer, and public access, and may contain any other restrictions and provisions as may be necessary or advisable to further the purposes of this article;
2. Define, consistently with the purposes of this article, the respective rights and duties of the owner and of the Commonwealth and provide procedures to be followed in case of violations of the restrictions;
3. Recognize and create reversionary rights, transfers upon conditions or with limitations, and gifts over; and
4. Vary in provisions from one natural area preserve to another in accordance with differences in the characteristics and conditions of the several areas.
D. Public departments, commissions, boards, counties, municipalities, corporations, colleges, universities and all other agencies and instrumentalities of the Commonwealth and its political subdivisions are empowered to dedicate suitable areas within their jurisdiction as natural area preserves.
E. Subject to the approval of the Governor, the Commonwealth may enter into amendments to the instrument of dedication upon finding that the amendment will not permit an impairment, disturbance, use, or development of the area inconsistent with the provisions of this article. If the fee simple estate in the natural area preserve is not held by the Department under this article, no amendment may be made without the written consent of the owner of the other interests therein.
(1989, c. 553.)

10.1-214. Virginia natural area preserves system established.
A state system of natural area preserves is hereby established and shall be called the Virginia Natural Area Preserves System. The system shall consist of natural area preserves dedicated as provided in ' 10.1-213. Once dedicated, a natural area preserve shall be managed in a manner consistent with continued preservation of the natural heritage resources it supports.
(1989, c. 553.)

10.1-215. Establishment of fund.
A. A fund consisting of general fund appropriations, gifts, bequests and devises known as the Natural Area Preservation Fund is hereby established.
B. Any funds remaining in such fund at the end of the biennium, including all appropriations, gifts, bequests and devises, and interest accruing thereon, shall not revert to the General Fund but shall remain in the Natural Area Preservation Fund.
(1989, c. 553.)

10.1-216. Natural area registry.
A. The Department shall maintain a state registry of voluntarily protected natural areas to be called the Virginia Registry of Natural Areas. Registration of natural areas shall be accomplished through voluntary agreement between the owner of the natural area and the Director. State-owned lands may be registered by agreement with the agency to which the land is allocated. Registry agreements may be terminated by either party at any time, and upon such termination the area shall be removed from the registry.
B. A natural area shall be registered when an agreement to protect and manage the natural area for its specified natural heritage resource has been signed by the owner and the Director. The

owner of a registered natural area shall be given a certificate signifying the inclusion of the area in the registry.
(1989, c. 553.)

10.1-217. Gifts, devises and bequests.
Gifts, devises or bequests, whether personal or real property, and the income derived therefrom, accepted by the Director, shall be deemed as gifts to the Commonwealth, which shall be exempt from all state and local taxes, and shall be regarded as the property of the Commonwealth for the purposes of all tax laws.
(1989, c. 553.)

Appendix B – Natural Heritage rarity ranks and status explanation

Each of the significant natural features (species, community type, etc.) monitored by DCR-DNH is considered an element of natural diversity, or simply an **element**. Each element is assigned a rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant; Table 1). The primary criterion for ranking elements is the number of occurrences, i.e., the number of known distinct localities or populations. Also of great importance is the number of individuals at each locality or, for highly mobile organisms, the total number of individuals. Other considerations include the condition of the occurrences, the number of protected occurrences, and threats. However, the emphasis remains on the number of occurrences, so that ranks essentially are an index of known biological rarity. These ranks are assigned both in terms of the element's rarity within Virginia (its State or S-rank) and the element's rarity over its entire range (its Global or G-rank). Subspecies and varieties are assigned a Taxonomic (T-) rank in addition to their G-rank. Taken together, these ranks give a concise picture of an element's rarity. For example, a designated rank of G5/S1 indicates an element which is abundant and secure range-wide, but extremely rare in the state.

Global Ranks for community types are based on existing information in the International Classification of Ecological Communities (ICEC; Grossman et al. 1998, Anderson et al. 1998, NatureServe 2005), but may be subject to change because of ongoing collaborative efforts by the Natural Heritage network. Similar to species elements, the primary ranking factors used in assessing the appropriate conservation status rank for a community element are: (1) the total number of occurrences and (2) the total area (acreage) of the element. Secondary ranking factors such as the geographic range over which the element occurs, the threats to the occurrences, and the viability of the occurrences also affect the rank.

Additional factors have been used in arriving at an assessment of a community's rangewide (global) rank include the geographic range over which the type occurs, the long term decline of the type across this range, the degree of site specificity exhibited by the type, and the rarity across the range based on state ranks assigned by state Natural Heritage Programs. Table 2 presents definitions for all global ranks for community types.

These global and state rarity ranks used by DCR-DNH are not legal designations, and they are continuously updated to reflect new information.

Table 1. Definition of Natural Heritage state rarity or conservation status ranks.
Global ranks for species are similar, but refer to a species' range-wide status. Note that G_T_ signifies the rank of a subspecies or variety. Sometimes ranks are combined (e.g. S1S2) to indicate intermediate or somewhat unclear status. Elements with uncertain taxonomic validity are denoted by the letter Q, after the global rank. These ranks should not be interpreted as legal designations.

S1 Extremely rare; usually 5 or fewer occurrences in the state; or may have a few remaining individuals; often especially vulnerable to extirpation. For communities: generally with 5 or fewer occurrences state-wide, and/or covering less than 50 ha (124 ac) in aggregate; or covering larger area but highly threatened with destruction or modification.

S2 Very rare; usually from 6 to 20 occurrences; or few occurrences with many individuals; often susceptible to becoming endangered. For communties: generally with 6 to 20 occurrences state-wide, and/or covering less than 250 ha (618 ac) in aggregate; or covering larger area but threatened with destruction or modification.

S3 Rare to uncommon; usually from 21 and 100 occurrences; may have fewer occurrences, but with a large number of individuals in some populations; may be susceptible to large-scale disturbances. For communities: generally with 21 to 100 occurrences state-wide; or with a larger number of occurrences

subject to relatively high levels of threat; may be of relatively frequent occurrence in specific localities or geographic parts of the state.

S4 Common; usually more than 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats. For communities: common, at least in certain regions of the state, and apparently secure.

S5 Very common; demonstrably secure under present conditions.

SH Historically known from the state, but not verified for an extended period, usually more than 15 years; this rank is used primarily when inventory has been attempted recently.

SN Regularly occurring migrants or transient species which are non-breeding, seasonal residents. (Note that congregation and staging areas are monitored separately).

SU Status uncertain, often because of low search effort or cryptic nature of the element.

SX Believed extirpated from Virginia with virtually no likelihood of rediscovery

S_? Rank uncertain or approximate.

S? Unranked. Conservation ranked not yet assessed.

S_S_ Rank is uncertain, but considered to be within the indicated range of ranks.

S_B/S_N Breeding and nonbreeding status of an animal (primarily used for birds) in Virginia, when they differ.

Table 2 Global Rarity or Conservation Rank definitions used for communities

GX ELIMINATED throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

GH PRESUMED ELIMINATED (HISTORIC) throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration (e.g., *Castanea dentata* Forest).

G1 CRITICALLY IMPERILED
Generally 5 or fewer occurrences and/or very few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G2 IMPERILED
Generally 6-20 occurrences and/or few remaining acres or very vulnerable to elimination throughout its range due to other factor(s).

G3 VULNERABLE
Generally 21-100 occurrences. Either very rare and local throughout its range or found locally, even abundantly, within a restricted range or vulnerable to elimination throughout its range due to specific factors.

G4 APPARENTLY SECURE
Uncommon, but not rare (although it may be quite rare in parts of its range, especially at the periphery). Apparently not vulnerable in most of its range.

G5 SECURE
Common, widespread, and abundant (though it may be quite rare in parts of its range, especially at the periphery). Not vulnerable in most of its range.

GU UNRANKABLE
Status cannot be determined at this time.

G? UNRANKED
Status has not yet been assessed.

Modifiers and Rank Ranges

? A question mark added to a rank expresses an uncertainty about the rank in the range of 1 either way on the 1-5 scale. For example a G2? rank indicates that the rank is thought to be a G2, but could be a G1 or a G3.

G#G# Greater uncertainty about a rank is expressed by indicating the full range of ranks which may be appropriate. For example, a G1G3 rank indicates the rank could be a G1, G2, or a G3.

Q A "Q" added to a rank denotes questionable taxonomy. It modifies the degree of imperilment and is *only* used in cases where the type would have a *less imperiled* rank if it were not recognized as a valid type (i.e., if it were combined with a more common type). A GUQ rank often indicates that the type is unrankable *because of* daunting taxonomic/definitional questions.

The spot on the landscape that supports a natural heritage resource is an **element occurrence**. Occasionally, separate but nearby locations of a species or community element are treated as subpopulations (species) or sub-occurrences (community) of the same occurrence due to factors such as the probability of gene flow or hydrologic linkage. Information on the location and quality of these element occurrences is computerized within the BCD system, and additional information is recorded on maps and in manual files.

In addition to ranking each element's rarity, each element occurrence is ranked to differentiate large, outstanding occurrences from small, vulnerable ones. In this way, protection efforts can be aimed not only at the rarest elements, but at the best examples of each. Species occurrences are ranked in terms of quality (size, vigor, etc.) of the population; the condition (pristine to disturbed) of the habitat; the viability of the population; and the defensibility (ease or difficulty of protecting) of the occurrence. Community occurrences are ranked according to their size and overall natural condition. These **element occurrence ranks** range from A (excellent) to D (poor). Sometimes these ranks are combined to indicate intermediate or somewhat unclear status, e.g. AB or CD, etc. In a few cases, especially those involving cryptic animal elements, field data may not be sufficient to reliably rank an occurrence. In such cases a rank of E (extant) may be given. A rank of H is assigned occurrences approximately 20 years or older that have been searched for unsuccessfully. Element occurrence ranks reflect the current condition of the species' population or community. A poorly-ranked element occurrence can, with time, become highly-ranked as a result of successful management or restoration.

Element ranks and element occurrence ranks form the basis for ranking the overall significance of sites. Site **biodiversity ranks** (B-ranks) are used to prioritize protection efforts, and are defined as follows:

B1 Outstanding Significance: only site known for an element; an excellent occurrence of a G1 species; or the world's best example of a community type.

B2 Very High Significance: excellent example of a rare community type; good occurrence of a G1 species; or excellent occurrence of a G2 or G3 species.

B3 High Significance: excellent example of any community type; good occurrence of a G3 species.

B4 Moderate Significance: good example of a community type; excellent or good occurrence of state-rare species.

B5 General Biodiversity Significance: good or marginal occurrence of a community type or state-rare species.

Note: sites supporting rare subspecies or varieties are considered slightly less significant than sites supporting similarly ranked species.

EXPLANATION OF FEDERAL AND STATE CATEGORIES

The U.S. Fish and Wildlife Service (USFWS) is responsible for the listing of endangered and threatened species under the Endangered Species Act of 1973, as amended. Federally listed species (including subspecific taxa) are afforded a degree of legal protection under the Act, and, therefore, sites supporting these species need to be highlighted. USFWS also maintains a review listing of potential candidate endangered and threatened taxa. Table 2 defines the various status categories used by USFWS and followed in this report. The status category of candidate species is based on the Service's current level of knowledge about the biological vulnerability of and threats to a species.

Literature Cited:

Anderson, M., P. Bourgeron, M. T. Bryer, R. Crawford, L. Engelking, D. Faber-Langendoen, M. Gallyoun, K. Goodin, D. H. Grossman, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, L. Sneddon, and A. S. Weakley. 1998. Terrestrial vegetation of the United States. Volume II: List of vegetation types. The Nature Conservancy, Arlington, VA.

Grossman, D. H., D. Faber-Langendoen, A. S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. D. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International Classification of Ecological Communities: Terrestrial Vegetation of the United States. Volume I: The National Vegetation Classification Standard. The Nature Conservancy. Arlington, VA.

NatureServe. 2005. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.6. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer.

Appendix C – Hickory Hollow Trail Map